## ATTACHMENT A
### PROPOSAL CHECKLIST (MANDATORY)

<table>
<thead>
<tr>
<th>Proposal Title</th>
<th>Ithaca Community Microgrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFP No.</td>
<td>3044 Stage 2</td>
</tr>
<tr>
<td>Due Date</td>
<td>10/12/2016</td>
</tr>
</tbody>
</table>

### Primary Contact
- **Title**: City of Ithaca Mayor
- **Company**: City of Ithaca
- **Phone**: (607) 274-6501
- **Fax**: (607) 274-6526
- **E-mail**: mayormyrick@cityofithaca.org

### Secondary Contact
- **Title**: Northwest WTP Chief Operator
- **Company**: Northwest WTP
- **Phone**: (607) 273-8381
- **Fax**: (607) 273-8433
- **E-mail**: dramer@cityofithaca.org

### THE PRIME CONTRACTOR MUST SIGN THIS FORM BELOW and ANSWER THE FOLLOWING QUESTIONS:

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you accept all Terms &amp; Conditions in the Sample Agreement? (If no, explain on separate page)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Do you wish to have any information submitted in your proposal package treated as proprietary or confidential trade secret information? If yes, you must identify and label on each applicable page &quot;proprietary&quot; or &quot;confidential&quot; (For additional information regarding this, please refer to the section entitled &quot;Proprietary Information&quot; in the solicitation document).</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Have you been indicted/convicted for a felony within the past 5 years? (If yes, explain on separate pg.)</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Are you a Minority or Women-Owned Business Enterprise?</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Does your proposal contain Minority or Women-Owned Business enterprises as subcontractor?</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Are you a certified Service-Disabled Veteran-Owned Business Enterprise?</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Does your proposal contain certified Service-Disabled Veteran-Owned Business Enterprises as Subcontractors?</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Are you submitting the required number of copies? (See proposal instructions,)</td>
<td>Yes</td>
<td>X</td>
</tr>
<tr>
<td>Is other public funding pending/awarded on this and/or very similar topic (prior and/or competing proposals)? (If yes, explain on separate page)</td>
<td>Yes</td>
<td>X</td>
</tr>
</tbody>
</table>

## ON WHAT PAGE IN YOUR PROPOSAL CAN THESE ITEMS BE FOUND?

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
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<tbody>
<tr>
<td>Indictment/Conviction of Felony</td>
<td>1</td>
</tr>
<tr>
<td>NYSERDA Contracts Awarded</td>
<td>1</td>
</tr>
<tr>
<td>Prior and/or Competing Proposals</td>
<td>2</td>
</tr>
<tr>
<td>Exceptions to Terms &amp; Conditions</td>
<td>3</td>
</tr>
<tr>
<td>Completed and Signed Contract Pricing Proposal Form(s)</td>
<td>4</td>
</tr>
<tr>
<td>Disclosure of Prior Findings of Non-responsibility Form</td>
<td>5</td>
</tr>
</tbody>
</table>

## AUTHORIZED SIGNATURE & CERTIFICATION

I certify that the above information, and all information submitted in connection with State Finance Law §139-J and §139-K, is complete, true, and accurate, that I have read and reviewed the Standard Terms and Conditions set forth in the attached Sample Agreement and that I accept all terms unless otherwise noted herein, and that the proposal requirements noted have been completed and are enclosed. I affirm that I understand and will comply with NYSERDA's procedures under §139-J(3) and §139-J(6)(b) of the State Finance Law. I understand that this proposal may be disqualified if the solicitation requirements are not met. I, the undersigned, am authorized to commit my organization to this proposal.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Svante Myrick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Mayor</td>
</tr>
<tr>
<td>Phone</td>
<td>(607) 274-6501</td>
</tr>
</tbody>
</table>

NOTE: This completed form **MUST** be signed and attached to the front of all copies of your proposal.
Attachment B
RFP 3044 Stage 2
Disclosure of Prior Findings of Non-responsibility Form
(Mandatory)

<table>
<thead>
<tr>
<th>Name of Individual or Entity seeking to enter the procurement contract:</th>
<th>Mayor Svante Myrick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address: 108 E. Green Street, Ithaca, New York 14850</td>
<td></td>
</tr>
<tr>
<td>Date: October 7, 2016</td>
<td></td>
</tr>
<tr>
<td>Solicitation or Agreement Number: #3044</td>
<td></td>
</tr>
<tr>
<td>Name and Title of Person Submitting this Form: Mayor Svante Myrick</td>
<td></td>
</tr>
</tbody>
</table>

Has any Governmental Entity made a finding of non-responsibility regarding the Individual or Entity seeking to enter the Procurement Contract in the last four years? | Yes | Yes |
<table>
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<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Was the basis for the finding of non-responsibility due to a violation of §139-j of the State Finance Law?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>No</td>
</tr>
<tr>
<td>Was the basis for the finding of non-responsibility due to the intentional provision of false or incomplete information to a Governmental Entity?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>No</td>
</tr>
</tbody>
</table>

If you answered yes to any of the above questions, please provide details regarding the finding of non-responsibility:

Government Agency or Authority: 

Date of Finding of Non-responsibility:
<table>
<thead>
<tr>
<th>Has any Governmental Entity or other governmental agency terminated or withheld a Procurement Contract with the above-named Individual or Entity due to the intentional provision of false or incomplete information?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

If you answered yes, please provide details:

Government Agency or Authority:

Date of Termination or Withholding of Contract:

Offerer certifies that all information provided to NYSERDA with respect to State Finance Law §139-k is complete, true, and accurate.

Signature: [Signature]

Date: 6/7/2016

Print Name: Svante Myrick

Title: Mayor, City of Ithaca
NY Prize
Community Grid
Competition –
Stage 2

The Ithaca Community Microgrid:
NY Stage 2 Proposal:
Detailed Engineering Design,
Financial and Business Plan
Assessment

Submitted By:
Hon. Svante Myrick
Mayor of the City of Ithaca
108 E Green St
Ithaca, NY 14850
(607) 274-6501
mayor@cityofithaca.org

Project Contact:
Dan Ramer
Chief Operator
Ithaca Area Waste Water Treatment Facility
525 3rd Street
Ithaca, NY 14850
(607)273-8381
dramer@cityofithaca.org

Submitted to:
NYSERDA, NY Prize Stage 2 Program
October 12, 2016

Project Partners: City of Ithaca, Town of Ithaca,
Town of Dryden, Ithaca Area Wastewater Treatment Facility,
NYSEG, Cornell University, Ithaca Community Energy,
SourceOne/Veolia and Ithaca Community Project Sponsors &
Stakeholders
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3. **EXECUTIVE SUMMARY**

The City of Ithaca is pleased to present the following proposal which demonstrates how our Integrated Design and Development Team plans to successfully implement: “The Ithaca Community Microgrid: NY Prize Stage 2: Detailed Engineering Design and Financial and Business Plan”, hereafter “the Project”.

3.1. **Team Members**

- City of Ithaca – local government, IAWWTF co-owner and lead applicant
- NYSEG – local electric and natural gas distribution company and key project partner
- Ithaca Area Wastewater Treatment Facility (IAWWTF) – generation asset host
- SourceOne/Veolia – Integrated Design & Development Program Manager
  - Hallam-ICS – Site Engineer, Mechanical, Electrical, Controls, Civil/Structural
  - Martin Energy Group – Microgrid Consultant and Distributed Generation Systems Integrator
- Project Sponsors: IAWWTF, Ithaca City School District, Department of Public Works, Cornell Cooperative Extension, Tompkins Consolidated Area Transit (TCAT)
- Project Community Stakeholders: Ithaca Community Energy, Cornell Atkinson Center

3.2. **Problem and Opportunity**

The City of Ithaca is vulnerable to grid-wide power outages caused by increasingly common extreme weather events and other emergencies. Of particular local concern is the possibility of a disruption at the area’s wastewater treatment plant (the IAWWTF), failure of which would not only make the City essentially uninhabitable, but would also endanger the operation of the nearby Bolton Point Water Treatment Plant that supplies drinking water to several area municipalities.

Beyond the need to keep water treatment and supply sources safe and reliable, the Project presents a unique opportunity to bolster the City’s services during times of emergency grid outages. By virtue of coupling low cost, low carbon sources of generation, with modifications to the existing electric distribution system, 100% power requirements can be delivered to several key critical facilities (refer to Attachment H). During emergency events the City of Ithaca will benefit through an increase in emergency shelter capacity. Specifically, the Ithaca High School is well positioned to serve as a 100% powered shelter; providing food, heat, hygiene and other services. Furthermore, key public works and transportation services will remain available as the nearby Department of Public Works and TCAT will be 100% powered by the microgrid.

Ithaca is highlighted in the New York Prize’s Finger Lakes "Opportunity Zone" as an area where microgrids may reduce utility system constraints and defer expensive infrastructure investment costs. The City of Ithaca has a unique opportunity to combat the aforementioned threats and gain a more reliable and sustainable energy infrastructure through the commissioning of the microgrid. NYSERDA’s microgrid guide for mayors states “There is no one type of microgrid. This is not a plug-and-play technology; it is customized to solve a particular community energy or grid problem.” The microgrid proposed solves both using a unique low-carbon and renewable energy solution. The Project will source fuel throughout the local community, simultaneously reducing and diverting waste streams while bolstering economic activity through local partnerships.

3.3. **Proposed Solution**

This Project will develop the Ithaca Community Microgrid, using anaerobic digester gas (ADG) from local wastewater, food waste and other diverted fats, oils and greases for electric and thermal energy generation. Currently, the ADG is produced using IAWWTF in-plant residuals from the primary and secondary treatment
biosolids representing about 60% of the carbon converted to biogas and the other 40% is created by treating trucked residuals representing a wide variety of substrates collected from mostly local sources (30 mile radius). Natural gas and fuel oil will be relied on only as redundant and backup fuel sources; primary generation will be fueled by ADG and solar; making this among the State’s first renewable microgrids. By leveraging existing NYSEG distribution infrastructure and new scalable district energy infrastructure, the Project will serve a city energy district as well as provide 100% electric power to critical facilities. The microgrid configuration as proposed would improve local electric system reliability, efficiency, expand capacity and emissions reduction and provide economic benefit to the community.

Utilizing standard industry-proven equipment and existing utility operating procedures, the proposed project modifies New York State Electric and Gas (NYSEG) infrastructure with new load-break switches to isolate certain sections of the distribution system while supplying 100% of the power requirements to all critical and non-critical facilities in the microgrid. The Team is committed to working in harmony with NYSERDA and NYSEG. We believe flexibility and nimbleness will be key in supporting both NY REV and NY Prize goals throughout the Project development.

The microgrid will combine traditional emergency generator power systems with dual fuel microturbines and reciprocating engines which will be powered by anaerobic digester gas (ADG) in a highly efficient combined heat and power (CHP) arrangement. Solar photovoltaic (PV) arrays will also be used during normal operating conditions and provide community members the opportunity to utilize solar to power their homes and businesses. Recovered thermal energy from the CHP plant will be delivered to end users through a scalable district energy system where it is used to offset NYSEG natural gas from the Marcellus Shale. The proposed system is scalable and can be developed in phases to serve existing loads as well as new loads which are developing in and around the Cayuga Lake waterfront.

3.4. Community Benefits

Combining a unique expansion of the existing low-carbon ADG, renewable energy and an efficient CHP district energy system allows the IAWWTF to be the microgrid hub during electric utility emergencies while simultaneously becoming a net exporter of energy during normal grid operations. Ithaca has significant capacity for a community based solar farm whereby local residents, who do not have space for PV arrays, can support renewable energy through their utility bills. The concept of a community solar farm would allow participants to better realize the benefit of the renewable energy resource they are supporting and own a tangible asset. The Project will also coordinate with the Reforming the Energy Vision (REV) work to provide a sustainable platform for the delivery of innovative services to end use customers. The favorable arrangement of the Project uses existing approved NYSEG tariffs which allows for securing the value of the microgrid energy products right away as the NY REV process continues to define of DER’s through regulatory rulemaking.

The microgrid will significantly increase the safety and quality of life for residents of the community. Tangible benefits include redirecting a significant amount of food waste from local landfills and the associated delivery/hauling jobs which will be created as part of this project. Ithaca will also become one of the few net zero waste water treatment facilities in the country and can potentially become a role model for other facilities looking to create a clean powered microgrid. Moreover, Ithaca is an intellectual hub and an environmentally progressive community which has the energy and academic resources to fully optimize this project and to optimize the information transfer necessary for replication in other communities. Finally, the project will set the stage for the development of the waterfront area based on a carbon neutral platform.
4. PROPOSER INFORMATION

The Mayor of the City of Ithaca, Hon. Svante Myrick, represents the City as the Proposer and Lead Applicant for the NY Prize Community Grid Competition-Stage 2.

4.1. Proposer
Hon. Svante Myrick, Mayor of the City of Ithaca

108 E Green St, Ithaca, NY 14850 – (607) 274-6501 mayor@cityofithaca.org

4.2. Project Contact
Dan Ramer, Chief Operator, Ithaca Area Waste Water Treatment Facility

525 3rd Street, Ithaca, NY 14850 – (607) 273-8381 dramer@cityofithaca.org

4.3. Legal Representative
Hon. Svante Myrick, Mayor of the City of Ithaca

The legally authorized representative of the Proposer, Hon. Svante Myrick, Mayor of the City of Ithaca certifies by the submission of this proposal that: the Proposer has reviewed this Notice and has investigated and informed itself with respect to all matters pertinent to this Notice and its proposal; the Proposer’s proposal is submitted in compliance with all applicable federal, state, and local laws and regulations, including antitrust and anti-corruption laws; and the information provided in the proposer’s proposal is true and accurate.

As a municipal corporation, the City of Ithaca is eligible for funding from NYSERDA and has financial resources to share the costs of conducting a Stage 2 Feasibility Assessment. For current financial data, refer to the balance sheet available in Appendix G.

4.4. Site Ownership & Control
This statement serves as documentation that the proposed assets will be located on the IAWWTF.

4.5. Stage 2 Program Delivery Structure
As described above, the City of Ithaca, represented by the Hon. Svante Myrick, will be the formal proposer for this submission. However, this project represents a coordination effort of numerous stakeholders. The principal organization for administering the stage 2 proposal and implementation of the microgrid facilities shall rely on the City of Ithaca and related stakeholders. For the purpose of this proposal this concept is being described as a “Board of Directors”. At a minimum the proposed Board will include members of the Mayor’s Office, Economic Development, Sustainability and Public Works along with key community stakeholders. The City will pursue legislative action to formalize the proposed board as part of the stage 2 process.

The organizational chart on the following page depicts the programmatic approach to developing and implementing the Project. It displays not only the Design and Development Team responsible for delivering the Stage 2 Scope of Work, but the broad-ranging community stakeholders and project sponsors already committed to support the project team along the way. In Proposer Qualifications (Section 5), the key components of this Program Delivery Structure will be described in detail.
Figure 1: Stage 2 Program Delivery Structure
5. **PROPOSER QUALIFICATIONS**

This section will first describe the teams that comprise the Stage 2 Program Delivery Structure depicted in Figure 1. Next, we describe specific roles and responsibilities of key individuals within each team as well as how their deep industry expertise will collectively deliver a world class project. Finally, we provide an abbreviated summary of our team’s Proposing Organizations.

### 5.1. Proposing Organizations

**City of Ithaca** – Located on the Southern edge of Cayuga Lake, the City of Ithaca is home to Cornell University and Ithaca College and is the largest metropolitan community in Tompkins County. As a member of the Special Joint Committee and owner of critical facilities to be served by the microgrid, the City of Ithaca is serving as the lead developer of the project and will be the largest beneficiary of the services provided by the Project.

**Special Joint Committee (SJC)** – The SJC is comprised of the three majority owners of the IAWWTF; the Town of Dryden, The Town of Ithaca, and the City of Ithaca as stated in the SJC’s letter of commitment to the project located in Appendix A. This committee oversees the operation of the IAWWTF. With the IAWWTF serving as host to the proposed generating assets and as a provider of feedstock for the ADG, the SJC has a vested interest in the success of the microgrid. The SJC is committed to adding microgrid equipment within its property as necessary for the successful deployment of the microgrid.

**Community Project Sponsors & Stakeholders** – Several organizations will be active sponsors and stakeholders of the Project. These include the IAWWTF, Ithaca City School District and Department of Public Works (DPW) and Tompkins Consolidated Area Transit (TCAT) who will be connected directly to the microgrid. Additionally, Ithaca Community Energy, the Tompkins County Environmental Management Council, Sustainable Tompkins, Cornell Cooperative Extension and the Cornell Atkinson Center are all key sponsors and stakeholders of the project.

The IAWWTF during the last five years has completely updated all the major components involved in the biogas renewable energy business including the trucked residuals receiving facility, digester mixing system, biogas cleanup system and microturbines for electric and heat production. There is an ongoing collaboration with Cornell University; taking their organic carbon resources from a carcass digester, dining services and eventually the teaching dairy barn manure has greatly improved the reliability of biogas production.

Additional details about the nature of support and involvement in the project are outlined in letters of commitment and support located in Appendix A.

### 5.2. Integrated Design and Development Team

The proposed project is a unique solution for a unique context. The Integrated Design and Development Team was conceived to harmonize the Project’s many moving and interconnected pieces. Led by SourceOne/Veolia, who specialize in implementing advanced energy infrastructure, this team is responsible for coordinating stakeholders’ efforts to ensure the project is technically sound, financially viable and legally complaint.

**Development Services Team** – This team is responsible for developing the business case for the Project. This includes technical and financial performance modeling of the microgrid. This team will also be responsible for ensuring the microgrid’s legal and regulatory compliance. This team also serves in an executive capacity, ensuring that the other teams deliver high quality analysis in a timely fashion.
Technical and Regulatory Assistance Team – Because the Project represents a novel power plant configuration, we envision NYSEG and NYSERDA will take on an active role developing the Project. This team’s primary responsibility will be to provide technical and regulatory oversight and guidance regarding utility regulation.

Design Team – This team will be responsible for developing a detailed microgrid design including, for example, plant-sizing, fuel specification, controls, and grid integration. Our proposed Design Team features experts in all relevant areas for this project: Biogas, CHP, Balance of Plant Integration, District Energy, and Solar PV.

Construction Team – The construction delivery method and team will be determined as part of Stage 2. Once determined, this team will be invited to contribute to the Stage 2 process.

Operations & Maintenance Team – The Operations & Maintenance (O&M) Team will be determined as part of Stage 2. Once determined this team will be invited to contribute to the Stage 2 process.

5.3. Integrated Design and Development Team Members

SourceOne/Veolia – Established 1997. Annual revenue $23m. 120 Employees. As a nationally recognized energy consulting firm, SourceOne helps large public and private entities manage their energy needs in more sustainable, reliable and cost effective ways. SourceOne specializes in managing large energy infrastructure projects from concept through construction and commissioning. SourceOne has been instrumental in completing some of the most ambitious microgrid projects in New York State and is currently implementing the Hudson Yards Development microgrid. SourceOne has offices in New York City, Boston, Philadelphia and Los Angeles and is a subsidiary of Veolia. Veolia is a world leading provider of water, waste and energy services with unparalleled experience planning, constructing and operating waste to energy facilities.

Martin Energy Group – An industry leader in the design and manufacturing of complete power plant packages, Martin Energy Group has packaged and installed over 300 gaseous-fueled engines in the United States. Martin Energy Group engineers, designs, packages, commissions, and services combined heat and power (CHP) systems to operate on a wide variety of fuel sources including bio-gas, natural gas, landfill gas, syngas, and other specialized alternative fuels. Martin Energy Group has significant expertise in the control and protection of several generators at one time. Martin Energy Group has dozens of successful installations in NY State, several nearby service offerings and the necessary Operation & Maintenance experience applicable to the proposed microgrid deployment. Martin Energy Group has a manufacturing facility in Ephrata, PA.

Hallam-ICS – Established 1981. Annual revenue $30m. 95 employees. An engineering, automation and commissioning company that designs MEP systems for facilities and plants, engineers control and automation solutions, and ensures safety and regulatory compliance. Hallam-ICS offers a client-centered full suite of engineering services. Hallam-ICS has significant experience with integrating several types of energy systems in novel configurations. Hallam-ICS has offices located in five states including one in Malta, NY.

Refer to Appendix B for additional details on SourceOne, Martin Energy Group and Hallam-ICS project development and implementation qualifications.

The following organizational chart (Figure 2) depicts the integrated project development and delivery team, whom will be responsible for the technical and financial preparation evaluation and execution of the specific tasks outlined in the Work Plan (7) and the Statement of Work as detailed in Attachment C of NYSERDA’s RFP 3044.
5.4. Qualifications of Key Individuals

The full resumes of key individuals leading the Project Design & Development are presented in Appendix B.

5.5. Previous Experience

The following is a brief list of the relevant projects that have been completed by members of the proposing team. In-depth write ups on relevant project experience can be found in Appendix B.

Gresham, Oregon Wastewater Treatment Plant: Veolia partnered with the City of Gresham and has steadily reduced power consumption at the City’s wastewater treatment plant while increasing renewable energy production by capturing methane.

Related Management, Hudson Yards Microgrid: SourceOne was selected to serve as Owner’s Representative for the development of a Combined Heat and Power (CHP) plant microgrid solution at Hudson Yards—currently the largest real estate development in New York City.

New York University Microgrid Plant Expansion: SourceOne served as the Owners Representative for the re-development of NYU’s existing 7000 kW cogeneration plant to support the additional electrical, steam and hot water needs for the campus. This microgrid “kept the lights on” during Superstorm Sandy.
Biogen IDEC Cogeneration Design/Implementation: SourceOne developed a solution to include a new central energy plant to serve six buildings with electricity and five with high pressure steam.

Freeman Athletic Center CHP Unit & Microgrid: Martin Energy Group developed a fully integrated 680 kWe CHP unit and microgrid system for Wesleyan University including switchgear allowing the system to operate in parallel and island mode.

Island Mode Power Plant with Hot Process Water: Martin Energy Group engineered a two (2) - 1050 kWe, 24/7 load tracking & shedding CHP system capable of operating in island mode.

District Heat, Montpelier, VT: Hallam-ICS designed the mechanical and electrical power upgrades needed for a new underground hot water heating utility for the city of Montpelier, VT.

Cornell University Laboratory Building Work: Hallam-ICS has been assigned various projects of over $5,000,000 for Cornell University in the City of Ithaca, NY. These projects involved an array of novel energy systems integration.

Columbo Energy: Hallam-ICS personnel have executed the development of an overall power distribution system for a 460,000 ton/year biomass pellet facility. Hallam-ICS personnel specified the power equipment, provided certified electrical drawings, installations specifications, balance of plant system integration specification and construction administration.

5.6. Prior NYSERDA Projects

The host site, IAWWTF has actively engaged with NYSERDA on several projects over the past five years. Key projects include an anaerobic digester gas micro turbine CHP system, lighting retrofits, variable speed drives on HVAC equipment and the recent NY Prize Stage 1 Feasibility Study.

5.7. Public Interests

The following public interests and organizations involved in the project have been identified:

Local Government
- City of Ithaca: project proposer, energy consumer, emergency services (City of Ithaca Police Department, the Streets and Facilities, and Water and Sewer Facilities Divisions of the Department of Public Works), partial owner of IAWWTF
- Town of Ithaca: partial owner of IAWWTF
- Town of Dryden: partial owner of IAWWTF

Retail/Institutional Customers
- Ithaca High School and Ithaca City School District Administration Buildings: microgrid load and critical facility (place of refuge)
- Cornell University: Several departments of the University have a strong interest in the project and have expressed their commitment.

Non-profit organizations
- Tompkins County Area Transit (TCAT): energy consumer, critical facility (public transportation coordinator)
- Sustainable Tompkins: community supporting long term well-being on the County
- Ithaca Community Energy (ICE): community coordinator of renewable energy projects
- Church of Christ: microgrid load
6. FEASIBILITY ASSESSMENT INFORMATION

A copy of the completed Stage 1 Feasibility Assessment with the Benefit Cost analysis can be found in Appendix H. Stage I Feasibility Assessment Report Checklist (Attachment I of NYERDA RFP 3044) can also be found in Appendix I.
7. WORK PLAN AND SCHEDULE

The plan that follows summarizes the 92 tasks and subtasks presented in NYSERDA’s RFP 3044, Attachment C: Statement of Work (henceforth, RFP Attachment C), into a succinct work plan and project approach summary. The team is fully capable of providing the services outlined in RFP Attachment C. The team would like to clarify its intention relative to the amendment to RFP 3044 stating that deviations from the scope of work contained in the RFP, while permissible, must be accompanied by a justification. Our team is confident the work plan below comprehensively addresses the constraints and criteria found in RFP Attachment C. We are prepared to submit necessary justification in the event the proposal review panel believes we have not fully addressed any of the tasks in RFP Attachment C.

The structuring and reporting functions within our team, as depicted in Figure 2, shall support parallel work functions of 1) Detailed Engineering, i.e. design and 2) Business and Financial Planning, i.e. development. Routine feedback between each function is critical for success. The team is aware of the potential obstacles identified during Stage 1 as well as those that may result from the ongoing NY REV proceeding. Notably, the microgrid will require new and/or modified utility regulation. As such, the team will proactively coordinate with NYSERDA and NYSEG to craft a workable solution. Because of their important and active role in this process, NYSERDA and NYSEG are designated as the Regulatory and Technical Assistance Team. We believe flexibility and nimbleness are required to support and achieve NY REV and NY Prize program goals throughout the Project development process.

The sections that follow outline how our Integrated Design and Development Team will execute the work.

Task 0 – Project Management and Progress Reporting

The Development Services Team shall provide project management and progress reporting services on behalf of the City of Ithaca throughout the Detailed Engineering Design, Financial and Business Plan Assessment. The team shall utilize its extensive experience in project and program management on similar energy projects and project development and design engagements. Our experience and background is highlighted in Section 5 as well as in Appendix B. SourceOne shall provide all project management activities necessary for the successful execution of this Statement of Work including coordination of work, ensuring control of the project budget, adherence to the schedule and all necessary project reporting to NYSERDA as defined in RFP Attachment C.

Task 1: Develop Detailed Technical Design Configuration and Costs

The Integrated Design and Development Team along with support from project sponsors and community stakeholders shall conduct a detailed assessment of the technical design configuration and costs for the proposed community microgrid through the following subtasks:

Task 1.1 Microgrid Capabilities

The Team shall initiate the design by conducting an integrated design charrette which shall use NYSERDA’s microgrid capabilities guidance for design constraints and criteria. The charrette shall include all design disciplines, representatives from the critical facilities in the microgrid and key NYSEG and NYSERDA technical and regulatory staff. The purpose and goals of the charrette are as follows: 1) kickoff the design process; 2) provide a common platform for project planning among decision makers to avoid miscommunication; 3) provide an opportunity to reflect on for lessons learned from previous or similar projects and structure the planning process accordingly; and 4) save time and money by collaborating on ideas, issues, and concerns early in the design process to avoid later iterative redesign.
Key actions under this task include the ASHRAE Level II audits of the facilities within the microgrid. Level II audits shall provide energy load and infrastructure data necessary to support the Project’s basis of design (BOD). We expect the audit process to allow the Design Team the necessary time to fully understand each facility being served by the microgrid and to determine how best to integrate electrical, mechanical and control connections. Facility operation and energy load information shall reveal demand side opportunities for permanent (i.e. energy efficiency) and curtailable (i.e. demand response) opportunities. Demand side measures shall support the right-sizing of cost effective generation. The ASHRAE auditing process shall be combined with other relevant tasks outlined in RFP Attachment C so as to deploy field resources and facility operational interviews in a cost effective and time efficient manner.

In collaboration with NYSEG, the Design Team shall review existing metering infrastructure and if required, implement a temporary metering plan so accurate electric and thermal load profiles can be established to support the Project BOD. Project energy load profiles will be memorialized into a formal Project load letter which shall be distributed and approved by Project stakeholders. The approved load letter shall support generation sizing, dispatch and control methodology which shall inform the BOD efforts and ultimate design documents drafted under the following Task 1.2.

**Task 1.2 Microgrid Configuration and Design**

Under this task key design documents and specifications for the microgrid shall be drafted. Using takeaways from the design charrette, the BOD shall be finalized and issued to NYSEG for review. The BOD, shall at a minimum include: site characterization, fuel specifications, water and other utilities, description of systems and sub-systems as well as describe how these components work jointly in achieving the microgrid capabilities as per Task 1.1.

It will be critical to have NYSEG involved in formulating the BOD and in particular provide guidance on required operational, control, automation and communication protocols. In discussing the project with NYSEG, one of the main issues that surfaced is the fact the New York State Standard Interconnection Requirement (NYSIR) does not address islanded operation on utility distribution systems. This and other regulatory and legal issues need to be addressed early on so proper technical, business and financial planning functions can be identified and resources can be assigned.

With the BOD as a guide, the Integrated Design and Development Team will break into specialized disciplines to perform their respective work while providing periodic updates and feedback to the business and financial planning project managers. Design documents and specifications shall include at a minimum, the following: Site Layout Diagram/Site Plan Drawing, Electrical One Line Diagram, Communication & Controls Schematic, Piping and Instrumentation Diagram, Sequence of Operations and Major Equipment Specifications. All design drawings and documents shall conform to Task 1.2 in RFP Attachment C.

The Design Team shall schedule preliminary, critical and final design review sessions with NYSEG. Milestone deliverables to NYSEDA under the task include a 30% design drawing package for review and comment, followed by summary memos after each of the aforementioned design review sessions.

**Task 1.3 Performance Criteria**

The Integrated Design and Development Team shall define quantitative metrics and/or performance criteria associated with establishing each of the microgrid capabilities as established in Task 1.1. Such metrics/criteria shall include the specific electrical and thermal loads to be served during grid normal and grid emergency
operations, system efficiency targets, standard operating procedures, maintenance targets and others as outlined in RFP Attachment C.

**Task 1.4 Distributed Energy Resources Analysis**
The Integrated Design and Development Team shall provide detailed documentation that describes the Distributed Energy Resources (DERs) that comprise the microgrid and document how such resources interact with the balance of microgrid system components. The team anticipates the requirements of this task to be identified and documented through the development of the Project’s BOD as described in Task 1.1 above and through the design process as further described in Task 1.2.

**Task 1.5 Distributed Energy Resources Design**
The Integrated Design and Development Team shall utilize a combination of industry standard, proprietary and custom built modeling programs to properly size, configure and dispatch the generation resources and systems in microgrid. These programs include but are not limited to Thermoflow and/or HOMER models as well as custom built hourly DG/CHP models. The models provided under this task will serve as the foundation for the economic evaluation of the energy products in the microgrid. All input variables and assumptions shall be provided in a summary document. These include but are not limited to technical and financial performance parameters such as heat rate, part load performance, minimum turndown, multi fuel impact, impact from ambient conditions (i.e. solar insolation, wind, temperature and relative humidity), system losses, parasitic loads, capital expense, operating expense, and fuel expense for each generation source in the microgrid. Hourly load data will be used for each of the analyses defined in Tasks 1.5.1-1.5.3. The team shall provide documentation in accordance with RFP Attachment C and as defined in the Project BOD process identified above.

**Task 1.6 Power Distribution Systems Design**
The Design Team shall collaborate with NYSEG as well as any NYSEG designated contractors to design and specify all electrical distribution system components and equipment which shall include those outlined in Task 1.6, 1.6.1-3 of RFP Attachment C and the Project BOD. Collectively, NYSEG and the Design Team shall determine the applicable specifications for all power distribution equipment, power distribution system controls and protection equipment, meters and sensors. Documentation shall cover pre-existing and planned components and highlight the interaction of such components with the rest of the microgrid system. Any non-standard and/or developmental features and requirements needed for microgrid operation shall be documented and submitted.

**Task 1.7 Microgrid Control Functionality / Task 1.8 Microgrid Controls and Communications Design**
The Design Team shall design a fully-customized microgrid controller that shall include the ability to balance load and generation, maintain grid stability (e.g. voltage, frequency, power factor, etc.), and manage the transition to and from an islanded operation. As part of the design process and as mentioned in Task 1.2, a detailed sequence of operations shall be developed describing all operating modes, the transition between these modes, and the interlocks required to maintain safety and reliability. The sequence of operations shall be documented in accordance with Task 1.7.1. The microgrid controller shall consist of a combination of utility-grade relays and PLC manufactured by NYSEG-preferred vendors (e.g. Schweitzer Laboratories, Beckwith, etc.). There are several commercially-marketed all-in-one microgrid controllers that bundle all necessary capabilities into a single hardware/software solution. While these solutions may be appropriate for completely off-grid or non-critical facilities, they do not meet the industry standard of "utility grade". As such, the proposed
microgrid shall use a combination of hardware and software that is already recognized by NYSEG as approved for utility grade installation.

Controller functionality shall monitor, control and store operational data for Tasks 1.8.1-8 and in accordance with the Project BOD. The Design Team shall work in harmony with NYSEG to determine the extent the project may benefit from various program elements planned by NYSEG, including a phased deployment of Advanced Metering Infrastructure (AMI) and increased Distribution Automation (DA).

Communications, software, and information technology support for the microgrid controller shall be designed in accordance with Sub Tasks 1.8.9-14 of RFP Attachment C and NYSEG requirements.

**Task 1.9 Microgrid Load Analysis**

The Integrated Design and Development Team shall determine the load of the proposed microgrid through information provided by NYSEG and through its metering efforts previously described in Task 1.1. Meta data shall be in accordance with Task 1.9, inclusive of subtasks in RFP Attachment C and shall consist primarily of interval meter data, modeled load profiles, and primary metered distribution line sections. Primary metering shall be installed by NYSEG at the project team’s cost to establish load data, as required. A power quality analysis shall be performed by NYSEG.

**Task 1.10 Power Distribution System Modeling and Simulation / Task 1.11 Harmonics and Flicker Studies**

This task shall require close coordination between the Design Team and NYSEG. The Design Team shall design everything on the customer's side of the main switch. That includes a microgrid controller that can monitor load and manage island/grid-connected modes. This design shall be passed along to NYSEG who shall review the design and perform all the system modeling. On the customer’s side of the switch (i.e. the host site), the Design Team shall manage generation and load and make sure there is no excessive available fault current on the host site equipment.

As noted in Task 1.2, the NYSIR is performed with an assumption of a grid connected system. However, the modeling required for an island mode is assumed to be just a permutation of the grid-connected modeling. NYSERDA shall review the model for system frequency, voltage, flicker, protection, amongst other power system parameters. Based on the Design Team’s experience working across many utility jurisdictions on matters of interconnecting DG, it is assumed that NYSEG will not be able to share the model of their distribution system in its entirety. Furthermore the Design Team will most likely not have access to a uniform set of standards that NYSEG needs to adhere to as such standards for an islanded microgrid do not yet exist.

The Design Team, in harmony with NYSEG shall develop project specific standards as the design and regulatory review process moves through Stage 2. It shall be the Design Team’s responsibility to feed NYSEG technical data along with proposed sequence of operations. In turn, NYSEG shall review the design, perform system modeling, and return comments to the Design Team. We anticipate this process will involve at least three iterations.

No power system studies are expected to be needed on the customer-owned portion of the microgrid. Any power system stability issues that may arise on the customer’s system shall be addressed by the Design Team. All area electric power system studies shall be performed by NYSEG or their designated agent at the customer’s expense in accordance with the NYSIR or others as determined during the Project BOD development stage. These studies may include, but are not limited to, steady-state load flow analyses, short-
circuit and protection analyses, system dynamics studies, grid synchronization reviews, and flicker and harmonics studies. The necessity for each of these studies shall be determined as part of the standard interconnection process. The Design Team shall provide all required project technical data.

**Task 2: Microgrid Commercial/Financial Business Plan**

The first step under this task will be to confirm the thermal off take scenario from the Stage 1 Feasibility Study. As can be referenced in Feasibility Assessment Information, Scenario 5 is the most economically feasible. This conclusion needs to be validated against recent external factors such as local development plans, or other loads which may have materialized since the Stage 1 timeframe. The project includes several flexible options for thermal off take in the event new loads do not materialize by the time the microgrid reaches commercial operation. These include modifying the IAWWTF process to utilize waste heat recovery products to enhance overall system efficiency or redirecting biogas to an alternate off take until such thermal loads materialize.

Regardless of the thermal off take scenario, the Development Team shall conduct an audit-grade analysis of the commercial and financial feasibility which will culminate in a 20 year business plan financial statement pro forma showing estimated yearly cash flows for the microgrid project. This evaluation shall be justified with legitimate thermal off take contracts. In addition to the final goal of a bankable 20 year pro forma, the Development Team shall conduct the necessary tasks of defining, measuring, analyzing and confirming the spectrum of ownership and operation aspects of the microgrid described within the subtasks listed in RFP Attachment C.

![Figure 3: Concept Commercial Structures](image-url)
Tasks 2.1 Project Team, 2.2 Commercial Viability – Customers, 2.3 Microgrid Service

The Development Team shall accomplish Tasks 2.1 through 2.4 by further refining the preliminary commercial structures depicted in Figure 3 above. The team acknowledges the critical tasks of defining and confirming the financial, legal and regulatory compliance mechanisms for each agreement. These agreements shall form the foundation of a successful project. Agreement types include but are not limited to operating agreements between owner(s), land lease, power purchase, operating and maintenance, fuel purchase, thermal off take and support services. Appendix F offers additional details on the service receiver, provider and tentative constructs for the Project agreements.

Task 2.4 Value Proposition

The Stage 1 assessment highlighted that the value proposition of this microgrid is based on the unique combination of dispatchable low-carbon electric generation fueled by what would otherwise be considered waste, in an expanded bio-digestion process. Aside from the benefits associated with converting food and other organic matter into useable fuel, the supply of additional electrical and thermal energy offers tremendous value to the local community by increasing resiliency and reducing emissions.

In addition to the low carbon and 100% renewable power characteristics of the proposed microgrid, the Project is arranged to use existing approved NYSEG tariffs. As such, the project can secure the value of the microgrid’s energy products right away as the NY REV process continues to define the spatial and temporal value of DER’s through regulatory rulemaking. This adds tremendous value to the project as its energy products have a current marketplace through regulation. The exception to this is the thermal heat recovery products which shall be secured and valued by way of a take or pay contract for the excess volume not utilized by the IAWWTF process.

The remaining product that requires valuing is the electrical power provided during times of a macrogrid outage. One way to propose the value of such power is to use the benefits quantified through the cost benefit analysis conducted during Stage 1 and refined as part of Task 3 in Stage 2, as a proxy. This methodology of valuing emergency power shall be further evaluated by the Development Team and in conjunction with discussions with the facilities on feeder 783 and 784, which are the end users during times of macrogrid outage.

The Development Team shall develop a clearly defined, reasonable, and comprehensive business model that considers all participants, types of assets involved, relevant value streams, risks to operation and financial viability. The Development Team shall present a clear and compelling case that the benefits to the local community outweigh the associated costs and risk. Such a presentation shall be in line with Task 3 of this Work Plan as well as Subtask 2.4.2 of RFP Attachment C.

Deliverables for this task shall include the development of a comprehensive business model and demonstration of the added value proposition to stakeholders of the proposed microgrid such as the community, the utility grid, governing entities, suppliers and purchasers of power.

Task 2.5 External Support

The Development Team shall clearly identify and document the ways in which the entities listed in Section 5 contribute to the project. As outlined in the organizational charts, the support for this project is immense, from sustainable initiatives at the city and grassroots level, to world class public policy and natural resource
educational institutions. It shall be incumbent on the Development Team to engage and harness this potential into actionable results to advance the Project.

Subtask 2.5.1 Government and Community – As outlined in Section 4 and through supporting letters of commitment (Appendix A), community involvement is key to the success of the project. As witnessed by the legal form of the lead proposer, the City of Ithaca, there is direct local government involvement and commitment.

Subtask 2.5.2 Financiers – The Development Team shall identify, describe and evaluate the impact of the chosen project finance delivery method. The team shall utilize the world class educational facilities and institutions in Ithaca to engage in an educational opportunity to highlight the value of public private partnerships, to the extent PPPs are deployed to support the financing and development of the microgrid.

Subtask 2.5.3 Grid Support – NYSEG shall play a critical role on both the Design and the Development Teams. NYSEG’s technical and regulatory review and direction shall be paramount in determining the operational criteria during a macrogrid outage and furthermore, the commercial impacts of the associated regulatory construct of such operations. These areas shall be fully vetted and documented under this task.

Task 2.6 Project Planning and Construction Management Services
The Integrated Design and Development Team shall develop a reasonable project schedule and project management plan to ensure that the schedule is maintained and supplier and other work requirements are appropriately coordinated. A preliminary schedule follows this Work Plan. The plan shall be reasonable, exhaustive and extensive as well as executable upon an award to construct and operate the microgrid under a subsequent stage of the NY Prize competition.

In addition to project planning, the Integrated Design and Development Team shall prepare an itemized budget of all of the construction costs by scope item to within +/- 10% based on the detailed design developed in Task 1, outlined above.

Task 2.7 Creating Value
This task shall involve close coordination between the Design and Development Teams and NYSEG as the questions asked involve both technical considerations and their commercial impacts. The Project BOD and standard operating procedures shall be thoroughly vetted to determine the commercial impact of the various scenarios and areas required in sub tasks 2.7.1-6. By way of example, NYSEG will weigh in heavily on subtasks 2.7.2 Control & Monitoring, 2.7.3 Distribution Strategy, 2.7.4 Maintenance and 2.7.5 Reliability, whereas project owners and financers will be required to address subtasks 2.7.1 Assets (inclusive of maintenance) and 2.7.6 Taxes. The Integrated Design and Development Team shall ensure proper coordination and documentation of this important task to truly convey the value of the microgrid in the business and financial plan documents.

Task 2.8 Project Profit and Revenues
Project pro forma spreadsheets shall be completed per RFP Attachment D. The pro forma spreadsheets shall summarize all revenue and cost flows over the lifetime of the project. Standard economic decision metrics related to profitability (Net Present Value, Internal Rate of Return, etc.) shall be included in the pro forma spreadsheets. Revenue and cost stream analysis shall be performed by addressing no less than the questions set forth in Subtask 2.8 of RFP Attachment C.
Task 2.9 Project Financing
In addition to NY Prize funding the Development Team in partnership with the City of Ithaca, Project Sponsors and Stakeholders shall identify and actively seek to obtain additional sources of government funding. Such sources of funding shall not present any conflict with the NY Prize competition’s objectives.

Task 2.10 Legal Terms and Conditions
The City of Ithaca’s legal team, with the support of the Development Team’s legal review services shall provide evidence that it understands the regulatory environment, can identify significant regulatory risks that would impede implementation of the Project and present options or measures to mitigate these risks. The Development Team and NYSEG will work upon award of the Stage 2 funding to determine utility related barriers. Additionally, the permits and approvals necessary to legally implement and operate the proposed project shall be evaluated for all stakeholders and their respective scopes of work.

Task 2.11 Operating Agreements
The Development Team along with the City of Ithaca’s authorized representative(s) shall demonstrate that they have established written and contractual agreements with the utility stakeholders and microgrid service purchasers to obtain explicit support and secure any needed services. These agreements are depicted in Figure 3 and further described in Appendix F.

Task 3: Develop Information for Benefit Cost Analysis
SourceOne shall develop and provide the information for the data capture and facility questionnaire information sheets required to support an independent evaluation of project costs and benefits for this stage of analysis. It is assumed this process shall follow that of Stage 1 whereby NYSERDA retains a contractor to lead the benefit cost program.

7.1. Schedule
The table below presents an overview of the proposed schedule. For a visual representation of the schedule, refer to Appendix D.

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>NY Prize Stage II- Ithaca Microgrid</td>
<td>255 days</td>
<td>Mon 1/2/17</td>
<td>Fri 12/22/17</td>
</tr>
<tr>
<td>Notice of Award</td>
<td>0 days</td>
<td>Mon 1/2/17</td>
<td>Mon 1/2/17</td>
</tr>
<tr>
<td>Project Initiation &amp; Administration</td>
<td>3 weeks</td>
<td>Mon 1/2/17</td>
<td>Fri 1/20/17</td>
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<tr>
<td>Task 0: Project Management and Progress Reporting</td>
<td>240 days</td>
<td>Fri 1/20/17</td>
<td>Fri 12/22/17</td>
</tr>
<tr>
<td>Task 1: Develop Detailed Technical Design Configuration and Costs</td>
<td>133 days</td>
<td>Mon 1/23/17</td>
<td>Wed 7/26/17</td>
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<tr>
<td>Task 2: Microgrid Commercial/ Financial Business Plan</td>
<td>199 days</td>
<td>Mon 1/23/17</td>
<td>Thu 10/26/17</td>
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<tr>
<td>Task 3: Benefit Cost Analysis</td>
<td>15 days</td>
<td>Thu 7/27/17</td>
<td>Wed 8/16/17</td>
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<tr>
<td>Project Closure</td>
<td>12 days</td>
<td>Thu 12/7/17</td>
<td>Fri 12/22/17</td>
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</table>
8. **MILESTONE BUDGET**

A comprehensive task based budget has been compiled for our Stage 2 funding request. The table below is an estimate of the milestone payments and associated deliverables throughout the Stage 2 process. The team expects that these fees will be adjusted during contract negotiation.

### 8.1. **Milestone Payments**

**Table 2: Milestone Payment Schedule**

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
<th>Amount</th>
<th>NYSERDA Contribution</th>
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<tr>
<td>Project Initiation and Mobilization</td>
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<td>Milestone Deliverable 2</td>
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<td>Milestone Deliverable 3</td>
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<tr>
<td>Final Deliverable</td>
<td>12/7/17</td>
<td>$123,768</td>
<td>$105,203</td>
</tr>
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</table>

### 8.2. **Cost Sharing**

**Table 3: Funding Source Table**

<table>
<thead>
<tr>
<th>FUNDING SOURCE TABLE</th>
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</thead>
<tbody>
<tr>
<td>Funding Source</td>
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<td></td>
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<td></td>
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<tr>
<td>NYSERDA</td>
</tr>
<tr>
<td>Proposer</td>
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<tr>
<td></td>
</tr>
</tbody>
</table>
APPENDIX A: LETTERS OF SUPPORT OR COMMITMENT

1. City of Ithaca Mayor
2. Special Joint Committee
3. City of Ithaca Mayor’s Office
4. City of Ithaca Department of Planning, Building, Zoning & Economic Development
5. Ithaca Department of Public Works
6. Tompkins Consolidated Area Transit
7. Cornell University
8. Ithaca Community Energy
9. Ithaca City School District
10. SourceOne/Veolia
11. Martin Energy Group
12. Hallam-ICS
October 5, 2016

To NY Prize Selection Committee:

On behalf of the City of Ithaca, I enthusiastically provide this letter of commitment for our proposal for funding of Phase 2 of the NY Prize Community Grid Competition. We are fully committed and motivated to participate in all aspects of the project implementation team activities. We shall utilize the resources and skill sets of the City to successfully conduct the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in Attachment C of NYSERDA’s Request for Proposal.

As Mayor and Chief Executive Officer for the City of Ithaca, I shall direct my staff, including the Director of Planning and Economic Development, the Superintendent of Public Works, the City Attorney and the City Controller, to work with community stakeholders and City Common Council members to develop a microgrid for the Northside Energy District, as presented in our NY Prize Phase 1 report. The City has made the Waterfront district, encompassed by the proposed microgrid, a key development and planning district. There are already a number of valuable community assets within the neighborhood, including the Ithaca Farmer’s Market, Ithaca Area Wastewater Treatment Facility (IAWWTF) and the Cayuga Waterfront Trail, that this microgrid development effort would surely complement.

The development structure proposed in our phase 2 application will be organized around a “Board of Directors” concept. At a minimum the board will include key department heads from the City’s senior staff, representatives from both the legislative branch of City government and the Special Joint Committee of the three municipal owners of the IAWWTF, and potential other community stakeholders, depending on their abilities and interests. The proposed board will utilize appropriate public purchasing and financing procedures to select consultants and developers to pursue the eventual construction of the infrastructure needed to supply electricity to the identified customers of the microgrid.
With the expected significant rise in development and demand for energy services in the City of Ithaca, coupled with a changing climate, I believe that the proposed microgrid will add significantly to the security and well-being of Ithaca’s population. The unique combination of locally-produced, affordable, reliable renewable energy provides the opportunity to create a sustainable energy infrastructure that will safeguard vital resources for the community of Ithaca.

Sincerely,

[Signature]

Svante L. Myrick
Mayor
To the NY Prize Selection Committee,

This is to affirm the continuing commitment of the Special Joint Committee, owner body for the IAWWTF representing the Towns of Ithaca and Dryden and City of Ithaca, toward the success of this microgrid project.

We have undertaken in these years to transform our Plant into a Resource Recovery Center and to not only be an integral part of our neighborhood on Ithaca’s North Side, but to also be a partner in building a stronger local economy.

Through our efforts at energy recovery we are proving to be a strong component of our community’s Energy Action Plans and Sustainability goals. This green microgrid will be the best expression of our investments and efforts to increase local energy production and resilience, and to greatly decrease carbon emissions.

We hope to build a positive, viable example for the State.

Respectfully,

Wade Wykstra
Chairman, SJC
To the NY Prize Selection Committee:

I am the Sustainability Coordinator for both the City of Ithaca and the Town of Ithaca. As a representative of sustainability efforts at both municipalities, I am providing this letter of commitment for the proposal being submitted by the City of Ithaca (on behalf of the City, the Town of Ithaca, and the Town of Dryden) to the New York Prize for funding for Stage 2 of the NY Prize Community Grid Competition. We are fully committed and motivated to participate on all aspects of project implementation team activities. We are fully dedicated to utilize our resources and skillset to successfully carry out the responsibilities for conducting the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in Attachment C of NYSERDA’s Request for Proposal.

With backing from the Mayor of the City of Ithaca and the Supervisor of the Town of Ithaca, I will support efforts to develop a microgrid for the Northside Energy District as presented in the NY Prize Phase 1 report.

The proposed microgrid would do much to further local and State sustainability efforts. Both the City and the Town joined New York State’s Climate Smart Communities initiative in 2009, and both are committed to reducing greenhouse gas emissions 80% by 2050 in government operations. The microgrid’s center, the jointly-owned Ithaca Area Wastewater Treatment Facility, would be one of the few net-zero energy facilities of its kind in the nation, resulting in huge energy use and cost savings, as well as significant greenhouse gas reductions. The project would help not only with climate change mitigation, but also with adaptation to climate change, by making our local facilities and energy system more resilient to grid disruptions.

The microgrid also supports New York State energy and climate goals. The project would help achieve many of the objectives of Reforming the Energy Vision, such as improving energy infrastructure, making the energy system more resilient, supporting innovation, and creating new energy business opportunities. Both the City and the Town are already actively involved with REV projects, such as AvanGrid/Iberdrola’s Energy Smart Community project.

With the expected significant rise in development and demand for energy services in the City of Ithaca coupled with an ever changing climate, I believe that the proposed microgrid would add significantly to the security and well-being of the population of the city. The unique combination of locally-produced, affordable, reliable renewable energy provides the opportunity to create a sustainable energy infrastructure that will safeguard vital resources for the community of Ithaca.

Sincerely,

Nick Goldsmith
Sustainability Coordinator
TO: To NY Prize Selection Committee

FROM: JoAnn Cornish, Director of Planning and Economic Development

DATE: October 5, 2016


I am providing this letter in support of the City of Ithaca’s proposal for Phase 2 funding of the NY Prize Community Grid Competition. We are fully dedicated to utilizing our resources and expertise to successfully engage in conducting the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in Attachment C of NYSERDA’s Request for Proposal.

The proposed microgrid would do much to further local and State sustainability efforts. Both the City and the Town of Ithaca joined New York State’s Climate Smart Communities initiative in 2009, and both are committed to reducing greenhouse gas emissions 80% by 2050 in government operations. The microgrid’s center, the jointly-owned Ithaca Area Wastewater Treatment Facility, would be one of the few net-zero energy facilities of its kind in the nation, resulting in huge energy use and cost savings, as well as significant greenhouse gas reductions. The project would help not only with climate change mitigation, but also with adaptation to climate change, by making our local facilities and energy system more resilient to grid disruptions.

The City of Ithaca has long been known as a pioneer in the field of sustainability and strives to become a CARBON-NEUTRAL community, with the initial goal of reducing community-wide emissions to 80 percent below 2010 levels by 2050. In 2001 Ithaca joined Local Governments for Sustainability (ICLEI) – over 600 local governments and entities working towards sustainability, energy, conservation, and climate protection. In 2006 Ithaca signed U.S. Mayors Climate Action Agreement, with 204 mayors in 38 states, committing to meet or exceed Kyoto Protocol targets for reducing global warming; In 2009, Ithaca adopted the Climate Smart Community Pledge, focused on improving operations and infrastructure, increasing energy independence and security, and boosting economic growth.

In 2011, Ithaca installed solar thermal hot water systems, using solar energy to produce 45-50% of hot water for 2 major city facilities and installed solar photovoltaic panels in 2 other major city facilities; in 2013 Ithaca adopted the Energy Action Plan 2012-2016 aimed at further reducing greenhouse gas emissions of City government operations; in 2014, Ithaca, in collaboration with four other municipalities launched the Residential Energy Score Project to develop a plan for scoring the energy performance of local homes. The project aims to use market forces to improve the energy efficiency of existing housing stock by providing meaningful home performance information to future home buyers.

In June of this year, 17 local building owners, community partners, and professional stakeholders came together to launch the first 2030 District in New York. In doing so, Ithaca joined the ranks of 12 other cities in the U.S. and Canada that are working toward the goal of cleaner and greener commercial buildings.

The microgrid will also be in alignment with New York State energy and climate goals. The project would help achieve many of the objectives of Reforming the Energy Vision, such as improving energy infrastructure, making the energy system more resilient, supporting innovation, and creating new energy business opportunities, all of which the City of Ithaca has made great strides in already. With the proposed microgrid in place, the unique combination of locally-produced, affordable, reliable renewable energy will provide the opportunity to create a sustainable energy infrastructure that will safeguard vital resources for the community of Ithaca.
NY Prize Selection Committee,

On behalf of City of Ithaca Public Works and Ithaca Area WWTF, I wish to provide our commitment to the City of Ithaca Community Microgrid NY Prize Phase 2 Application. The main focal point of this application is to develop a microgrid around the IAWWTF production of biogas and a solar panel array proposed to be sited at the IAWWTF. The end result will be a microgrid distribution network that relies on renewable resources located in a key waterfront development district which surrounds IAWWTF. IAWWTF’s owners have been committed to the improvement of the waterfront district for 30 years. One of its first contributions to the neighborhood was providing the land which houses the very popular farmers market and recently, a second contribution resulted in the development of a waterfront trail. The City of Ithaca has prioritized the development of this neighborhood. Our key customers for emergency services are located within this area as well. The proposed microgrid would provide emergency power to two schools, two public works offices and equipment deployment garages, Tompkins Consolidated Area Transit garage and offices and IAWWTF.

During the last six years IAWWTF owners have prioritized upgrading key parts of the treatment processes that involved reducing energy intensity while increasing energy production from biogas. Total investment amounts to greater than twelve million dollars. Current planning includes other improvements to further increase the production of biogas derived electricity. In addition to these capital investments, planning efforts within the community to develop a program for the delivery of food waste from Cornell’s dining services and manure from Cornell’s Teaching Dairy Barn will provide more carbon resources for the production of biogas in the upcoming years.

The proposal for phase 2 is centered on the City of Ithaca creating a Board of Directors. Ithaca Area WWTF owners and key members of the Department of Public works will be included as part of the proposed board. The proposed board will develop the project in compliance with City procurement rules and will create the legislation necessary to accept the phase 2 funds and provide the necessary matching funds.

We look forward to continuing our work with NYSERDA and NYSEG in developing this cutting edge resource.

Sincerely,

Daniel Ramer
Chief Operator IAWWTF
September 27, 2016

Re: Ithaca Microgrid NYSERDA State II Proposal

Dear New York Prize Committee,

Tompkins Consolidated Area Transit, Inc. (TCAT) supports the City of Ithaca in its pursuit of funding to create a project plan, budget, schedule and proposed commercial structure that would lead to the construction of a local microgrid system. The proposed project’s location encompasses the Ithaca Area Wastewater Treatment Facility on the City’s Northside, an area that includes TCAT’s facility at 737 Willow Ave.

TCAT provides essential public transit for Tompkins County, especially for those in our community who are most vulnerable in the event of inclement weather. The creation of the microgrid would give TCAT an alternative to remain operational during power outages. As TCAT’s fleet is stored and maintained, and, as TCAT’s bus operators report to and are subsequently dispatched to duty from our facility, it is important that it — as well as the community’s municipal services it relies upon — remain operational.

Clearly, TCAT and the community it serves will benefit from local, innovative transportation technologies, and, as such, we fully support the City of Ithaca’s proposal to create a local energy source with the ultimate goal of reducing both fuel costs and carbon emissions, and boosting local economic development.

Sincerely,

Alice Eccleston
Acting General Manager
TCAT, Inc.
October 7, 2016

Dear New York Prize Committee,

I’m pleased to provide this letter of support for the City of Ithaca’s proposal to the New York Prize for funding for Stage 2 of the NY Prize Community Grid Competition. The Cornell Campus Sustainability Office strives to empower, equip, and engage our diverse partners to catalyze a sustainable campus transformation, and to be an active partner in a similar transformation of our community. We envision Cornell University as a carbon neutral, living laboratory for sustainability innovation; a place where every Cornellian can make a positive impact on social, environmental, and economic progress. Cornell University has developed a comprehensive Climate Action Plan using our own campus as a living laboratory with the goal of achieving carbon neutrality with scalable and transferable strategies by 2035. We fully support community efforts advancing sustainability and a clean energy future. Microgrids are well suited to renewable energy sources and offer significant benefits from both an energy efficiency and energy reliability and resiliency standpoint.

The Cornell Ithaca campus is supported by a 37MW optionally islanding microgrid. To the extent possible we will support the City’s effort through sharing our operational and academic expertise.

With the expected significant rise in development and demand for energy services in the City of Ithaca coupled with an ever changing climate, we believe that the proposed microgrid would add significantly to the security and well-being of the population of the city. The unique combination of locally-produced affordable, reliable renewable energy provides the opportunity to create a sustainable energy infrastructure that will safeguard vital resources to the community of Ithaca.

Sincerely,

Sincerely,

Sarah Zemanick
Director, Campus Sustainability Office
October 10, 2016

Re: Ithaca Stage Two Microgrid NYSERDA Proposal

Dear New York Prize Committee,

Cornell Cooperative Extension of Tompkins County supports the efforts of the City of Ithaca to pursue Stage Two funding for the creation of a microgrid for the Ithaca community. The technical designs and system configurations that were developed from Stage One concepts will lead to the construction of a sustainable, local microgrid system with the Ithaca Area Wastewater Treatment Facility serving as the primary source of renewable energy for this innovative Northside Energy District.

Cornell Cooperative Extension, located within the proposed energy district, has been a vital and active team member for this project from day one, with applicable expertise in the areas of alternative energy, as well as energy infrastructure awareness and education. As a participant in NY Extension Disaster Education Network, Cornell Cooperative Extension will also serve as an essential hub for disaster relief, information and response teams, critical components to any successful emergency response effort. It has also been applying its expertise in energy and disaster response in the redevelopment of its energy and other infrastructure systems to improve its own ability to maintain operations in the event of a disaster.

Creating a renewable energy microgrid would certainly benefit the Ithaca community and meet the various challenges of energy resilience and sustainability. As these are core values of our organization, we enthusiastically support the City of Ithaca’s proposal.

Sincerely,

Ken Schlather, Ph.D.
Executive Director
City of Ithaca Community Microgrid Stage 2 NYSERDA Grant Application

Dear NY Prize Committee,

Ithaca Community Energy Inc. (ICE) was formed during the proposal development for Stage 1 of the NY Prize Community Grid Competition. ICE, a registered New York State not-for-profit, was established to foster economic development through the effective use of local renewable energy resources. We are proud that our work contributed to the award of the New York Prize to the City of Ithaca and the Ithaca Area Waste Water Treatment Facility.

Ithaca’s NED (Northside Energy District) is poised to develop a microgrid to support critical infrastructure. The Ithaca model will eventually evolve into a multi-user microgrid and district energy system that encourages economic development while enhancing energy reliability, sustainability and resiliency. This model will be applicable to other parts of our community and beyond.

Our mission is to promote clean energy development by supporting successful sustainable energy strategies that emerge from a committed community. We also support the use of integrative business models that encourage net-zero fossil fuel use. ICE strives to collaborate with the human resources that exist in our own community (including Cornell University and Ithaca College) and further afield.

Members of ICE believe the NY Prize Community Microgrid initiative will have strong appeal in Ithaca because it will support the goals of both the city’s new Comprehensive Plan and its Energy Action Plan. (That plan calls for an 80% reduction in GHG emissions by 2050.) Ithaca is also located in the center of Tompkins County, which has also committed to an 80% GHG reduction by 2050 according to its Tompkins County Energy Roadmap published in March 2016.

The members of ICE are willing to commit effort to implementation of Stage 2 of the NY Prize Community Grid Competition.

The final design calls for increasing the production of Anaerobic Digester Gas (ADG) at the IAWWTF. ADG is a carbon negative fuel and it will power critical facilities within the NED in the event of a major power failure. ICE is quite certain that a successful NED microgrid that supports critical infrastructure will also encourage green private-sector investment within the NED. This advancement will help Ithaca reach its Energy Action Plan in the Northside and along the Cayuga waterfront, which is a focus area in the new City Comprehensive Plan.

ICE's ongoing role will be to interact with policymakers and the community in building a sustainable urban environment through distributed energy innovation. The members of ICE will continue to provide technical assistance for sustainable urban development. We will continue working with City government, the private sector and not-for-profits to help launch a citywide multi-user community microgrid and district energy system in Ithaca.

Signers: Ithaca Community Energy Inc. Member-Associates

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>John Graves</td>
<td>Associate, Civic Engagement</td>
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<tr>
<td>Tom Hanna</td>
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<tr>
<td>Francis Vanek</td>
<td>Associate, Energy Engineering</td>
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<tr>
<td>Bill Reed</td>
<td>Associate, Real Estate Development</td>
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<td>George Frantz</td>
<td>Associate, Urban Planning</td>
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<td>John Howard Foote</td>
<td>Associate, Policy and Financing</td>
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<td>Associate, Civic Engagement</td>
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<tr>
<td>Bruce Abbott</td>
<td>Adviser, District Energy</td>
</tr>
</tbody>
</table>
October 7, 2016

Re: Ithaca Microgrid NYSERDA Proposal

Dear New York Prize Committee,

The Ithaca City School District enthusiastically supports the City of Ithaca’s efforts to create a project plan, budget, schedule and proposed commercial structure that would lead to the construction of a local microgrid surrounding the Ithaca Area Wastewater Treatment Facility, that would serve as the energy hub for the proposed Northside Energy District. The Ithaca City School District currently has two large schools that are located within the proposed microgrid, Ithaca Senior High School and Boynton Middle School, both of which are vital facilities that would provide shelter and essential services to community members in need during a power outage.

The values and mission of the Ithaca City School District align closely with those proposed within this microgrid project: utilizing local renewable energy, providing economic stability and resiliency, reducing carbon emissions, and promotion of cohesion within the community at large.

The Ithaca City School District and local community would be well served by the creation of this community microgrid, resulting in the development of new technologies and better service to the people of Ithaca.

That being said, the Ithaca City School District fully endorses and supports this proposal.

Sincerely,

[Signature]

Amanda Verba
Chief Operations Officer
Ithaca City School District
October 7th, 2016

Dear New York Prize Committee,

Veolia enthusiastically supports the City of Ithaca’s proposal for funding for Stage 2 of the NY Prize Community Grid Competition. We are committed to participate on all aspects of the project implementation and look forward to a long-term partnership with the City of Ithaca and the other Project stakeholders. We are fully dedicated to utilize our resources and skillsets to successfully carry out the responsibilities for conducting the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in NYSERDA’s RFP 3044.

SourceOne is a subsidiary of Veolia North America and brings to bear seasoned utility experts, energy engineers and industry experts strategically positioned to support and guide the project from concept to commercial operations. Veolia provides innovative environmental solutions in energy, water and waste. The Ithaca microgrid project touches on each of Veolia’s core business units and truly demonstrates how the circular economy concept can be put into action. We are committed to drawing on our worldwide experience base to provide the necessary insight and guidance to successfully deliver this project. We commend the IAWWTF in its ambitious goal of becoming a net zero facility.

The microgrid will significantly increase the safety and quality of life for residents of the community. Tangible benefits, in addition to powering critical facilities, include redirecting a significant amount of food waste from local landfills and the associated delivery/hauling jobs which will be created as part of this project. Ithaca will also become one of the few net zero waste water treatment facilities in the country and quite possibly the first renewable microgrid. Veolia and SourceOne are pleased to be part of a role model for other facilities looking to create a clean powered microgrid. Moreover, Ithaca is an intellectual hub and an environmentally progressive community which has the energy and academic resources to fully optimize this project and to optimize the information transfer necessary for replication in other communities. We are both committed and proud to join the ranks of the good work that has already been done at the IAWWTF and are excited to lead the team through the next stage of development.

Sincerely,

Michael V. Byrnes P.E.
Senior Vice President
Veolia North America
September 26, 2016

Dear New York Prize Committee,

**Martin Energy Group Services, llc.** provides this letter of commitment for the City of Ithaca’s proposal to the New York Prize for funding for Stage 2 of the NY Prize Community Grid Competition. We are fully committed and motivated to participate on all aspect of project implementation team activities and are fully dedicated to utilize our resources and skillset to successfully carry out the responsibilities for conducting the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in Attachment C of NYSERDA’s Request for Proposal.

**Martin Energy Group** an industry leader in the designing and manufacturing of complete power plant packages. Resilient CHP Systems, Tri-generation Packages, Successful Microgrid Applications, Modular Enclosure Packages, Critical Power Systems, Island and Black Start Capable. Alternative Fuels and Fuel Blending Systems supported by our advanced Engine/Generator Controls, Switchgear and SCADA Systems. With complete Product and Service Support. We firmly believe that our engineering capabilities will aid the project team in exceeding the goals and objectives of this project.

With the expected significant rise in development and demand for energy services in the City of Ithaca coupled with every changing climate we believe that the proposed microgrid would add significantly to the security and well-being of the population of the city. The unique combination of locally-produced affordable, reliable renewable energy provides the opportunity to create a sustainable energy infrastructure that will safeguard vital resources to the community of Ithaca.

Sincerely,

Aaron M Fox

Aaron M. Fox

Project Development

**Martin Energy Group Services, llc.**
39415 Excelsior Drive
Latham, MO 65050 - USA
Phone: (660) 458-7000
Fax: (660) 458-7100
www.martinenergygroup.com
October 06, 2016

Dear New York Prize Committee,

Hallam-ICS provides this letter of commitment for the City of Ithaca’s proposal to the New York Prize for funding for Stage 2 of the NY Prize Community Grid Competition. We are fully committed and motivated to participate on all aspects of project implementation team activities. We are fully dedicated to utilize our resources and skillset to successfully carry out the responsibilities for conducting the Stage 2 Detailed Engineering Design, Financial and Business Assessment in accordance with the requirements set forth in Attachment C of NYSERDA’s Request for Proposal.

Hallam-ICS is a 90 person firm, with offices in five states. Our business lines cover mechanical, electrical and process engineering, industrial controls and automation and commissioning and qualification. We have been in business since 1991 with engineering as our core. We firmly believe that our engineering capabilities will aid the project team in exceeding the goals and objectives of this project.

With the expected significant rise in development and demand for energy services in the City of Ithaca coupled with an ever changing climate, we believe that the proposed microgrid would add significantly to the security and well-being of the population of the city. The unique combination of locally-produced affordable, reliable renewable energy provides the opportunity to create a sustainable energy infrastructure that will safeguard vital resources to the community of Ithaca.

Sincerely,

[Signature]

William Neuburger, PE
Director of Engineering

Hallam-ICS
38 Eastwood Drive, South Burlington, VT 05043
802-685-4891
www.Hallam-ICS.com
APPENDIX B: RESUMES AND COMPANY QUALIFICATIONS

1. City of Ithaca

2. Ithaca Community Energy (ICE)

3. SourceOne/Veolia

4. Martin Energy Group

5. Hallam-ICS
DANIEL R. RAMER

143 JAMESVILLE DRIVE  
SYRACUSE, NY 13210  
CELL 315-762-3489

EDUCATION:
High school regents diploma  Nottingham High School  1979
Bachelor’s of Science Degree  SUNY College of Env. Sci. And Forestry  1984
NYSDEC Grade 4A Operator  1989

EXPERIENCE:
4/09 TO Present  Ithaca Area Wastewater Treatment Plant Chief Operator
Duties include: Operation and maintenance of a 13.1mgd activated sludge facility with tertiary phosphorous removal and anaerobic digestion. Assisted by a 13 member staff including eight licensed operators, lab director, lab technician and account manager. Other features of the plant include cogeneration system and trucked waste receiving center. Treatment is conducted for three municipalities and chief operator is tasked with preparing budgets and capital projects for the governing board made up of members of the three municipal boards. Recent capital projects have included replacement of the trucked waste center, replacement of the old aeration system, replacement of the cogeneration system. Working with Cornell University to add food waste as a substrate for codigestion. Pursuing beneficial reuse of biosolids generated as a result of anaerobic digestion of in plant and trucked waste solids.

8/94 TO 7/08:  City of Oneida Sanitary Engineer II, Oneida NY
Duties include: Operation and Maintenance of a 2.5 MGD advanced activated sludge wastewater treatment plant including 40 miles of sewer main and 6 pump stations. Responsible for 10 full-time staff and a two million dollar annual budget. Perform project planning and project management duties. Oversee the industrial pretreatment program and initial enforcement response. Manage reclaimed water system for Turning Stone Resort Golf Course irrigation system, a NYSDEC permitted treated wastewater reuse project. Serve as the City’s liaison to the Oneida Lake watershed management plan watershed advisory board and served as Chairman of the board of directors for two years.

PROJECTS: Developed Sewer Use Ordinance, Enforcement Response Plan, Industrial User Permit and Industrial Waste Questionnaire as part of Pretreatment Program. Modified Industrial Waste Surcharge Formula for calculating the monthly charge for high strength waste. Planned, helped install, start-up and operate Reclaimed Water System to irrigate a nearby golf course. Planned and installed two new computer controlled VFD pumping systems. Oversight on installation and start-up of a Belt Filter Press and dual fuel Waukesha Cogeneration System. Managed and participated in digester cleaning projects (first cleaning in more than fifteen years). Served as safety coordinator for the city. Planned and implemented a multi year 10 million dollar upgrade program. Upgrade program focused on Compliance and Energy Savings. Reduced electric usage by 45% as a result of project implementation.


7/90 TO 8/94:  Onondaga County Department of Drainage and Sanitation Sanitary Engineer II
Duties included: Management of the Industrial Pretreatment Program for Onondaga County. Supervised Engineers and Technicians responsible for field work and program documentation. Supported legal staff and Program Manager in resolving enforcement actions against industries. Prepared responses to EPA as a result of an ongoing lawsuit and annual program reviews. Issued Permits and performed routine and surprise inspections of County industrial users.

12/89-7/90: OBG Operations, Operations Specialist
Worked at various facilities as a contract operator. Oversaw operations at Seneca County Sewer District, Wellesley Island Customs Station, and GE French Road pH neutralization treatment system. Prepared O&M Manual for the US Naval Station Wastewater Treatment Plant. Designed solids handling facilities for Groveland State Prison. Startup of Elkland Pennsylvania Wastewater Treatment Plant. Laboratory Training for City of Norwich Wastewater Treatment Plant.

8/88-11/89  Ithaca Area Wastewater Treatment Facility Operator/Operator Trainee
Performed all duties of an operator and served as Assistant Laboratory Technician and Pretreatment Program Coordinator. Managed anaerobic digesters and Phostrip facility for
BIOLOGICAL PHOSPHORUS REMOVAL. PARTICIPATED IN MAINTENANCE AND TROUBLESHOOTING PROJECTS.

8/85-11/89 CORNELL UNIVERSITY GRADUATE RESEARCH ASSISTANT, DEPARTMENT OF MICROBIOLOGY
STUDIED VARIOUS PHYSIOLOGICAL CHARACTERISTICS OF THERMOPHILLIC METHANOCOGENIC BACTERIA AS PART OF A GRANT SPONSORED BY THE OFFICE OF NAVAL RESEARCH. UTILIZED FAST PROTEIN LIQUID CHROMATOGRAPHY TO ISOLATE VARIOUS KEY ENZYMATIC ACTIVITY CENTERS THOUGHT TO BE COMPONENTS IN CATABOLIZING ACETATE INTO METHANE. TAUGHT TWO DIFFERENT MICROBIOLOGY COURSE LAB SECTIONS DURING FIVE SEMESTERS. COMPLETED 60 HOURS OF GRADUATE COURSE WORK.
Ithaca Community Energy Inc. Member-Associates

John Graves,
Associate, Civic Engagement
Former member of the Local Action Plan to Reduce GHG Emissions for the City of Ithaca, current President of the South Hill Civic Associate, member of the team that won the NY Prize Stage 1 Community Microgrid competition.

Tom Hanna
Associate, Civic Engagement
Former Common Council member for City of Ithaca, former President East Hill Neighborhood Association, co-founder, DeWitt Park Neighborhood Association, secretary, Friends of Newman Golf Course, member of the team that won the NY Prize Stage 1 Community Microgrid competition.

Francis Vanek
Associate, Energy Engineering
Senior Lecturer in the School of Civic & Environmental Engineering at Cornell, author of textbook *Energy Systems Engineering: Evaluation and Implementation* (3rd Edition, McGraw Hill 2016) member of the team that won the NY Prize Stage 1 Community Microgrid competition.

Bill Reed
Associate, Real Estate Development
On the team that is developing the 95-acre Chain Works District, member of the team that won the NY Prize Stage 1 Community Microgrid competition.

George Frantz
Associate, Urban Planning
Visiting Critic in the Department of City and Regional Planning at Cornell, current Principal, George R. Frantz and Associates a planning and design firm specializing in urban design, comprehensive land use planning and zoning.

John Foote
Associate, Policy and Financing
Lecturer in Science, Technology and Infrastructure Policy at the Cornell Institute for Public Affairs, Senior Fellow at the Taubman Center for State and Local Government at Harvard's Kennedy School of Government.

Jerone Gagliano
Associate, Energy Engineering
Former Director of Energy Management and Sustainability at Ithaca College, Performance System Development, IMR Test Labs, Tecnico Nacional de Nicaraqua.

Anna Kelles
Associate, Civic Engagement
Current Tompkins County Legislator, faculty at Cornell University teaching Nutrition, Public Health and Public Policy, member of the team that won the NY Prize Stage 1 Community Microgrid competition.

Bruce Abbott
Adviser, District Energy
Long time Advocate for Danish style District Energy, former member of the International District Energy Association (IDEA), member of the team that won the NY Prize Stage 1 Community Microgrid competition.
SourceOne, Inc. Overview

Company Overview & Corporate Structure

As a nationally recognized energy consulting firm, SourceOne helps large public and private entities manage their energy needs in more sustainable, reliable and cost effective ways. SourceOne specializes in managing large energy infrastructure projects from concept through construction and commissioning providing energy master planning and engineering/owner’s representative services. SourceOne has been instrumental in completing some of the most ambitious microgrid projects in New York State and is currently implementing the Hudson Yards Development microgrid. SourceOne has offices in New York City, Boston, Philadelphia and Los Angeles with a staff of over 100 highly qualified and cross-trained energy professionals. We are proud to serve some of the most energy conscious public and private entities in the Northeast; some of which include the Durst Organization, Vornado Realty Trust, New York University, NYU-Langone Medical Center, Grand Central Terminal/Metro-North, New York Power Authority, Biogen IDEC, Novartis, and BioMed Realty Trust.

In 2007, SourceOne was acquired by Veolia Energy North America, a division of Veolia Environnement (NYSE: VE and Paris Euronext: VIE) – the world leader and benchmark provider of sustainable energy, environmental, and water/wastewater solutions with 174,000 employees in 74 countries, creating global and integrated solutions for more than 160 years. Veolia is one of the largest independent single-source providers of comprehensive energy related solutions in the world, providing energy and O&M services at over 96,000 facilities. Veolia’s expertise and operational practices in critical environments contribute to the optimization of efficiencies and dramatic reduction in greenhouse gases for customers worldwide.

The integration of SourceOne with Veolia North America has further enhanced Veolia’s ability to help customers meet their financial, operational, environmental, and institutional goals through the efficient management of their energy needs. We are an energy services company self-sufficient in all energy technology, engineering, and design categories, possessing a thorough understanding of central utility plant, cogeneration, building HVAC systems and equipment, building envelope, control strategies, lighting, water conservation, operations and maintenance, utility rate structures, and codes and regulations.
SourceOne Company Information

<table>
<thead>
<tr>
<th>Company Name</th>
<th>SourceOne, Inc. - a division of Veolia North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Mission</td>
<td>The development and deployment of reliable and cost-effective energy solutions that support growth, and encourage sustainable and reliable operations.</td>
</tr>
<tr>
<td>Telephone Number</td>
<td>(212) 612 – 7600</td>
</tr>
<tr>
<td>Website</td>
<td><a href="http://www.sourceone-energy.com">www.sourceone-energy.com</a></td>
</tr>
<tr>
<td>Parent Company</td>
<td>Veolia Environment: The world leader and benchmark provider in environmental, energy, and water/waste services. S1 was acquired in 2007 by Veolia.</td>
</tr>
</tbody>
</table>
| Award Winning Projects| • New York University – 13.4 MW CHP Expansion – EPA EnergyStar CHP Award  
                          • Medical Area Total Energy Plant (MATEP) 46 MW CHP – EPA EnergyStar CHP Award  
                          • Durst – One Bryant Park – 4.5 MW CHP – One of world’s greenest skyscrapers |
| Key Company Metrics   | • S1 - Performed site-assessments for over 300 million sqft of building space in NA  
                          • S1 - Managed the implementation of over $750 million of energy infrastructure capital improvements; some the most high profile and visible CHP projects in NYC  
                          • Veolia - manages nearly 900 district and local heating or cooling systems worldwide; owns and operates the largest portfolio of district energy in U.S.  
                          • Veolia – Provides energy and O&M services at over 96,000 facilities worldwide |

With 174,000 employees worldwide and €24,965 million in annual revenue (2014), Veolia designs and deploys sustainable solutions for **water**, **waste** and **energy** management.

**WATER**

- Management of the global water cycle, from production and distribution of drinking water to the collection, treatment and recycling of wastewater.
  - 4,245 water production plants managed
  - 100 million people supplied with water
  - 3,303 wastewater treatment plants managed
  - 63 million people connected to wastewater systems
  - €11,347.7 Million in Water Revenue

**WASTE**

- Liquid and solid non-hazardous and hazardous waste management
  - We cover the entire waste life cycle from collection to recycling, leading to the final recovery of waste as materials or energy.
  - 39 million people provided with collection services on behalf of municipalities
  - 42.9 million metric tons of treated waste
  - 553,500 business customers
  - 601 waste processing facilities operated
  - €8,692.0 Million in Waste Revenue

**ENERGY**

- Energy efficiency, efficient management of heating and cooling networks, green energy production, all unique expertise for a sustainable world.
  - 53 million MWh produced
  - 3.4 million collective housing units managed
  - 779 heating and cooling networks managed
  - 2,027 industrial sites managed
  - €4,925.1 Million in Energy Revenue
Utility Plant Development Qualifications

Utility Plant Development, specifically CHP (Combined Heat and Power) and Central Utility Plant development, is one of SourceOne’s core business focuses and is an area where our firm truly excels. We are a subsidiary of Veolia North America which is the largest operator and developer of efficient district energy (heating, cooling and cogeneration) systems in the United States. The front end engineering analysis, business plan development, plant design & optimization, and utility coordination expertise that SourceOne provides is complemented by Veolia’s broader financing and O&M capabilities. By engaging SourceOne to act as their Owner’s Representative, our clients are able to draw on our proven track record and expertise leading cogeneration projects from business concept development all the way through construction and startup.

SourceOne has recently served as the Owner’s Representative for several high profile CHP projects across the Northeast, including a 13.4 MW expansion at New York University, 4.6 MW at One Bryant Park (Bank of America Building), 5 MW at Biogen IDEC Cambridge HQ, and a 7.5 MW expansion at UMASS Medical School complex. These projects have involved interconnecting multiple buildings electrically and thermally.

Project Experience

Key Case Study – NYU Washington Sq. Park Campus Cogeneration Expansion

By engaging SourceOne to act as Owner’s Representative, NYU was able to rely on true energy and engineering experts to guide them through planning and implementation.

In order to meet the increasing demands for electricity, New York University (NYU) decided to expand its existing cogeneration plant on the Greenwich Village campus from 7,000 kW to 13,400 kW. The expansion would allow for the University to generate its own electricity to accommodate additional buildings on campus. SourceOne served as the Owners Representative for the re-development of NYU’s existing 7,000 kW cogeneration plant to support the additional electrical, steam and hot water needs for the campus. The NYU site consists of over 50 buildings. SourceOne provided technical review, financial evaluation, contract development, assembly of development team, and served as the university’s utility liaison. Following the successful completion of the expansion in 2010, this project represented the largest renewable energy purchase of any college or university, as determined by the US Environmental Protection Agency. By engaging SourceOne to act as Owner’s Representative, NYU was able to rely on true energy and engineering experts to guide them through planning and implementation.
Key Case Study – Hudson Yards Eastern Rail Yard Development CHP Owner’s Representative

From initial consult through startup and commissioning – SourceOne is providing a sustainable, resilient energy supply solution for the largest real estate development in New York City.

Related requested SourceOne’s services to develop their combined heat and power (CHP) plant in the most economical manner possible. As the energy consultant, SourceOne developed the design for a 13MW reciprocating gas engine CHP plant will be installed on the 10th floor of the Retail Podium and provide electricity to three buildings and thermal energy (hot and chilled water) to five buildings. With (4) 3,300 kW reciprocating natural gas engines, (4) 650-ton absorption heater-chillers and (2) 1,250-ton electric centrifugal chillers, the plant will distribute electricity, hot and chilled water to 7 million square feet of mixed-use space. The plant will be capable of operating both in parallel with the local utility or in island mode as a viable independent energy source in the event of a grid outage.

Through SourceOne’s CHP expertise, the plant was designed to maximize sustainability, reduce overall utility expenses and allow increased budget control and predictability. As the project manager and owner’s engineer, SourceOne’s responsibilities include: Project Management and Construction Oversight of Central Utility Plant; Economic Cash-Flow Projections and Sustainability Evaluation; Project Schedule Development and Management; Utility and Regulatory Coordination; Major Equipment and Trade Contractor Procurement Support; Central Utility Plant Startup and Commissioning.

Key Case Study – One Bryant Park CHP Development

As Durst’s strategic energy advisor, SourceOne oversaw the development of a CHP plant that serves the entire thermal load of the 52-story building, minimizing its environmental footprint.

The Durst Organization is one of New York City’s largest and most successful developer/owners of commercial office buildings. They have been recognized nationally for the creativity of their building designs and have been the recipient of numerous energy efficiency/energy innovation awards and accolades from the EPA/DOE Energy Star and New York State Energy Research and Development Authority (NYSERDA).

As Durst’s strategic energy and power advisor for development of the One Bryant Park Building—a 2 million square foot, 52-story structure—with the aim of achieving the lowest environmental footprint. SourceOne provided comprehensive technical, economic and environmental support to The Durst Organization development team. SourceOne’s design analysis included equipment sizing/selection, reliability standards, electrical interconnection equipment, and steam supply. SourceOne also evaluated alternative energy sources for the combined electric and steam supply to the building.

The final design for One Bryant Park incorporates a gas-turbine based Combined Heat and Power (CHP) facility located on the 7th floor podium. The complete plant is designed around the Solar Mercury 50 gas turbine that exhausts into a fired heat recovery steam generator (HRSG). The HRSG is sized to serve the complete thermal needs of the building.
<table>
<thead>
<tr>
<th>Project Experience</th>
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<tbody>
<tr>
<td><strong>4.5MW CHP Development - Owner’s Rep and O&amp;M - One Bryant Park</strong></td>
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<tr>
<td>- Strategic energy consultant to the Durst Organization for more than 10 years</td>
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<tr>
<td>- Business concept development and owner’s representative for 4.5MW on-site CHP plant</td>
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<tr>
<td>- Plant operated and maintained by Veolia North America</td>
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<tr>
<td><strong>13.4MW CHP Expansion - Owner’s Rep - New York University - Washington Sq.</strong></td>
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<tr>
<td>- Owner’s representative &amp; technical consultant for 13.4 MW campus CHP expansion – EPA CHP Award Winner</td>
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<tr>
<td>- $125 million capital project – S1 represented NYU in all phases of the project including initial concept, business plan development, design, construction, startup and plant commissioning</td>
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<tr>
<td><strong>11 MW CHP Development – Pre-Operations Services – NYU Langone-MC</strong></td>
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<tr>
<td>- S1 and Veolia are providing pre-operations and O&amp;M services for NYU Langone’s new 11 MW cogeneration plant under an eight-year agreement</td>
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<tr>
<td>- Dispatched staff to help NYU-LMC restore utility services following Superstorm Sandy</td>
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<tr>
<td><strong>5.3 MW Campus CHP Development – Owner’s Rep and O&amp;M - Biogen Campus Headquarters, Cambridge MA</strong></td>
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<tr>
<td>- Managed the entire effort for 5.3 MW campus CHP project – including feasibility/concept development, procurement, construction, commissioning, and utility coordination</td>
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<tr>
<td>- Veolia operated plant since 2007 – maintained performance guarantees since initial startup</td>
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<tr>
<td><strong>64 MW Simple Cycle Power Plant - Design, Engineering &amp; Permitting - Vineland, NJ</strong></td>
</tr>
<tr>
<td>- S1 provided Design Development services, Engineering Oversight, Permitting and Procurement Support</td>
</tr>
<tr>
<td>- S1 additionally provided critical technical support during construction</td>
</tr>
<tr>
<td><strong>17.5 MW Central Plant - Owner’s Agent &amp; Independent Engineer – UMASS Medical</strong></td>
</tr>
<tr>
<td>- S1 provided technical and financial analysis, conceptual design and major equipment sizing and selection. Assisted UMMS in structuring and selecting design and construction team.</td>
</tr>
<tr>
<td>- Provided on site project engineering oversight for the construction phase services, startup and commissioning for the plant expansion</td>
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**Energy Efficiency Implementation Program Services**

- Identified, designed, and managed construction for more than $80 million in energy upgrades
- Designed and implemented projects for landmark facilities including Grand Central Terminal, New York Public Library, Bronx Zoo, Brooklyn Cruise Terminal and others.

**2.8 MW Campus Trigen Plant Development - Owner’s Rep – Novartis Institute for Biomedical Research**

- Led feasibility and conceptual development of a 2.8 MW combined heating, cooling, and power plant
- Owner’s Rep for design, sourcing, construction, commissioning, and utility negotiations with LDC
A City’s Approach to Cost-Effective Sustainability

The City of Gresham, Oregon, Partners with Veolia Water North America to Achieve 100 Percent Sustainability at Wastewater Treatment Plant

In Gresham, Ore., a partnership between the Gresham City Council and Veolia Water North America has worked together to implement a sustainable operation for the City’s wastewater program. This paper details the innovative techniques implemented by this partnership to decrease power consumption, while increasing renewable energy production.

A WHITE PAPER BY VEOLIA WATER
Veolia Water has actually surpassed Gresham’s up-time requirement each year since the start of its partnership, ensuring co-generator up-time that’s better than 94 percent annually. As a result, electricity costs at the facility have been reduced by an average of $23,100 a month.

Decreasing power consumption, while increasing renewable energy.

Today’s headlines often offer glimpses of companies pledging to “go green” and seek true sustainability, but it’s not very often when an entire city makes that pledge and then starts achieving it.

That’s about to change. Thanks to the strong leadership of Mayor Shane Bemis and an environmentally-focused City Council, community-wide support and public-private partnerships, Gresham, Oregon, has big plans to become a national model of sustainable planning, design and development.

Over the last several years, Oregon’s fourth-largest city (located 16 miles east of downtown Portland in Multnomah County) has examined every aspect of its operations and identified practical, cost-effective and achievable ways to ‘go green.’ This includes Gresham’s utilities, buildings and vehicle fleets, as well as its approach to urban design and planning, business development and the everyday habits of employees at all City facilities.

One area where the City identified potential to significantly reduce its carbon footprint and lower energy costs was the Gresham Wastewater Treatment Plant, a 20 million gallon-per-day facility that serves 108,000 customers and treats wastewater from the cities of Gresham, Fairview and Wood Village.

The city’s goal was ambitious: It wanted the wastewater plant to start producing energy, rather than consuming it. Gresham commissioned the design of a cogeneration engine that uses methane gas produced from the plant’s digesters (a natural byproduct of the wastewater treatment process) to generate its own electrical power and heat. It also sought a partner with the experience and technical expertise who could successfully manage plant operations to reduce energy usage while ensuring maximum output from the cogeneration engine.

Partnering to Raise Sustainability While Lowering Costs

In 2005, the City selected Veolia Water North America (Veolia Water), the world’s leading wastewater partnership services provider. The driving factor in the competitive decision was Veolia Water’s experience (the company serves more than 650 North American communities) as well as its access to experts and technical solutions and its strength in asset management. Gresham’s decision to partner with Veolia Water was influenced as well by the company’s shared commitment to environmental stewardship.

As part of a seven-year, $21 million contract with Gresham, Veolia Water agreed to the City’s request that it guarantee an 90 percent or better “up-time” of the co-generator, even though the engine had not yet been built. (Up-time is the term for how long a co-generator can run – 100% is considered 24/7 uptime and is technically impossible given the need for maintenance).

As with most things in Gresham, the plan has gone exceedingly well. Veolia Water has actually surpassed Gresham’s up-time requirement each year since the start of its partnership, ensuring co-generator up-time that’s better than 94 percent annually. As a result, electricity costs at the facility have been reduced by an average of $23,100 a month. Even more important from a sustainability perspective, the co-generator has enabled the plant to produce more than 50 percent of the energy it uses by capturing naturally-occurring methane gas from the wastewater process and transforming it into energy.

Recognizing the City’s vision to become 100 percent energy independent, Veolia Water North America is working with the city to achieve its goals beyond the use of a co-generation system. This includes the city’s decision to install one of the largest land-based solar arrays in the Northwest at the wastewater treatment plant.

Solar panels are expected to provide eight percent of the plant’s total power each year and Veolia Water North
America is responsible for tracking that energy. Through the combination of the cogeneration engine and solar panels, more than 70 percent of the facility’s energy is generated on site from the sun and naturally-produced methane gas.

In addition to solar power and co-generation, the city’s vision was to utilize wind power to further increase the renewable energy which powers the plant. Although traditional energy charges would typically be treated as a pass-through cost, Veolia Water has partnered with the City to split the costs of a wind energy surcharge 50/50. As a result, the wastewater facility picks up additional energy from another renewable source – wind. Veolia Water tracks the energy from wind power (which the City purchases from Portland General Electric).

Further, the City is experimenting with other forms of energy production to exceed 100 percent independence – which means that the City’s goal is for the plant to actually generate more energy than it uses, via the installation of additional renewable energy systems. To this end, Veolia Water and the city are looking at doubling the co-generation systems and generating energy from grease waste.

Although creating sustainable energy is part of energy independence, the other half is reducing energy usage. Working with the city, Veolia Water has reduced the average monthly energy use from 556,000 kilowatt-hours (kWh) per month to 452,000 kWh per month (an approximate 20% reduction in energy use), and is currently moving into construction with various process improvements, including replacing the digester mixing system with new technology that uses much less energy and high-efficiency aeration blowers.

By proactively managing the wastewater treatment plant’s assets, Veolia Water and the City are able to drive down capital maintenance and replacement costs, increase asset lifecycle, improve reliability and reduce unnecessary and inefficient energy usage. Gresham city officials anticipate the asset management program will help reduce costs of the city’s assets by 15 to 25 percent over the term of the contract. Money saved can be used for other municipal priorities.

“The best part of this project has been helping the City of Gresham meet its incredibly progressive vision for the city. We’re looking forward to implementing new technologies and programs to drive down energy usage and increase use from renewable sources.”

– Paul Proctor, Veolia Water North America Project Manager, Gresham, Ore.
Gresham’s Reputation Grows

The City of Gresham is garnering recognition for its efforts around sustainability:

- In 2009, the partnership with Veolia Water helped garner a Platinum Peak Performance Award from the National Association of Clean Water Agencies. The wastewater facility was honored for achieving 100 percent compliance with National Pollutant Discharge Elimination System permit requirements for five consecutive years, and is actually now at Platinum Plus (6 consecutive years of perfect environmental compliance).

- In 2008, the City of Gresham and Veolia Water received a Public-Private Partnership Award from the National Council of Public-Private Partnerships for its collaboration on this innovative, renewable energy solution.

- In 2006, the League of Oregon Cities recognized Gresham with an Award of Excellence, while the American Public Works Association Oregon chapter awarded the City with a Julian Award for Sustainability.

- Gresham also is ranked #4 on the U.S. Environmental Protection Agency’s (EPA) list of Green Power Communities based on its annual green power usage.

Through the public-private partnership with Veolia Water North America, the City of Gresham has been able to steadily decrease power consumption at its wastewater treatment plant, while increasing renewable energy production by capturing methane. It is achieving its vision of becoming a completely sustainable city and expects to eventually generate and capture more power than it needs so it can actually become a sustainable energy provider as well.
About Veolia Water and the Gresham Partnership

As the world’s leading provider of comprehensive water and wastewater services and technologies, Veolia Water brings 150 years of experience, leading-edge technology and unmatched management skills to municipal and industrial customers worldwide.

Based in Chicago, Veolia Water North America is the leading provider of comprehensive water and wastewater partnership services to municipal and industrial customers, providing services to more than 14 million people in approximately 650 North American communities. The company is part of the Veolia Environnement companies in North America, with 30,000 North American employees providing sustainable environmental solutions in water management, waste services, energy management, and passenger transportation.

In 2005, the Gresham City Council chose to partner with Veolia Water in a public-private partnership to implement a best-in-class operation for Gresham’s wastewater program, with the goal of protecting the community’s infrastructure assets while improving the environment. For more on Gresham, please visit http://tinyurl.com/4hzgnfn.

Veolia Water, the water division of Veolia Environnement, is the world leader in water and wastewater services and technological solutions. Veolia Environnement (NYSE: VE and Paris Euronext: VIE) is the worldwide reference in environmental services. With more than 312,000 employees, Veolia Environnement recorded annual revenues of $50 billion in 2009. Visit the company’s Web sites at www.veolianorthamerica.com and www.veoliawaterna.com.
Matthew Cinadr, CEM  
Project Manager  

Summary of Experience  
Mr. Cinadr is an experienced engineering professional in assessing and analyzing all forms of energy utilization and resources, including supply and demand energy industry issues and energy policy and regulations for the electric industry. He has hands on design and field experience, from developing design concepts, performing financial analysis to commissioning of various energy plants, systems and equipment. Mr. Cinadr has firsthand experience with the analysis, development, application and operations of various energy systems including both conventional, renewable and hybrid power technologies. He has been involved with the design, assessment and performance modifications of central chilled water and boiler plants, combined heating power and cooling systems, utility scale combined cycle plants, and energy efficiency measures in commercial and industrial applications.

Project Experience  
As a Senior Project Engineer and Energy Consultant, Mr. Cinadr has presented numerous energy efficiency and generation projects to a variety of technical and financial audiences. He has also been involved in developing and implementing Energy Master Plans to help various clients assess, monitor and control energy costs. As a Design Engineer he has prepared Combined Heat and Power (CHP) drawing packages, specified equipment, created scopes of work, evaluated bid packages, prepared existing plant CHP system design modifications, and tracked heat rate improvements.

In addition, Mr. Cinadr has assisted numerous clients in understanding the energy market and navigating specific state and federal regulations pertaining to energy project permitting, project incentives, and financing support. His deep understanding of state utility incentive program design and operation has helped several clients obtain and leverage maximum utility program support and incentives to meet energy management goals.

Mr. Cinadr has led investment grade assessments for data center CHP applications. He has also served as the lead mechanical commissioning engineer at a number of data center sites, in particular the Equinix MI3 and CH3-PHC2A IBX’s. In addition he has evaluated and presented several energy system applications for clients in the healthcare, manufacturing, software, food processing and educational industries.

Prior to joining SourceOne Mr. Cinadr was responsible for a team of Energy Engineers charged with identifying, analyzing and implementing energy efficiency projects in support of statewide performance contracts. Mr. Cinadr successfully
graduated from General Electric Field Engineering program where he travelled the globe installing, commissioning and performance tuning combined cycle gas turbine power plants. In prior roles, Mr. Cinadr was a Lead Mechanical Engineer for Distributed Energy Systems (EPC Firm) focused on designing, installing and commissioning efficient and hybrid power systems for mission critical applications and environments.
Jack Griffin
Vice President and General Manager, Boston

Summary of Experience
With over 25 years of experience in the energy industry, Mr. Griffin is a highly experienced engineer and an expert in all aspects of energy systems development and application. As the Vice President and General Manager of SourceOne’s Boston office, Mr. Griffin oversees all projects and operations. As a proven leader, he has played a pivotal role in growing the SourceOne business. His consulting experience includes energy efficiency, sustainability, distributed generation, district energy system development, and utility-grade design. Mr. Griffin has over 15 years of broad-based experience in both electric and gas utilities, particularly in the areas of natural gas system operations, utility operations optimization and improvement, electric and gas revenue metering, metering data management, utility rate design and analysis, energy master planning, and energy engineering. Prior to his current role, Jack was SourceOne’s Director of Energy Systems. His focus on energy strategic plans, energy efficiency programs, and energy systems development strengthens his ability to make strategic business decisions, while keeping operational impact and benefits in mind. Prior to joining SourceOne, Jack held a variety of engineering, consulting and operational roles with NSTAR Electric & Gas, Boston Gas, and leading engineering consulting firms, working on all aspects of electric and gas utility operations. Mr. Griffin has spoken at several national conferences regarding utility metering systems and Automated Meter Reading (AMR) systems and the application of Combined Heat and Power systems in the marketplace. Mr. Griffin has also served as an expert witness in legal disputes specifically related to utility rate issues.

Project Experience
Mr. Griffin’s management experience spans across all aspects of energy systems development and application, and includes the following highlights:

Energy Efficiency & Energy Solutions – Mr. Griffin leads a team of accomplished professionals who develop real solutions to our client’s energy supply and infrastructure issues. Our services span from providing support on energy supply decisions, identifying ways to reduce energy costs with energy audits, developing master plans for implementation of solutions, and executing projects from concept through design and into construction and operation.

Power Plant Development – Mr. Griffin lead the design and permitting team for a 64MW simple cycle power plant for the Vineland Municipal Electric Utility (VMEU). This 64MW, $60 million project was delivered on time and on budget, meeting all the VMEU Requirements. VMEU Director Joe Isabella stated, “SourceOne was an excellent partner in helping move...
this project forward.”

Gas Supply Infrastructure – Mr. Griffin’s team guided a major pharmaceutical company through the process of identifying a method of eliminating the use of liquid fuel oil at their manufacturing facility. The options spanned the spectrum of self-supply of Liquid Natural Gas, development of a multi-mile pipeline to connect to the interstate system, to engagement with the local distribution company. The solution resulted in a project that cut implementation time by over two years and supplied natural gas as required.

Distributed Generation – Mr. Griffin led a project team to re-build a 2MW distributed energy system that had catastrophically failed. The effort included the evaluation of all options, the identification of the re-build strategy, and the management of design and construction.

Utility Experience – Mr. Griffin has experience in Natural Gas City Gate Operations, distribution system renewal, natural gas metering, assessing gas, and electric utility compliance with statutes and regulations. These engagements included utility rate class application, Dig-Safe operations, seven-year gas meter exchange programs, cast-iron replacement projects, compliance with energy supplier regulations, as well as a series of other customer-related efforts.
Kevin Hagerty
Vice President of Engineering

Summary of Experience
Mr. Hagerty is an energy industry professional with comprehensive experience in the construction, start-up, operation, maintenance, and engineering of natural gas, coal, renewable power generation and district energy systems. As V.P. of Engineering for Veolia, SourceOne’s parent company, he manages 35 engineers among 4 departments responsible for engineering oversight and technical support for Veolia’s commercial and municipal business including 350 municipal water, waste, power, and district energy facilities. As Director of Engineering, his team managed 22 district energy systems in Boston, Philadelphia, Baltimore and other major North American cities. Mr. Hagerty has worked with facilities ranging in size from 2 to 250 MW of power generation; 2,000 to 40,000 tons of chilling; and 20 to 2,300 Mlb/hr of steam generation. He has been responsible for technical support of capital improvements, performance monitoring, solving technical issues, and creating procedures and practices for better maintenance and operation.

Project Experience


International Power America, Fleet Gas Turbine Engineer for 14 Alstom GT24B combined cycle units distributed between 4 generation plants ranging in size from 500-1,650 MW. Responsible for capital improvements, performance monitoring, solving technical issues and creating best practices and procedures for maintenance and operation.

Fleet Engineering Manager. Responsible for the engineering oversight of 5.9 GW of generating capacity. Managed a diverse 7 person team responsible for the engineering oversight of International Power’s North American portfolio including 14 Alstom GT24B combined cycle units.

Commissioning Manager. Commissioning manager for International Power’s North American major maintenance group. Responsible for planning, project management and personnel management of major maintenance outages.

Alstom Power, Commissioning Manager. Commissioning manager for new erection and re-commissioning of multiple ABB/Alstom combined cycle, single cycle, and cogeneration plants. Power plant capacity ranged from 150-1,650 MW. Responsible for the management of small and large
engineering teams, cost planning, scheduling, supervision of craft labor, material logistics, and quality assurance supervision.

*Start-up Engineer.* Gas turbine engineer for the new erection and start-up of multiple ABB/Alstom gas turbine power plants, and custom retrofits. Power plant capacity ranged from 270-1,000 MW. Commissioning responsibilities encompassed commissioning of automated systems, cold commissioning of the gas turbine, and operational commissioning of the gas turbine and related auxiliaries.

*Crowley Marine Tote Shipping, Operator.* Operations and maintenance on 4 separate merchant ships. Power plants ranged from 30,000 HP to 70,000 HP diesel engines, and 30,000 to 50,000 HP steam engines.
Peter Glover, EIT
Energy Engineer

Summary of Experience

Mr. Glover joined the SourceOne team after 6 years of experience in the nuclear power industry. The experience garnered from years in a heavily scrutinized industry has honed his natural attention to detail and dedication to excellence. Mr. Glover is currently pursuing a Master of Science from the Energy Systems engineering program at Northeastern University.

Project Experience

**VEOS Metering Evaluation** – During his first two years at SourceOne, Mr. Glover was the lead project engineer for the Veolia Efficiency Optimization System (VEOS) Metering Evaluation project. VEOS is an integrated plant efficiency monitoring system that is being developed by Veolia North America to provide oversight of real-time actual and target efficiencies at 25 of the company’s district heating, chilled water, and co-generation facilities throughout the country. Mr. Glover’s team evaluated the existing metering and instrumentation at each facility to determine the availability and accuracy of data necessary to calculate actual and target efficiencies on both the plant and equipment level. As a testament to the work of Mr. Glover’s team, the VEOS project was presented by collectively by SourceOne and Veolia at the International District Energy Association’s 106th Annual Conference and Trade Show in June 2015.

**Brown University Water Master Plan** – Development of the Water Master Plan at Brown University involved a comprehensive understanding of the 200+ domestic water accounts and focused assessments of several high-use accounts to determine opportunities for use reductions and cost savings. Mr. Glover identified several opportunities for sub-metered sewage charge abatement from cooling tower evaporation with a short payback period and annual savings of over $50,000. Other opportunities for savings included replacement of domestic water-cooled compressors, condensate return improvements, dedicated irrigation service, cooling tower level switch upgrades, and water meter downsizing.

**UNH Backpressure Steam Turbine Feasibility** – Mr. Glover evaluated the feasibility of installing a micro steam turbine in place of a pressure reducing station, which included load profile and load duration curve analysis for both steam and electric demand of the building. The analysis revealed questionable metered data and poor steam quality, prompting much-needed meter repair and steam trap survey.

**Philadelphia Family Court Boiler Failure Analysis** – After chronic failures of newly installed boilers at the Philadelphia Family Court, Mr. Glover was assigned as the lead engineer
to determine the root cause of the failed aluminum boilers. His experience in the nuclear industry primed Mr. Glover for this type of work, which included review of submittals, correspondences, and other documentation as well as exhaustive interviews with key players in the design, construction, and commissioning phases.

**Prior Experience** – Mr. Glover began his career as a System Engineer at Entergy’s 1500-MW Grand Gulf Nuclear Station, where he was responsible for all open and closed cooling water systems at the plant as well as safety-related ventilation and drainage systems. The role of the system engineer is to ensure continuous reliable operation of all equipment and components within the boundaries of assigned systems. Typical duties include performance monitoring and data analysis, predictive and preventive maintenance optimization, equipment failure and root cause evaluation, development of corrective action plans to mitigate failure recurrence, and assisting with troubleshooting, planning, and work execution. Less frequent duties include design change tests and special performance testing, capital project funding requests, contract management for supplemental resources, and establishing special guidelines and limitations for operation of degraded equipment. In the nuclear power industry, the system engineer is the liaison that continuously champions long-standing and emergent issues to protect the safety and health of the public.

In addition to his daily monitoring and troubleshooting responsibilities, he was intimately involved with several large pump, motor, cooling tower, and instrumentation modifications and overhauls that required rigorous submittal review, factory witness testing, and post-modification performance test development and coordination. In 2011 he was transferred to Pilgrim Nuclear Power Station in Massachusetts, where he was initially hired as an Instrumentation and Controls Fix-It-Now Engineer to resolve emergent issues at the station. Mr. Glover was later reassigned to the critical role of Service Water System Engineer, where he brought to light numerous legacy systemic issues that had been inadvertently obscured by years of slowly normalized deviation.
Brant Davis
Vice President and Director of Commodities Management

Summary of Experience
With nearly 20 years of experience in the energy industry, Mr. Davis manages SourceOne's Commodity Management team and has responsibility for SourceOne's energy advisory business for natural gas, electricity, and heavy fuels. His extensive knowledge of different ISO requirements, LDC rules, and local supplier constraints impacting end-user costs has maximized client savings and benefits. Mr. Davis also served as a Senior Manager - Strategy & Operations for Deloitte Consulting for 12+ years, providing strategic and operational management consulting services to the electric utility and heavy asset manufacturing industries in North America. Mr. Davis was most recently responsible for the fuel and power procurement strategies for all Veolia Energy locations across the U.S. accounting for approximately 20 Bcf of natural gas, 125,000 MWh of power, and 15,000,000+ gallons of liquid fuels in annual load.

Project Experience
Mr. Davis is responsible for the strategic and tactical support provided to customers by the SourceOne Commodity Management team. The team provides energy commodity procurement and risk management advisory services, ranging from project specific procurement activities requiring the development of options and specifications for energy procurement, advice around current market conditions and how they impact current customer physical positions, to ongoing reporting of energy consumption. Representative advisory services include the structuring of competitive procurement activities for client energy supply requirements, ranging from a single facility with 230,000 MWh (32MW peak) to national aggregation efforts for large corporates of 350,000+ MWh of power and 10 bcf of natural gas.

Having worked at Deloitte Consulting, providing strategy and operations for energy clients, Mr. Davis has a deep operational understanding of national power and gas markets. He also has a broad range of energy related experience ranging from M&A for large electric utilities to operational implementation of advanced metering. As part of this energy consulting experience, Mr. Davis has direct experience developing coordinated / centralized contracting strategies for bulk liquid fuels with OPIS +/- indexed pricing off of wholesale rack pricing. Additionally, he has demonstrated experience running complex engagements requiring key stakeholder input from both client executives and client team members.

At Veolia Energy, Mr. Davis had corporate oversight for the development of national fuel management strategy for the company which included the optimization of a broad range of
Brant Davis  
Vice President and Director of Commodity Management

power and gas supply accounts across the nation. The scope of power and gas assets at Veolia Energy included bidding of capacity into MISO markets, the development of daily indexed gas contracts with daily and monthly nominations, bidding block and index power load contracts in deregulated states across the U.S., and options for operational fuel switching based on operational and market load characteristics.
Reid Sprite, PE  
Engineering Manager  
Summary of Experience  
Mr. Sprite manages SourceOne’s Utility Engineering team. He and his team have primary responsibilities focused on design and integration of medium and high voltage systems. He has over ten years’ experience in the electrical industry with municipal and investor owned electric utilities focused in the areas of transmission and power distribution, substation design, system protection, and metering. In his time at SourceOne, Mr. Sprite has become a key resource in the development and implementation of combined heat and power (CHP) plants and their integration into the existing power system. In conjunction with other distributed generation developers and local utility companies, Mr. Sprite advocates for fair and consistent interconnection standards on the Massachusetts Technical Standards Review Group. In addition, he is actively involved in public transportation advocacy and urban revitalization efforts throughout Boston.

Project Experience  
Mr. Sprite’s engineering experience includes distribution equipment upgrades, HV & LV substation maintenance, facility infrastructure audit, electrical one-line development and new equipment installation projects. His abilities include: budgetary planning, conceptual development of underground and overhead distribution systems, due diligence investigations and project management for wide range of disciplines, including upgrades or installation of new facilities. Currently, Mr. Sprite is focusing his efforts on the interconnection of various renewable and alternative generation projects including: wind, solar, fuel cells, and combined heat and power (CHP) applications.

Mr. Sprite leverages highly effective engineering and operational utility experience to efficiently shepherd clients through the utility interconnection process, for both new and existing projects, while actively managing key process stakeholders. For utility customers, he has provided overall project management and electrical engineering services through the engineering, design, estimating, and construction phases of power system projects, including scheduling and cost control. Mr. Sprite is also very familiar with overhead and underground distribution design, construction, and safety practices. As an expert in electric system reliability metrics and measurement, he also relies on his broad analytical skills to generate high-quality reports that help drive key project decisions.
Alexey Cherniack
Senior Commodities Manager

Summary of Experience
Mr. Cherniack is responsible for key account management, structuring and executing commodity procurements, market analysis, and SourceOne’s regulatory compliance for the Commodity Management team. Prior to joining SourceOne, Mr. Cherniack was a Senior Economist with the Massachusetts Department of Public Utilities where he provided policy recommendations to the Commission regarding cost-effective and equitable regulation of the electric power and natural gas distribution companies in Massachusetts.

Project Experience
As a Senior Economist with the Massachusetts Department of Public Utilities, Mr. Cherniack provided technical analysis and recommendations to Department Commissioners and he assisted in writing various high profile Department orders and rulemakings. Mr. Cherniack conducted cross examination of expert witnesses in a formal regulatory environment, often pertaining to multi-billion dollar energy investments. He has been involved in various regulatory proceedings covering electric and natural gas company rate cases, rate decoupling and capital tracker mechanisms, isolated energy investments such as long-term power contracts (e.g. Cape Wind PPA), energy efficiency program cost-benefit evaluation, and smart grid infrastructure projects. Mr. Cherniack was also the primary staff person responsible for monitoring restructured electricity markets, proposing changes, and vetting new market entrants.

Previous to his work with the Department of Public Utilities, Mr. Cherniack structured and executed natural gas and power contracts for a MA based energy procurement firm where he served as the company’s sole liaison with competitive electric and gas providers. Mr. Cherniack has a deep understanding of commodities markets, contract structuring, and utility regulation. He has also received Wholesale Electric Market training from the New England Independent System Operator, and rate case training from the Center for Public Utilities at New Mexico State University.
Joseph Hurrie
Senior Project Engineer

Summary of Experience

With over thirty-eight years of experience in consulting, operations and construction of electric utility and commercial power systems, Mr. Hurrie is responsible for planning, permitting, project management, start-up and commissioning of high profile projects for SourceOne.

Mr. Hurrie started his career at the Pilgrim I Nuclear Power Station working in the electric lab testing and troubleshooting components and systems from construction through start up, until the plant went on line. Mr. Hurrie later became Pilgrim’s Performance Engineer and assured the operating design requirements were attained and the maximum economic benefit was derived within the limits imposed by the regulatory agencies. Mr. Hurrie later became the supervisor of engineering at a 45MW domestic utility where he developed a comprehensive engineering model that serves as the basis for all energy management policy decisions. He engaged in rate negotiations for high voltage (115kv) electric service and utility interconnections, and represented his employer at the Massachusetts State House and, on Capitol Hill pertaining to franchise rights and regulatory issues. Mr. Hurrie later directed the day to day operations of the utility before becoming Manager of Capital Construction for all power improvement projects. Mr. Hurrie moved into new high profile commercial projects, such as the Boston Convention and Exhibition Center and the Delta Terminal A at Boston's Logan International Airport, where he managed the construction activities for all power, security and communications before moving back to managing medium and high voltage projects (345kv to 13.8kv) for NSTAR and National Grid.

Project Experience

Mr. Hurrie directed the 24/7 day to day operations of a 45MW domestic utility (Massachusetts Bay Transportation Authority) which encompassed a 115kv switching station, 40 traction power substations, a 15kv underground and overhead distribution network, an emergency jet turbine generator, supervisory control & data acquisition system (SCADA), 24/7 power control center and 110 operating personnel. As the Manager of Capital Construction at the MBTA Mr. Hurrie was accountable for the design, construction and administration of all power improvement projects from consultant selection through project close out. Mr. Hurrie was responsible for all field personnel, project coordination, adherence to equipment specifications, safety, environmental compliance, schedules and budget signoff.

As Construction Services Manager for a small consulting firm Mr. Hurrie acted as the utility’s construction manager and directed the substation construction phase activities for the largest transmission project in NSTAR history ($300M). The
work included a new 345kv switchyard, 50 miles of underground transmission, 2-345/115kv substations which integrated into an existing 115kv system.

For SourceOne, Mr. Hurrie has completed the onsite start-up and commissioning for the Massachusetts Water Resource Authority’s back pressure steam turbine generator and managed the construction phase activities for the Combined Heat and Power (CHP) facility at the University of Massachusetts Medical Center Campus, as well as utility interconnections for major developments in metropolitan Boston.
Enrique Frances
Energy Engineer

Summary of Experience
As an Energy Engineer for SourceOne, Mr. Frances is primarily focused on project management and economics, energy efficiency, energy audits, renewables, power plants, feasibility studies, construction, and metering/monitoring systems. Prior to joining SourceOne, Mr. Frances has had engineering experience in the pumps and hydraulics as well as in the modular construction industry. Coming from a diverse background and speaking three languages he is a very energetic team member bringing in a passion for problem solving and energy efficiency.

Project Experience
Mr. Frances graduated from Northeastern University with high honors with a Master’s degree in Energy Systems and a Bachelor’s degree in Mechanical Engineering. He has extensive academic experience with solar thermal systems as well as project management and economics. During his studies he took part in two co-op assignments as well as several internships.

During his most recent co-op assignment he joined SourceOne acting as an assistant project engineer. His project experience at SourceOne comprised of working on several energy efficiency projects including performing audits for the state of Massachusetts aimed to secure investments for cost & emissions reduction. He delivered a feasibility study for an emergency generator installation in a healthcare facility aimed to provide power reliability. Moreover, he coordinated and led the implementation of computer based multi-tenant energy billing and energy management solutions. He also assisted and took initiative in several renewable energy projects including solar, wind and geothermal. Additionally, he has been involved with the assessment and performance modifications of boiler and combined heat & power (CHP) plants. Finally, he has experience with the commodities market developing electricity and natural gas market analytic tools.

For his first co-op assignment he worked for a modular construction firm acting as an assistant Plant Manager. He gained experience with supervising complex projects involving numerous parts and stakeholders. Furthermore, he utilized CAD to design engineering solutions aimed at streamlining manufacturing processes. Mr. Frances also has international experience working in the pumps and hydraulics industry as well as retail management industries in Europe.
Kelly Hensey
Contracts Administrator

Summary of Experience
Kelly Hensey has provided contract support services to the entire SourceOne organization for the previous six years. These services include, but are not limited to, the management of all contracts for SourceOne through their entire life cycle. In addition, she provides supplemental support related to insurance, licensing and risk management processes.

Project Experience
Ms. Hensey’s primary responsibilities include:

- Manage all contract processes for Boston, New York, Philadelphia, Hartford and Los Angeles offices.
- Reading, editing, negotiating and filing all service contracts, vendor/subcontractor contracts, confidentiality agreements, licensing contracts and proposals.
- Review all request for proposals and request for quotations and assist sales team in completing compliance forms and drafting proposal qualifiers for submittal to requestor.
- Manage legal compliance of all contracts in accordance with corporate governance issued by parent company.
- Facilitate risk management approval process for all non-compliant service contracts with CEO, General Counsel, Chief Financial Officer and President of SourceOne, Inc.
- Manage all insurance paperwork related to customers and vendors/subcontractors.
- Manage the licensure of SourceOne, Inc. to act as an engineering corporation in all of the states where engineering services are provided.
Joseph A. Mulvihill
Senior Vice President of Project Development

Summary of Experience
As Senior Vice President of Project Development for SourceOne in New York, Mr. Mulvihill is responsible for all aspects of facility analysis, project planning, engineering oversight and construction consulting for the firm’s clients. Mr. Mulvihill is a graduate engineer with over 25 years experience in facility, project, and construction management. He has developed and managed over $1 billion in diverse projects: new commercial office buildings, base building renovations, tenant improvements, data centers, electrical substations, generator plants, and healthcare facilities. Prior to joining SourceOne, Mr. Mulvihill held a similar position with an international construction manager; was Director of Construction for a Real Estate Investment Trust (REIT), and the Director of Facilities at a major NYC hospital.

Project Experience
New York University, New York, NY - Acted as Owner's Representative of NYU's new combined heat and power plant, which connected 30 buildings thermally and 20 buildings electrically.

Cooper Union, Foundation Building, New York, NY - Owner’s Representative on this major infrastructure project at the "Foundation Building." The project included the replacement of the chiller plant and the air handling units. It also included the construction of a new boiler plant and cogeneration plant.

Hospital for Special Surgery, NYC - Hospital Modernization Project - Oversaw ongoing upgrade of existing hospital facilities; construction of laboratories, offices, MRI suite, ambulatory surgery center, and pediatric solarium; and major HVAC replacement.

Harborside Plaza 10, Jersey City, NJ - Oversaw design and construction of a 3 MW standby generation plant in a commercial office tower.

712 Fifth Avenue, Office Building, NYC - Constructed approximately 200,000 SF of tenant improvements.

EXODUS Data Center, Waltham, MA - Construct 60,000 SF data center which included all new raised floor, HVAC, power distribution, emergency power, UPS, security and fire protection. Also constructed 20,000 SF enclosed generator and tank farm.

EXODUS Data Center, Weehawken, NJ - Constructed 180,000 SF data center which required extensive collaboration with local planning board on zoning issues.
Power Project Business Development - Asset Management

Tom McCarthy has more than 25 years power industry experience in operations, maintenance, asset management, construction, and business development. He has project development, engineering, procurement, and construction experience on nuclear, WTE, fossil fueled projects, and Extra High Voltage (EHV) infrastructure projects. He is also experienced in asset economic modeling, acquisition due diligence and asset management. Much of this experience involved Public Private Partnerships (PPP) with municipalities and regional financing authorities in both North America and Europe. This project development experience encompassed a wide range of customer requirements that included fuel sourcing, steam and energy sales, and operations and maintenance services as part of the larger project structure. Mr. McCarthy is experienced in leading and shepherding complex corporate projects through multi-functional corporate teams.

During his career, he has been a Regional Business Manager for a large municipal PPP projects where he was responsible for contract administration, fuel sourcing, steam sales and all community and business related issues associated with the facility. He was also Vice President of Asset Management for Covanta Energy where he was responsible for several WTE asset improvement projects including the negotiations of the restructuring of the Mid-Connecticut RDF facility in Hartford, Connecticut. In this role he was also responsible for assisting the Connecticut Resources Recovery Authority in developing steam sales for a proposed commercial re-development of downtown Hartford, CT.

Education

MASTER OF SCIENCE, concentration in Finance, Rensselaer Polytechnic Institute, Hartford Graduate Center
BACHELOR OF SCIENCE, in Business/Operations Management, University of the State of New York
NAVAL NUCLEAR POWER TRAINING
PROJECT MANAGEMENT INSTITUTE, PMP CERTIFICATION
SIX SIGMA GREENBELT TRAINING (CERTIFICATION IN PROGRESS)

SELECTED RECENT PROFESSIONAL EXPERIENCE

Gestamp Biomass International
Gestamp Biomass International (GBI) is a long term project developer and asset owner of technologies such as waste to fuel oils, biomass to bio-coal, and biomass to power.

Vice President and General Manager
Responsible for deal flow and project development for a wide range of conversion technologies including bio-coal and waste plastic to fuel oil. Managed all project disciplines to pursue green field projects from site selection to contract execution.

- Business and project lead to analyze, evaluate and recommend suitable projects that met corporate business model. Reviewed a wide range of mature and emerging renewable technologies including biomass to power, biomass to torrefied fuel, bio solids to solid fuel, waste plastic to liquid fuels. Lead project development efforts on several torrefied fuel projects including feedstock studies, site evaluation, land options, site layout and transportation logistics by rail to an eastern seacoast port.

Wheelabrator Technologies Inc.
Waste Management subsidiary engaged in the design, build, own/operate of large-scale ($400MM +) waste to energy projects.

Senior Manager Business Development
Senior corporate lead responsible for full project development/acquisition efforts on North American and European projects. Project Management role to oversee the legal, financial, permitting, engineering, estimating and works planning for green field projects and asset acquisitions.
- Business and technical lead to pursue large EPC energy from waste projects in North America and Europe. Project Lead for the largest EPC proposal effort in the history of the company on a $647 million dollar construction project with a $25 million dollar, twenty year operating agreement.
- Company representative on multiple PFI procurements in Wales and Ireland. The projects were energy from waste projects that included mechanical biological treatment processes at the front end of the project.
- Participated with other Waste Management affiliates to propose a wide range of emerging technologies including anaerobic digestion, plastic to liquid fuels, process engineered fuels, plasma arc gasification and many other technologies.

**General Electric Nuclear Energy**  
August 2006 to June 2007  
New Nuclear Power Plant business unit focused on providing full project engineering, procurement, and construction services to utility companies on the Economically Simple Boiling Water Reactor (ESBWR) nuclear power plant.

**Project Manager – Exelon Project Development**  
Responsible for managing all aspects of project support to Dominion and Exelon’s selection of the ESBWR plant for future nuclear power project development. Coordinated all engineering, permitting, project controls, commercial operations and other support functions to help Exelon license, permit and economically evaluate the ESBWR technology.

**Entergy Operations Services, Inc.**  
December 2004 to August 2006  
An electrical transmission and distribution contractor providing engineering, procurement, and construction services to electric power systems across the United States.

**Manager of Business Development – Northeast United States**  
Responsible for all business development in the United States. Industry liaison to engineering, and construction firms in the transmission, distribution, and substation market.

- Responsible for leading project proposal efforts. Coordinated various firms in responding to large-scale ($25 million to $100 million) engineering, procurement, and construction (EPC) transmission and distribution projects in the Northeast.
- Developed company presence with various utility customers such as PECO-Exelon, National Grid, Progress Energy, Consolidated Edison and Northeast Utilities Services Company (NUSCO). Responsible for all contract negotiations.

**AECOM Technology Corporation**  
April 2002 to October 2004  
An international Architectural and Engineering Consulting Company providing complete professional services to the utility and heavy infrastructure industries.

**Associate Vice President, Energy Infrastructure**  
Reported to the Senior Vice President, Director of US Operations at DMJM+HARRIS Inc. Responsible for identifying and pursuing opportunities to provide services in the power generation, distributed generation, substation, and energy services markets. Specific accomplishment include:

- Provided fixed and variable operating cost models to support the selection of equipment and development of a 65 MW, two on one combined cycle power project. Supported power purchase negotiations with the New York Power Authority by modeling construction and operating costs.
- Provided commercial and technical guidance on the implementation of a long-term operation and maintenance agreement for a distributed generation project on a major Northeastern college campus. Identified and pursued professional services offering to mid merit and base load generating projects in the Metro New York area to provide Program and Construction Management services. Identified and targeted major transmission projects that are under development in the New York City market.
- Provided cost modeling for several 80 MW simple cycle power projects in the Metro New York area.
- Lead the effort on a successful proposal submission of a joint venture to provide full turn Engineering, Procurement and Construction services on a 500 megawatt submarine cable installation from New Jersey to New York City.
Jesse M. Douglas, LEED AP
Senior Project Engineer / Manager

Education
Mr. Douglas is a Licensed United Stated Green Building Council 3rd Assistant Engineers, is a LEED® Accredited Professional, is part of the Association of Energy Engineers (AEE) and of the American Society of Mechanical Engineers (ASME). Mr. Douglas received a bachelors degree from SUNY Maritime College in Marine Engineering, Conventional Power plant design. He is currently seeking his MBA from Baruch College.

Summary of Experience
Mr. Douglas is a Senior Project Engineer and Manager at SourceOne. He has more than 6 years of experience in the energy industry and extensive scholarly training and accomplishments. He has led infrastructure projects through all phases of development, from feasibility through design and construction, to commissioning. Mr. Douglas’s experience performing inspections, technical & financial studies, engineering design, project development, commissioning and consulting services for commercial, residential and institutional customers makes him a valuable member of the SourceOne team.

Detailed Project & Managerial Experience
Commercial & Government
• New York Power Authority (NYPA) – Senior Project Manager for NYPA Energy Efficiency Implementation Contract. Major projects include:
  o Bronx Zoo: Medium Temperature Hot Water distribution system renovation – 3 miles of underground distribution connecting 25 buildings, cogen plant upgrades, boiler plant installation, and general infrastructure upgrades.
  o Murry Bergtraum High School: Chiller Plant Renovation and implementation of new control system on central plant and air distribution systems.
  o City of Yonkers: Portfolio of 11 municipal buildings across Yonkers. Improvements include control/prosess improvements, boiler & chiller replacements, control system upgrades, building shell improvements.
  o Coney Island Rail Yard: Renovation of a high pressure steam boiler plant that serves the largest rail yard in the US.
• Harborside Plaza 10, Jersey City, NJ As Plant Manager, oversee the operation and maintenance of a 3 MW standby generation plant in a commercial office tower.
New York State Energy Research and Development Authority (NYSERDA) – On a number of projects, Mr. Douglas has won grants for energy efficiency project, including feasibility studies, chiller plant renovations, cogeneration plant installation, and lighting & motor replacements.

**Educational**

- Cooper Union, New York, NY: Lead Project Manager responsible for the infrastructure master planning, coordination of design, and construction project management of a complete infrastructure renovation of an eight-story, New York City Landmark building – Cooper Union Foundation Building. Project Scope included installation of:
  - Cogeneration Plant
  - Boiler Plant
  - Chiller Plant & Cooling Towers
  - Building Management System
  - Replacement & Upgrade of Air Distribution Systems
  - Electrical & Gas Service Upgrades
- New York University, New York, NY: Provide construction management of a high temperature hot water boiler renovation in NYU’s main central plant for the Washington Square Campus.
- Ethical Culture Fieldston School, New York, NY: Lead Commissioning Engineer on a LEED New Construction project for K-12 classroom, gymnasium and pool buildings.
- Columbia University, New York, NY: Conducted a detailed steam system analysis for main high pressure steam distribution system - the second largest in New York City.
**Seth Berkman**  
**Marketing Coordinator**

**Summary of Experience**

As a member of the Business Development team, Mr. Berkman is responsible for supporting SourceOne’s internal sales efforts. He supports business development throughout the sales pipeline including customer prospecting, developing a strategic sales approach, proposal writing, and preparing customer interviews and presentations.

Mr. Berkman also develops and manages SourceOne’s online content including the company website, blog, and social media. As Marketing Coordinator, his goal is to help customers and potential customers become better educated about opportunities and challenges in energy.

Prior to joining SourceOne, Mr. Berkman completed his MSc in Carbon Management with distinction at the University of Edinburgh. Drawing from his training in energy auditing, carbon footprinting, greenhouse gas accounting, and emission reduction project development, Mr. Berkman also supports SourceOne’s programmatic work as needed.

**Project Experience**

**SourceOne – Marketing Coordinator (2015-present)**

Mr. Berkman has been involved in a variety of energy projects and supports all aspects of SourceOne’s service offerings including: advanced metering infrastructure, utility invoice management, energy efficiency auditing, combined heat and power feasibility studies, electricity and natural gas procurement, and renewable energy studies. He has been responsible for securing over $2 million in successful proposals.

**Environment America – Midwest Federal Field Associate (2012-2013)**

Garnered public support for green state and federal policies via coalition building, grassroots activism, stakeholder engagement, earned media and direct lobbying. Mr. Berkman’s editorial articles were published in major newspapers such as Chicago Tribune, Chicago Sun-Times, Cleveland Plain Dealer, Toledo Blade, and Kansas City Star.
Company Overview


"Creating energy efficiency and energy distribution solutions that are reliable, sustainable and in line with the needs of customers from every sector. This is our work, these are our ethics”.

- Martin Energy Group Services, LLC

Quick CHP Facts

✦ 364 CHP Unit Installations
✦ 36 States / Provinces
✦ 6 Countries
✦ 173 MW of CHP Power Installed

Services Provided

- Engineering & Design
- Application Engineering
- Plant Controls Integration
- Utility Interconnects
- Manufacturing
- Global Sales
- Service & Support

Technically Advanced & Professionally Designed CHP Package Systems
MARTIN ENERGY GROUP SERVICES, LLC QUALIFICATIONS
“Creating energy efficiency and energy distribution solutions that are reliable, sustainable and in line with the needs of customers from every sector. This is our work, these are our ethics”.

- MARTIN ENERGY GROUP SERVICES, LLC
Martin Energy Group Services, LLC brings a comprehensive range of resources to the industry that have made our company stand out as a leading manufacturer of electrical power penetration equipment. We have provided a brief overview of our range and capabilities for your consideration.


Martin Energy Group evaluates each project and engineer solutions that meet or exceed our customers expectations. After evaluating the needs of the customer, we present the project to our engineering department. After the project is engineered, drawings are represented to the customer for further evaluation. With the consent of all parties involved, we manufacture and assemble the project in our facilities, followed by comprehensive testing prior to shipment and installation.

Martin Energy Group has the capacity to supply and service the full range of power generation products. Our goal is to provide each customer with a “Balance of Plant” product that integrates all of the components into a totally coordinated project – the “Martin Energy Group Power Package.”
Martin Energy Group Services, LLC is a privately held company with over 40 years of power generation experience. With installed power plants all over the world operating in environments of ambient temperatures ranging from minus 30° degrees (F) to 110° degrees (F). These units are located in the remote landscapes of many varied industries—from landfill sites to manufacturing facilities, from mines to oil fields, critical power supply sites, and from hospitals to universities. Martin Energy Group has the expertise required to give proper specifications for nearly any job.

Our mission is to provide the highest levels of quality and value to the clients we support the energy production industry. Our firm has upheld this commitment for more the 40 years through the efforts of our dedicated team members and our unique combination of in-house resources. We understand what it takes for modern businesses to thrive in a fast-paced marketplace, and we are here to support our clients by adapting to their needs.

We serve a continuously expanding geographic area of operations throughout North America with strategically positioned offices. Today, we have our Corporate facility in Latham, MO with a satellite facility in Ephrata, PA and offices/support facilities in IL, IN, WI, MN, CO, CA, OR, NY, and MA. Our team members take a highly collaborative approach to our clients’ projects and programs, employing the latest technological solutions and industry best standards. Responsiveness and accountability are central to our goal of earning and sustaining the confidence of our clients.
Our Services

Martin Energy Group Services, LLC provides our industry-leading services to our clients via a wide range of delivery platforms. The foundation of all of these platforms is our customer-centric approach, which allows us to be flexible and accountable with the services we offer. We have the capability and leadership to manage technically complex projects and programs through every phase. Our professionals are working with the latest in technology, industry best practices, and regulatory compliance guidelines to support our clients and their projects. Today, Martin Energy Group is typically providing services under the following delivery options:

Professional Services

- Mechanical and Electrical Engineers
- ASME Certified Welders and Facilities
- UL Certified Controls and Switchgear Facilities
- Certified Project Management Professionals
- Certified Process Engineers
- Design / Build and EPCM
- Preconstruction and Procurement
- Construction and Installation Management
- Integrated Project Delivery (IPD)
- Owner and Company Representation
- Third-Party Civil, Structural and Architectural (CSA)
While our approach to each project is custom-tailored to meet our client’s goals, our team members are consistently supported by the latest technology platforms and best practices to enhance collaboration and efficiency. We support complete Building Information Modeling (BIM) in all disciplines, assemblies, and systems with our own internal staff modelers. This design and construction practice can be a powerful advantage that allows the project team to combine design and building info into an integrated and collaborative process, enabling design visualization in a 3D Model.

Martin Energy Group also utilizes proven online solutions to facilitate and enhance our procurement process through web-based applications. This allows for the rapid and secure transfer of files with our approved subcontractors without the expense of individual reproductions. We can manage all of our project documentation in a real-time environment.
Our Experience Highlights

**Martin Energy Group** has had the opportunity to support the growth and evolution of many of the leading businesses and organizations over the past 40 years. During this time, we have gained experience on projects and programs of every scale and complexity. We have assembled a collection of projects that we believe may be relevant to upcoming opportunities with your company.

**Combined Heat & Power (CHP) Project Overview**

We have established ourselves as an industry leader in the design, engineering, manufacturing and integration of CHP solutions for clients in a broad spectrum of industries. From small scale single-facility units to large scale plants, we have the flexibility to design, engineer, manufacture, commission and support a wide variety of systems. One of the greatest values that Martin Energy Group provides to our clients is our ability to provide seamless support for every stage of CHP implementation: this includes initial feasibility studies and recommendations, design/ engineering, fabrication and manufacturing, planning, integration, installation, commissioning, and product support and service. Having all of these services provided by Martin Energy Group’s in-house professionals results in highly responsive and accountable support throughout the life of the project. We have provided an overview of CHP projects below and also included cut sheets detailing some of the initiatives.
## Combined Heat & Power (CHP) Project Quick Facts

<table>
<thead>
<tr>
<th>CUSTOMER</th>
<th>PRIME MOVER</th>
<th>CAPACITY</th>
<th>EQUIPMENT SUPPLIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wesleyan University CHP Facility # 2</td>
<td>Dresser-Rand Recip. Engine</td>
<td>680 kWe</td>
<td>Compact Enclosure, Natural gas genset, System Controls, Switchgear</td>
</tr>
<tr>
<td>City of Lamar LFG to Energy Facility</td>
<td>Dresser-Rand Recip. Engine</td>
<td>2,300 kWe</td>
<td>LFG engine / generators, System controls, Paralleling Switchgear</td>
</tr>
<tr>
<td>Bio-Town AG Renewable Energy</td>
<td>GE Jenbacher Recip. Engine</td>
<td>6,192 kWe</td>
<td>Bio-gas engine / generators, SCADA, EHRU, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>Great Lakes Greenhouses</td>
<td>Dresser-Rand Recip. Engine</td>
<td>2,000 kWe</td>
<td>Natural Gas genset, EHRU, Island Mode, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>Vessels Coal Gas - Oxbow Mining CO.</td>
<td>Dresser-Rand Recip. Engine</td>
<td>3,300 kWe</td>
<td>Enclosures, Coal bed methane gensets, System Controls, Switchgear, Substation</td>
</tr>
<tr>
<td>IPG Photonics Corp.— MicroGrid</td>
<td>Dresser-Rand Recip. Engine</td>
<td>4,000 kWe</td>
<td>Enclosures, Natural Gas engine/ gensets, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>CAL-BIO Energy— Utility Peaking Plant</td>
<td>Caterpillar Recip. Engine</td>
<td>2,000 kWe</td>
<td>Enclosures, Bio-gas gensets, fuel clean-up, SCADA, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>Sula Valley Bio-Gas</td>
<td>Dresser-Rand Recip. Engine</td>
<td>4,200 kWe</td>
<td>Enclosures, Bio-gas gensets, fuel clean-up, SCADA, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>MO Electric Utility Commission</td>
<td>Caterpillar Recip. Engine</td>
<td>10 MW</td>
<td>Integrated Switchgear &amp; System Controls for Diesel Black-start, to coordinate with Gas Turbines</td>
</tr>
<tr>
<td>Blakely &amp; Associates Engineering</td>
<td>Pratt Whitney Gas Turbines</td>
<td>80 MW</td>
<td></td>
</tr>
<tr>
<td>Fisher Ranch Corporation</td>
<td>Dresser-Rand Recip. Engine</td>
<td>2,700 kWe</td>
<td>Natural Gas engine/ gensets, SCADA, System Controls &amp; Switchgear</td>
</tr>
<tr>
<td>Kingfisher Foods</td>
<td>Waukesha Recip. Engine</td>
<td>1,400 kWe</td>
<td>System Controls &amp; Switchgear, Plant is in Island Mode Operations</td>
</tr>
<tr>
<td>Stubbe’s Precast Concrete</td>
<td>Dresser-Rand Recip. Engine</td>
<td>1,600 kWe</td>
<td>Natural Gas engine/ gensets, SCADA, System Controls &amp; Switchgear, Island Op.</td>
</tr>
<tr>
<td>Goshen Green Cow Power</td>
<td>GE Jenbacher Recip. Engine</td>
<td>3,000 kWe</td>
<td>Bio-gas engine/ gensets, fuel conditioning, System Controls &amp; Switchgear, SCADA</td>
</tr>
</tbody>
</table>
Freeman Athletic Center CHP Unit & MicroGrid

Project Scope:

- 680 kWe Dresser-Rand Engine
- 24/7 Base-loaded, Grid Connected
- MicroGrid System / Island Mode
- CHP System, hot water and steam
- System Controls for engine/genset
- Switchgear for Paralleling & Island
Island Mode Power Plant with Hot Process Water

Project Scope:

- 2-1050 kWe Dresser-Rand Engines
- 24/7 Load Tracking & Shedding
- Island Mode Power Plant
- CHP System, hot process water
- System Controls for engine/gensets
- Switchgear for Island Operation
Island Mode Operation for Lumber Mill

**Project Scope:**

- 2-800 kWe Dresser-Rand Engines
- Plant Load Tracking & Shedding
- Island Mode Power Plant
- Integration with Diesel Back-up
- System Controls for engine/gensets
- Switchgear for Island Mode Operation
Coal Bed Methane Recovery - Remote Power Generation

**Project Scope:**

- 3-1150 kWe Dresser-Rand Engines
- 24/7 Base-loaded, Grid Connected
- Modular Built Substation
- Synchronization/ Utility Relay Control
- System Controls for engine/gensets
- Paralleling Switchgear
Bio-gas CHP with Gas Scrubbing - Utility Peak Shaving

**Project Scope:**

- 2-1000 kWe Caterpillar Engines
- Utility Peak Shaving, Grid Connected
- Modular Built Power Enclosures
- Synchronization/ Utility Relay Control
- System Controls for engine/gensets
- Paralleling Switchgear
Modular Power Package - Greenhouse CHP Island Mode

Project Scope:

- 1-600 kWe Dresser-Rand Engine
- Island Mode, Load Tracking
- Modular Built Power Enclosures
- CHP System, process Hot Water
- System Controls for engine/gensets
- Switchgear for Island Operations
Examples of Project Partners and Clients
Our Facility Locations

Corporate Facility
39415 Excelsior Drive
Latham, MO 65050     USA     Central MO
PH: ( 660 ) 458 - 7000
Fax: ( 660 ) 458 - 7100

Satellite Facility
34 W. Mohler Church Road
Ephrata, PA 17517       USA       Southeastern PA
PH: ( 717 ) 738 - 0300
Fax: ( 717 ) 738 - 4329
Our Service & Support Centers

24 – 7 Support
Our Department Contacts

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Daryl Sensenig, Service & Parts Manager
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Aaron M. Fox, Marketing & Project Development
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Email: afox@martinenergygroup.com
Marcus R. Martin  CEO ~ Business Executive

PH: (660) 458-7000  ext. 104
Email: mmartin@martinenergygroup.com

--------------- Professional Profile ---------------

♦ Experience with CHP, Gas and Diesel fired engine/generator systems for over 22 years.

♦ Seasoned Field Service Technician on all types and models of power generation systems.

♦ Motivated Sales Department leader for over 12 years for power generation packages.

♦ Senior-Level General Manager Experience as a motivated business developer.

♦ Highly analytical decision-maker with extensive experience in building, operating and growing business opportunities.

♦ Seasoned executive with in-depth understanding of emerging technologies, applications, as well as international business expertise.
Areas of Expertise

- Asset & Liability Management
- Budget Developments
- Building Strategic Alliances
- Business Start-up
- Corporate Management
- New Market Strategy
- New Business Development
- Operations Management
- National / Regional Sales
- International Sales
- Product Analysis & Development
- Sales Direction & Initiatives
- Relationship Building
- Staff Coaching & Mentoring
- Corporate Team Building
- Business Revenue Growth
- Organizational Restructuring
- Operations Management
- Training & Development
- Visionary Strategies

Business Profile


**Product Support & Services.**

- **360** CHP Unit Installations
- **36** States / Provinces
- **6** Countries
- **166** MW of CHP Power Installed
Richard Mattocks  
*Environmental Scientist*

**Education:**
- M.S., Environmental Science and Engineering, Virginia Tech, Blacksburg, Virginia
- M.A., International Administration, School for International Training, Brattleboro, Vermont
- B.S., Animal Science, California State Polytechnic University, Pomona, California

**Qualifications and Experience:**

**Organic Waste, Manure, Energy Crop Digestion, Energy Recovery Systems since 1985.**
Internationally recognized authority: contributed to 100’s of digestion system projects (including 800,000 hogs; 30,000 cattle; 1500 TPD mixed waste): assessing technical and financial feasibility, system business development, project management; methane potential assessment, modeling, engineering and process design and review; troubleshooting, consulting; equipment selection, construction, startup, training, regulatory compliance; energy and by-product recovery, processing and marketing; nutrient management; financing, incentives; direct management coordination of animal, organic waste methane systems. Organic waste digestion cogen systems: 80 TPD + 700 cow manure, 150 TPD retrofit of manure digester, 1500 TPD + 30,000 cattle manure, 200 TPD food waste to 600 kW.

Technical advisor: large scale multiple farm manure to biogas energy utilization. Consulting services: EPA-AgSTAR farm waste energy recovery; public and private clients in Brazil, Chile, China, Colombia, Ecuador, Great Britain, Honduras, India, Mexico, Netherlands, Pakistan, Philippines, Russia, Serbia, Taiwan, Ukraine, US. Performed scores of farm, centralized manure, food waste digestion system feasibility studies. Managed construction of and operated animal production facilities and digestion/energy recovery systems.

**CURRENT**

**Martin Energy Group Systems LLC**
- Senior advisor – high strength, high solids, organic waste management system analysis, design and installation, Domestic, International

**PREVIOUS**

**Environomics LLC,**
- Principal - organic waste digestion system consulting - US, Asia, Europe, South America

**Veolia (Biothane), Inc,**
- Senior advisor – organic waste management system, Domestic, International

**AgCert International**
- Manager - Digester Development - organic waste management systems analysis, design and installation, Domestic and International, Brazil, Mexico

**Tetra-Tech**
- Technical Advisor to AgStar - organic waste management, design, installation, US

**ICF Incorporated**
- Senior Technical Advisor to AgStar - organic waste management systems analysis, design and installation, Domestic
Tillamook County MEAD Project
• Technical Advisor - organic waste management systems analysis, community relations, design and installation, Domestic

USAID
• Technical Consultant - Environmental waste management systems, Ukraine, Russia

UNISYN
• Director Digester Development – organic waste management systems analysis, design and installation, Project development/community relations, Domestic and International

Hershey Equipment Company
• Digester Projects Manager - organic waste management systems analysis, design and installation; community relations, US

Resource Conservation Management
• Technical Consultant – organic waste management systems analysis, design and installation, Domestic and International

World Bank
• Technical Consultant - Environmental waste management systems analysis, India

Draper Aden, Inc.
• Environmental Scientist - Environmental waste management systems analysis, design and installation, US

C.A.R.E. Inc.
• Manager - Community development and disaster relief, Colombia and India,

US Peace Corps
• Volunteer - Agricultural extension, project development community relations, Ecuador

Responsibility Highlights:
• Confidential Fortune 500 Food Producer: assessed, analyzed, modeled, researched organic waste to CNG/LNG complex, 1 ½ years
• US AgStar: consulted on all 14 commercial farm digesters, seven of which responsible for assessment, design, construction, start, operator training
• CARE: Managed emergency feeding program: Indian state, 3 million recipients

Memberships:
• American Biogas Council: Founding member (via Biothane)
• American Society of Agricultural and Biological Engineers

Publications:
• Scores of organic waste treatment feasibility, assessment, consulting studies/reports, domestic and international, biogas production, power production

Presentations:
• Webinars: Internal corporate, International: Waste to Energy, Methane potentials
• Numerous: US government, trade organization presentations; wide spectrum technical area: organic waste system assessments/feasibility studies to bio-based energy system
**COMPANY OVERVIEW**

**Established in 1981**
**85 employees**
**4 office locations**
- New York
- Massachusetts
- Connecticut
- North Carolina
- Vermont
**CSIA Member**

**GEOGRAPHICALLY**

- N/V/TY Region 40%
- MA/CT Region 40%
- Mid-Atlantic Region 20%

**SERVICES**
- Engineering 35%
- Systems Integration & Instrumentation 35%
- Commissioning & Qualification 30%

**MARKETS**
- Life Sciences, R&D, Higher Education 70%
- Semiconductor/ Nanotech 15%
- Industrial 15%

**Partial Client List**

**Higher Education & Research**
- Boston College
- Harvard University
- MIT-Cambridge
- MIT-Lincoln Labs
- Tufts University
- University of Connecticut
- University of Massachusetts
- University of Rhode Island

**Biotech & Pharma**
- Amgen
- AstraZeneca
- Biogen Idec
- Genzyme
- Lonza Biologics
- Novartis
- Pfizer
- Shire HGT

**Microelectronics**
- Analog Devices
- Applied Materials
- GLOBALFOUNDRIES
- IBM Microelectronics
- Intel
- Kopin
- Skyworks Solutions
- Varian
Founded in 1981 by David Hallam, Hallam-ICS has continuously satisfied clients resulting in steady growth. Our philosophy is high quality service and total client commitment.

We’ve identified several industries where we feel we would bring the most value to our clients through our knowledge, experience and passion. Some of them include:

MICROELECTRONICS  FOOD & BEVERAGE
HEALTH CARE  BIOTECH & PHARMACEUTICAL

A large number of our clients require highly engineered, innovative solutions. While we are always eager to accept a challenge, we can also offer the tried and true solution. Countless projects during our 34 years in business have given us knowledge of the industries we serve. And with an 80% rate of repeat clients, we are confident that our experience and expertise produce results.

Our team provides solutions to clients in the Eastern and Mid-Atlantic regions of the United States from our offices in Mansfield MA; Middletown, CT; Malta, NY; So. Burlington, VT and Raleigh, NC.

The Hallam-ICS approach uses a proprietary process (CODESTM) that allows us to better understand your organization, team and culture. The result is a customized Project and Communication Plan that ensures project success.

Hallam-ICS is an Employee-Owned Company. Our ownership culture, supported through the creation of an Employee Stock Ownership Plan (ESOP), provides new energy and ideas which are vital to the company’s success.
**Who We Are**

Mechanical, Electrical, and Plumbing (MEP) consulting engineering team with specialty systems experience in highly engineered facilities.

**Our Approach**

We combine technical know-how with business-minded practicality to deliver creative solutions in a timely and efficient manner.

**Market - Focused**

Our market-focused teams, lead by Project Managers enhance our ability to respond to our clients’ individual needs. We service clients in these markets:

- **Life Science**
- **Microelectronics**
- **Education**
- **Commercial**
- **Industrial**

**Relationship Based**

Our business is based on our long-term repeat clients. We recognize the importance of our client relationships and will work diligently to exceed each client’s expectations.

---

**Top Four Things Clients Want in an Engineering Firm:**

1. Systems Work - Reliability
2. Customer Service - Responsiveness
3. System Efficiency
4. Creativity and Flexibility
A recent study found that the primary complaint clients have about working with engineers is that they don’t take time to understand their needs... We will listen!

**ENGINEERING AREAS OF EXPERTISE**

**BASEBUILDING DESIGN**

- HVAC
- Electrical Power & Lighting
- Plumbing

| Central Utility Plants | Controls | Life Safety/ Security/Data/Comm |

**SPECIALIZED/REGULATED ENVIRONMENTS**

- Cleanroom to sub-class 1
- GMP Validated Areas
- Bio-safety Research Settings
- Animal Research
- Hazardous Classifications
- Patient Care Surgical Settings
- Acoustic Sensitive to NC 25

**PROCESS SUPPORT**

- Process Equipment Layout
- Process Exhaust & Ventilation
- Process Controls

| Environmental & Safety Systems | Process Material Storage & Delivery | House Systems |

**MICROELECTRONICS SPECIALTIES**

- Cleanroom Design
- Process Tool Accommodation
- Ultrapure Water

| HPM (HRM) Gases & Liquids | Chemical Storage & Delivery | Toxic Gas Monitoring & Control |
Champlain College  
Burlington, VT  
**Ice Plant Expansion**

Hallam-ICS performed a detailed energy analysis to validate and optimize the performance of an Ice Plant supporting existing and new buildings. The solution included high efficiency chillers, modular ice storage, and underground distribution. All systems were selected to meet strict acoustic criteria.  
Construction value: $465,000

Champlain College  
Burlington, VT  
**Site Utilities**

Hallam-ICS provided concept design and project management for a campus-wide upgrade to power a Voice/Data/Communication (VDC) system. The project was phased to integrate into the construction of three buildings plus ongoing campus functions.  
Construction value: $2,000,000

Norwich University  
Northfield, VT  
**Master Plan**

Hallam-ICS, together with the architectural firm of Perry Dean & Rogers Partners conducted an infrastructure analysis to prioritize capital Projects for the Norwich campus. Together we developed a 20 year Master Plan for the entire campus.  
Construction value: N/A

Norwich University  
Northfield, VT  
**Boiler Plant / Cogen Study**

Study to evaluate major expansion of an existing central heating plant (CHP). Systems included 100 psi steam, steam turbine cogeneration, underground fuel tanks, and medium temperature hot water heat recovery (from diesel generator). This study led to a follow-up project to add two new boilers.  
Construction value: N/A

St. Michael’s College  
Colchester, VT  
**Main Quad Boiler Plant Study**

Hallam-ICS was retained to study options to replace and consolidate the individual plants in five buildings. We evaluated an option to consolidate the plants to a single location. The total area served by the combined heating plants was over 125,000 sq. ft.  
Construction value: N/A
Bill will be the project principal on this project, responsible for control of in-house and subcontracted engineers. He is also the Director of Engineering at Hallam-ICS. He has division-level responsibility for technical execution, customer relations, budgets and schedules.

Bill has been a practicing engineer since 1995, working on the design and installation of integrated (mechanical, electrical and controls) systems in the built environment. He has experience in industrial, institutional, commercial, educational and governmental facilities. His background includes mainly retrofit work in the industrial market.

Transamerica Pyramid Center – San Francisco, CA
1.0 MW Cogeneration Project
✓ Served as project engineer responsible for the entire project. Duties included: selection and management of sub-consultants, management of in-house mechanical /electrical /controls engineers (review and approve all technical documentation), lead mechanical engineer role, lead all in-house and with-customer design reviews, participated in City planning process for permitting, administered client meetings and records, developed detailed “existing condition” drawings, solicited equipment purchase, construction period administration, documented and lead startup/commissioning, designed integration of new equipment into existing building control system, provided training to the owner.

Industrial Client – Southern Vermont
Chloride Brewery
✓ Project manager and lead mechanical engineer for the entire project through construction. Duties included: management of the outside structural engineer and in-house mechanical and electrical engineers, process development with the client’s assistance, functional specification, control panel specification, process and instrumentation diagrams, equipment specification and selection, calculations for pipe pressure capacity, control valve selections, thermodynamic evaluation, in-field direction of connections to existing systems and construction administration.
✓ The project includes reuse of existing electrolyte conditioning tanks, new heat exchangers, new pumps, new cooling piping, new process piping, integration of two machine tools to the new electrolyte system, a control panel and commissioning.

Imerys Talc – Ludlow, VT
Genesis Project
✓ Project manager and mechanical engineer responsible for project. Duties included sub-consultant hiring and management, principal authorship of the Basis of Design, overview of the mechanical design, client coordination and obtaining the construction permit from Vermont Fire Safety. The project’s scope includes a new building on a complicated site, pneumatic conveyance, owner-provided milling equipment, an industrial water system, connections to the existing mill and shipping center and significant coordination with the contractor and installers.

B.S. Degree in Civil Engineering, State University of New York, Buffalo

New York, Vermont
Dan Laird, PE  
Lead Electrical Engineer

Related Skills

☑ Over 20 years of electrical engineering experience in designing and installing power systems, coordinated drive systems, and PLC-based control systems. Extensive background in power system studies, arc flash mitigation, and MV power systems.

☑ Projects include Industrial, Commercial, Healthcare, Education, and Campus settings.

Experience

Colombo Energy – Greenwood, SC  
Greenfield Pellet Mill

☑ Electrical PE designing 460,000 Tons/year Pellet Mill Facility. Design included 15 kV switchgear, underground duct bank, site and equipment grounding, 4160V and 480V switchgear, emergency Generator, UPS, fiber-optic backbone, MCC’s, 4160 VFD’s, 480V VFD’s, power distribution panels, lighting panels and site lighting, power and control cable and conduit schedules, and electrical room layouts.

GE Aviation – North Clarendon, VT

Main Transformer Upgrade, Substation Replacement

☑ Power and protection design for a dual 10.0 MVA, 46,000 to 12,470 volt transformer station including new primary switches and fuses, secondary ductbank and cables, station power system, cable and termination specification, containment design and phasing/testing sequence.

☑ Power design for a unit substation, 3.0 MVA including cable splice plan and specification, new general arrangement, future/spare conduit installation, switchgear setting review, owner coordination of trades disciplines and standby plans for splicing a short section of primary cable, if needed.

Westervelt – Aliceville, AL

Air Pollution Control

☑ Power and controls design for $25M Regenerative Thermal Oxidizer (RTO) for state air quality compliance. Design included MV power poles, transformer, site and equipment grounding, packaged electrical room (PCR), switchgear, MCC, power panels, site lighting and lighting panels, power and control cable and conduit schedules, and virtual main relaying system for arc flash reduction.

Moen, Inc. – Sanford, NC

Mission Critical PLC

☑ Electrical control system to monitor scrubbers, exhaust fans, boilers, air compressors, and cooling towers. Designed and programmed a CompactLogix System with Point I/O that monitored critical fume control and production failure points. Out of tolerance systems caused PLC to immediately send priority emails to iPhones of plant maintenance personnel, facility engineers and plant manager. The system would also send a back to normal email when back in tolerance.

SD Warren Paper – Westbrook, ME

Flood Recovery

☑ Recovery of paper mill following devastating hurricane and flood. Work included clean-up and restoration of electrical switchgear, transformers and drives.

Education

M.S. Degree in Electrical Engineering, Drexel University
B.S. Degree in Electrical Engineering, Drexel University

Certification

Professional Engineer (PE – Power Systems)  
North Carolina, South Carolina, Ohio, Pennsylvania, Alabama, Virginia, West Virginia
**CHARLES B. RAINVILLE, P.E.**  
**LEAD MECHANICAL ENGINEER**

<table>
<thead>
<tr>
<th>RESPONSIBILITIES</th>
<th>Responsibilities include heat and mass balance, process flow diagrams, PIDs, code review, functional specification, coordination of all disciplines.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELATED SKILLS</td>
<td>✓ Chuck has over thirty five years of mechanical design experience and possesses a thorough knowledge of applicable codes and standards. Chuck is experienced in industrial, institutional and advanced technology markets.</td>
</tr>
</tbody>
</table>
| EXPERIENCE       | **Brattleboro Wastewater Treatment Facility & Pump Stations Upgrade** - Brattleboro, VT  
 ✓ Senior mechanical engineer and project manager for $23 million upgrade to WWTF and three pump stations to replace aged equipment, improve treatment processes and increase efficiencies.  
 ✓ Design components include construction of new headworks/septage receiving building and renovations to digester, dewatering, pumping, chlorine disinfection, control and pump station buildings.  
 ✓ Systems included methane gas/#2-oil fired boiler plant, ventilation with energy recovery units, geo-thermal rated heat pump system using plant effluent water for heat source/sink, digester gas fired microturbine co-generation system, solar hot water, DDC controls and plumbing. |
|                  | **South Burlington Airport Parkway Wastewater Treatment Facility** - South Burlington, VT  
 ✓ Senior mechanical engineer and project manager for new and renovated treatment facility buildings to increase capacity, replace aged equipment and increase efficiencies. Facility upgrade includes new headworks, dewatering and filter/UV disinfection buildings and renovations to digester complex, secondary complex and operations/garage buildings for this $25 million upgrade.  
 ✓ Systems include high efficiency gas fired hot water boiler systems, digester gas fired microturbine co-generation system, energy recovery type ventilation units, DDC controls and plumbing. |
|                  | **Village of Essex Junction WWTF Co-Generation System** - Essex Junction, VT  
 ✓ Project manager on feasibility study for implementation of a new co-generation system that uses digester gas as a fuel source.  
 ✓ Project included a preliminary design of a system using micro turbine technology and determination of the probable cost of construction and the investment payback period. The project continued with the development of a performance specification for a design-build contract for the co-gen system installation and assisting the Village with design, shop drawing submittals and construction reviews. |

<table>
<thead>
<tr>
<th>EDUCATION</th>
<th>A.A.S. Degree in Architectural &amp; Building Engineering Technology, Vermont Technical College</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGISTRATION</td>
<td>VT, NH, ME, NC</td>
</tr>
<tr>
<td>AFFILIATIONS</td>
<td>American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)</td>
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</tbody>
</table>
APPENDIX C: LEGAL VIABILITY

This statement serves as the Statement of Compliance for the application by the City of Ithaca, which is one of the Ithaca Area Wastewater Treatment Facility owners, for Stage 2 funding from NYSERDA’s NY Prize Community Grid Competition.

If awarded Stage 2 funding, the City will comply with NY General Municipal Law Article 5-a (Public Contracts), including Sections 103 and 104-b, and with the City’s Procurement Policy for all activities associated with the funding. The City has not yet sought or awarded contracts for any services that would be paid for with Stage 2 funding, because it is awaiting notification of whether it will receive the funding.

To the extent the Stage 2 detailed microgrid design and assessments are performed through professional services contracts, both New York case law and the City’s Procurement Policy exempt professional services from competitive procurement requirements. The City nonetheless currently anticipates it will undertake a competitive procurement process to obtain these services. It does not anticipate award of a Stage 2 design-build contract, and it anticipates it will undertake another competitive process for a build partner at Stage 3. The City will draft the Stage 2 contract with the design professional to identify the agreements and consents it will need, including licenses to use design documents and to disclose potentially confidential or otherwise proprietary information, in order to provide prospective bidders with sufficient information for the Stage 3 competitive procurement process.

If the project advances to Stage 3 implementation, the City will comply with all laws, regulations and tariffs that exist and/or may be developed to allow and facilitate public-private contracts related to community microgrids. NY Public Service Commission regulations and tariffs need to be developed to allow for community microgrids. The NY General Municipal Law and/or NY Energy Law may need to be amended to allow municipalities to provide energy to and participate in such microgrids.

The City anticipates the following public-private contracts will be needed:

- Construction contract(s) to build the microgrid infrastructure
- Contract to operate and maintain the microgrid
- Grid interconnect agreement with NYSEG, which will be governed by any Public Service Commission regulations
- Contract with NYSEG for the Ithaca Area Wastewater Treatment Facility to supply electricity to the grid via a solar photovoltaic system and a biogas system, and that compensates the Facility’s municipal owners for the electricity they provide to NYSEG’s grid (to the extent these items are not covered by tariffs that will be administered by the Public Service Commission and NYSEG)
- “Take or Pay” contracts with private entities that will receive electricity from the microgrid during periods of time when the normal grid is down due to emergency or other events (to the extent these items are not covered by tariffs that will be administered by the Public Service Commission and NYSEG).
APPENDIX D: SCHEDULE

The following image is a visual representation of the proposed Project schedule.
APPENDIX E: ASSUMPTIONS, EXCLUSIONS, CLARIFICATIONS

1. It is assumed the level of design drawings and specifications necessary to obtain a +/-10% cost estimate will not require an Issued for Construction status.

2. Clarifications to the funding request amount is provided below:

   - **NYSEG Regulatory and Technical Cost for Islanding Operation** – Referring to clarification 4 below, the proposal team has interpreted NYSEG’s cost to be $62,800 (as per RFP 3044 Attachment H) with an additional $21,920 for supporting technical support. Additionally, $21,500 has been allocated for Tasks 2.10.3 and 2.11 towards the preparation, review and approval of contractual operating agreements.

   - **Microgrid Load Characterization (Electric and Thermal)** – The proposal team has allocated $24,000 for temporary metering for the determination of microgrid electric and thermal loads. This assumes eight commercial and industrial and four residential (for the forty residential end users) metering points. This estimate is subject to change upon further discussions with NYSEG.

   - **PV Design** – Given the strong support for community solar and the applicable community DG Tariff inspired by NY REV, the proposal team has allocated a lump sum design fee of $30,000 for the design of a 430 kW community PV array. This fee may be drastically reduced or eliminated should the Integrated Design & Development team determine that a 3rd party developer will offer design services as part of a turnkey delivery.

   - **Proposer Cost Share** – The City of Ithaca has allocated $148,522 towards cash and in-kind contributions. This includes $122,521 of cash contributions in terms of direct labor involvement and $26,000 in terms of in-kind contributions in terms of community involvement and outreach.

3. Task 3 (Benefit Cost Analysis) is assumed to be administered by a NYSERDA contractor similar to that of Stage 1. The fee carried for Task 3 scope only covers providing inputs to questionnaires and forms provided by others.

4. NYSEG to conduct Tasks 1.10 and 1.11 with technical support from Design Team.

   According to NYSEG, they have not developed fees for microgrids and interconnections as they need NY PSC guidance on how a microgrid would interconnect with their system. Therefore, they were unable to comment on cost estimates for Tasks 1.10 and 1.11.

   Regarding the utility’s role and responsibility in the NY Prize project, NYSEG will have responsibility for evaluating the interconnection. NYSEG awaits guidance on who is responsible for power quality and reliability during islanding and under which circumstances. Additional unknowns remain such as, but not limited to: customer rights, treatment of Life Support and Critical customers, load shedding, etc. NYSEG follows a NYS Standardized Interconnection Requirement (SIR) process for new generation that is 2 MW and less.

   Because the NYSIR does not address islanding, NYSEG requires a better understanding of its
responsibility and the technical standards that the microgrid and utility will be held to. NYSEG is not able to respond to the questions referring to Attachment H of the RFP.

5. The scope of work and the associated funding request is assumed to be finalized during contract negotiations upon award of Stage 2. This assumption is primarily based on NYSERDA’s amendment to RFP 3044 stating that adjustments to Attachment C Scope of Work will require justification.
## APPENDIX F: CONCEPT PROJECT AGREEMENTS

The following table outlines the concept primary agreements presented in Figure 3.

<table>
<thead>
<tr>
<th>AGREEMENT</th>
<th>AGREEMENT PURPOSE / SERVICE</th>
<th>SERVICE PROVIDER</th>
<th>SERVICE RECEIVER</th>
<th>TENTATIVE CONSTRUCT</th>
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</thead>
<tbody>
<tr>
<td>Operating Agreement</td>
<td>SPV/LLC/Other Ownership and Governance</td>
<td>NA</td>
<td>NA</td>
<td>Commercially reasonable structure, with each owner contributing equity via their own financing</td>
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<tr>
<td>Land Lease Agreement</td>
<td>Provide Use of Land for Plant Life</td>
<td>IAWWTF</td>
<td>Microgrid Co.</td>
<td>Annual or More Frequent Fixed Fee for Term</td>
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<tr>
<td>Power Purchase</td>
<td>Buy Back of Excess Generation</td>
<td>Microgrid SVP or LLC</td>
<td>NYSEG</td>
<td>Per PSC approved NYSEG buy back tariff</td>
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<tr>
<td>Power Purchase</td>
<td>Aggregate NYSEG accounts for PV solar capacity</td>
<td>NYSEG</td>
<td>Microgrid Co., IAWWTF</td>
<td>Per PSC approved NYSEG Community DG tariff</td>
</tr>
<tr>
<td>Power Purchase</td>
<td>Balance of electric energy and capacity for plant and all behind the meter generation accounts served by NYSEG</td>
<td>NYSEG</td>
<td>Microgrid Co., IAWWTF</td>
<td>Per PSC approved NYSEG tariff</td>
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<tr>
<td>Power Purchase</td>
<td>Emergency/ Island Mode Power Supply</td>
<td>Microgrid SVP or LLC</td>
<td>783/784 Feeder Customers</td>
<td>Premium for backup power or otherwise as negotiated with NYSEG</td>
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<tr>
<td>Operating &amp;</td>
<td>Microgrid Operation and Maintenance</td>
<td>OpCo</td>
<td>Microgrid Co.</td>
<td>Annual or Other Interval Fixed Fee for Term</td>
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<tr>
<td>Maintenance Agreement</td>
<td>Long term service agreements with major OEM's</td>
<td>OEM</td>
<td>Microgrid Co.</td>
<td>Annual or Other Interval Fixed and/or Variable Fee for Term</td>
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<tr>
<td>Operating Agreement</td>
<td>Microgrid operation during macrogrid outage</td>
<td>NYSEG</td>
<td>Microgrid Co.</td>
<td>Annual or Other Interval Fixed and/or Variable Fee for Term or event driven</td>
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<td>Fuel Purchase</td>
<td>Purchase of Biogas</td>
<td>Biogas FuelCo.</td>
<td>Microgrid Co.</td>
<td>Take or Pay</td>
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<tr>
<td>Thermal Purchase</td>
<td>District Energy Heating Products</td>
<td>Microgrid Co.</td>
<td>Thermal Offtakers</td>
<td>Take or Pay</td>
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<tr>
<td>Support Services</td>
<td>Comprehensive Support Services to Operate, Maintain, and Manage All Operating and Maintenance Requirements for Microgrid. Separate Agreements by Service is Also Possible</td>
<td>OpCo</td>
<td>Microgrid Co.</td>
<td>Annual Budget Approval, Operating Performance Benefit / Penalty, and Management Fee</td>
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</tbody>
</table>
## CITY OF ITHACA

### BALANCE SHEET FOR 2015 13

#### FUND: A GENERAL FUND /

<table>
<thead>
<tr>
<th>FUND: A GENERAL FUND</th>
<th>NET CHANGE FOR PERIOD</th>
<th>ACCOUNT BALANCE</th>
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<td><strong>ASSETS</strong></td>
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<td>A 200 CASH IN BANK</td>
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<td>A 201 CASH IN TIME DEPOSITS</td>
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<td>A 2105 PETTY CASH-DEPT PUBIC WORKS</td>
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<td>A 21051 PETTY CASH-STREET &amp; FACILITIES</td>
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<td>A 2107 PETTY CASH-ALEX HALEY POOL</td>
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## CITY OF ITHACA

### BALANCE SHEET FOR 2015 13

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# CITY OF ITHACA

## BALANCE SHEET FOR 2015 13

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**END OF REPORT – Generated by Scott Andrew**
APPENDIX H: STAGE I FEASIBILITY ASSESSMENT
Ithaca Microgrid
NY Prize Stage I
Feasibility Assessment

PREPARED FOR:

PREPARED BY:

SourceOne, Inc.
A Veolia Energy Company

53 State Street
Boston, MA 02109
Phone: (617) 399-6100
www.sourceone-energy.com

July 14, 2016
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1. **EXECUTIVE SUMMARY**

The New York State Energy Research and Development Authority (NYSERDA) awarded the City of Ithaca (the “City”) funding for the first of the three-staged NY Prize program, and the City has retained SourceOne as its lead contractor for the project. The NY Prize is a first-in-the-nation $40 million competition to help communities create microgrids—standalone energy systems that can operate independently in the event of a power outage. NY Prize offers support for feasibility studies (Stage 1), audit-grade engineering design and business planning (Stage 2), and project build-out and post-operational monitoring (Stage 3). Applications will be judged against program requirements at each stage of the competition for which funding is being requested. Cost sharing will be required for Stage 2 and Stage 3 of the competition.

In its request for proposal for the Stage 1 NY Prize, the City identified high-level concepts for a microgrid that involve two separate energy districts within the city: the North Energy District (NED) and the South Energy District (SED). These energy districts, according to the NY Prize definition, would qualify as microgrids because they contain a minimum of one critical facility and have both supply and demand resources capable of connecting and disconnecting from the electric utility (otherwise referred to as the macrogrid). Based on NYSEG’s response to the feasibility of a microgrid concept in the South Energy District and per direction of NYSERDA, this report focuses only on the North Energy District.

The proposed microgrid in the NED will be located at the Ithaca Area Waste Water Treatment Facility (IAWWTF). Utilizing standard industry-proven equipment and existing utility operating procedures, the proposed project modifies New York State Electric and Gas (NYSEG) infrastructure with new load-break switches to isolate certain sections of the distribution system while supplying 100% of the power requirements to all critical and non-critical facilities in the microgrid. The microgrid will combine traditional emergency generator power systems with several unique low-carbon generating assets including microturbines and reciprocating engines powered by anaerobic digester gas (ADG) in a combined heat and power (CHP) arrangement. Solar photovoltaic (PV) arrays will also be used during normal operation but would not be used during an isolated microgrid event as they do not provide firm power. Recovered thermal energy from the CHP plant will be delivered to end users through a district energy system where it is used to offset NYSEG natural gas from the Marcellus shale. The proposed system is scalable and can be developed in phases to serve existing loads as well as new loads which are developing in and around the Cayuga Lake waterfront.

The combination of the unique expansion of the existing low-carbon ADG (produced with sewage and food waste), renewable energy, and efficient combined heat and power district energy system allows the IAWWTF to be the microgrid hub during electric utility emergencies while simultaneously becoming a net exporter of energy during normal grid operations.

The proposed Ithaca microgrid represents a unique opportunity that would be a model for other communities within New York State, throughout the northeast, and potentially nationwide. As this
feasibility study came to completion, numerous benefits became apparent making this site unique in its potential as a model site for a community microgrid. The exceptional benefits which could be realized with this project are summarized as follows:

- The proposed distributed generation assets for this site are either low carbon, no carbon or carbon neutral. No fossil fuel based generation is proposed. Further carbon reductions are realized by utilizing energy recovery from the combustion of ADG. This will set the stage for the development of the waterfront area (in the current Ithaca master plan) based on a carbon neutral platform that does not require procurement of offsets (credits).

- Ithaca is an intellectual hub and an environmentally progressive community which has the energy and academic resources to fully optimize this project and to optimize the information transfer necessary for replication in other communities. After speaking with several professors and program leaders, they stated that this community microgrid would be integrated into the sustainable energy academic programs at Cornell University and Ithaca College.

- Ithaca has significant interest for a community based solar farm whereby local residents, who do not have space for PV arrays, can support renewable energy through their utility bills. The concept of a community solar farm would allow participants to better realize the benefit of the renewable energy resource they are supporting and own a tangible asset.

- More broadly, if this project moves forward, there is significant local support for creating a “community carbon cycle” whereby food-scrapes from locally grown produce would be collected to provide the raw material for production of additional ADG fuel. Recovered heat would be utilized to operate the drying process for residual solids from the digester which would then be returned to the growers as a soil amendment. The result would be locally sourced renewable fuel that reduces landfill waste and handling impacts. A microgrid project in Ithaca could easily become the catalyst for a national model demonstrating community level sustainable practices.

- Ithaca is the selected community for the NYSEG Community Energy Coordination (CEC) demonstration project in compliance with PSC Track One Order for Case 14-M-0101, Reforming the Energy Vision. This project is a natural fit for garnering the full support of NYSEG to further develop a community microgrid and to showcase a successful demonstration project.

This report accomplishes three main tasks:

1. Evaluation of the technical and financial feasibility of conceptual microgrid deployments in the North Energy District.

2. Fulfillment of the NY PRIZE Stage 1 feasibility study requirements.

3. Establishment of the project’s basis of design for subsequent development efforts or NY Prize program participation.
In support of the goals of the NY Prize program, this study focuses on city facilities that offer resources deemed as critical during an electric utility emergency/outage, including wastewater treatment, public works, public transportation, and places of refuge. However, other private facilities were considered for inclusion in the proposed microgrid. These private facilities were included because of locational advantages, existing electrical distribution configurations, the community value of a large-scale fully-powered place of refuge, the ability to efficiently serve future planned development, and the ability to maximize the effective use of low-carbon ADG power and recovered thermal energy products.

The City initially provided a list of over eighteen facilities to evaluate for inclusion in the microgrid. After receiving information from NYSEG and developing infrastructure survey maps, some facilities were dropped and additional facilities were added. The table below lists the final facilities that are included in the microgrid along with a summary of the existing loads and proposed generation for each facility.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Peak Load kW</th>
<th>Existing Generation kW</th>
<th>Proposed Generation kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ithaca Area Wastewater Treatment Facility</td>
<td>778</td>
<td>1,018</td>
<td>985</td>
</tr>
<tr>
<td>High School and Admin Complex</td>
<td>575</td>
<td>300</td>
<td>-</td>
</tr>
<tr>
<td>Tompkins Consolidated Area Transit (TCAT)</td>
<td>174</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Department of Public Works (Streets &amp; Facilities)</td>
<td>78</td>
<td>150</td>
<td>-</td>
</tr>
<tr>
<td>Balance of Feeder 783 Boatyard &amp; Boat Center*</td>
<td>200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hydroponics Shop*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golf course*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Church*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 Residential Units*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual totals</td>
<td>1,805</td>
<td>1,468</td>
<td>985</td>
</tr>
<tr>
<td>The coincident peak load</td>
<td>1,453</td>
<td>Total Generation</td>
<td>2,453</td>
</tr>
</tbody>
</table>

*These are not critical facilities and were not part of the City’s initial list. However, they are included by virtue of existing NYSEG distribution configuration.

Table 1: Microgrid Load and Generation Summary

The project’s technical and financial feasibility constraints were mainly driven by how the facilities are connected through NYSEG’s existing distribution infrastructure and the existing prices of electric and natural gas service. Based on the premise that new generation should be cost effective during normal macrogrid operation, current biogas production constraints at the IAWWTF and the lack of nearby thermal and electric loads limited the total installed electrical capacity of the project. The peak load of the microgrid is therefore limited by the amount of cost effective generation that can be installed. The proposed project uses existing NYSEG regulations, interconnect requirements, and
tariff structures to govern the value of the power generated by the microgrid during normal electric utility operation and can be expanded with future increases in biogas production.

SourceOne evaluated several deployment configurations to determine the optimum scenario for the City and have selected five options to include in this study, with the top option presented as the most feasible. The evaluation process included energy load profile applicability, critical operational needs, existing electrical distribution infrastructure, electric distribution system constraints, geographical constraints for district heating, and overall compliance with the goals and objectives of the New York’s Prize and Reforming the Energy Vision (REV).

The following illustration provides an overall context of the major energy flows and how they connect in the proposed microgrid.

SourceOne has constructed indicative project proformas for each of the five scenarios evaluated. These scenarios have configurations ranging from electric-only generation to an integrated combined heat and power with district energy deployment. Additional details on the scenarios evaluated can be found in Section 4.2.

In addition to SourceOne’s project level benefit cost and proforma analysis, a benefit cost analysis was conducted by NYSERDA. More information on this analysis can be found in Section 6: Benefit...
Cost Analysis (NYSERDA Task 4) and through the New York State Public Service Commission (NYPSC) order establishing the benefit cost analysis framework. This benefit cost analysis utilizes inputs and assumptions that may differ from those that would be used by project investors or developers or others involved in making investment decisions relative to the concepts presented. As for SourceOne’s technical and financial analysis, Appendix C: Technical, Financial & Operational Summary contains a summary of the key inputs and assumptions used to develop the preliminary technical and financial feasibility of the concepts presented in this study.

The following table provides a summary of deployment scenarios evaluated in this study.

<table>
<thead>
<tr>
<th>Scenario Parameter</th>
<th>Units</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
<th>Scenario 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Mover</td>
<td></td>
<td>Duel Fueled Natural Gas/Biogas Reciprocating Engine</td>
<td>IAWWTF</td>
<td>IAWWTF</td>
<td>IAWWTF</td>
<td>IAWWTF</td>
</tr>
<tr>
<td>Prime Mover Location</td>
<td></td>
<td>IAWWTF</td>
<td>IAWWTF</td>
<td>High School</td>
<td>IAWWTF</td>
<td>IAWWTF</td>
</tr>
<tr>
<td>Electric Revenue Source</td>
<td></td>
<td>Net Meter w/ Export at Wholesale Rate</td>
<td>Net Meter w/ Export at Retail Rate</td>
<td>Net Meter w/ Export at Wholesale Rate</td>
<td>Net Meter w/ Export at Retail Rate</td>
<td>Net Meter w/ Export at Retail Rate</td>
</tr>
<tr>
<td>Heat Recovery / Distribution</td>
<td></td>
<td>None</td>
<td>IAWWTF &amp; High School</td>
<td>High School</td>
<td>IAWWTF &amp; Waterfront</td>
<td>IAWWTF &amp; Waterfront</td>
</tr>
<tr>
<td>PV Location</td>
<td></td>
<td>IAWWTF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Life</td>
<td>Yrs.</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WACC</td>
<td>%</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New ADG Expansion</td>
<td>MMBTU/ Yr</td>
<td></td>
<td>41,230</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New ADG Generation Capacity</td>
<td>KW</td>
<td></td>
<td>550</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG CHP System Cost</td>
<td>$</td>
<td>$1,709,500</td>
<td>$1,839,500</td>
<td>$2,567,500</td>
<td>$1,839,500</td>
<td>$1,839,500</td>
</tr>
<tr>
<td>Available Heat Recovery</td>
<td>MMBTU/ Yr</td>
<td>0</td>
<td></td>
<td>12,509</td>
<td></td>
<td></td>
</tr>
<tr>
<td>District Energy System Cost</td>
<td>$</td>
<td>0</td>
<td>$2,470,000</td>
<td>$260,000</td>
<td>$910,000</td>
<td>$910,000</td>
</tr>
<tr>
<td>PV System Capacity</td>
<td>KW</td>
<td></td>
<td></td>
<td></td>
<td>435</td>
<td></td>
</tr>
<tr>
<td>PV System Cost</td>
<td>$</td>
<td></td>
<td></td>
<td></td>
<td>$1,400,000</td>
<td></td>
</tr>
<tr>
<td>Microgrid System Infrastructure Cost</td>
<td>$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,222,650</td>
</tr>
<tr>
<td>Total Project Cost</td>
<td>$</td>
<td>$4,250,331</td>
<td>$6,850,331</td>
<td>$5,368,331</td>
<td>$5,290,331</td>
<td>$5,290,331</td>
</tr>
<tr>
<td>Year 1 Value of Electricity Generated</td>
<td>$</td>
<td>$429,886</td>
<td>$429,886</td>
<td>$452,204</td>
<td>$429,886</td>
<td>$487,931</td>
</tr>
<tr>
<td>Year 1 Value of Heat Recovered</td>
<td>$</td>
<td>0</td>
<td>$106,474</td>
<td>$110,882</td>
<td>$66,803</td>
<td>$154,962</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>Scenario Parameter</th>
<th>Units</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
<th>Scenario 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 Operating Costs</td>
<td>$</td>
<td>$342,242</td>
<td>$355,369</td>
<td>$350,369</td>
<td>$355,369</td>
<td>$355,369</td>
</tr>
<tr>
<td>Year 1 Cash Flow</td>
<td>$</td>
<td>$87,644</td>
<td>$180,991</td>
<td>$212,717</td>
<td>$141,320</td>
<td>$287,524</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>$</td>
<td>-$2,358,690</td>
<td>-$3,162,414</td>
<td>-$629,133</td>
<td>-$1,617,765</td>
<td>-$149,874</td>
</tr>
<tr>
<td>Required Incentive for Zero NPV</td>
<td>$</td>
<td>$2,470,514</td>
<td>$3,314,544</td>
<td>$654,599</td>
<td>$1,692,662</td>
<td>$151,377</td>
</tr>
</tbody>
</table>

Table 2: Summary of Microgrid Scenarios

1.1. **Preferred Microgrid Solution**

Final deployment configuration selection was based on project level financial metrics including net present value (NPV), internal rate of return (IRR), and return on investment (ROI), as well as overall constructability and anticipated developments occurring on the waterfront. Siting the proposed CHP plant at the IAWWTF and recovering the available heat for immediate use at the IAWWTF with thermal loads developing at the nearby waterfront in Year Six of the project proved to be the most attractive combination of these criteria. The proposed project is scalable and project financial performance will improve should the new development loads materialize sooner than Year Six.

This scenario (referenced as “Scenario 4” throughout the rest of this report) is expected to cost $5.2 million and yields a negative NPV of $1.6 million without financial incentive through the NY Prize or other funding mechanisms. The table below illustrates the project’s financial performance with and without the incentive to get the project to a zero net present value.

<table>
<thead>
<tr>
<th>Scenario #4</th>
<th>Capital Cost</th>
<th>Simple Payback Yr</th>
<th>ROI</th>
<th>IRR</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Incentive</td>
<td>$5,290,331</td>
<td>19</td>
<td>17%</td>
<td>1%</td>
<td>-$1,617,765</td>
</tr>
<tr>
<td>With Zero NPV Incentive</td>
<td>$3,597,699</td>
<td>15</td>
<td>90%</td>
<td>5%</td>
<td>$0</td>
</tr>
</tbody>
</table>

Table 3: Financial Analysis of Preferred Microgrid – Minimum Incentive

Although Stage 2 and 3 funding could theoretically cover the entire project cost, there is a 25% cost share requirement. Taking the cost share into account and assuming the project receives the full funding amounts for Stage 2 and 3 of the NY Prize, for a total award of $3,967,748, the project’s financial performance would be as follows:

<table>
<thead>
<tr>
<th>Scenario #4</th>
<th>Capital Cost</th>
<th>Simple Payback Yr</th>
<th>ROI</th>
<th>IRR</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Maximum Incentive</td>
<td>$1,322,583</td>
<td>8</td>
<td>428%</td>
<td>18%</td>
<td>$2,020,335</td>
</tr>
</tbody>
</table>

Table 4: Financial Analysis of Preferred Microgrid – Maximum Incentive
1.2. Findings and Recommendations

1. The NED has direct and immediate opportunity for continued involvement in the NY Prize program. SourceOne recommends a thorough review of all applicable federal, state and local incentive and grant programs to determine the most cost effective approach for the City to further develop the NED microgrid and continue with the NY Prize program.

2. The City should hold a meeting with project stakeholders to determine a strategy for applying for subsequent stages of the NY Prize. In particular, SourceOne recommends developing a single strategy for project delivery and implementation so that NYSERDA has a clear understanding of how this project will be implemented. SourceOne has provided additional context in Section 5.4: Commercial Viability - Project Team (NYSERDA Task 3.3).

3. The IAWWTF has already demonstrated the successful operation of anaerobic digester to electricity technology using a microturbine-based CHP system. IAWWTF is planning on additional anaerobic gas production by way of expanding existing digester capacity, modifying its sludge handling process, and increasing the amount of trucked in digester feedstock. SourceOne has assumed that an increase in digester capacity is feasible based on the results of a separate study commissioned by the IAWWTF. As such the results of this study are predicated on the IAWWTF providing gas in the quality and quantity indicated in this report.

4. All scenarios presented under the NY Prize program will require a strong partnership with NYSEG to co-develop and implement the microgrid solutions presented. This is imperative because the design involves reconfiguring NYSEG distribution feeders during macrogrid outages. SourceOne recommends conducting a review meeting with NYSEG to inform the application process for Stage 2 and 3.

5. All scenarios are cash flow positive within the first year of operation. However, due to large infrastructure investment requirements, incentive money is required to yield a positive net present value. If the project advances through the next stage of the NY Prize program, available funding will provide the project with a positive net present value.

6. Expanding biogas production and scaling existing combined heat and power operations is cost effective and should be pursued regardless of continued NY Prize or microgrid project status.

7. Future developments within the proposed microgrid territory, namely the development adjacent to the IAWWTF known as the Cayuga Lake Inlet could feasibly be added to the microgrid. SourceOne recommends this development be served with
a new cost effective natural gas CHP plant coupled with district energy from the biogas
CHP plant proposed as part of this study. It is recommended that consideration be
given to including these new development loads in subsequent project development
efforts.

8. All of the proposed changes to NYSEG’s distribution system will be managed, owned,
and operated through NYSEG’s existing standard operating procedures. Project
stakeholders should work with NYSEG staff to develop detailed operating
requirements of the microgrid under both normal and emergency conditions.

9. Project benefits would increase if the biogas based generation could qualify as a net
metered facility under NY PSL § 66-j. This would effectively value all generation at the
retail rate as opposed to exporting a fraction of the generation through NYSEG’s
wholesale buy back tariff (refer to Scenario #5). Project stakeholders should further
evaluate the most applicable NYSEG tariffs for the microgrid, such as the recently
announced Community DG tariff that has been developed under REV.

10. All facilities in the microgrid should request access to NYSEG’s “Energy Profiler Online”
so that more detailed consumption data can be captured. Using this existing energy
management system to aggregate microgrid consumption data and provide utility and
consumer access will help establish buy in from the various facilities within the
microgrid as well as advance the design and development of the project.

11. The project should leverage the fact that NYSEG has already proposed to the New York
State Public Service Commission (NYPSC) that Tompkins County serve as a
demonstration project under the REV proceedings. The proposed microgrid project
has direct synergies with the concepts put forth by NYSEG in their January 4, 2016
report titled “Reforming the Energy Vision Demonstration Project Assessment Report
Iberdrola, USA: Community Energy Coordination”.

12. The facilities included in the study have a variety of energy procurement strategies in
place, ranging from NYSEG-supplied electricity and natural gas to various third party
supplier agreements. For purposes of this study actual costs incurred at the IAWWTF
in 2015 were used to establish a reference year with retail delivered electricity and
natural gas costs of $91/MWh and $6.61/MMBTU, respectively. For purposes of
valuing excess generation delivered from the project to NYSEG’s system, a wholesale
buyback rate of $62/MWh was used for the baseline year. Both SourceOne commodity
forecasts and NYSERDA’s benefit cost forecasts can be found in Appendix E.

13. SourceOne recommends further evaluation of additional heat loads through sludge
drying during subsequent phases of development. Finding thermal loads located closer
to the proposed heat recovery system will increase financial benefits to the project.
1.3. **Report Structure and Organization**

As stated previously, this report has been organized to accomplish three main tasks:

1. Evaluate the technical and financial feasibility of conceptual microgrid deployments in the North Energy District.

2. Fulfill the NY PRIZE Stage 1 feasibility study requirements

3. Establish of the project’s basis of design for subsequent development efforts or NY Prize program participation.

Some of the content may be repeated and may be addressed in multiple sections of the report due to the organizational structure, contents and requirements of NYERDA’s NY Prize requirements document.
2. **INTRODUCTION TO PROPOSED MICROGRID AND EXISTING INFRASTRUCTURE**

As defined in the NY Prize Grid Competition RFP 3044, Attachment C, microgrids rely on a combination of Demand-side Resources (DR) (i.e. resources such as energy efficiency or curtailable load that impact how energy is consumed) and Distributed Generation resources (DG) (i.e. resources that produce energy). For the purposes of the NY Prize competition, these collectively are considered Distributed Energy Resources or DER as defined below:\(^2\):

### 2.1. Distributed Energy Resources (DER) Definitions

#### 2.1.1. Demand-side resources

Demand-side resources are those that affect how and when energy is consumed within the microgrid. Most commonly, these will include intelligent energy management systems and energy efficiency investments. Intelligent energy management technologies are systems that monitor and control electricity consumption in real time. These technologies allow the operator of the microgrid to reduce demand for either practical reasons (such as the microgrid islanding and needing to curtail consumption to match local generation) or in response to economic incentives (such as the microgrid's participation in a demand response program).

#### 2.1.2. Supply-side resources

Supply-side resources affect energy production within a microgrid. The most common are distributed generators (DG). DG encompasses a wide range of generation technologies, including gas turbines, solar electric (photovoltaic or PV), wind turbines, fuel cells, biomass, and small hydroelectric generators.

DG units that use conventional fuel-burning engines may be designed to operate as combined heat and power (CHP) systems that are capable of providing heat for buildings or industrial processes using the “waste” energy from electricity generation. Some of the key attributes for microgrid developers to consider when choosing between types of DG to install in a microgrid include the intermittency of the generator’s output (e.g. solar panels produce power only “intermittently,” when the sun is shining), whether it is renewable or non-renewable, its location, its size, its relationship with the conventional electric grid, and its operating regime.

A microgrid is defined by the U.S. Department of Energy as a group of interconnected loads and distributed energy resources (DER) with clearly defined electrical boundaries that acts as a single,
controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.

The proposed microgrid for Ithaca is referred to as a partial feeder microgrid as further illustrated in the following figure from the US Department of Energy.

![Figure 2: Types of Microgrids](image)

**Figure 2: Types of Microgrids**

### 2.2. Existing Infrastructure Summary

#### 2.2.1. Electric

Electricity is delivered to Ithaca through multiple 115-kV transmission lines which are fed by a 345-kV transmission network east of Ithaca, both of which are owned and operated by Iberdrola, SA. NYSEG, a subsidiary of Iberdrola, delivers power from the 115-kV transmission system throughout the city through its underground and overhead distribution system which ranges from 5 kV to 34.5 kV.

NYSEG owns and operates four substations which serve the City. The facilities evaluated in this study are served from the Fourth Street substation.

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3 US Department of Energy: Office of Electricity Delivery and Energy Reliability
2.2.2. **Natural Gas**

Natural gas is delivered to Ithaca through the high pressure interstate gas transmission system owned by Dominion Resources, Inc. This pipeline transports gas to what is referred to as the city gate station, whereby NYSEG takes delivery of the gas and distributes it throughout the city. The city gate station is located east of Route 96 B, north of Ithaca College, and next to the former Emerson Plant.

2.3. **Critical Facilities and Places of Refuge in Proposed Microgrid**

According to the NY Prize program requirements, community microgrids eligible to receive NY Prize awards must involve at least one facility that provides a critical service to the public (i.e. critical facility). The proposed microgrid has four critical facilities, the IAWWTF, Ithaca High School, the Tompkins Consolidated Area Transit (TCAT) garage (public transportation), and the City of Ithaca Department of Public Works Streets and Facilities (DPW). In times of emergency the microgrid will provide full load power requirements for all of these critical facilities as well as several commercial establishments which could potentially serve as places of refuge during an emergency. Further investigation is required to determine the feasibility of and logistics involved with allowing the general public to use privately owned facilities during times of emergencies and electric utility outages.
3. **SUMMARY OF MICROGRID CAPABILITIES (NYSERDA TASK 1)**

3.1. **Introduction**

The IAWWTF will be the anchor load and host for the NED microgrid. The IAWWTF is designed to treat thirteen million gallons of wastewater per day and discharges its effluent into Cayuga Lake. It treats wastewater from the City of Ithaca, the Town of Ithaca, and the Town of Dryden. It also accepts trucked waste from a number of other sources, including a growing tonnage of local food and agricultural waste. Going forward the increase in trucked waste will enable additional biogas production.

The microgrid for the NED will combine the existing four 65-kW ADG-powered microturbine CHP systems, 7.5-kW solar PV array, and 750-kW diesel emergency generator with additional generation capacity. Additional new capacity will include the installation of an additional 435 kW of solar PV and 550 kW of dual fuel (ADG and natural gas) reciprocating engine CHP. Heat recovery through a small and scalable district energy system will immediately offset the IAWWTF’s natural gas purchases and may serve a neighboring new development during later phases of the project. The total generation proposed to be active in the microgrid is 2,003 kW, which excludes emergency generation at the high school and the DPW. The proposed microgrid operation does not require the existing non-parallel emergency generators at the high school or DPW because the coincident load for all facilities within the microgrid is only 1,453 kW. New generation as part of this project totals 985 kW, of which 550 kW is dispatchable and the remaining 435 kW is subject to solar radiation. The new generation, plus the existing microturbines and emergency generator at the IAWWTF provide 1,560 KW of dispatchable generation to serve the microgrid loads.

The control and protection system will allow for flexible dispatch to accommodate economic operation during grid normal conditions and to comply with all applicable NYSEG interconnect requirements. NYSEG’s existing distribution system will be utilized to export power during times when generation exceeds loads. It is anticipated that approximately 50% (2,500 MWh) of the total new generation capacity will be exported into NYSEG’s system on an annual basis under normal grid conditions. Under emergency grid conditions, the electrical distribution system will be reconfigured by NYSEG under standard operating procedures to provide power to the loads on circuits 783 and 784 as listed in Table 1 above.

There are notable critical facilities in the microgrid which provide crucial services to the community. The IAWWTF provides water treatment for 40,000 residents; Ithaca High School will serve as a large scale place of refuge; the TCAT provides mass transportation services; the DPW provides critical infrastructure services to the city. The proposed microgrid will provide 100% power to these facilities during electric utility outages.
3.2. NED Future Loads

The area between the IAWWTF and the waterfront is expected to be redeveloped into a variety of mixed use facilities. Due to the unknown nature of the development cycle and ultimate end use typology, this study makes two assumptions relative to the deployment scenarios for the NED microgrid. The first assumption is that additional electrical and thermal load will be added to the area, above what is already being supplied by NYSEG to the existing facilities. The next assumption is that the heating loads of the new facilities could be served by thermal energy from the microgrid and are assumed to materialize in the out years of the initial operation of the microgrid. Based on a cursory review of publicly available information pertaining to the waterfront redevelopment, SourceOne has determined that a range of 6,000 to 14,000 square feet of commercial space with up to 130 residential units and the potential for a new 124 room hotel are slated to be developed right next to the IAWWTF.

It is recommended that additional evaluation be conducted as soon as details on end use typology and square footage become available. SourceOne recommends that new developments tie into the microgrid electrical or thermal distribution network. This will allow the energy requirements of the development to be cost effectively served through a scaled approach to CHP and district energy while allowing the microgrid project to move forward.

The following figure illustrates some proposed concepts for the new development. Note the grey building in the top right corner of each figure is the IAWWTF.

![Figure 3: Proposed New Development Concepts](image)
3.3. Residential Engagement in Microgrid

The proposed concept of utilizing NYSEG’s existing distribution system as part of the microgrid presents both opportunities and challenges with respect to the residential loads that are fed from feeder 784. In the event this project moves forward, NYSEG could potentially reach out to these customers and engage them with smart grid initiatives under the current REV construct in a way that links their participation in the microgrid. Although the details of this are beyond the scope of this project, SourceOne recognizes the importance of garnering the support of the City residents that will be impacted by the proposed microgrid and how that support ties into other NYSEG initiatives such as their Community Energy Coordination project. Based on a public property records, a preliminary list of property owners whose facilities/homes may be fed off the 784 feeder and associated microgrid can be found in Appendix G: Property Owners Included in Microgrid. The list of property owners was compiled from publically available information made available through Tompkins County GIS Division.

3.4. Minimum Required Capabilities (NYSERDA Task 1.1)

The microgrid will incorporate the minimum required capabilities, as called for under Task 1.1 of NYSERDA’s NY Prize requirements document Attachment C: Scope of Work.

3.4.1. Microgrid Fuel

The proposed prime movers will be primarily fueled by anaerobic digester gas with natural gas as a backup in the event of a process interruption. The production of biogas will remain operational during an electric utility grid emergency as the existing 750-kW emergency diesel generator and the existing microturbine-based CHP system are configured to provide power and heat to support the anaerobic digestion process. Although trucked in fats, oils, grease (FOG) and other organic matter may be disrupted in the event of a natural disaster, the gravity fed influent portion of the waste water treatment facility will provide adequate supply to the digesters to sustain the methane production process. Specific quantities of methane production during a natural disaster will need to be determined during the design development phase of the project and incorporated into operational and contingency planning protocols.

In addition to anaerobic digester methane production, a significant fuel supply depot is located only 1,500 feet from the IAWWTF and could serve as a primary supply source for the diesel generators in the event of a prolonged digester fuel interruption.

3.4.2. Microgrid Generation Technology

Proposed generation includes microturbine CHP, reciprocating engine CHP, power only emergency generators, and solar PV. All generating assets will be capable of providing power in both grid-connected and island modes of operation. The proposed reciprocating engines will be black start capable. The existing 750-kW diesel emergency
generator is currently operated via an automatic transfer switch (ATS). The microturbine system has an induction generator and requires utility voltage to operate as is not a synchronous machine. The proposed system will reconfigure the microturbine system to allow for black start capability, adding to the reliability of the treatment plant and the facilities served by the microgrid. NYSEG’s distribution will be modified to include switching on certain feeders during a macrogrid outage. All switching equipment on NYSEG’s system would be specified, installed, owned, operated, and maintained by NYSEG in accordance with their standard operating procedures.

3.4.3. Islanding Capabilities

The new generation will be capable of forming an intentional island (i.e. the microgrid) in the event of an electric utility outage and at a minimum be capable of self-supplying 100% of its energy requirements. Switching between the microgrid and the normal utility supply will be a manual, coordinated effort between NYSEG and IAWWTF staff.

3.4.4. Maintenance and Reliability

All of the equipment proposed as part of the microgrid will comply with manufacturers’ requirements for scheduled maintenance intervals so as to maintain reliability and to uphold the financial performance of the project. The proposed system includes 435 kW of solar PV. However, this capacity is not required to meet the peak load of the microgrid, making the system that much more reliable because all generation is dispatchable. Under normal conditions, the PV system will be paired with the dispatchable generation resources to allow 24/7 use of the power produced by these resources.

3.4.5. Generator Control and Protection

All rotating machines and any PV arrays will be capable of maintaining voltage and frequency while connected to the grid and maintain all standards in accordance with ANSI c84-1 while operating in island mode.

Pending additional information and collaboration with NYSEG, the most applicable communication system will be adopted for the control and protection of the microgrid, especially the portions that will be owned and operated by NYSEG. It is anticipated that NYSEG will have full view and control of the generating assets on the microgrid. Refer to Section 4.2 Microgrid for further details on the operations, control, and protection.

3.5. Preferred Capabilities (NYSERDA Task 1.2)

3.5.1. Control Systems

The control system will include an active network control system that optimizes demand, supply, and other network operation functions within the microgrid. Sufficient
metering and or other SCADA will be part of the system such that load and generation can be monitored and/or controlled to allow for the most effective dispatch of supply and demand during both grid normal and grid emergency operations. The project will utilize an existing microgrid controller solution offered by Schweitzer, ABB, GE, or other manufacturer that is able to meet the project requirements.

3.5.2. **Energy Efficiency**

Energy efficiency options to minimize new microgrid generation requirements will be reviewed during design development of the project. IAWWTF has recently implemented a wide range of demand side projects to reduce their electrical load. As part of the next phase of development, all facilities proposed to be connected to the microgrid should take necessary action to fully qualify and quantify all cost effective demand side projects. This will simultaneously improve the microgrid’s financial position while supporting the right-sizing of the generating assets within microgrid. The facilities should utilize all applicable NYERDA programs and resources in their efforts to identify and optimize demand side solutions.

3.5.3. **Coordination with REV**

The project will coordinate with the Reforming the Energy Vision (REV) work to provide a platform for the delivery of innovative services to end use customers. This project can benefit from the fact that NYSEG is dedicating resources to Tompkins County through its existing Community Energy Demonstration project.

SourceOne intends to coordinate this project with NYSEG’s Ithaca region Energy Smart Community (ESC) project. The City may benefit from the various program elements planned by NYSEG, including a phased deployment of advanced Metering Infrastructure (AMI) and increased Distribution Automation (DA). According to NYSEG’s May 20, 2015 testimony on the Reforming the Energy Vision, the program elements, whose budget is estimated at $15.5 million involve Integrated System Planning, Grid Automation and Communications, Volt/VAR Optimization, Customer Research and Engagement, Customer Communications Platform, Customer Web Portal, and Joint Partnership Development. The ESC Project is described in more detail in NYSEG’s May 20, 2015 testimony on the Reforming the Energy Vision Panel.

In addition to coordinating with the ongoing REV work that NYSEG is performing, the project could benefit from a change in the net metering definition for waste water biogas generation. This would allow the new biogas generators to qualify as part of the recent REV work whereby the utilities are now offering a Community Distributed Operating Agreement. According to NYSEG’s Community Distributed Generation Operating Agreement, a CDG Host is a non-residential customer who owns or operates electric generating equipment eligible for net metering under New York Public Service.
Law § 66-j or 66-l and whose net energy produced by its generating equipment is applied to accounts of other electric customers (“CDG Satellites”) with which it has a contractual arrangement related to the disposition of net metering credits.

It is recommended to closely monitor net metering legislation to determine how the proposed digester gas CHP and PV generation (i.e. Microgrid Host Plant) might qualify as a net metered facility. In the event the Microgrid Host Plant is unable to qualify as a net metered facility through the Community Distributed Generation Operating Agreement and underlying Community Distributed Generation Tariff, the net output of the plant will then be sold through NYSEG’s existing Buy Back Tariff Rate, which is represented as the wholesale power cost for NYISO Zone C.

3.5.4. **Comprehensive Benefit Cost Analysis**

SourceOne has developed a comprehensive benefit cost analysis that includes, but is not limited to, the community, utility and developer’s perspective. Section 5: Assessment of Commercial and Financial Feasibility (NYSERDA Task 3), Appendix C, and Appendix D provide the results of project financial analysis using commodity forecasts developed by SourceOne and as well as those provided by NYSERDA a part of their benefit cost test.

3.5.5. **Clean Power**

To minimize its environmental impact the microgrid will utilize both solar PV as well as anaerobic digester gas generated from waste created by the community. The combination of these generating sources provides a unique opportunity to provide a resilient and reliable microgrid with low carbon sources and potentially create a one of a kind carbon neutral microgrid.

3.5.6. **Community Benefits**

Tangible community benefits, including redirecting a significant amount of food waste from local landfills and the associated delivery/hauling jobs which will be created as part of this project. Ithaca will also become one of the few net zero waste water treatment facilities in the country and stands the chance of being a role model for other facilities looking to create a clean powered microgrid.

Additional community benefits could be created by integrating microgrid participants with NYSEG programs such as peak load relief and system load reduction programs that are being evaluated as part of REV. Additional PV could also be installed on microgrid participant rooftops.

Ithaca is an intellectual hub and an environmentally progressive community. This community will have the energy and academic resources to fully optimize this
installation and to optimize the information transfer necessary for replication in other
communities. After speaking with several professor and program leaders, they stated
that this community microgrid would be integrated into the sustainable energy
academic programs at Cornell University and Ithaca College. Ithaca has significant
interest for a community based solar farm whereby local residents, who do not have
space for Solar PV arrays, can support renewable energy through their utility bills. The
concept of a community solar farm would allow participants to better realize the benefit
of the renewable energy resource they are supporting and own a tangible asset.
4. PRELIMINARY TECHNICAL DESIGN COSTS AND CONFIGURATION (NYSERDA TASK 2)

4.1. Project Siting Considerations

The map below shows possible locations for the new biogas CHP plant and PV array as well as the new tie line (green) which connects the existing NYSEG distribution circuits to enable the microgrid during a macrogrid outage. Due to the preliminary nature of the project, these areas are shown for scale and concept only. Project stakeholders have identified other available parcels around the IAWWTF that could be used for the new biogas CHP plant, all of which will be identified during subsequent phases of development.

![Figure 4: Project Site General Arrangement](image)

4.2. Microgrid Infrastructure and Operations (NYSERDA Task 2.1)

4.2.1. Existing NYSEG Distribution System Description

The IAWWTF is supplied electricity via the 784 distribution feeder which originates at NYSEG’s Fourth Street Substation and operates at a nominal voltage of 8.3 kV. With the exception of several non-critical commercial facilities near the IAWWTF, the 784 feeder serves mostly residential customers within the eastern portion of Fall Creek neighborhood.

In addition to the 784 feeder, NYSEG’s 783 feeder also clips the northeast corner of the property occupied by the IAWWTF. Also originating from the Fourth Street Substation to the south, the 783 feeder follows the western bank of the Cascadilla Creek, crossing over N. Meadow Street (NY-13) and the Norfolk Southern Railroad before entering the property near the Cayuga Waterfront Trail. The parcel is city-owned, providing easy
access to a potential extension of the 783 feeder. An overview of the locations of the 783 and 784 feeders relative to the IAWWTF are shown in Figure 5. A broader area overview can be found in Appendix A: Project Development Maps and Appendix B: Project Conceptual Design Drawings.

![Figure 5: IAWWTF Area Feeder Locations (Existing)](image)

The 783 feeder continues north and east of the Cascadilla Creek and serves the key facilities that are shown in Appendix A: Project Development Maps. Of key interest is Ithaca High School to the proposed microgrid as it will be capable of operating with full power during an emergency or disaster event. The other facilities were specifically selected because they are along the route between the IAWTTF and include critical public services. The total coincident peak load of these facilities is estimated to be less than 1,500 kW.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Classification</th>
<th>Critical</th>
<th>Peak Load (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ithaca Area Waste Water Treatment Facility</td>
<td>Public</td>
<td>Yes</td>
<td>778</td>
</tr>
<tr>
<td>Ithaca High School and Administration</td>
<td>Public</td>
<td>Yes</td>
<td>575</td>
</tr>
<tr>
<td>Tompkins Consolidated Area Transit</td>
<td>Public</td>
<td>Yes</td>
<td>174</td>
</tr>
<tr>
<td>the City Department of Public Works</td>
<td>Public</td>
<td>Yes</td>
<td>78</td>
</tr>
<tr>
<td>Johnson Boatyard</td>
<td>Commercial</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Newman Municipal Golf Course Clubhouse</td>
<td>Public</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Finger Lakes Boating Center</td>
<td>Commercial</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Hydroponic Shops of America</td>
<td>Commercial</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Municipal Pumping Stations</td>
<td>Industrial</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Church of Christ</td>
<td>Religious</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Residential (40 homes estimated)</td>
<td>Residential</td>
<td>No</td>
<td>200 (Est.)</td>
</tr>
<tr>
<td><strong>Coincident Peak Load: 1,453 kW</strong></td>
<td></td>
<td></td>
<td><strong>Sum of Peak Loads: 1,805 kW</strong></td>
</tr>
</tbody>
</table>

Table 5: Key Facilities Served by NYSEG 783 Feeder
4.2.2. Ithaca Area Wastewater Treatment Facility Electrical Systems

Electricity from NYSEG’s 784 feeder is stepped down from 8.3 kV to 480/277 V by one 2,500 KVA transformer at the plant’s outdoor unit substation. The main bus distributes power to the plant at 480/277 V. A single line diagram of this arrangement can be found in Appendix B: Project Conceptual Design Drawings. The IAWWTF has multiple types of existing generation. Note that as currently configured, the emergency generator at the IAWWTF is never connected in parallel with the utility. A summary of both existing and proposed generation is shown below.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Type</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>Proposed ADG Recip CHP</td>
<td>550 kW</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>Proposed Solar PV</td>
<td>435 kW</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>Existing Diesel E-Gen</td>
<td>750 kW</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>Existing ADG Microturbine CHP</td>
<td>260 kW</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>Existing Solar PV</td>
<td>7.5 kW</td>
</tr>
<tr>
<td>Public Works Facility</td>
<td>Existing Diesel E-Gen</td>
<td>150 kW</td>
</tr>
<tr>
<td>Ithaca High School</td>
<td>Existing Diesel E-Gen</td>
<td>300 kW</td>
</tr>
<tr>
<td><strong>Total Generating Capacity</strong></td>
<td></td>
<td><strong>2,453 kW</strong></td>
</tr>
</tbody>
</table>

Table 6: Existing and Proposed Generation within Microgrid

4.2.3. Required NYSEG Distribution System Modifications

Based on the critical loads served by the 783 feeder and its close proximity to the IAWWTF, there is an opportunity to extend the 783 feeder to the IAWWTF and use a portion of the feeder as a microgrid in the event of an extended utility interruption. By extending the feeder and installing new load-break switches in key locations, the most critical portion of the feeder could be isolated and repurposed for the microgrid.

Figure 6 depicts (in red) this proposed line extension. The feeder would be extended for approximately 500 feet on an overhead pole line on the IAWWTF property to the existing outdoor unit substation.
Figure 6: Proposed Extension of NYSEG 783 Feeder

Two new load-break switches would need to be installed on the 783 distribution feeder at the following locations:

- North Cayuga Street at a location just north of the tap to Ithaca High School
- N. Meadow Street (NY-13) at Cascadilla Creek crossing

The locations can be seen graphically in the map in Appendix A: Project Development Maps and the feeder main line diagram in Appendix B: Project Conceptual Design Drawings. Due to standard operating procedures and in an effort to reduce cost, SourceOne recommends that the new switches be manual, non-SCADA-controlled devices. More information on this rationale can be found in Section 4.3.2. Additionally, for ease of operation, SourceOne recommends the installation of fault indicators at each load-break location.

When the load-break switches are open and the microgrid is isolated, the IAWWTF could be transferred to the 783 feeder and distribute electricity on the isolated section of the feeder. This would serve the loads noted in Table 4 along Willow Avenue, Pier Road, W. York Street, and N. Cayuga Street. It is estimated that the total peak load for this area would be 1,453 kW including the IAWWTF.

Because the upgrades needed to facilitate a microgrid are limited in scope, the capital cost is expected to be minimal. However, because the IAWWTF will likely export power on its normal feeder on a regular basis, SourceOne has also added costs that will likely be associated with such an interconnection. Table 7 summarizes the estimated capital costs for NYSEG distribution system upgrades.
### Required IAWWTF Electric System Modifications

Most of the required electrical work needed to establish the microgrid will be at the existing service to the IAWWTF. The existing 8.3-kV service line will need to be tapped before the existing transformer and fed to a new 15-kV switchgear line up. The new switchgear will act as a collector bus for all new generation and will allow for back-feeding on to the 783 feeder during microgrid operation. To interconnect to the 783 feeder, a new transformer is also required. Refer to Appendix B: Project Conceptual Design Drawings for the proposed single line diagram.

To facilitate the transition to microgrid mode, when required, SourceOne recommends that the switchgear is designed and constructed to NYSEG standards for customer-owned substations. NYSEG will have exclusive control of the two breakers on the incoming 783 and 784 feeders and will also need to install primary metering within the switchgear. This will allow NYSEG personnel to activate the microgrid with the support of IAWWTF staff.

An estimate for the required equipment (including labor) is shown in Table 8.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-kV Switchgear with 6 Breakers</td>
<td>$300,000</td>
</tr>
<tr>
<td>3000 KVA Transformer</td>
<td>$70,000</td>
</tr>
<tr>
<td>15-kV Cabling and Terminations</td>
<td>$7,500</td>
</tr>
<tr>
<td>Microgrid Controller</td>
<td>$10,000</td>
</tr>
<tr>
<td>Metering</td>
<td>$10,000</td>
</tr>
<tr>
<td>Engineering and Overhead</td>
<td>$79,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$477,000</strong></td>
</tr>
</tbody>
</table>

Table 8: Estimated Capital Cost of IAWWTF Distribution System Upgrades

### Microgrid Operations

#### Normal Operation

Under normal conditions, there will be no microgrid in operation, that is to say the CHP and PV systems will operate in parallel with the grid. NYSEG will continue to supply the
IAWTF on the 784 feeder and all of the aforementioned critical loads on the 783 feeder. NYSEG has indicated a peak load of 1.44 MW on the 783 and 1.77 MW on the 784 feeder. The IAWTF will operate approximately 443 kW of photovoltaic, 260 kW of microturbine, and 550 kW of biogas-powered engines to offset their electrical use. During periods where generation exceeds the facility’s load, power will be exported on to the 784 feeder. At no time during normal operation will the existing emergency generation be placed in parallel with the 784 feeder. The existing 750-kW emergency generator will be modified to provide black start and synchronizing support for the microgrid. It will also be modified so it can be placed in parallel with the microgrid to contribute, along with the other generators to serve the load of the microgrid during a macrogrid outage.

4.3.2. Emergency Operation

For purposes of this microgrid, an “emergency” can be defined as an event that interrupts the NYSEG 783 feeder for an extended period of time without local feeder damage (e.g. substation issue or loss of transmission supply). In this situation, after evaluating the outage, the NYSEG control center and the IAWWTF would need to mutually agree to activate the microgrid.

Upon agreement, the following steps would be taken to bring the microgrid online:

1) NYSEG will dispatch a trouble man, line crew, or supervisor to survey the 783 feeder to ensure that no damage or faults exist on the feeder. This process may be accelerated by observing fault indicators on the line.

2) After determining that the feeder is clear to energize, NYSEG crews will commence switching on the feeder to isolate the microgrid. This will require crews to open and tag the load-break switches at the following locations:
   - N. Cayuga Street at a location just north of Ithaca High School (new switch)
   - N. Meadow Street (NY-13) at Cascadilla Creek crossing (new switch)
   - N. Cayuga Street at W. York Street (existing 785 tie point)

3) At the new switchgear at the IAWWTF, NYSEG will:
   - Check open the 783 feeder breaker.
   - Open, check open, and lock open the 784 feeder breaker.

4) This will de-energize the IAWWTF. All existing PV, biogas, and microturbine generation will be automatically tripped. The on-site emergency generator will start, and the facility will automatically be transferred to the back-up generator.

5) IAWWTF staff will activate microgrid operation at the switchgear using the proposed microgrid controller. The controller will start the biogas reciprocating
engines and sync them to the main bus that will already be energized by the back-up generator.

6) When the IAWWTF is ready to accept load, the plant staff will notify NYSEG that they are ready to energize the microgrid.

7) At the IAWWTF switchgear, NYSEG will close the 783 feeder breaker. For protection purposes, the 783 feeder breaker will be interlocked with the 784 feeder breaker to ensure that both breakers cannot be closed simultaneously. In addition, when microgrid mode is activated, the 783 feeder breaker will be unable to close if the upstream 783 feeder is energized.

8) At this point, the microgrid will be energized and the generation at the IAWWTF will control voltage and frequency within parameters to be determined by NYSEG. This will ensure that no customers on NYSEG’s system within the microgrid will experience power quality problems.

9) The existing emergency generators at Ithaca High School and DPW will not require modification and will continue to operate according to their existing configuration. Furthermore, the existing ATS systems should not be able to discriminate between microgrid and utility supplied power and therefore will remain in service as currently configured.

When returning back to normal operation, these steps will essentially be taken in reverse. The IAWWTF will stop generating and return to its normal feed through a break-before-make switching operation. Likewise, NYSEG will restore the 783 feeder to its normal configuration.

4.3.3. Control and Protection Considerations

With additional generation at the IAWWTF, a short-circuit and protection coordination study will need to be performed to ensure that the available fault current will not exceed the fault duty rating of NYSEG’s distribution equipment. NYSEG will also need to specify the protection settings for the 783 breaker at the IAWWTF because it is the exclusive protection of their equipment during a microgrid event.

Considerations will also need to be made for distribution line control protection. Within the microgrid area, there is limited existing feeder control and protection. There are no capacitor banks, voltage regulators, reclosers, fused taps, or other downstream protection for the distribution line. Individual transformers are fused with cutouts. The size of these fuses should be evaluated to ensure compatibility with both normal operation and microgrid operation. If available fault current during microgrid operation is calculated to be extraordinarily high, current-limiting fuses may be considered as a mitigating solution.
4.4. **Load Characterization (NYSERDA Task 2.2)**

SourceOne obtained energy consumption data from a variety of sources for each of the facilities contemplated as part of the microgrid. Data resolution ranges from hourly to monthly and has been provided from either the facility itself or through NYSEG by way of a letter of authorization executed between SourceOne and the end customer.

Curve fit techniques were applied to monthly data to combine with metered hourly data to create an 8,760 hourly model for the electrical and thermal consumption of facilities in the microgrid. The figure below shows the hourly electric and thermal load profiles for the combined hourly interval data for each facility within the microgrid.

![Figure 7: Microgrid Energy Profile](image)

Appendix F: Facility Energy Profiles presents load profile summaries for the microgrid facilities. Unlike the plot above, these profile summaries are for each facility and include monthly, annual hourly and load duration curves for both electric and thermal loads. Summary statistics such as load factors and peak values are provided, utility account meters and account numbers where available and the reference source for the consumption data.

4.5. **Distributed Energy Resources Characterization (NYSERDA Task 2.3)**

4.5.1. **Anaerobic Digester Gas Combined Heat and Power Deployments**

A cursory review of the historical monthly performance data for the existing microturbine CHP system reveals the average heat rate of the system in 2014 was 14,168 BTU/kWh. A reciprocating engine in the size range for this application has an average heat rate of 8,200 BTU/kWh, a 42% improvement over the microturbine. The
existing electric and thermal loads, natural gas and electricity prices, physical location of the interconnects, and dual fuel capability proved that the reciprocating engine presents a higher value to this project and as such is the prime mover technology of choice. Further information pertaining to the value of electric generation versus recoverable heat is presented in Section 5: Assessment of Commercial and Financial Feasibility (NYSERDA Task 3).

To identify the most economically feasible deployment configuration, SourceOne investigated the impact that different site locations, recovered heat utilization, and tariff changes have on the net present value of the project. The following are brief descriptions of the five different deployment scenarios that were evaluated. The table in Appendix C: Technical, Financial & Operational Summary provides a summary of key performance and cost metrics for each of these scenarios. Note that each scenario includes the utilization of the existing PV array as well as the existing four 65-kW microturbines currently in operation at the IAWWTF. It is also important to note that all ADG, associated feedstock handling, tank and process expansion as well as required gas conditioning will be the responsibility of IAWWTF. The IAWWTF will provide ADG at the quality and pressure required by the reciprocating engines. It is also assumed that all available ADG will be used for generating electricity for the microgrid.

Scenario 1 – This option calls for the deployment of a single 550-kW dual fuel, natural gas and ADG-powered reciprocating engine at the IAWWTF without heat recovery. The biogas will be generated by the anaerobic digesters at the IAWWTF. The generation will be used to offset existing NYSEG-supplied power at the retail rate. The balance of generation, if any, will be exported at the wholesale rate through NYSEG Service Classification 10, buy back agreement. No waste heat will be recovered in this electric-only configuration.

Appendix C: Technical, Financial & Operational Summary summarizes the key metrics for this scenario and the indicative proforma for this scenario is located in Appendix D: Indicative Project Proformas.

Scenario 2 – This option calls for the deployment of a single 550-kW dual fuel, natural gas and ADG-powered reciprocating engine at the IAWWTF. The biogas will be generated by the anaerobic digesters at the IAWWTF. The generation will be used to offset existing NYSEG-supplied power at the retail rate. The balance of generation, if any, will be exported at the wholesale rate through NYSEG Service Classification 10, buy back agreement. The available recoverable heat will be used to generate hot water to serve loads at the IAWWTF as well as at Ithaca High School. To serve the loads at the high school, a new two-pipe low-enthalpy hot water district energy system will be
installed. The estimated distance between the IAWWTF and the High School is 1,700 feet.

Appendix C: Technical, Financial & Operational Summary summarizes the key metrics for this scenario and the indicative proforma for this scenario is located in Appendix D: Indicative Project Proformas.

**Scenario 3** – This option calls for the deployment of a single 550-kW dual fuel, natural gas and ADG-powered reciprocating engine at the Ithaca High School and Administration building complex. The biogas will be generated by the anaerobic digesters at the IAWWTF and supplied to the high school via polyethylene SDR-10 piping routed from the IAWWTF to the high school (1,700 feet). The generation will be used to offset existing NYSEG-supplied power at the retail rate. The balance of generation, if any, will be exported at the wholesale rate through NYSEG Service Classification 10, buy back agreement. The recoverable heat will be captured to generate hot water which will serve the thermal loads at the High School.

Appendix C: Technical, Financial & Operational Summary summarizes the key metrics for this scenario and the indicative proforma for this scenario is located in Appendix D: Indicative Project Proformas.

**Scenario 4** – This option is the preferred microgrid configuration and consists of the deployment of a single 550-kW dual fuel, natural gas and ADG-powered reciprocating engine at the IAWWTF. The biogas will be generated by the anaerobic digesters at the IAWWTF. The generation will be used to offset existing NYSEG-supplied power at the retail rate. The balance of generation, if any, will be exported at the wholesale rate through NYSEG Service Classification 10, buy back agreement. The available recoverable heat will be captured to generate hot water which will be used to serve thermal loads at both the IAWWTF and any development at the nearby waterfront properties. Although heat loads are expected to develop in Year Six of the project, heat recovery can be immediately used at the IAWWTF. To serve the thermal load at the nearby waterfront properties, a new two-pipe low-enthalpy hot water district energy system will be installed in Year Five of the project, from the IAWWTF to the development (500 feet).

Appendix C: Technical, Financial & Operational Summary summarizes the key metrics for this scenario and the indicative proforma for this scenario is located in Appendix D: Indicative Project Proformas.

**Scenario 5** – This option calls for the deployment of a single 550-kW dual fuel, natural gas and ADG-powered reciprocating engine at the IAWWTF. The biogas will be supplied by the anaerobic digesters at the IAWWTF. The generation will be used to offset existing NYSEG-supplied power at the retail rate. The balance of generation, if any, is assumed to
qualify as net metered generation and will therefore be exported at the retail rate through the community DG tariff or other, as agreed to by NYSEG. The available recoverable heat will be captured to generate hot water which will be used to serve thermal loads at both the IAWWTF and any development at the nearby waterfront properties. To serve the thermal load at the nearby waterfront properties, a new two-pipe low-enthalpy hot water district energy system will be installed from the IAWWTF to the development (500 feet).

Appendix C: Technical, Financial & Operational Summary summarizes the key metrics for this scenario and the indicative proforma for this scenario is located in Appendix D: Indicative Project Proformas.

4.5.2. Photovoltaic Array

The proposed PV array will be a ground mounted array with a total nominal capacity of 435 kW. Sited on the grounds at the IAWWTF, preliminary estimates indicate that the proposed system will cost $1.4 million and generate an estimated 565 MWh/yr. This proposed installation of PV capacity will be in addition to the existing 7.5 kW rooftop mounted PV array already in operation at the IAWWTF. The proposed array will operate on either a solar net metered tariff, the community DG tariff or other as agreed to by NYSEG and thus will export power at a retail rate.

To serve as a compliment to the PV array, energy storage in the form of batteries was also investigated. Both an 800 kWh (100 kW peak) lithium ion (LiO) and 1600 kWh (200 kW peak) LiO battery options were considered with prices being estimated at $644/kWh and $597/kWh, respectively. At these prices, SourceOne was unable to find a revenue stream that would make the addition of energy storage to the microgrid a financially viable option. It is forecasted that prices for these installations will continue to drop, and REV models currently being evaluated may provide a compensation mechanism for ancillary services and storage capacity in the near future. As such consideration for installation in the future is recommended.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Size</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Photovoltaic Array, ground mount</td>
<td>430 kW</td>
<td>IAWWTF Grounds</td>
</tr>
<tr>
<td>Existing Photovoltaic Array, roof mount</td>
<td>7.5 kW</td>
<td>IAWWTF Roof</td>
</tr>
<tr>
<td>Total</td>
<td>437.5 kW</td>
<td>IAWWTF</td>
</tr>
</tbody>
</table>

Table 9 - Photovoltaic Array Summary

4.5.3. Existing and Proposed Emergency Generators

Three of the facilities intended to be included in the microgrid currently have emergency generators. As currently configured, these generators are standby generators which utilize an automatic transfer switch to select between emergency
generator power and utility supplied power. Although these existing backup generators play a critical role in safeguarding against utility outages, the proposed microgrid will provide all facilities with 100% power during macrogrid outages without utilizing any of the existing emergency generators in the microgrid, with the exception of the 750 KW unit at the IAWWTF. This unit will serve as the black-start generator which will allow the synchronization of all other generators to the microgrid during a macrogrid outage.

<table>
<thead>
<tr>
<th>Location</th>
<th>Size</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School</td>
<td>300 kW</td>
<td>Diesel</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>750 kW</td>
<td>Diesel</td>
</tr>
<tr>
<td>Department Public Works</td>
<td>150 kW</td>
<td>Nat. Gas</td>
</tr>
</tbody>
</table>

Table 10: Existing Emergency Generation Summary

It should be noted that if additional capacity is required, the generators at the High School and DPW could be converted into paralleling generators and controlled via the Microgrid controller. As mentioned above, this is not necessary as the peak load in the microgrid can be met without them.

4.5.4. Microgrid Thermal Energy Operations

The proposed microgrid incorporates a straightforward combined heat and power system with recoverable heat distributed to IAWWTF and the neighboring new development. SourceOne evaluated local thermal loads in an attempt to find a steady and reliable thermal host for the recovered heat. The heat recovered from the generation proposed at the IAWWTF is greater than the current thermal load at the IAWWTF. Therefore an offsite thermal host is needed. The IAWWTF can use approximately 60% of the recovered heat, with the balance either being dumped to the atmosphere or delivered to an end user. As presented in Scenario 3, low temperature hot water could be delivered to the high school. However, given the relatively low cost of natural gas and the considerable investment required, SourceOne determined this to be cost prohibitive. The most feasible approach is to use recovered heat to offset natural gas loads at the IAWWTF while planning to deliver the remaining 40% of useful heat to future neighboring loads as presented in Scenario 4.

4.5.5. Microgrid Fuel Supply

The existing anaerobic digester has approximately one day of biogas storage based on the current energy loads of the process, inclusive of heating and microturbine operation. The proposed anaerobic digester expansion will increase onsite biogas storage to approximately two days. In addition to this short term biogas storage, there is an existing 2,000 gallon diesel storage tank that is dedicated to the existing 750-kW emergency generator. Assuming a sustained plant load at 90% of the rated capacity of
the generator, or 675 kW, the existing diesel storage can support approximately 37 hours of operation. This is an adequate amount of time based on the fact that there is a significant fuel depot within walking distance of the IAWWTF and the proposed reciprocating engines as well as the existing microturbines can be run on natural gas.

4.6. Electrical and Thermal Infrastructure Characterization (NYSERDA Task 2.4)

The proposed system will be capable of full operation during grid outages that are either caused by natural phenomenon (e.g. storm, animal activity, etc.) or human related interruptions (e.g. operator error, terrorism, vandalism, general equipment/infrastructure failures, etc.). One must also consider the level of redundancy incorporated into the project design and the level of confidence in the operator of the generating assets. Leaving generator outages aside, any of the aforementioned events could occur on the NYSEG owned distribution system that is part of the microgrid, specifically the 784 or 783 feeders. However, based on past reliability, it is less likely that any of the facilities proposed to be connected to microgrid experience a power interruption.

The NYPSC evaluates electric reliability using two metrics, the System Average Interruption Frequency Index (SAIFI) and the Customer Average Interruption Duration Index (CAIDI). SAIFI is a measurement of the number of customers interrupted over the total customer base, and CAIDI is a measurement of the average duration of each interruption that customers experienced. Based on the data reported by NYSEG in their Annual Reliability Report filed with the NYPSC, the Fourth Street 783 and 784 feeders have had substantially fewer customer interruptions than the rest of the Ithaca area and the rest of the NYSEG system (Table 11).

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>5-Yr Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourth St. 783</td>
<td>2.03</td>
<td>0.10</td>
<td>1.02</td>
<td>0.05</td>
<td>0.01</td>
<td>0.64</td>
</tr>
<tr>
<td>Fourth St. 784</td>
<td>1.01</td>
<td>0.34</td>
<td>0.07</td>
<td>0.00</td>
<td>0.05</td>
<td>0.29</td>
</tr>
<tr>
<td>Ithaca Area</td>
<td>1.07</td>
<td>0.89</td>
<td>1.11</td>
<td>0.76</td>
<td>1.04</td>
<td>0.97</td>
</tr>
<tr>
<td>NYSEG System</td>
<td>1.14</td>
<td>1.20</td>
<td>0.98</td>
<td>1.09</td>
<td>1.03</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Table 11: NYSEG Reliability Statistics (SAIFI)

Likewise, when customers did an experience an interruption, power was restored more quickly than average on the NYSEG system. On average, under non-major storm conditions, power has been restored in less than two hours. However, during major storms, the 783 feeder has seen partial interruptions that have been over 24 hours in duration. However, these long interruptions only affected fused side-taps with a limited number of customers (<150 customers). Considering the proposed microgrid on the 783 does not include any fused side-taps, these interruptions should have no effect on the ability to activate the microgrid.

4 Excludes PSC Major Storms.
Thermal loads within the microgrid can be categorized as those associated with the heat recovery from new ADG CHP and those at each of the facilities that will be served by microgrid power in the event of an electric utility outage. The thermal loads associated with the anaerobic digester process are critical as proper temperature is required to produce biogas. Future loads at the waterfront, although important to maintain, will most likely be comfort heating based. All thermal loads, whether served directly or indirectly from recovered heat, will have natural gas as a redundant fuel.

4.7. **Microgrid and Building Controls Characterization (NYSERDA Task 2.5)**

The following excerpt taken from a recent report on NYSEG’s interconnection of distributed generation characterizes the anticipated protection, control, and communications systems for the proposed microgrid:

Systems larger than 250 kW automatically go through the Preliminary Technical Review and CESIR study process. The number of applications requiring a CESIR has also been increasing recently and, depending on volume, the 60 business-day time window to do a CESIR study can be challenging. The typical cost of a CESIR study is $3,000 to $5,000. NYSEG requires the installation of a reclosing device for all non-net-metered systems 250 kW and above. This device is capable of connection to the system’s supervisory control and data acquisition (SCADA) control system, enables revenue metering and can help with monitoring and control of multiple DG on the same distribution circuit. The specific purposes of the recloser device are:

- System Protection – the recloser will be programmed to operate in a traditional protection mode to isolate the utility system for faults beyond the recloser. Fuses in each phase cannot be used for protection as blown fuse(s) would allow for the solar electric system to be interconnected in a single phase causing overvoltage conditions.

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5 Excludes PSC Major Storms.
• Safety – the recloser will be SCADA-equipped to provide the local switching authority and the ability to isolate the generation from the utility system when needed either remotely or locally in the event of an emergency

• Operational Efficiency – the recloser will be SCADA equipped to provide the local switching authority the ability to switch the generator offline for non-normal circuit contingencies when needed either remotely or locally in the event of routine switching and operation of the utility system.

• Telemetry – various data measurements will be collected and transmitted via the SCADA system to track the generator individual system’s performance and its contribution to the overall performance of the distribution system. NYSEG uses a number of software tools to internally process and study interconnection applications, and human interaction with these tools is key to proper use. When CESIR studies are required, data needs to be pulled from several different databases to perform the evaluation, including GIS, SAP (for customer peak load), and an Access database (moving to Sequel database) where customer and application information and equipment ratings are stored. In addition, different tools are used for feeder analysis and load flow (CYME) and protection (Aspen One Liner). The NYSEG distribution system is documented except for the Rochester and Binghamton downtown networks. Even so, there are several human interfaces required to conduct the studies.6

4.7.1. Demand Response Opportunities

Water treatment facilities involve processes that are capable of being operated on a variable and or reduced basis while still remaining in compliance with applicable laws and regulations. Such processes may include dewatering operations, pumping, and aeration blowers. The ability to vary the electric loads of these processes may provide a host of benefits for the microgrid and the interconnecting utility. Participation in either formal NYSEG-sponsored demand response programs or a self-sponsored economic dispatch strategy may be beneficial in times where the locational and/or temporal market price signals suggest that a reduction and subsequent increase in onsite generation are cost effective. Additional evaluation of this strategy, along with a review

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6 “Interconnection of Distributed Generation in New York State: A Utility Readiness Assessment Final Report”, prepared for New York State Energy Research and Development Authority (NYSERDA) and New York State Department of Public Service (NYS DPS), prepared by: Electric Power Research Institute (EPRI). September 2015
of potential storage integration and ancillary service (frequency and voltage support) is
recommended as part of the next phase of development.

4.8. Information Technology (IT)/Telecommunications Infrastructure Characterization
(NYSERDA Task 2.6)

The microgrid will be equipped with adequate IT/Telecommunications Infrastructure (wide
area networks, access point, Ethernet switch, cables etc.) and protocols necessary to support
the safe and economical operation of all equipment in the microgrid. Specific IT and SCADA
design criteria will be determined during the next phase of project development and design
however for purposes of informing the project’s basis of design, the following criteria will be
included:

1. All communications and control systems necessary for the safe operation of equipment
connected to NYSEG’s distribution system will be able to operate in both grid normal and
grid emergency modes. Battery backup or otherwise will be included for seamless
transfer.

2. In the event of a complete power failure, last known state or otherwise will be programmed
into all control logic as to hold equipment in a safe operating condition.

3. Communication equipment protocol will be in accordance with NYSEG approved design
requirements and specifications.
5. **ASSESSMENT OF COMMERCIAL AND FINANCIAL FEASIBILITY (NYSERDA TASK 3)**

This section defines the project value proposition, microgrid customers, project team, commercial structures, development and delivery models, and a summary of the financial performance of the project.

A discussion surrounding commercial viability must begin by understanding the status quo. In this case, the status quo represents the existing commercial terms and conditions for electric and gas service from NYSEG as compared to the additional value that will be brought by the proposed microgrid.

5.1. **Energy Pricing and Forecasts**

5.1.1. **Existing Rate and Tariff Structure**

Table 13 shows a summary of the average 2015 electric and natural gas rates at the IAWWTF. The IAWWTF is currently on a NYSEG Time of Use rate for delivery and purchases power from a third party supplier. Natural gas is delivered by NYSEG through a non-residential aggregation rate and is also purchased through a third party supplier.

<table>
<thead>
<tr>
<th>Energy Product</th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYSEG Delivery</td>
<td>$0.03/kWh</td>
<td>$2.60/MMBTU</td>
</tr>
<tr>
<td>Third Party Supply</td>
<td>$0.06/kWh</td>
<td>$4.00/MMBTU</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$0.09/kWh</strong></td>
<td><strong>$6.60/MMBTU</strong></td>
</tr>
</tbody>
</table>

Table 13: Baseline Year Electric and Natural Gas Pricing

Through utility bill observation, it appears the IAWWTF is penalized for low power factor. SourceOne recommends further investigation during subsequent design efforts so that this power quality problem is not exacerbated with the expansion of on-site generation.

5.1.2. **Proposed Rate and Tariff Structure**

SourceOne has assumed the ADG CHP generation will be subject to a different tariff than the solar PV. Although this assumption is subject to final project agreements with NYSEG, as proposed, the generation at the IAWWTF will exceed the facility’s electricity needs on an annual basis. Based on the fact ADG CHP does not currently qualify as a net metered facility, any excess generation exported to NYSEG’s distribution system will fall under SC-10 – Non-Residential Distributed Generation Firm Sales Service. This is effectively the wholesale rate and is valued at NYISO’s Zone C day ahead and real time prices. SourceOne has forecasted $0.06/kWh as a representative value for the wholesale rate during the first year of the project.

New solar PV power may fall under NYSEG’s Solar Non-Residential Electric Service Option or the Community Distributed Generation tariff, whichever provides greater
value to the project. Final determination will be made when the project requests an interconnection agreement from NYSEG. SourceOne has reviewed the recent Community DG tariff and understands that 60% of the generator (i.e. PV) output needs to be allocated to loads that are less than 25 kW. Therefore the project may need to enter into contractual agreements with satellite loads and could be the foundation for a community based PV farm. These loads do not necessarily need to be within the microgrid but do need to be within NYSEG’s distribution territory.

Should the microgrid be approved to distribute power using NYSEG’s infrastructure the generator(s) should not be subject to standby rates. A similar clause is currently included in NYSEG’s Service Classification #11 (SC11) wherein it is stated that Standby Service is not applicable to emergency generators. Although the microgrid is not a dedicated emergency generator, by design, it will functionally operate as one during an electric utility outage.

5.1.3. Electric and Natural Gas Price Forecasts

To support comparisons between the two benefit costs tests presented in the study and to document the values driving the economic analysis of the project, two separate commodity forecasts are provided. The reason for the two forecasts is based on NYSERDA’s Task 1.2, which requests that the contractor take account of a comprehensive cost/benefit analysis that includes, but is not limited to, the community, utility, and developer’s perspective. The forecasts provided by NYSERDA do not represent the actual market conditions in Ithaca. As such, to represent the perspectives of the community, utility, and developer, SourceOne has developed a separate forecast.

For reference purposes these forecasts are presented below and in Appendix E: Commodity Forecasts.
5.2. Commercial Viability – Customers (NYSERDA Task 3.1)

5.2.1. Facility and Customer Impact

As presented in Table 1: Microgrid Load and Generation Summary, the customers in the microgrid are those located on the portion of NYSEG’s 783 and 784 feeders that will become energized during a macrogrid outage. During normal operations the energy from the new generating assets in the microgrid will serve the IAWWTF, aggregated solar net metered customers, and eventually thermal off-takers at the new waterfront development. The number of individuals affected by/associated with critical loads within the microgrid number in the tens of thousands as the IAWWTF, TCAT, and DPW provide services for the entire City and beyond. Specifically, Ithaca High School could serve upwards of two thousand community members when configured as a fully powered emergency shelter.

It should also be noted that the proposed microgrid may require an interruption of service to customers served by the microgrid during testing and commissioning. Close coordination with NYSEG is paramount for a successful implementation. Construction will primarily be contained to grounds on the IAWWTF and therefore will have minimum impact on the surrounding community.

5.2.2. Energy Sales and Contracts – Grid Normal

It is anticipated that the owner of the new generation and thermal distribution system will establish energy service agreements with thermal off-takers under normal operating conditions. In the event IAWWTF is the owner, they will account for the value of the
project through NYSEG’s tariff structures as previously discussed. As proposed, the owner of the generating asset, if other than IAWWTF could establish a back to back energy service agreement that mimics the IAWWTF’s existing NYSEG rate and third party supply costs. Additional electrical energy would be compensated at the NYSEG wholesale rate from the ADG CHP system and through a net metering agreement or community distributed generation tariff for the solar PV. These concepts and how they relate to the underlying NSYEG rates and tariffs are more fully presented in the commercial block diagram located in Appendix B: Project Conceptual Design Drawings. Proper revenue grade metering will be installed at each generator and as required at the points of interconnection with IAWWTF or NSYEG’s system to be used for billing and performance evaluation purposes.

5.2.3. Energy Sales and Contracts – Grid Emergency

It is anticipated that the owner of the new generation and thermal distribution system will establish energy service agreements that clearly define the availability of thermal energy during emergency (i.e. macrogrid outage) conditions. It is assumed that the project will have backup natural gas boiler capacity or the end users will have separate heating systems they can rely on should the proposed system be incapable of providing thermal energy during a macrogrid outage.

The energy service agreements could consider a cost sharing clause to cover the operational costs of the microgrid during a macrogrid outage. As further defined in Section 6: Benefit Cost Analysis (NYSERDA Task 4), there are costs associated with a macrogrid outage which need to be covered through rate design or by a per event assessment by the City or its designated authority. Proper revenue grade metering, along with system integration with existing NYSEG supplied meters, will be installed at each generator and as required at the points of interconnection with IAWWTF or NYSEG’s system to be used for billing and performance evaluation purposes.

5.3. Commercial Viability - Value Proposition (NYSERDA Task 3.2)

The value proposition of this microgrid is based on the unique combination of dispatchable low-carbon electric generation fueled by what would otherwise be considered waste, in an expanded bio-digestion process. Expanding existing bio-digestion, adding new PV, and recovering heat through a new district energy system creates a unique value to the community at large and, in particular, the microgrid customers. By introducing standard equipment and using industry-accepted operating procedures, the existing NYSEG-owned distribution system can be modified to increase reliability and provide 100% power to critical facilities in the event of a macrogrid outage. In particular, having Ithaca High School serve as a place of community
refuge and providing 100% power to the transportation center and Department of Public Works enhances the emergency preparedness of the City.

Due to the nature of the ADG-based generation coupled with solar PV, this microgrid will be by far one of the cleanest emergency backup systems in the area. Dispatchable and controllable reciprocating engines enhance the reliability and operability of the microgrid.

Aside from the benefits associated with converting food and other organic matter into useable fuel, the value of the converted energy products need be compared to existing or status quo supplied energy. The following analysis compares the value of converting the biogas produced through increased anaerobic digestion to either electricity or heat. Based on 2015 NYSEG electric and gas rates, the value of each delivered energy product, on a $/MMBTU basis is as follows.

<table>
<thead>
<tr>
<th>Item</th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Delivered Price (Traditional Units)</td>
<td>$0.09 / kWh</td>
<td>$6.61 / MMBTU</td>
</tr>
<tr>
<td>Current Delivered Price (Comparative Units)</td>
<td>$26.38 / MMBTU</td>
<td>$6.61 / MMBTU</td>
</tr>
<tr>
<td>Anaerobic Digester Gas Price</td>
<td>$4.04 / MMBTU</td>
<td></td>
</tr>
<tr>
<td>Conversion Efficiency: Separate Heat and Power</td>
<td>41%</td>
<td>85%</td>
</tr>
<tr>
<td>Resulting Finished Product Value</td>
<td>$11.59 / MMBTU</td>
<td>$5.59 / MMBTU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Energy Product Price</th>
<th>Market Implied Heat Rate</th>
<th>Proposed Generator Heat Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Electric Price</td>
<td>$0.09/kWh</td>
<td>$6.61/MMBTU</td>
<td>8,248 BTU/kWh</td>
</tr>
<tr>
<td>Total Natural Gas Price</td>
<td>$6.61/MMBTU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market Implied Heat Rate ($/kWh / $/MMBTU)</td>
<td>13,615 BTU/kWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of Electric Generation (Fuel Only, ADG @ $4.04/MMBTU)</td>
<td>$0.03/kWh</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14 - Biogas Conversion Value

Admittedly, this high level analysis does not take into account the required conversation and distribution costs to get the energy products to end users. However, it does provide a framework to determine the highest and best use of the ADG. Based on the table above, ADG converted into electricity is of higher value than if it were converted into heat.

When evaluating the feasibility of on-site electrical generation, the implied heat rate based on existing market prices can be compared to the proposed prime mover technology. Using the values presented in Table 13, the table below compares the market implied heat rate to the prime mover of the proposed ADG CHP system.

<table>
<thead>
<tr>
<th>Energy Product Price</th>
<th>Market Implied Heat Rate</th>
<th>Proposed Generator Heat Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Electric Price</td>
<td>$0.09/kWh</td>
<td>8,248 BTU/kWh</td>
</tr>
<tr>
<td>Total Natural Gas Price</td>
<td>$6.61/MMBTU</td>
<td></td>
</tr>
<tr>
<td>Market Implied Heat Rate ($/kWh / $/MMBTU)</td>
<td>13,615 BTU/kWh</td>
<td>8,248 BTU/kWh</td>
</tr>
<tr>
<td>Cost of Electric Generation (Fuel Only, ADG @ $4.04/MMBTU)</td>
<td>$0.03/kWh</td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Market Implied Heat Rate vs. Proposed Generation

Not only does the proposed generator have a heat rate 40% better than the market implied heat rate, the fuel being supplied to the generator costs less than the market price of natural
gas. Lower cost gas, via anaerobic digestion coupled with thermal heat recovery sales allows the project to be cost effective when compared to macrogrid power and utility supplied natural gas.

5.3.1. **Commercial Block Diagram**

The following commercial block diagram presents an overview of the energy streams and how they are valued throughout the project. The energy flow and tariffs are shown under normal operating conditions. It is assumed that no special tariffs will be required during emergency operation; however the project may wish to establish agreements with the facilities in the microgrid to establish a clear understanding of expectations during emergency mode of operations.

![Commercial Block Diagram](image)

**Figure 9: Commercial Block Diagram**

As discussed above in Section 4.5, the IAWWTF will be providing ADG to the project at the required pressure and quality for use in the proposed reciprocating engines. The project has assumed an ADG price of $4.04/MMBTU for the first year and then escalated at 2% per year thereafter.

5.3.2. **Promoting State Policy Objectives**

In an order issued February 26, 2015, the New York State Public Service Commission (NYPSC) directed the six large investor owned electric utilities, which includes NYSEG, to develop and file initial demonstration projects, consistent with the guidelines adopted by the Order, on or before July 1, 2015. These projects are intended to demonstrate the potential of various aspects of the Reforming the Energy Vision (REV), the regulatory
Ithaca Microgrid
NY Prize Phase I Feasibility Report
City of Ithaca, NY

initiative launched by the NYPSC as part of Governor Cuomo’s comprehensive energy strategy for New York.

Of relevance to this project, Iberdrola, NYSEG’s parent company, has selected Tompkins County as the host for its demonstration project. As such, SourceOne recommends coordinating the project concepts presented in this feasibility study with NYSEG’s proposed Ithaca region Energy Smart Community (ESC) project. There are particular components of the proposed microgrid, namely the modification of NYSEG’s distribution system, which may benefit from NYSEG’s current project plans for the ESC. Specifically, NYSEG has stated a phased deployment of advanced Metering Infrastructure (AMI) and increased Distribution Automation (DA). The estimated of $15.5 million involves Integrated System Planning, Grid Automation and Communications, Volt/VAR Optimization, Customer Research and Engagement, Customer Communications Platform, Customer Web Portal and Joint Partnership Development.

In addition to coordinating with the ESC initiatives the proposed project may also be a suitable candidate for NYSEG’s Community Energy Coordination (CEC) efforts where it has stated that it will utilize its customer and system data to identify optimal candidates for product offerings at locations with specific system features (i.e., distribution system constraints, etc.). Participating service providers will receive leads identified during the customer solicitation phase. The service providers will pursue sales with customers that have already expressed interest, thus reducing acquisition costs. Service providers will then pay the Company a lead generation fee for this service. As such, this aspect of the demonstration will help inform decisions related to developing DSP (Distributed System Platform) functionalities.

NYSEG has indicated that the goals of the CEC project will the coincide with the existing energy and sustainability goals in Tompkins County and Ithaca, such as reducing greenhouse gas emissions by 40% by 2025.

5.4. Commercial Viability - Project Team (NYSERDA Task 3.3)

The project has the support from the City, various community leaders, and community based energy groups. Through its proposal for the NY Prize, the City has also secured a letter of commitment from NYSEG. Of particular interest, this project involves community stakeholders involved in the supply chain for the feedstock for the production of biogas. This makes this


8 Before the NYS PSC - Direct Testimony of Reforming the Energy Vision, May 20, 2015
project unique in its ability to bring together a wide range of community members who are either involved in or impacted by, water, waste, energy, and the local food supply. Therefore, by design, the project team and the resulting project is truly a community microgrid.

Because the IAWWTF is jointly owned by the City of Ithaca, Town of Ithaca, and Town of Dryden, various project team structures have been contemplated. In subsequent phases of the project additional assessment and evaluation will determine the most advantageous project development and delivery model.

The simplified block diagram below shows the major project assets and the various development, design, construction, ownership, operation, and maintenance possibilities.

![Project Team Roles & Relationship Matrix](image)

Figure 10: Project Team Roles & Relationship Matrix

5.4.1. **Project Delivery Models**

It is understood that the project may be executed through a variety of development models. At this point in the development the following project delivery models are contemplated:

5.4.1.1. **Public Private Partnership**

A public private partnership (PPP) is a government service or private business venture, which is funded and operated through a partnership of government and one or more private sector companies.
PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project.

PPPs are claimed to enable the public sector to harness the expertise and efficiencies that the private sector can bring to the delivery of certain facilities and services traditionally procured and delivered by the public sector. A PPP is structured so that the public sector body seeking to make a capital investment does not incur any borrowing.

5.4.1.2. Utility Ownership

Pursuant to the New York State Public Service Commission’s “Order Adopting Regulatory Policy Framework and Implementation Plan” there may be the possibility that Iberdrola, or a subsidiary may be interested in owning and or operating the project.

Regardless of final ownership structures, it is assumed that NYSEG will own and operate all distribution system equipment necessary and related to the line switching and isolation of feeders 783 and 784 to create the microgrid circuit.

5.4.1.3. City of Ithaca Ownership

The City may choose to own all or a portion of the assets proposed as part of the microgrid or choose to purchase them once they are developed and or operational.
5.4.2. General Development & Delivery Methods

Once the final ownership and commercial structure of the project is determined, the development and delivery model must be selected. Below is a summary of methods which outline the possible ways the City could implement the project. Each method has inherent pros and cons as well as risks and rewards.

5.4.2.1. Internally Develop

This method is similar to the traditional design-bid-build approach where the customer/owner/end user facility hires a consultant, manages the design and construction scope and maintains control of the project from concept to commercial operation. Although this method maximizes the owner’s financial return, it also comes with the greatest amount of project risk and requires a high level of oversight, project management and staff resources.

It is possible for the City to internally develop some or all of the project systems or sub systems. For example, the City may wish to develop and install the PV portion of the project while another firm or approach is used for the CHP system.

5.4.2.2. Purchase Turnkey Project

With this method the owner selects a project developer to design and build the project on a “turnkey” basis whereby the developer turns over the project to the owner after startup and commissioning. Although this method relieves some of the project risk from the owner it comes at a price and can sometimes limit customized solutions or specific technologies. Multiple developers may be required to meet the needs of the project should it involve one or more base technologies that cannot be served by a single entity. The project developer could also retain ownership and or operational responsibility of the project after construction.

It is possible for the City to utilize a turnkey approach for some or all of the project systems or sub systems. For example, the City may wish to approach the CHP system as a turnkey project while implementing another approach for the microgrid/electrical distribution component of the project.

5.4.2.3. Team with Partner(s)

This method involves teaming with one or more of the following entities: equipment vendor, engineer, procurement, and construction firm (EPC) or joint venture partnership to develop the project. This approach assumes that both the risk and financial reward are shared amongst the parties involved.
The City could choose which portion of the project components it wishes to partner on.

5.4.2.4. Design through Design Build Own Operate Maintain (DBOOM)

The Design Build Own Operate Maintain delivery method is based on an underlying energy purchase or energy service agreement with a turnkey system provider or joint venture/consortium of system providers. The system provider agrees to take on the responsibility similar to that of a turnkey project provider however also owns or partially owns, operates and maintains the energy system(s). The provider is usually compensated through power purchased agreement contacts and or an operations and maintenance contract with the host facility.

The City could choose to Design the project first, then go to market for the BOOM portion of the development or choose to select a complete DBOOM provider. The City could choose to split the DBOOM by major equipment/plant/system boundaries or wrap the entire project with a DBOOM contract.

5.5. Commercial Viability - Creating and Delivering Value (NYSERDA Task 3.4)

The technologies selected for this microgrid have a strong track record of proven performance. In addition, the anaerobic digester gas to electricity concept is currently operational at the IAWWTF and has been successfully deployed throughout the world. It is anticipated that existing systems and operating procedures at the IAWWTF will be used in support of this project.

One challenge that has been identified is the reliance on biogas production to power the microgrid. This challenge can be overcome by ensuring all processes are backed up with emergency power. As is currently the case, in the event of a macrogrid outage; this emergency power will also serve as the main synchronizing source for all other microgrid generators. Synchronizing operations can easily be accomplished with standard commercially available systems.

Once operational, the rotating machines (i.e. microturbines and reciprocating engines) can be dispatched to meet the loads of the microgrid during a macrogrid outage. Providing the community with an increased level of resiliency for utilities serving critical facilities helping the City meet its emergency preparedness goals. The solar PV will be incorporated through the use of a load and microgrid controller. During normal operations, generation will be distributed through NYSEG’s system.

Standard construction and operating permits will be required for the majority of the project with the exception of the permits and permissions from NYSEG to modify their distribution
system with the proposed load-break switches. Working with NYSEG to develop, design, and agree to operational requirements for the project will be critical to success.

Section 5.2 of this report describes how the project owner plans to charge the purchasers of electricity services and how will the purchasers' use be metered.

With respect to business/commercialization and replication plans appropriate for this type of project, there are several systems in the country that incorporate the generating assets similar to those proposed in this project. What is unique is the application in the context of a microgrid to serve certain facilities in the event of a macrogrid outage. Recent efforts at other waste water treatment facilities to become net energy exporter or at least net zero energy users should be reviewed so that lessons learned can be applied to this project.

With the exception of obtaining NYSEG approval there are no barriers to market entry that have been identified for the microgrid participants. The market has been identified as the operational and functional services provided by the facilities in the microgrid and the energy requirements necessary to conduct such operations.

5.6. Financial Viability (NYSERDA Task 3.5)

The overall financial viability of this project stems from the operational and economic efficiencies of converting otherwise wasted organic matter into biogas and then converting that biogas to electricity and recovered heat. If this project were a straightforward behind the meter campus style CHP project the required incentives to allow for a positive net present value would be lower. However, based on the goal of creating a microgrid, additional infrastructure to the tune of $1.2 million is necessary to enable the system to provide power to the critical facilities within the microgrid.

Detailed feasibility level cost estimates are located in Appendix C: Technical, Financial & Operational Summary and are broken out by the major systems that constitute the microgrid project as a whole. It should be noted that the digester expansion project is not part of the microgrid project as it is being developed separately by the IAWWTF, whose intention is to supply ADG to the project.

As described in Section 5.1.3: Electric and Natural Gas Price Forecasts, two forecasts were used in a comprehensive cost benefit analysis, one from the customer or developer perspective and one from NYSERDA’s perspective. Each forecast yields a separate financial result as the revenue streams are based on these forecasts. The recommended option referred to as Scenario 4 and as further detailed in Section 4.5.1 Anaerobic Digester Gas Combined Heat and Power Deployments has a negative net present value. Depending on the forecast, an incentive ranging from $1.6 to $3.1 million is required to bring the project to a zero net present value. Additional details of this conclusion can be seen in Appendix D: Indicative Project Proformas.
The project’s revenue streams and/or savings that will flow to the microgrid owner are comprised of electricity and natural gas avoided costs at the IAWWTF, electricity sales to other facilities within NYSEG’s distribution territory, and thermal hot water sales to neighboring facilities. These revenue streams are further described in the table below and in the project proformas located in Appendix D: Indicative Project Proformas. It should be noted that revenues vary in accordance with the forecasts presented in Appendix E: Commodity Forecasts.
## Project Revenue Descriptions

<table>
<thead>
<tr>
<th>Project Revenue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided Costs: Electric PV Generation</td>
<td>This revenue stream stems from the value of the electricity produced from the PV array in accordance with NYSEG’s non-residential net metering tariff or NYSEG’s Community Distributed Generation tariff, whichever is greater. The project has assumed the value of the electric generation is at the avoided retail rate, which is described above in Section 5.1: Energy Pricing and Forecasts.</td>
</tr>
<tr>
<td>Avoided Costs: Electric CHP Generation</td>
<td>The project has assumed the value of this electric generation is at IAWWTF’s avoided retail rate, which is described above in Section 5.1: Energy Pricing and Forecasts. The proposed CHP generation capacity will exceed the load at the IAWWTF therefore this revenue stream only applies to the balance of the IAWWTF load as currently supplied by NYSEG. The remaining generation is valued as export revenue, described later in this table.</td>
</tr>
<tr>
<td>Avoided Costs: Thermal NG</td>
<td>This revenue stream stems from the value of the heat recovered from the ADG CHP system. This value is based on the cost of hot water produced by natural gas in an 85% efficient boiler system. The proposed heat recovery will exceed the load at the IAWWTF therefore this revenue stream only applies to the balance of the IAWWTF load as currently supplied by NYSEG. The remaining recovered heat is valued as export revenue, described later in this table.</td>
</tr>
<tr>
<td>Export Revenue: Electric CHP Generation</td>
<td>This revenue stream applies to the balance of the generation from the CHP system and the value of the electricity is in accordance with NYSEG’s Buy Back tariff or as otherwise agreed to with NYSEG. This is not the full retail value, rather the wholesale value or what NYSEG purchased power for, which for this project is represented by NYISO Zone C pricing.</td>
</tr>
<tr>
<td>Export Revenue: Thermal Export – Hot Water</td>
<td>This revenue stream applies to the heat recovered from the ADG CHP system that is in excess of that needed by IAWWTF. This value is based on the cost of hot water produced by natural gas in an 85% efficient boiler system. To be conservative, the project does not take into account the avoided capital and operating costs for a separate heat and power system at the end users facility.</td>
</tr>
</tbody>
</table>

*Table 16: Project Revenue Descriptions*
The project’s expenses and operating costs are comprised of the fixed and variable operating costs associated with the ADG CHP system, district energy system, PV array, and microgrid components. Appendix C: Technical, Financial & Operational Summary provides a table of the assumptions and corresponding costs for all operating and maintenance activities for the project.

The financing structure for this project during development, construction, and operation will be determined in subsequent phases and may include a variety of private and public funding mechanisms.

5.7. Legal Viability (NYSERDA Task 3.6)

The ownership definition and structure for this project is still being developed at this time, with the concepts presented in Section 5.4: Commercial Viability - Project Team (NYSERDA Task 3.3) still being evaluated. It is anticipated that once this report is reviewed by the City they will be able to assess the project ownership structure with more certainty.

Access to the site will require coordinating with the City as they own the property that is being proposed as the site of the new systems.

In order to protect the privacy rights of the microgrids’ customers, the project anticipates relying on NYSEG’s standard operating procedures and codes of conduct. This includes privacy rights of microgrid customers including establishing proper protocols in the event a privacy concern is identified during subsequent project development, design, or operation of the microgrid.

With respect to regulatory hurdles and their implications, the proposed project includes the modification and use of NYSEG’s existing distribution system, namely the Fourth Street 783 and 784 feeders, and as such the project will need to work closely with NYSEG to obtain approval to do so. Additional regulatory hurdles include the need to further evaluate the best tariff options for the various forms of generation. As of this report, the current applicable tariffs include NYSEG’s net metering tariff, distributed generation buyback tariff, and the standard interconnection agreement for behind the meter generators. The project may further benefit should the anaerobic digester generation qualify as electric generating equipment eligible for net metering under New York Public Service Law § 66-j.
6. **Benefit Cost Analysis (NYSERDA Task 4)**

To assist with completion of the project’s NY Prize Stage 1 feasibility study, NYSERDA has retained IEc to conduct a screening-level analysis of the project’s potential costs and benefits. This section describes the results of that analysis, which is based on the methodology outlined below.

For IEc’s full report, refer to Appendix H: NYSERDA COST BENEFIT REPORT, for the inputs and assumptions used to develop the results of the cost benefit test refer to Appendix I: NYSERDA COST BENEFIT QUESTIONNAIRES.

6.1. **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. Of note, 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.9 It also calculates an annualized estimate of costs and benefits based on the anticipated

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9 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
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.\(^\text{10}\)

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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.]

\(^\text{10}\) 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.
6.2. Developing Cost Benefit Test Inputs and Assumptions

To facilitate IEc’s cost benefit test, SourceOne compiled information necessary to complete the questionnaires as provided by NYSERDA. The areas of information requested are summarized as follows:

- Facility and Customer Description
- Characterization of Distributed Energy Resources
- Capacity Impacts and Ancillary Services
- Project Costs
- Costs to Maintain Service during a Power Outage
- Services Supported by the Microgrid

Additional information pertaining to the above topics can be found in Appendix I: NYSERDA COST BENEFIT QUESTIONNAIRES.

6.3. Cost Benefit Test Results

As summary of the results of IEc’s Cost Benefit Test are provided below.

<table>
<thead>
<tr>
<th>ECONOMIC MEASURE</th>
<th>ASSUMED AVERAGE DURATION OF MAJOR POWER OUTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SCENARIO 1: 0 DAYS/YEAR</td>
</tr>
<tr>
<td>Net Benefits - Present Value</td>
<td>-$534,000</td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td>0.96</td>
</tr>
<tr>
<td>Internal Rate of Return</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

Table 17: Cost Benefit Test Results

Details for each scenario are provided in the tables below.

<table>
<thead>
<tr>
<th>COST OR BENEFIT CATEGORY</th>
<th>PRESENT VALUE OVER 20 YEARS (2014$)</th>
<th>ANNUALIZED VALUE (2014$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Design and Planning</td>
<td>$1,380,000</td>
<td>$122,000</td>
</tr>
<tr>
<td>Capital Investments</td>
<td>$5,280,000</td>
<td>$465,000</td>
</tr>
<tr>
<td>Fixed O&amp;M</td>
<td>$1,380,000</td>
<td>$121,000</td>
</tr>
<tr>
<td>Variable O&amp;M (Grid-Connected Mode)</td>
<td>$839,000</td>
<td>$74,000</td>
</tr>
</tbody>
</table>
### Table 18: Scenario 1 Cost Benefit Test Details

<table>
<thead>
<tr>
<th>Description</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel (Grid-Connected Mode)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emission Control</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emissions Allowances</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emissions Damages (Grid-Connected Mode)</td>
<td>$4,200,000</td>
<td>$274,000</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$13,100,000</td>
<td></td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in Generating Costs</td>
<td>$3,510,000</td>
<td>$310,000</td>
</tr>
<tr>
<td>Fuel Savings from CHP</td>
<td>$969,000</td>
<td>$85,500</td>
</tr>
<tr>
<td>Generation Capacity Cost Savings</td>
<td>$1,960,000</td>
<td>$173,000</td>
</tr>
<tr>
<td>Distribution Capacity Cost Savings</td>
<td>$315,000</td>
<td>$27,800</td>
</tr>
<tr>
<td>Reliability Improvements</td>
<td>$434,000</td>
<td>$38,300</td>
</tr>
<tr>
<td>Power Quality Improvements</td>
<td>$1,680,000</td>
<td>$148,000</td>
</tr>
<tr>
<td>Avoided Emissions Allowance Costs</td>
<td>$1,930</td>
<td>$170</td>
</tr>
<tr>
<td>Avoided Emissions Damages</td>
<td>$3,680,000</td>
<td>$240,000</td>
</tr>
<tr>
<td>Major Power Outage Benefits</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Total Benefits</td>
<td>$12,500,000</td>
<td></td>
</tr>
<tr>
<td>Net Benefits</td>
<td>-$534,000</td>
<td></td>
</tr>
<tr>
<td>Benefit/Cost Ratio</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>Internal Rate of Return</td>
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**Table 19: Scenario 2 Cost Benefit Test Details**
7. **ADDITIONAL PROJECT CONCEPTS**

This section provides a summary of concepts that have been contemplated during the evaluation of the microgrid and which warrant fatal flaw screening and evaluation in subsequent phases of development.

7.1. **Biogas Upgrading and Effluent Heat Recovery**

The ability to produce and combust pipeline quality natural gas has several benefits over the combustion of raw biogas; increased flexibility for conversion to electricity, vehicle fuel, standard boiler fuel to name a few. From a marketing perspective the pipeline natural gas could be viewed as a source of non-frack gas. The following two diagrams are provided to show a simplified schematic of the existing process as compared to a modified process which includes a biogas upgrading unit and effluent heat pump system.

![Existing IAWWTF - Simplified Process](image-url)

**Figure 12: Existing IAWWTF - Simplified Process**

---

7.2. **Sludge Drying w/ Biogas or Heat Recovery**

The following diagram depicts concept options for additional sludge drying (i.e. increased use of biogas or heat recovery from onsite biogas electrical generation). The IAWWTF currently produces approximately 4500 tons of sludge per year and utilizes a belt filter press for dewatering. There is currently no active heating system used to further remove moisture. The belt filter press process produced sludge at 23% T.S which is hauled from the plant at a cost of approximately $55/Wet Ton.

SourceOne recommended further evaluation of additional heat loads through sludge drying during subsequent phases of development. Thermal loads closer to the proposed new biogas and heat recovery system have greater financial benefit over distant thermal loads.
7.3. **Hydro w/ and w/o Pumped Storage**

Six Mile creek, Fall Creek and Cascadilla creek along with two local reservoirs may offer the opportunity for small scale hydroelectric power and or pumped storage. As the City continues to evaluate options to meet its energy requirements, these concepts should be vetted through an initial fatal flaw analysis to determine their applicability. The area has a rich history of hydroelectric generation and a small (1MW) run of the river facility is currently in operation on the Cornell University Campus (Fall Creek).

---

12 Andritz Separation, drying technologies for sewage sludge
7.4. Other Potential District Energy Systems\(^{13}\)

Through research conducted as part of this feasibility study SourceOne revealed a summary document of other potential microgrid/district energy concepts that have been noted in and around the City. The intention of listing these potential projects is to provide context for the City as it evaluates the concepts presented in this study relative to other energy project developments.

- The Commons: Potential 12 MW grid to serve 3.5 million square feet of building space in downtown Ithaca
- Cornell Business and Technology Park: 300 acres (200 commercial, 100 residential), 26 buildings, approximately 700,000 square feet of space, large concentration of wet labs and clean rooms
- Healthcare Facilities: Cayuga Medical Center (CMC) has a thermal energy plant and future expansion of this system could convert it to CHP. The peak electricity load for Cayuga Medical Center is \(~2.2\) MW. CMC completed the first phase of a CHP feasibility study in fall 2012 and conducted a technical study on assessing whether district heating for structures near the medical center could be incorporated into the system.
- Retirement Communities: Kendal at Ithaca, a senior living community in Ithaca, owns 212 cottages of different sizes ranging from a studio to a two bedroom with den, a 36-room Enhanced Assisted Living Residence, and a 35-room Skilled Nursing Facility. Constant heat and electricity are also required for Kendal to provide reliable medical care and nursing services.
- Hotels: Hotels have a number of characteristics that make them good targets for installing CHP systems.
- Ithaca Chainworks District: This active project will redevelop upwards of 1 million square feet of a former industrial site. A recent CHP and renewable energy study has been performed and concluded that a 2MW CHP system would be viable.

8. LESSONS LEARNED

This section provides a brief summary of some of the key lessons that the project team has learned throughout the process of evaluating the proposed microgrid.

1. Understanding key drivers for the development of the microgrid is critical for the entire project team to understand from the onset of the project. For example, will the generating equipment be expected to only operate when there is an emergency event or for the entirety of the year.

2. It is difficult to identify a clear revenue stream associated with the equipment upgrades on the host utility’s distribution system. Including these costs into a potential combined heat and power plant increases the difficulty in developing a financially feasible project without financial incentives. As such, it is likely necessary to separate control and association of these assets from the generating equipment to encourage private development of the generating equipment.

3. Stakeholder management is complex and difficult as there are a large number of varying interests and levels of support. Stakeholders range from the end use facilities, host utility, various city and town agencies as well as the feedstock supply chain for anaerobic digester gas production.

4. There still exists an extensive amount of policy work to be done regarding the responsibility and liability for the equipment served by the microgrid during an event. It is still not clear who will be held responsible in the event that equipment served by the microgrid is damaged.

5. Difficulty in obtaining information from both the participating utility and potential load sites resulted in delays in developing the study. Feeder maps and feeder load information became critical path early on in the development process and the project needed to be put on hold until the information was made available.
APPENDIX A. PROJECT DEVELOPMENT MAPS
ITHACA COMMUNITY MICROGRID
NORTH ENERGY DISTRICT—OVERVIEW

FOR DISCUSSION PURPOSES ONLY.
NOT FOR CONSTRUCTION.
Ithaca Community Microgrid
North Energy District—Feeder, Microgrid Buildings, and Existing Emergency Generators

Legend
Points of Interest
- Microgrid Buildings
- Buildings
- Substations
- Roads
- Waterways
- NYSEG Distribution Lines
- 783
- 784
- 785
- Proposed Changes

Peak Energy Loads

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<td>Ithaca High School</td>
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</table>

For Discussion Purposes Only. Not for Construction.
APPENDIX B. PROJECT CONCEPTUAL DESIGN DRAWINGS
ITHACA COMMUNITY MICROGRID
COMMERCIAL BLOCK DIAGRAM

---

IAWWTF: Microgrid Host Site

New Anaerobic Digester Gas CHP

Avoided Costs (Est. @ $90/MWH)

IAWWTF Electric Loads

NYSEG Distribution System

NYSEG Net Metering or Community DG Tariff (Est. @ $90/MWH)

Aggregated City of Ithaca Electric Loads

Avoided Costs (Est. @ $6.61/MMBTU)

IAWWTF Thermal Loads

NYSEG Buy Back Rate (Est. @ $60/MWH)

NYSEG Loads

District Energy System

Energy Service Agreement Negotiated $/MMBTU

Waterfront Thermal Loads

Legend

---

COMMENTARY:

New PV

Avoided Costs (Est. @ $90/MWH)

IAWWTF Electric Loads

NYSEG Net Metering or Community DG Tariff (Est. @ $90/MWH)

Aggregated City of Ithaca Electric Loads

Avoided Costs (Est. @ $6.61/MMBTU)

IAWWTF Thermal Loads

NYSEG Buy Back Rate (Est. @ $60/MWH)

NYSEG Loads

Legend

---

FOR DISCUSSION PURPOSES ONLY.
NOT FOR CONSTRUCTION.

---
### General Notes
- Symbols shown in green indicate proposed microgrid equipment.
Ithaca Area Wastewater Treatment Facility (see dwg. MG2)

784 (Normal)

783 Extension on IAWWTF Property

Montessori School

783 Existing Load Break Switch

New Load Break Switch

Existing 783 Source

Norfolk Southern Railroad

North Meadow St.

W. York St.

N. Cayuga St.

Cascadilla Creek

Willow Ave.

Pier Rd.

Ithaca High School

Pump Station

New Load Break Switch

General Notes
- Black color indicates existing infrastructure and equipment.
- Green color indicates future/proposed infrastructure and equipment.

FOR DISCUSSION PURPOSES ONLY. NOT FOR CONSTRUCTION.
APPENDIX C. TECHNICAL, FINANCIAL & OPERATIONAL SUMMARY
Conceptual Microgrid Deployment Scenarios

Technical and Financial Summary

### Scenario 1

**Prime Mover**
- IAWWTF IAWWTF IAWWTF IAWWTF IAWWTF

**Electric Revenue Source**
- Net Meter at Retail Rate w/ Export at Wholesale Rate Net Meter w/ export at retail

**Electric Distribution**
- Connect Partial 783 to Partial 784 Feeder

### District Energy & Thermal Distribution System

| **Total New Biogas Available for Export** MMBTU/Yr | 41,230 | 41,230 | 41,230 | 41,230 | 41,230 |
| **Estimated Generator Heat Rate** BTU/KWH | 8,248 | 8,248 | 8,248 | 8,248 | 8,248 |
| **New Biogas Production Capacity Factor** % | 90% | 90% | 90% | 90% | 90% |
| **Maximum Biogas Generator Capacity** KW | 418 | 418 | 418 | 418 | 418 |
| **Proposed Installed Biogas Capacity** KW | 550 | 550 | 550 | 550 | 550 |
| **Partial Biogas Electrical Generation** KWH/Year | 4,336,200 | 4,336,200 | 4,336,200 | 4,336,200 | 4,336,200 |
| **Estimated Total Component Cost - Gross** $ | 1,790,500 | 1,839,500 | 2,567,500 | 1,839,500 | 1,839,500 |

### PV System

| **Installed Solar Capacity** KW | 430 | 430 | 430 | 430 | 430 |
| **Annual Capacity Factor Solar** % | 13% | 13% | 13% | 13% | 13% |
| **Estimated Total Project Cost - Gross** $ | 1,303,029 | 1,303,029 | 1,303,029 | 1,303,029 | 1,303,029 |

### Microgrid System

| **Estimated Total Project Cost - Gross** $ | 1,222,650 | 1,222,650 | 1,222,650 | 1,222,650 | 1,222,650 |

### Project Financial Summary Metrics

| **Total Project Cost** $ | 4,275,179 | 4,275,179 | 4,275,179 | 4,275,179 | 4,275,179 |
| **Year 1 Value of Electricity Generated** $ | 429,233 | 429,233 | 451,551 | 429,233 | 487,278 |
| **Year 1 Value of Heat Recovered** $ | 106,413 | 110,882 | 110,882 | 110,882 | 110,882 |
| **Year 1 Operating Costs** $ | 342,167 | 355,294 | 355,294 | 355,294 | 355,294 |
| **Year 1 Cash Flow** $ | 87,066 | 180,413 | 212,139 | 140,741 | 286,946 |
| **Net Present Value (Source One Forecasts)** $ | (2,352,870) | (3,156,708) | (623,428) | (1,612,059) | (144,168) |
| **Required Incentive for Zero NPV** $ | 2,470,514 | 3,314,544 | 654,599 | 1,692,662 | 151,377 |
## Conceptual Microgrid Deployment Scenarios
### Operations and Maintenance Cost Estimates

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Prime Mover Location</th>
<th>Electric Revenue Source</th>
<th>Heat Recovery</th>
<th>Heat Recovery Distribution</th>
<th>Heat Recovery Revenue Source</th>
<th>PV Location</th>
<th>PV Revenue Source</th>
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#### Project Cost Estimates

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<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
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#### Biogas Routing

| Gas Distribution Piping, 4" Polyethylene SDR-10 | $300 | $/ft | 0 | $0 | $0 | 1,700 | $510,000 | 0 | $0 | 0 | $0 |
| Piping specialties, trim and interconnect | $50,000 | $/UNIT | 0 | $0 | $0 | 1 | $50,000 | 0 | $0 | 0 | $0 |
| Total Hard Costs | $0 | $0 | $0 | $560,000 | 0 | $0 |
| Engineering | 12% | % | 1 | $67,200 | 1 | $0 |
| Construction and Project Management | 10% | % | 1 | $56,000 | 1 | $0 |
| Start-Up and Commissioning | 3% | % | 1 | $16,800 | 1 | $0 |
| Legal/Permits/Permissions | 5% | % | 1 | $28,000 | 1 | $0 |
| Total Soft Costs | $0 | $0 | $168,000 | 0 | $0 |
| Total Biogas Routing | $0 | $0 | $728,000 | 0 | $0 |

#### ADG CHP Plant

| Prime Movers | $800 | $/kW | 550 | $440,000 | 550 | $440,000 | 550 | $440,000 | 550 | $440,000 | 550 |
| Heat Recovery Unit | $100,000 | $/MMBTU | 0 | $0 | 1 | $100,000 | 1 | $100,000 | 1 | $100,000 | 1 |
| SCR / Emission System | $150,000 | $/kW | 550 | $275,000 | 550 | $275,000 | 550 | $275,000 | 550 | $275,000 | 550 |
| Electrical Scope of Work | $150,000 | $/kW | 550 | $150,000 | 1 | $150,000 | 1 | $150,000 | 1 | $150,000 | 1 |
| Mechanical Scope of Work | $175,000 | $/kW | 550 | $175,000 | 1 | $175,000 | 1 | $175,000 | 1 | $175,000 | 1 |
| Civil Scope of Work | $50,000 | $/kW | 550 | $50,000 | 1 | $50,000 | 1 | $50,000 | 1 | $50,000 | 1 |
| Control System Scope of Work | $125,000 | $/kW | 550 | $125,000 | 1 | $125,000 | 1 | $125,000 | 1 | $125,000 | 1 |
| Building/Enclosure | $200 | $/sq ft | 500 | $100,000 | 500 | $100,000 | 500 | $100,000 | 500 | $100,000 | 500 |
| Total Hard Costs | $1,315,000 | $1,415,000 | $1,415,000 | $1,415,000 | $1,415,000 |
| Engineering | 12% | % | 1 | $169,800 | 1 | $169,800 | 1 | $169,800 | 1 | $169,800 |
| Construction and Project Management | 10% | % | 1 | $141,500 | 1 | $141,500 | 1 | $141,500 | 1 | $141,500 |
| Start-Up and Commissioning | 3% | % | 1 | $42,450 | 1 | $42,450 | 1 | $42,450 | 1 | $42,450 |
| Legal/Permits/Permissions | 5% | % | 1 | $70,750 | 1 | $70,750 | 1 | $70,750 | 1 | $70,750 |
| Total Soft Costs | $394,500 | $424,500 | $424,500 | $424,500 | $424,500 |
| Total ADG CHP Plant | $1,709,500 | $1,839,500 | $1,839,500 | $1,839,500 | $1,839,500 |
## Conceptual Microgrid Deployment Scenarios

### Project Cost Estimates

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### District Thermal Energy System

| Two pipe hot water system | $1,000 | $/UNIT | 0 | $0 | $1,700 | $1,700,000 | 0 | $0 | $500 | $500,000 | 0 | $500,000 |
| Piping trim, valves, metering and interconnect | $200,000 | LS | 0 | $0 | 1 | $200,000 | 1 | $200,000 | 1 | $200,000 | 1 | $200,000 |
| Total Hard Costs | $0 | $1,900,000 | $200,000 | $200,000 | $200,000 | $700,000 | $700,000 |
| Engineering | 12% | % | 1 | $0 | 1 | $228,000 | 1 | $24,000 | 1 | $84,000 | 1 | $84,000 |
| Construction and Project Management | 10% | % | 1 | $0 | 1 | $190,000 | 1 | $20,000 | 1 | $70,000 | 1 | $70,000 |
| Start-Up and Commissioning | 3% | % | 1 | $0 | 1 | $57,000 | 1 | $6,000 | 1 | $21,000 | 1 | $21,000 |
| Legal/Permits/Permissions | 5% | % | 1 | $0 | 1 | $95,000 | 1 | $10,000 | 1 | $35,000 | 1 | $35,000 |
| Total Soft Costs | $0 | $570,000 | $60,000 | $210,000 | $210,000 | $910,000 | $910,000 |
| Total District Thermal Energy System | $0 | $2,470,000 | $260,000 | $910,000 | $910,000 |

### PV Array (w or w/o storage)

| Indicative EPC Pricing - PV | $2,730 | $/KW | 430 | $1,173,900 | 430 | $1,173,900 | 430 | $1,173,900 | 430 | $1,173,900 | 430 | $1,173,900 |
| Total Hard Costs | $1,173,900 | $1,173,900 | $1,173,900 | $1,173,900 | $1,173,900 |
| Engineering | 5% | % | 1 | $58,695 | 1 | $58,695 | 1 | $58,695 | 1 | $58,695 | 1 | $58,695 |
| Construction and Project Management | 3% | % | 1 | $35,217 | 1 | $35,217 | 1 | $35,217 | 1 | $35,217 | 1 | $35,217 |
| Start-Up and Commissioning | 2% | % | 1 | $23,478 | 1 | $23,478 | 1 | $23,478 | 1 | $23,478 | 1 | $23,478 |
| Legal/Permits/Permissions | 1% | % | 1 | $11,739 | 1 | $11,739 | 1 | $11,739 | 1 | $11,739 | 1 | $11,739 |
| Total PV Array (w or w/o storage) | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 | $1,303,029 |
### Conceptual Microgrid Deployment Scenarios

#### Project Cost Estimates

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#### Microgrid System

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APPENDIX D. INDICATIVE PROJECT PROFORMAS
## Indication of Project Formosa

### North Energy District - Scenario 1

#### Generation Breakdown

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<th>Nominal Capacity (TW)</th>
<th>Heat Recovery</th>
<th>Location</th>
<th>Commodity:</th>
<th>Source of</th>
<th>Commodity Baselines</th>
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#### Financial Performance

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<th>Commodity Forecast:</th>
<th>Source of</th>
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| ...  | ... | ... | ... | ... | ...

#### Exclusion Schedule

- Natural Gas: 5% per Reciprocating Delivery
- Natural Gas: 2% per Baseline Maintenance

#### Commodity Baselines

- Mettis Baseline 2015 Rate 8.7%
- Third Party Supply: 61% NYSERDA
- Natural Gas Baseline Year 2015 Rates: NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0% NYSERDA 2.0%
- Export Tariff: 3.3% NYSERDA 3.3% NYSERDA 3.3% NYSERDA 3.3% NYSERDA 3.3%

#### Energy Use & Consumption

<table>
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<tr>
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<th>Source of</th>
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<th>Source of</th>
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<tbody>
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#### Plant Production Volumes

- Total Biogas Gas Production
- Biogas Electric Generation - Anadarko Biogas Power
- Biogas Heat Energy - Anadarko Biogas Power

<table>
<thead>
<tr>
<th>Year</th>
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<th>Source of</th>
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#### Expenses

- Total Biogas Gas Production
- Biogas Electric Generation - Anadarko Biogas Power

<table>
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<th>Source</th>
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<th>Source of</th>
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#### Cash Flow

- Total Biogas Gas Production
- Biogas Electric Generation - Anadarko Biogas Power

<table>
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<th>Source</th>
<th>Commodity</th>
<th>Source of</th>
<th>Commodity Forecast:</th>
<th>Source of</th>
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## Generation Breakdown

<table>
<thead>
<tr>
<th>Source</th>
<th>Nominal Capacity (kW)</th>
<th>Heat Recovery</th>
<th>Location</th>
<th>Fuel Source</th>
<th>SourceOne</th>
<th>NYSERDA</th>
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<td>Gas Microturbine</td>
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<td>Biogas Microturbine</td>
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### Financial Performance

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<th>Fuel Source</th>
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### Commodity Baseline

<table>
<thead>
<tr>
<th>Year</th>
<th>Wholesale Electric Costs per Source One (kW)</th>
<th>NYSERDA Electric Costs per Source One (kW)</th>
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<tr>
<td>2015</td>
<td>22,313,758</td>
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### Wholesale Rates

<table>
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<th>Year</th>
<th>Wholesale Electric Rates per Source One (kW)</th>
<th>NYSERDA Electric Rates per Source One (kW)</th>
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<tbody>
<tr>
<td>2015</td>
<td>$2,260/MMBTU</td>
<td>$1,592/MMBTU</td>
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### Capacity Forecasts

<table>
<thead>
<tr>
<th>Year</th>
<th>Total New DG Power: Investment Generation</th>
<th>Total New DG Power: Adderuced Peak Power</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,453</td>
<td>3,113</td>
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### Savings

<table>
<thead>
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<th>Year</th>
<th>Total New DG Power: Investment Generation</th>
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<tbody>
<tr>
<td>2015</td>
<td>1,453</td>
<td>3,113</td>
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### Energy Loads and Consumption

<table>
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<th>Year</th>
<th>Total New DG Power: Investment Generation</th>
<th>Total New DG Power: Adderuced Peak Power</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,453</td>
<td>3,113</td>
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### Plant Production Volumes

<table>
<thead>
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<th>Total New DG Power: Adderuced Peak Power</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,453</td>
<td>3,113</td>
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### Commodity Baseline

- Electric Rates: 2015
  - Wholesale Electric Rates: $2,260/MMBTU
  - NYSERDA Electric Rates: $1,592/MMBTU

### Operational Forecasts

<table>
<thead>
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<td>3,113</td>
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### Energy Costs

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<tr>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,453</td>
<td>3,113</td>
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### Generation Breakdown

- Gas Microturbine: 75 kW
- Biogas Reciprocating Engine: 200 kW
- Biogas Microturbine: 125 kW
- Emergency Generation: 125 kW

### Financial Performance

- Nominal Capacity: 75 kW
- Heat Recovery: Yes
- Location: WWTP
- Fuel Source: Gas
- SourceOne: N/A
- NYSERDA: N/A

### Commodity Baseline

- Electric Rates: 2015
  - Wholesale Electric Rates: $2,260/MMBTU
  - NYSERDA Electric Rates: $1,592/MMBTU

### Capacity Forecasts

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW

### Savings

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW

### Energy Loads and Consumption

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW

### Plant Production Volumes

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW

### Commodity Baseline

- Electric Rates: 2015
  - Wholesale Electric Rates: $2,260/MMBTU
  - NYSERDA Electric Rates: $1,592/MMBTU

### Operational Forecasts

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW

### Energy Costs

- Total New DG Power: Investment Generation: 1,453 kW
- Total New DG Power: Adderuced Peak Power: 3,113 kW
## Generation Breakdown

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Nominal Capacity (MW)</th>
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<tr>
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## Financial Performance

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<th>Tapping Fees</th>
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<th>IRR</th>
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<td>$42,706</td>
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<td>$427,059</td>
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## Electricity Costs

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<tr>
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<th>Natural Gas Rate: Commercial</th>
<th>Wholesale Electric Rate (Firm Power: Energy + Capacity)</th>
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<tbody>
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<td>$2.7</td>
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## Plant Production Volumes

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<th>Electricity Production</th>
<th>Thermal Production</th>
<th>Total Production</th>
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<tr>
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<td>7536 MMBTU</td>
<td>8989 MMBTU</td>
</tr>
<tr>
<td>2022</td>
<td>1453 MWh</td>
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<td>8989 MMBTU</td>
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<td>2031</td>
<td>1453 MWh</td>
<td>7536 MMBTU</td>
<td>8989 MMBTU</td>
</tr>
</tbody>
</table>

## Generation Source

- North District: 300 MW, Heat Recovery: Yes High, Location: High
- South District: 50 MW, Heat Recovery: Yes High, Location: High

## Generation Year 2031 Rates

- Natural Gas Rate: Commercial
- Wholesale Electric Rate (Firm Power: Energy + Capacity)
- Retail Electricity Delivery
- Retail Natural Gas Delivery
- Operations & Maintenance
- Tapping Fees
- Biogas

## Cumulative Cash Flow

<table>
<thead>
<tr>
<th>Year</th>
<th>Cumulative Cash Flow</th>
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<tr>
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<td>$42,706</td>
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<td>2030</td>
<td>$427,059</td>
</tr>
<tr>
<td>2031</td>
<td>$469,765</td>
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</tbody>
</table>

## Emergency Operations

- Existing Capacity: 1,453 MWh
- Proposed Capacity: 1,453 MWh

## Forecast

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity Forecast</th>
<th>Thermal Forecast</th>
<th>Total Forecast</th>
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<tbody>
<tr>
<td>2021</td>
<td>1453 MWh</td>
<td>7536 MMBTU</td>
<td>8989 MMBTU</td>
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## Energy District Breakdown

### Financial Performance

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<tbody>
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<td>4,336</td>
<td>2,350</td>
<td>1,987</td>
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<td>21,805</td>
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<td>1,222,166</td>
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### Commodity Baselines

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<th>NYSERDA</th>
<th>Gas Base Rate Year-1 Rates</th>
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## Energy Load and Consumption

### Plant Production Volumes

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### Energy and Consumption

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### Energy Forecasts

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<th>Electric MMBTU</th>
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### Indicative Project Proforma

**North Energy District - Scenario S**

#### Generation Breakdown

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<th>Nominal Capacity (MW)</th>
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<td>750</td>
<td>Yes</td>
<td>WAT</td>
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<tr>
<td>Biogas Microturbine - Existing</td>
<td>260</td>
<td>Yes</td>
<td>WAT</td>
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<td>Emergency Generation - Existing &amp; Proposed</td>
<td>1325</td>
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#### Financial Performance

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<tbody>
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<td>$1,468,966</td>
<td>$1,570,003</td>
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#### Evaluation Schedule

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<th>per Source or NWP Forecast</th>
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<tbody>
<tr>
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<td>20%</td>
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<tr>
<td>Retail Price</td>
<td>20%</td>
<td>30%</td>
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<tr>
<td>Natural Gas Delivery</td>
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#### Commodity Baselines

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<tr>
<td>Biogas Barge Rate</td>
<td>20%</td>
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### Energy Loads and Consumption

#### Commodity Forecasts

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<tbody>
<tr>
<td>Biogas SourceNOS</td>
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<td>$1,468,966</td>
<td>$1,570,003</td>
<td>$1,570,003</td>
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</tbody>
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#### Plant Production Volumes

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Biogas SourceNOS</td>
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### Cash Flow

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<td>$1,468,966</td>
<td>$1,570,003</td>
<td>$1,570,003</td>
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### Notes

1. **Generation Breakdown**
   - Biogas Reciprocating Engine - Proposed: 750 MW
   - Biogas Microturbine - Existing: 260 MW
   - Emergency Generation - Existing & Proposed: 1325 MW

2. **Financial Performance**
   - Northwest Power Polling Forecast: $1,397,110
   - Northwest Power Polling Actual: $1,468,966
   - Wholesale Load: $1,570,003

3. **Evaluation Schedule**
   - Wholesale Price: 10% / 20%
   - Retail Price: 20% / 30%
   - Natural Gas Delivery: 20% / 30%

4. **Commodity Baselines**
   - Electric Energy 2015 Baseline: $(1,570,003)
   - Biogas Barge Rate: 20% / 20%

5. **Energy Loads and Consumption**
   - Commodity Forecasts: Northwest Power Polling

6. **Plant Production Volumes**
   - Northwest Power Polling Forecast: $1,397,110
   - Northwest Power Polling Actual: $1,468,966
   - Wholesale Load: $1,570,003

7. **Cash Flow**
   - Northwest Power Polling Forecast: $1,397,110
   - Northwest Power Polling Actual: $1,468,966
   - Wholesale Load: $1,570,003
APPENDIX E. COMMODITY FORECASTS
### Commodity Forecasts

<table>
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<tr>
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<td>9.76</td>
<td>9.79</td>
<td>9.82</td>
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<td>7.69</td>
<td>7.86</td>
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### Commodity Forecasts (Cont.)

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</table>

![Graph](image-url)
APPENDIX F.  FACILITY ENERGY PROFILES
Ithaca Area Wastewater Treatment Facility Energy Profile

Facility Study ID # 1
Facility Name: Ithaca Area Wastewater Treatment Facility
Facility Address: 525 3rd St, Ithaca, NY 14850
Emergency Generator: Y | 750kW | Diesel

NYSEG Gas Account # 1001-2456-348
Gas Meter # NRT0000580289
Gas Service Classification SC2

NYSEG Electric Account # 1001-2456-355
Electric Meter # TBD
Electric Service Classification SC7

Peak Demand: 778 kW
Annual Consumption: 2,359,697 kWh
Average Demand: 269 kW
Load Factor: 35%

Load Demand 778 kW
Annual Consumption 2,359,697 kWh
Average Demand 269 kW
Load Factor 35%

Data sources: NYSEG electric interval meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
Ithaca High School and Administration Building Complex Energy Profile

Facility Study ID # 2
Facility Name: Ithaca High School and Administration Building Complex
Facility Address: 1401 N Cayuga St, Ithaca, NY 14850
Emergency Generator: Y | 300kW | Diesel
NYSEG Electric Account #: 1001-2133-509
NYSEG Circuit #: 783

Electricity
- Peak Demand: 575 kW
- Annual Consumption: 3,113,463 kWh
- Average Demand: 355 kW
- Load Factor: 62%

Natural Gas
- Annual Consumption: 19.22 MMBTU
- Average Demand: 21,805 MMBTU
- Load Factor: 13%

Load Duration Curves

Annual Monthly Consumption

Annual Hourly Consumption

Data sources: NYSEG electric interval meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
Boynton Middle School Energy Profile

Facility Study ID # 3  NYSEG Gas Account # TBD
Facility Name Boynton Middle School  Gas Meter # NMT00A1330038
Facility Address 1601 N Cayuga St, Ithaca, NY 14850  Gas Service Classification SC2
Emergency Generator N  NYSEG Electric Account # 1001-2133-483
NYSEG Circuit # 785  Electric Meter # NAB0018704584
NYSEG Electric Account # 1001-2133-483  Electric Service Classification SC2

### Electricity
- Peak Demand: 312 kW
- Annual Consumption: 1,047,501 kWh
- Average Demand: 120 kW
- Load Factor: 38%

### Natural Gas
- Annual Consumption: 4,972 MMBTU
- Average Demand: 0.57 MMBTU
- Load Factor: 20%

---

**Data sources:** NYSEG electric interval meter, NYSEG monthly gas meter

For purposes of this study 1 cf natural gas = 102,800 Btu
Fall Creek Elementary School Energy Profile

- **Facility Study ID #**: 4
- **Facility Name**: Fall Creek Elementary School
- **Facility Address**: 202 King St, Ithaca, NY 14850
- **Emergency Generator**: N
- **NYSEG Electric Account #**: 1001-2795-739
- **Electric Meter #**: NAB0004358510
- **NYSEG Circuit #**: 784
- **Electric Service Classification**: SC2
- **NYSEG Gas Account #**: 1001-0013-745
- **Gas Meter #**: NAM0005400368
- **Gas Service Classification**: SC2

### Electricity
- **Peak Demand**: 46 kW
- **Annual Consumption**: 180,320 kWh
- **Average Demand**: 21 kW
- **Load Factor**: 45%

### Natural Gas
- **Annual Consumption**: 1,395 MMBTU
- **Average Demand**: 0.16 MMBTU
- **Load Factor**: 20%

### Data sources:
- NYSEG monthly electric meter, NYSEG monthly gas meter

For purposes of this study 1 cf natural gas = 102,800 Btu
Tompkins Consolidated Area Transit (TCAT) Energy Profile

Facility Study ID #  5
Facility Name  Tompkins Consolidated Area Transit (TCAT)
Facility Address  737 Willow Ave, Ithaca, NY 14850
Emergency Generator  N
NYSEG Circuit #  783

NYSEG Gas Account #  1001-2456-477
Gas Meter #  NRT0008070633
Gas Service Classification  SC2
NYSEG Electric Account #  1001-2456-477
Electric Meter #  NGE0051040272
Electric Service Classification  SC2

Peaks Demand  174 kW
Annual Consumption  790,800 kWh
Average Demand  90 kW
Load Factor  52%

Annual Consumption  4,625 MMBTU
Load Factor  15%

Data sources: NYSEG monthly electric meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
City of Ithaca Department of Public Works Energy Profile

Facility Study ID # 6  NYSEG Gas Account # TBD
Facility Name City of Ithaca Department of Public Works  Gas Meter # NRT001480318
Facility Address 245 Pier Road, Ithaca, NY 14850255  Pier Road, Ithaca, NY 14850  Gas Service Classification SC2
Emergency Generator Y | 150kW | Natural Gas  NYSEG Electric Account # TBD
NYSEG Circuit # 783  Electric Meter # 4, NGE0079154325  Electric Service Classification SC2

### Electricity
- Peak Demand: 78 kW
- Annual Consumption: 256,906 kWh
- Average Demand: 29 kW
- Load Factor: 38%

### Natural Gas
- Annual Consumption: 0.83 MMBTU
- Average Demand: 0.18 MMBTU
- Load Factor: 22%

#### Load Duration Curves

#### Annual Monthly Consumption

#### Annual Hourly Consumption

Data sources: NYSEG monthly electric meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
Storage Building First St. Energy Profile

Facility Study ID # 7
Facility Name Storage Building First St.
Facility Address 300 Franklin Street, Ithaca, NY 14850
Emergency Generator N
NYSEG Circuit # 784

GSTP Gas Account # TBD
Gas Meter # NAM0070000360
Gas Service Classification SC2

NYSEG Electric Account # TBD
Electric Meter # NGE0069066817
Electric Service Classification SC6

Peak Demand 3 kW
Annual Consumption 6,114 kWh
Average Demand 1 kW
Load Factor 22%

0.15 MMBTU
0.03 MMBTU

Data sources: NYSEG monthly electric meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
600 First St. Energy Profile

Facility Study ID # 8  
Facility Name 600 First St.  
Facility Address 600 First St, Ithaca, NY 14850  
Emergency Generator N  
NYSEG Circuit # 785

NYSEG Gas Account # TBD  
Gas Meter # NRT0000880185  
Gas Service Classification SC2  
NYSEG Electric Account # TBD  
Electric Meter # NAB0009642273  
Electric Service Classification SC2

Electricity  
Peak Demand 14 kW  
Annual Consumption 36,649 kWh  
Average Demand 4 kW  
Load Factor 31%

Natural Gas  
Annual Consumption 1.05 MMBTU  
Average Demand 0.14 MMBTU  
Load Factor 13%

Data sources: NYSEG monthly electric meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
Water & Sewer Energy Profile

Facility Study ID # 9 NYSEG Gas Account # TBD
Facility Name Water & Sewer Gas Meter # NRT0000580037
Facility Address 510 1st St, Ithaca, NY 14850 Gas Service Classification SC2
Emergency Generator N NYSEG Electric Account # TBD
NYSEG Circuit # 785 Electric Meter # NGE0076704614
NYSEG Electric Account # TBD Electric Service Classification SC2

Electricity

- Peak Demand: 31 kW
- Annual Consumption: 88,480 kWh
- Average Demand: 10 kW
- Load Factor: 32%

Natural Gas

- Monthly Consumption: 0.27 MMBTU
- Annual Consumption: 565 MMBTU
- Average Demand: 0.06 MMBTU
- Load Factor: 24%

Data sources: NYSEG monthly electric meter, NYSEG monthly gas meter
For purposes of this study 1 cf natural gas = 102,800 Btu
APPENDIX G. PROPERTY OWNERS INCLUDED IN MICROGRID
<table>
<thead>
<tr>
<th>Property Name</th>
<th>Owner(s)</th>
<th>Address</th>
<th>Tax ID</th>
<th>ZONING</th>
<th>PROCLASS</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Schumacher, Nancy</td>
<td>102 FALLS ST E</td>
<td>13-3-19</td>
<td>R-2b</td>
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<tr>
<td>Hansteen, Henry</td>
<td>103 YORK ST E</td>
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<td>R-2b</td>
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<td>3 Family Res</td>
<td></td>
</tr>
<tr>
<td>Ithaca High School</td>
<td>1306 CAYUGA ST N</td>
<td>13-3-21</td>
<td>R-2b</td>
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<td>Davenport, Lynn</td>
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<tr>
<td>Semp, James E</td>
<td>105-07 YORK ST E</td>
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<tr>
<td>Buffam, Larry &amp; Laura</td>
<td>109 YORK ST E</td>
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<tr>
<td>Rice, Charles V &amp; Sanfilippo, Lisa S</td>
<td>1108 CAYUGA ST N</td>
<td>14-1-7</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Cummins, Craig &amp; Sarah</td>
<td>1106 CAYUGA ST N</td>
<td>14-1-8</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
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<tr>
<td>Grace, Emily</td>
<td>123 YORK ST E</td>
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<td>R-2b</td>
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<tr>
<td>Adelweit, Andrew &amp; Michelle</td>
<td>1102 CAYUGA ST N</td>
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<tr>
<td>Longo, Michael &amp; Amici, Gina</td>
<td>1110 CAYUGA ST N</td>
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<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Rice, Charles V &amp; Sanfilippo, Lisa S</td>
<td>1108 CAYUGA ST N</td>
<td>14-1-7</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Cummins, Craig &amp; Sarah</td>
<td>1106 CAYUGA ST N</td>
<td>14-1-8</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Arif, Mohammed</td>
<td>1105 CAYUGA ST N</td>
<td>14-2-2</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>City of Ithaca</td>
<td>725-45 WILLOW AVE</td>
<td>16-3-3</td>
<td>P-1</td>
<td>Community Svcs</td>
<td>Highway gar</td>
<td></td>
</tr>
<tr>
<td>City of Ithaca</td>
<td>715-31 WILLOW AVE</td>
<td>16-1-4-1</td>
<td>P-1</td>
<td>Vacant</td>
<td>Vacant comm</td>
<td></td>
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<tr>
<td>Kahan, Lee</td>
<td>707 WILLOW AVE</td>
<td>16-1-5-1</td>
<td>I-1</td>
<td>Commercial</td>
<td>1 use sm bld</td>
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<tr>
<td>Coates, Randall &amp; Michelle</td>
<td>709 WILLOW AVE</td>
<td>16-1-5-2</td>
<td>I-1</td>
<td>Commercial</td>
<td>Multi-use bld</td>
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<tr>
<td>Lansing Instrument Corp.</td>
<td>707 WILLOW AVE</td>
<td>16-1-5-1</td>
<td>I-1</td>
<td>Industrial Manufacture</td>
<td>Industrial Manufacture</td>
<td></td>
</tr>
<tr>
<td>Lansing Instrument Corp.</td>
<td>705 WILLOW AVE</td>
<td>16-1-3-1</td>
<td>I-1</td>
<td>Industrial Manufacture</td>
<td>Industrial Manufacture</td>
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<tr>
<td>The Haunt of New York, Inc</td>
<td>702 WILLOW AVE</td>
<td>16-1-3-1</td>
<td>M-1</td>
<td>Commercial Night club</td>
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<tr>
<td>Pier Rd Properties, LLC</td>
<td>101 PIER RD</td>
<td>17-1-1-2</td>
<td>M-1</td>
<td>Recreation</td>
<td>Marina</td>
<td></td>
</tr>
<tr>
<td>730 Willow Ave LLC c/o Robert Haney</td>
<td>726-30 WILLOW AVE</td>
<td>17-1-2</td>
<td>M-1</td>
<td>Commercial</td>
<td>Crystal Lake</td>
<td></td>
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<tr>
<td>City of Ithaca</td>
<td>STEWART PARK RD</td>
<td>2-2-2</td>
<td>P-1</td>
<td>Recreation</td>
<td>Park</td>
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<td>City of Ithaca</td>
<td>545 THIRD ST</td>
<td>24-5-1-2</td>
<td>P-1</td>
<td>Community Svcs</td>
<td>Government</td>
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<td>Ithaca High School</td>
<td>1375-1401 CAYUGA ST N</td>
<td>5-1-1</td>
<td>P-1</td>
<td>Community Svcs</td>
<td>School</td>
<td></td>
</tr>
<tr>
<td>Cohen, B &amp; Dillmann, G</td>
<td>1309 CAYUGA ST N</td>
<td>5-2-2</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Lopina, Joseph</td>
<td>1307 CAYUGA ST N</td>
<td>5-2-3</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
<tr>
<td>Mitchell, Emerson &amp; Holley</td>
<td>1301 CAYUGA ST N</td>
<td>5-2-5</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
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<tr>
<td>Bell, Mary &amp; Andrus, Richard</td>
<td>112 YORK ST E</td>
<td>5-2-6</td>
<td>R-2b</td>
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<td>1 Family Res</td>
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<td>Darling, Patricia</td>
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<td>R-2b</td>
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<tr>
<td>Edmunds, Emme</td>
<td>118 YORK ST E</td>
<td>5-2-9</td>
<td>R-2b</td>
<td>Residential</td>
<td>1 Family Res</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX H. NYSERDA COST BENEFIT REPORT
Benefit-Cost Analysis Summary Report

Site 68 – City of Ithaca

PROJECT OVERVIEW

As part of NYSERDA’s NY Prize community microgrid competition, the City of Ithaca has proposed development of a microgrid that would serve five local facilities:

- The Ithaca Area Wastewater Treatment Facility (IAWWTF), which provides wastewater treatment services to 40,000 customers in the City of Ithaca, the Town of Ithaca, and the Town of Dryden;
- Ithaca High School, a public secondary school with a total enrollment of approximately 1,400 students;¹
- Tompkins Consolidated Area Transit (TCAT), a not-for-profit corporation that provides public transportation for Tompkins County, New York;
- The Department of Public Works for the City of Ithaca; and
- The Balance of Feeder 783, which serves a combination of 40 residential homes and four small commercial entities.

The microgrid would be powered by two existing distributed energy resources - a 260 kW biogas microturbine and a 7.5 kW photovoltaic (PV) array - and two new distributed energy resources - a 550 kW reciprocating biogas engine and a 435 kW PV array.²,³ The two biogas units would incorporate combined heat and power (CHP) systems that would produce thermal energy as well as electricity. In addition, the microgrid would incorporate backup generators, including an existing 750 kW diesel backup unit at the IAWWTF, a new 125 kW diesel backup unit at the IAWWTF, an existing 300 kW diesel backup generator at the Ithaca High School, and an existing 150 kW natural gas backup generator at the Department of Public Works. The project’s proponents anticipate that the biogas and PV units would produce electricity for consumption during periods of normal operation. In contrast, the backup generators would produce power only during an outage, when the microgrid would operate in islanded mode. The system as designed would have sufficient generating capacity to meet average demand for electricity from the five facilities during a major outage. The project team also indicates that the system could provide black start support to the grid.

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.

² Because the existing 260 kW biogas microturbine and 7.5 kW PV array are already in operation, the energy they currently generate is not treated as a benefit of the microgrid. However, as part of the microgrid project, the existing biogas unit is projected to increase its annual electricity production by 775 MWh. This incremental increase in energy generation is treated as a benefit of the microgrid.
³ The existing biogas microturbine utilizes anaerobic digester gas produced by the IAWWTF. Currently, the IAWWTF flares off excess anaerobic digester gas. The new reciprocating biogas engine will also utilize anaerobic digester gas produced by the IAWWTF. Once this new biogas unit is operating, the IAWWTF will no longer produce excess anaerobic digester gas.
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. Of note, 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. 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.\(^5\)

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 project’s costs would exceed its benefits. In order for the project’s benefits to outweigh its costs, the average duration of major outages would need to equal or exceed 0.2 days per year (Scenario 2). The discussion that follows provides additional detail on these findings.

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

<table>
<thead>
<tr>
<th>ECONOMIC MEASURE</th>
<th>ASSUMED AVERAGE DURATION OF MAJOR POWER OUTAGES</th>
<th>SCENARIO 1: 0 DAYS/YEAR</th>
<th>SCENARIO 2: 0.2 DAYS/YEAR</th>
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</thead>
<tbody>
<tr>
<td>Net Benefits - Present Value</td>
<td>-534,000</td>
<td>467,000</td>
<td></td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td>0.96</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Internal Rate of Return</td>
<td>6.2%</td>
<td>8.2%</td>
<td></td>
</tr>
</tbody>
</table>

Scenario 1

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

---

\(^5\) 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.
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)

<table>
<thead>
<tr>
<th>COST OR BENEFIT CATEGORY</th>
<th>PRESENT VALUE OVER 20 YEARS (2014$)</th>
<th>ANNUALIZED VALUE (2014$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
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<tr>
<td>Initial Design and Planning</td>
<td>$1,380,000</td>
<td>$122,000</td>
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<tr>
<td>Capital Investments</td>
<td>$5,280,000</td>
<td>$465,000</td>
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<tr>
<td>Fixed O&amp;M</td>
<td>$1,380,000</td>
<td>$121,000</td>
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<tr>
<td>Variable O&amp;M (Grid-Connected Mode)</td>
<td>$839,000</td>
<td>$74,000</td>
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<tr>
<td>Fuel (Grid-Connected Mode)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emission Control</td>
<td>$0</td>
<td>$0</td>
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<td>Emissions Allowances</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emissions Damages (Grid-Connected Mode)</td>
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<td>$274,000</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
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<td><strong>$274,000</strong></td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
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<tr>
<td>Reduction in Generating Costs</td>
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<td>$310,000</td>
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<td>Fuel Savings from CHP</td>
<td>$969,000</td>
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<td>Generation Capacity Cost Savings</td>
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<td>Distribution Capacity Cost Savings</td>
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<td>Reliability Improvements</td>
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<td>Power Quality Improvements</td>
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<td>Major Power Outage Benefits</td>
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<td><strong>Total Benefits</strong></td>
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</tr>
<tr>
<td><strong>Net Benefits</strong></td>
<td><strong>-534,000</strong></td>
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</tr>
<tr>
<td><strong>Benefit/Cost Ratio</strong></td>
<td><strong>0.96</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Rate of Return</strong></td>
<td><strong>6.2%</strong></td>
<td></td>
</tr>
</tbody>
</table>

**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 $1.4 million. The present value of the project’s capital costs is estimated at approximately $5.3 million, including costs associated with acquiring and installing the new PV array and biogas CHP system; a district energy system; electrical upgrades at the host facilities; upgrades and modifications to the local distribution system; and hardware and software equipment for microgrid operation and control. The present value of fixed operation and maintenance (O&M) costs over a 20-year operating period is estimated to be approximately $1.4 million.

**Variable Costs**
The project team estimates that it will cost approximately $13.02 per MWh of electricity produced to cover variable O&M costs associated with operating the biogas CHP systems, the PV arrays, and the district energy system (e.g., labor, maintenance, and administration). Given the microgrid’s projected annual electricity production, this would translate to variable O&M costs of approximately $74,000 annually. The
present value of the project’s variable O&M costs over a 20-year operating period is estimated to be approximately $839,000.

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 biogas units would not be subject to emissions allowance requirements. In this case, the damages attributable to emissions from the biogas units are estimated at approximately $274,000 annually. The majority of these damages are attributable to the emission of CO₂ and PM₂.⁵. Over a 20-year operating period, the present value of emissions damages is estimated at approximately $4.2 million.

Avoided Costs

The development and operation of a microgrid may avoid or reduce a number of costs that otherwise would be incurred. In the case of the City of Ithaca’s proposed microgrid, one of the primary sources of cost savings would be a reduction in demand for electricity from bulk energy suppliers, with a resulting reduction in generating costs. The BCA estimates the present value of these savings over a 20-year operating period to be approximately $3.5 million; this estimate assumes the microgrid provides base load power, consistent with the operating profile upon which the analysis is based. The reduction in demand for electricity from bulk energy suppliers would also reduce emissions of CO₂ and particulate matter from these sources, and produce a shift in demand for SO₂ and NOₓ emissions allowances. The present value of these benefits is approximately $3.7 million.⁶

The microgrid’s CHP systems could deliver additional cost savings over the microgrid’s 20-year operating period. The fuel savings provided by the CHP system would lead to avoided natural gas fuel costs with a present value of approximately $969,000.⁷

In addition to the savings noted above, development of a microgrid could yield cost savings by avoiding or deferring the need to invest in expansion of the conventional grid’s energy generation or distribution capacity.⁸ Based on standard capacity factors for the solar and biogas generators, the project team estimates the project’s impact on demand for generating capacity to be approximately 2.3005 MW per year⁹. Based on this figure, the BCA estimates the present value of the project’s generating capacity benefits to be approximately $2.0 million over a 20-year operating period. Similarly, the project team estimates that the microgrid project will impact distribution capacity by approximately 0.762 MW per year. Based on this estimate, the BCA estimates the present value of the project’s distribution capacity benefits to be approximately $315,000 over a 20-year operating period.

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⁶ Following the New York Public Service Commission’s (PSC) guidance for benefit-cost analysis, the model values emissions of CO₂ 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 SO₂ and NOₓ 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.

⁷ The model adjusts the State Energy Plan’s natural gas and diesel price projections using fuel-specific multipliers that are 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.

⁸ Impacts on 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.

⁹ This projected impact on demand for generating capacity includes the peak load support capacity that will be provided by the existing 260 kW biogas microturbine and 7.5 kW PV array. Though these existing DER units are already in operation, they do not currently provide peak load support. They will begin providing peak load support when integrated into the microgrid.
The project team has indicated that the proposed microgrid would be capable of providing ancillary services (black start support) to the New York Independent System Operator (NYISO). Whether NYISO would select the project to provide these services depends on NYISO’s requirements and the ability of the project to provide support at a cost lower than that of alternative sources. Based on discussions with NYISO, it is our understanding that the market for ancillary services is highly competitive, and that projects of this type would have a relatively small chance of being selected to provide support to the grid. In light of this consideration, the analysis does not attempt to quantify the potential benefits of providing such services.

**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 $38,300 per year, with a present value of $434,000 over a 20-year operating period. This estimate is calculated 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:10

- System Average Interruption Frequency Index (SAIFI) – 1.03 events per year.
- Customer Average Interruption Duration Index (CAIDI) – 118.2 minutes.11

The estimate takes into account the number of residential customers the project would serve; the number of small and large commercial or industrial customers the project would serve; the distribution of these customers by economic sector; average annual electricity usage per customer, as provided by the project team; and the prevalence of backup generation among these customers. It also takes into account the variable costs of operating existing backup generators, both in the baseline and as an integrated component of a microgrid. Under baseline conditions, the analysis assumes a 15 percent failure rate for backup generators.12 It assumes that establishment of a microgrid would reduce the rate of failure to near zero.

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.

**Summary**

The analysis of Scenario 1 yields a benefit/cost ratio of 0.96; i.e., the estimate of project benefits is approximately 96 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

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10 [www.icecalculator.com](http://www.icecalculator.com).
11 The analysis is based on DPS’s reported 2014 SAIFI and CAIDI values for New York State Electric & Gas.
12 [http://www.businessweek.com/articles/2012-12-04/how-to-keep-a-generator-running-when-you-lose-power#p1](http://www.businessweek.com/articles/2012-12-04/how-to-keep-a-generator-running-when-you-lose-power#p1).
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— including plausible assumptions about the failure of backup generation— 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.13,14

As noted above, the City of Ithaca’s microgrid project would serve five facilities. The project’s consultants indicate that at present, three of these facilities are equipped with backup generators: the IAWWTF, Ithaca High School, and the Department of Public Works. Should there be a power outage, these facilities would maintain some level of operations by using their backup generators. The analysis assumes that the supply of fuel necessary to operate backup generators would be maintained indefinitely, and each generator is assumed to have a 15 percent chance of failing. The other two facilities - the Tompkins Consolidated Area Transit and the Balance of Feeder 783 - have no backup generators and would experience a complete loss in service capabilities during a power outage. For the three facilities with backup power, Table 3 summarizes the project team’s estimates for the costs of operating backup generators, the cost of emergency measures necessary while on backup power, and the percent loss in service capabilities while on backup power:

<table>
<thead>
<tr>
<th>FACILITY NAME</th>
<th>ONE-TIME COST OF MAINTAINING SERVICE WITH BACKUP GENERATOR ($)</th>
<th>ONGOING COST OF MAINTAINING SERVICE WITH BACKUP GENERATOR ($/DAY)*</th>
<th>ONGOING COSTS OF EMERGENCY MEASURES WHILE ON BACKUP POWER ($/DAY)</th>
<th>PERCENT LOSS IN SERVICE WHEN ON BACKUP GENERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>$480</td>
<td>$1,100</td>
<td>$0</td>
<td>0%</td>
</tr>
<tr>
<td>Ithaca High School</td>
<td>$160</td>
<td>$1,422</td>
<td>$1,000</td>
<td>50%</td>
</tr>
<tr>
<td>Department of Public Works</td>
<td>$160</td>
<td>$145</td>
<td>$500</td>
<td>0%</td>
</tr>
</tbody>
</table>

* The ongoing costs for operating backup generators include fuel costs.

In the absence of backup power - i.e., if the backup generators failed and no replacement was available—all of the facilities would experience a 100 percent loss in service capabilities. In addition:

- Ithaca High School would incur emergency measure costs of $2,000 per day.
- The Department of Public Works would incur emergency measure costs of $1,000 per day.

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13 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.

14 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.
The economic consequences of a major power outage also depend on the value of the services the facilities of interest provide. The analysis calculates the impact of a loss in the city’s wastewater and electric services using standard FEMA methodologies that characterize the value of these services. The impact of a loss in service at Ithaca High School is valued at approximately $86,000 per day. This figure is based on the school district’s budget for the current school year, scaled to an average daily value and prorated by the percentage of the district’s student body attending the high school.

For the other facilities, the impact of a loss in service is based on the following value of service estimates, which were developed using the U.S. Department of Energy’s ICE Calculator:

- For the Tompkins Consolidated Area Transit, a value of approximately $85,000 per day.
- For the Department of Public Works, a value of approximately $52,000 per day.
- For the four small commercial entities served by the Balance of Feeder 783, a value of approximately $22,000 per day.

Based on these values, the analysis estimates that in the absence of a microgrid, the average cost of an outage for the six facilities is approximately $439,000 per day.

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 0.2 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.

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15 The BCA uses FEMA methodologies that characterize the value of electric service to evaluate the impact of a loss in service for the 40 residences served by the Balance of Feeder 783. The loss in service for the four small commercial entities served by the Balance of Feeder 783 is evaluated separately.


Figure 2. Present Value Results, Scenario 2 (Major Power Outages Averaging 0.2 Days/Year; 7 Percent Discount Rate)
### Table 4. Detailed BCA Results, Scenario 2 (Major Power Outages Averaging 0.2 Days/Year; 7 Percent Discount Rate)

<table>
<thead>
<tr>
<th>COST OR BENEFIT CATEGORY</th>
<th>PRESENT VALUE OVER 20 YEARS (2014$)</th>
<th>ANNUALIZED VALUE (2014$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Design and Planning</td>
<td>$1,380,000</td>
<td>$122,000</td>
</tr>
<tr>
<td>Capital Investments</td>
<td>$5,280,000</td>
<td>$465,000</td>
</tr>
<tr>
<td>Fixed O&amp;M</td>
<td>$1,380,000</td>
<td>$121,000</td>
</tr>
<tr>
<td>Variable O&amp;M (Grid-Connected Mode)</td>
<td>$839,000</td>
<td>$74,000</td>
</tr>
<tr>
<td>Fuel (Grid-Connected Mode)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emission Control</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emissions Allowances</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Emissions Damages (Grid-Connected Mode)</td>
<td>$4,200,000</td>
<td>$274,000</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$13,100,000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction in Generating Costs</td>
<td>$3,510,000</td>
<td>$310,000</td>
</tr>
<tr>
<td>Fuel Savings from CHP</td>
<td>$969,000</td>
<td>$85,500</td>
</tr>
<tr>
<td>Generation Capacity Cost Savings</td>
<td>$1,960,000</td>
<td>$173,000</td>
</tr>
<tr>
<td>Distribution Capacity Cost Savings</td>
<td>$315,000</td>
<td>$27,800</td>
</tr>
<tr>
<td>Reliability Improvements</td>
<td>$434,000</td>
<td>$38,300</td>
</tr>
<tr>
<td>Power Quality Improvements</td>
<td>$1,680,000</td>
<td>$148,000</td>
</tr>
<tr>
<td>Avoided Emissions Allowance Costs</td>
<td>$1,930</td>
<td>$170</td>
</tr>
<tr>
<td>Avoided Emissions Damages</td>
<td>$3,680,000</td>
<td>$240,000</td>
</tr>
<tr>
<td>Major Power Outage Benefits</td>
<td>$1,000,000</td>
<td>$88,400</td>
</tr>
<tr>
<td><strong>Total Benefits</strong></td>
<td><strong>$13,500,000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Net Benefits</strong></td>
<td><strong>$467,000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Benefit/Cost Ratio</strong></td>
<td><strong>1.0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Rate of Return</strong></td>
<td><strong>8.2%</strong></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I. NYSERDA COST BENEFIT QUESTIONNAIRES
NY Prize Benefit-Cost Analysis: Facility Questionnaire

This questionnaire requests information needed to estimate the impact that a microgrid might have in protecting the facilities it serves from the effects of a major power outage (i.e., an outage lasting at least 24 hours). The information in this questionnaire will be used to develop a preliminary benefit-cost analysis of the community microgrid you are proposing for the NY Prize competition. Please provide as much detail as possible.

For each facility that will be served by the microgrid, we are interested in information on:

I. Current backup generation capabilities.

II. The costs that would be incurred to maintain service during a power outage, both when operating on its backup power system (if any) and when backup power is down or not available.

III. The types of services the facility provides.

If you have any questions regarding the information requested, please contact Industrial Economics, Incorporated, either by email (NYPrize@indecon.com) or phone (929-445-7641).

Microgrid site: 68. City of Ithaca

Point of contact for this questionnaire:

Name: Dan Ramer  
Address: 525 3rd St, Ithaca, NY 14850  
Telephone: 607.273.8381

Email: dramer@cityofithaca.org

I. Backup Generation Capabilities

1. Do any of the facilities that would be served by the microgrid currently have backup generation capabilities?
   a. ☐ No - proceed to Question 4  
   b. ☒ Yes - proceed to Question 2

2. For each facility that is equipped with a backup generator, please complete the table below, following the example provided. Please include the following information:
   a. Facility name: For example, “Main Street Apartments.”  
   b. Identity of backup generator: For example, “Unit 1.”
c. **Energy source**: Select the fuel/energy source used by each backup generator from the dropdown list. If you select “other,” please type in the energy source used.

d. **Nameplate capacity**: Specify the nameplate capacity (in MW) of each backup generator.

e. **Standard operating capacity**: Specify the percentage of nameplate capacity at which the backup generator is likely to operate during an extended power outage.

f. **Average electricity production per day in the event of a major power outage**: Estimate the average daily electricity production (MWh per day) for the generator in the event of a major power outage. In developing the estimate, please consider the unit’s capacity, the daily demand at the facility it serves, and the hours of service the facility requires.

g. **Fuel consumption per day**: Estimate the amount of fuel required per day (e.g., MMBtu per day) to generate the amount of electricity specified above. This question does not apply to renewable energy resources, such as wind and solar.

h. **One-time operating costs**: Please identify any one-time costs (e.g., labor or contract service costs) associated with connecting and starting the backup generator.

i. **Ongoing operating costs**: Estimate the costs ($/day) (e.g., maintenance costs) associated with operating the backup generator, excluding fuel costs.

Note that backup generators may also serve as distributed energy resources in the microgrid. Therefore, there may be some overlap between the information provided in the table below and the information provided for the distributed energy resource table (Question 2) in the general Microgrid Data Collection Questionnaire.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>EGEN 1</td>
<td>Diesel</td>
<td>.750</td>
<td>80%</td>
<td>14.4</td>
<td>83.9</td>
<td>3 man x 4 hours/day x $40/hr</td>
<td>$100</td>
</tr>
<tr>
<td>High School</td>
<td>EGEN1</td>
<td>Diesel</td>
<td>.300</td>
<td>80%</td>
<td>5.76</td>
<td>110.89</td>
<td>1 man x 4 hours/day x</td>
<td>$100</td>
</tr>
</tbody>
</table>
**Second Table: Facility Questionnaire**

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Generator ID</th>
<th>Energy Source</th>
<th>Nameplate Capacity (MW)</th>
<th>Standard Operating Capacity (%)</th>
<th>Avg. Daily Production During Power Outage (MWh/Day)</th>
<th>Fuel Consumption per Day</th>
<th>Quantity</th>
<th>Unit</th>
<th>One-Time Operating Costs ($)</th>
<th>Ongoing Operating Costs ($/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Public Works (Streets &amp; Facilities)</td>
<td>EGEN1</td>
<td>Natural Gas</td>
<td>.15</td>
<td>80%</td>
<td>0.70</td>
<td>7.03</td>
<td>1 man</td>
<td>MMBtu/Day</td>
<td>$100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>57T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 hours/day x</td>
<td></td>
</tr>
</tbody>
</table>

**II. Costs of Emergency Measures Necessary to Maintain Service**

We understand that facilities may have to take emergency measures during a power outage in order to maintain operations, preserve property, and/or protect the health and safety of workers, residents, or the general public. These measures may impose extraordinary costs, including both one-time expenditures (e.g., the cost of evacuating and relocating residents) and ongoing costs (e.g., the daily expense of renting a portable generator). The questions below address these costs. We begin by requesting information on the costs facilities would be likely to incur when operating on backup power. We then request information on the costs facilities would be likely to incur when backup power is not available.
A. **Cost of Maintaining Service while Operating on Backup Power**

3. Please provide information in the table below for each facility the microgrid would serve which is currently equipped with some form of backup power (e.g., an emergency generator). For each facility, please describe the costs of any emergency measures that would be necessary in the event of a widespread power outage (i.e., a total loss of power in the area surrounding the facility lasting at least 24 hours). In completing the table, please assume that the facility’s backup power system is fully operational. In your response, please describe and estimate the costs for:

   a. One-time emergency measures (total costs)
   b. Ongoing emergency measures (costs per day)

Note that these measures do not include the costs associated with running the facility’s existing backup power system, as estimated in the previous question.

In addition, for each emergency measure, please provide additional information related to when the measure would be required. For example, measures undertaken for heating purposes may only be required during winter months. As another example, some commercial facilities may undertake emergency measures during the work week only.

As a guide, see the examples the table provides.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Type of Measure (One-Time or Ongoing)</th>
<th>Description</th>
<th>Costs</th>
<th>Units</th>
<th>When would these measures be required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>One-Time Measures</td>
<td>N/A</td>
<td>0</td>
<td>$</td>
<td>All measures associated with running the process are accounted for regardless of emergency status</td>
</tr>
<tr>
<td>Facility Name</td>
<td>Type of Measure (One-Time or Ongoing)</td>
<td>Description</td>
<td>Costs</td>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------</td>
<td>-------------</td>
<td>-------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>Ongoing Measures</td>
<td>Costs for meeting the operational requirements of the microgrid using High School facility staff. O&amp;M of microgrid is by others, however system checks at the High School will be required to verify microgrid power and functionality is satisfactory during the duration of the outage.</td>
<td>$1000</td>
<td>$/day</td>
<td></td>
</tr>
</tbody>
</table>

The proposed microgrid will provide 100% of the High School's power requirements therefore it is assumed there would be no incremental costs as the same facility staffing and operational procedures would be executed as if there were no power outage.

The cost estimate of $1000/day for High School staff/facility represents costs associated with meeting the operational requirements during microgrid operation, once the existing emergency generators have come offline and the highschool is ready to sync to the microgrid.
<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Type of Measure (One-Time or Ongoing)</th>
<th>Description</th>
<th>Costs</th>
<th>Units</th>
<th>When would these measures be required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>Ongoing Measures</td>
<td>Costs for meeting the operational requirements of the microgrid using Department of Public Works facility staff. O&amp;M of microgrid is by others, however system checks at the DPW will be required to verify microgrid power and functionality is satisfactory during the duration of the outage.</td>
<td>$500</td>
<td>$/day</td>
<td>The proposed microgrid will provide 100% of the Department of Public Works power requirements therefore it is assumed there would be no incremental costs as the same facility staffing and operational procedures would be executed as if there were no power outage. The cost estimate of $500/day for Department of Public Works staff/facility represents costs associated with meeting the operational requirements during microgrid operation, once the existing emergency generators have come offline and the highschool is ready to sync to the microgrid.</td>
</tr>
<tr>
<td>57T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**B. Cost of Maintaining Service while Backup Power is Not Available**

4. Please provide information in the table below for each facility the microgrid would serve. For each facility, please describe the costs of any emergency measures that would be necessary in the event of a widespread power outage (i.e., a total loss of power in the area surrounding the facility lasting at least 24 hours). In completing the table, please assume that service from any backup generators currently on-site is not available. In your response, please describe and estimate the costs for:

a. One-time emergency measures (total costs)

b. Ongoing emergency measures (costs per day)

In addition, for each emergency measure, please provide additional information related to when the measure would be required. For example, measures undertaken for heating purposes may only be required during winter months. As another example, some commercial facilities may undertake emergency measures during the work week only.

As a guide, see the examples the table provides.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Type of Measure (One-Time or Ongoing)</th>
<th>Description</th>
<th>Costs</th>
<th>Units</th>
<th>When would these measures be required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>One-Time Measures</td>
<td>Renting additional portable generator</td>
<td>1500</td>
<td>$/day</td>
<td>24/7 when installed egen not available</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>One-Time Measures</td>
<td>Hooking up additional portable generation</td>
<td>500</td>
<td>$/day</td>
<td>One Time</td>
</tr>
<tr>
<td>IAWWTF</td>
<td>Ongoing Measures</td>
<td>Staff and operations during outage</td>
<td>3 man x $40/hr</td>
<td>$/hr</td>
<td>Exclusive of fuel, these are operating costs during egen outage</td>
</tr>
<tr>
<td>High School</td>
<td>One-Time Measures</td>
<td>Renting additional portable generator</td>
<td>1500</td>
<td>$/day</td>
<td>24/7 when installed egen not available</td>
</tr>
<tr>
<td>High School</td>
<td>One-Time Measures</td>
<td>Hooking up additional portable generation</td>
<td>500</td>
<td>$/day</td>
<td>One Time</td>
</tr>
<tr>
<td>High School</td>
<td>Ongoing Measures</td>
<td>Costs for meeting the operational requirements of the High School during outage with no backup generation available. Assumes twice that of when backup generation is available due to additional operational and administrative requirements to either procure emergency backup power or evacuate if not available.</td>
<td>$2000</td>
<td>$/day</td>
<td>In the event backup power is not available</td>
</tr>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>One-Time Measures</td>
<td>Renting additional portable generator</td>
<td>1500</td>
<td>$/day</td>
<td>24/7 when installed egen not available</td>
</tr>
<tr>
<td>Facility Name</td>
<td>Type of Measure (One-Time or Ongoing)</td>
<td>Description</td>
<td>Costs</td>
<td>Units</td>
<td>When would these measures be required?</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------</td>
<td>-------------</td>
<td>-------</td>
<td>-------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>One-Time Measures</td>
<td>Hooking up additional portable generation</td>
<td>500 $/day</td>
<td></td>
<td>One Time</td>
</tr>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>Ongoing Measures</td>
<td>Costs for meeting the operational requirements of the High School during outage with no backup generation available. Assumes twice that of when backup generation is available due to additional operational and administrative requirements to either procure emergency backup power or evacuate if not available.</td>
<td>$1000 $/day</td>
<td></td>
<td>In the event backup power is not available</td>
</tr>
</tbody>
</table>

### III. Services Provided

We are interested in the types of services provided by the facilities the microgrid would serve, as well as the potential impact of a major power outage on these services. As specified below, the information of interest includes some general information on all facilities, as well as more detailed information on residential facilities and critical service providers (i.e., facilities that provide fire, police, hospital, water, wastewater treatment, or emergency medical services (EMS)).
A. **Questions for: All Facilities**

5. During a power outage, is each facility able to provide the same level of service when using backup generation as under normal operations? If not, please estimate the percent loss in the services for each facility (e.g., 20% loss in services provided during outage while on backup power). As a guide, see the example the table provides.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Percent Loss in Services When Using Backup Gen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>0%</td>
</tr>
<tr>
<td>High School</td>
<td>50%</td>
</tr>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>0%</td>
</tr>
<tr>
<td>Tompkins Consolidated Area Transit (TCAT)</td>
<td>100%</td>
</tr>
<tr>
<td>Balance of Feeder 783</td>
<td></td>
</tr>
<tr>
<td>Boatyard &amp; Boat Center</td>
<td>100%</td>
</tr>
<tr>
<td>Hydroponics Shop</td>
<td></td>
</tr>
<tr>
<td>Golfcourse</td>
<td></td>
</tr>
<tr>
<td>Church</td>
<td></td>
</tr>
<tr>
<td>40 Residential Single Family Homes</td>
<td></td>
</tr>
</tbody>
</table>

6. During a power outage, if backup generation is not available, is each facility able to provide the same level of service as under normal operations? If not, please estimate the percent loss in the services for each facility (e.g., 40% loss in services provided during outage when backup power is not available). As a guide, see the example the table provides.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Percent Loss in Services When Backup Gen. is Not Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAWWTF</td>
<td>100%</td>
</tr>
<tr>
<td>High School</td>
<td>100%</td>
</tr>
<tr>
<td>Department of Public Works (Steets &amp; Facilities)</td>
<td>100%</td>
</tr>
<tr>
<td>Tompkins Consolidated Area Transit (TCAT)</td>
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<td>Balance of Feeder 783</td>
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</tr>
<tr>
<td>Golfcourse</td>
<td></td>
</tr>
<tr>
<td>Church</td>
<td></td>
</tr>
<tr>
<td>40 Residential Single Family Homes</td>
<td></td>
</tr>
</tbody>
</table>
B.  Questions for facilities that provide: **Fire Services**

7.  What is the total population served by the facility?

   N/A

8.  Please estimate the percent increase in average response time for this facility during a power outage:

   N/A

9.  What is the distance (in miles) to the nearest backup fire station or alternative fire service provider?

   N/A

C.  Questions for facilities that provide: **Emergency Medical Services (EMS)**

10.  What is the total population served by the facility?

   N/A

11.  Is the area served by the facility primarily (check one):

   ☐ Urban
   ☐ Suburban
   ☐ Rural
   ☐ Wilderness

12.  Please estimate the percent increase in average response time for this facility during a power outage:

   N/A

13.  What is the distance (in miles) to the next nearest alternative EMS provider?

   N/A

D.  Questions for facilities that provide: **Hospital Services**

14.  What is the total population served by the facility?

   N/A
15. What is the distance (in miles) to the nearest alternative hospital?
   
   N/A

16. What is the population served by the nearest alternative hospital?
   
   N/A

**E. Questions for facilities that provide: Police Services**

17. What is the total population served by the facility?
   
   N/A

18. Is the facility located in a (check one):
   
   ☐ Metropolitan Statistical Area
   ☐ Non-Metropolitan City
   ☐ Non-Metropolitan County

19. Please estimate:
   
   a. The **number** of police officers working at the station under normal operations.
      
      N/A
   
   b. The **number** of police officers working at the station during a power outage.
      
      N/A
   
   c. The **percent reduction** in service effectiveness during an outage.
      
      N/A

**F. Questions for facilities that provide: Wastewater Services**

20. What is the total population served by the facility?
   
   40,000

21. Does the facility support (check one):
   
   ☐ Residential customers
☐ Businesses
☒ Both

**G. Questions for facilities that provide: Water Services**

22. What is the total population served by the facility?

N/A as multiple water suppliers, none of which part of MG

23. Does the facility support (check one):

☐ Residential customers

☐ Businesses

☐ Both
24. What types of housing does the facility provide (e.g., group housing, apartments, nursing homes, assisted living facilities, etc.)?

40 residential single family homes

25. Please estimate the number of residents that would be left without power during a complete loss of power (i.e., when backup generators fail or are otherwise not available).

120, assume 3 members per household.
APPENDIX I: STAGE I FEASIBILITY ASSESSMENT REPORT CHECKLIST
ATTACHMENT I

Stage 1 Feasibility Assessment Report Checklist

Instructions on completing the checklist:

Click on “Choose an item” for each question and respond accordingly.

Microgrid Capabilities and Technical Design

Microgrid Capabilities

- Does the microgrid serve at least one but preferably more, physically separated critical facilities located on one or more properties? Yes. Where in the study has this been addressed?
  - ✓ Table 5 (Page 26) & Appendix G
- Does the microgrid serve both critical and non-critical loads at those facilities? Yes. Where in the study has this been addressed?
  - ✓ Table 5 (Page 26) & Appendix G
- Does the microgrid design provide on-site power in both grid-connected and islanded mode? Yes. Where in the study has this been addressed?
  - ✓ Section 3.4.3 (Page 21), Section 43.1 and 4.3.2 (Pages 29-31), Appendix B: Project Conceptual Design Drawings
- Does the microgrid distributed energy resources provide 24 hrs per day and 7 days per week utilization of the power? Yes. Where in the study has this been addressed?
  - ✓ Section 4.5.3 (Pages 35-36)
- What percentage of the total power consumption in the microgrid will be supplied by resources in the microgrid? Local utility? Yes. Where in the study has this been addressed?
  - ✓ Section 3.4.3 (Page 21) and Section 4.5.3 (Pages 35-36)
- Are microgrid resources designed to follow the electrical load while maintaining the voltage and frequency when running parallel connected to grid? Yes. Where in the study has this been addressed?
  - ✓ Section 3.4.5 (Page 21), Section 4.7 (Page 38)
- Does the microgrid design provide a means for two-way communication and control between the distributed energy resources owner/operator and the local distribution utility through automated, seamless integration? Or, is the transition initiated by the microgrid operator? Yes. Where in the study has this been addressed?
  - ✓ Section 3.5.1 (Pages 21-22), Section 4.7 and Section 4.8 (Pages 38-40)
- Does the microgrid design include secure control/communication systems from cyber-intrusions/disruptions and protect the privacy of sensitive data? Yes. Where in the study has this been addressed?
  - ✓ Section 5.7 (Page 55) and Section 4.8 (Page 40)
- Does the microgrid design include an uninterruptible fuel supply for DER for no less than one week? Yes. Where in the study has this been addressed?
  - ✓ Section 4.5.5 (Pages 36-37) - Onsite biogas storage of 2 days and diesel storage for 37 hours. However, if for some reason biogas cannot be produced, natural gas can be utilized in the duel fuel gensets as in Section 2.2.2 (Page 17). Same for diesel fuel for the emergency generators as in Section 3.4.1 (Page 20). Also see Appendix H & I: Benefit Cost Analysis.
• If generation in the microgrid is dependent to the supply of natural gas or other fuels, what are the arrangements for continuous access to these supplies? What agreements will be made for fuel supply under catastrophic events and for what duration would these supplies support microgrid operation? Where in the study has this been addressed?
  ✓ Section 2.2.2 (Page 17) and Section 3.4.1 (Page 20)

• Does the microgrid design describe how many days of continuous operation can be achieved with current fuel storage capability? If additional fuel storage is required, provide a description of needs required for this or otherwise describe how fuel security is to be managed? Where in the study has this been addressed?
  ✓ Section 4.5.5 (Pages 36-37) - Onsite biogas storage of 2 days and diesel storage for 37 hours. However, if for some reason biogas cannot be produced, natural gas can be utilized in the dual fuel gensets as in Section 2.2.2 (Page 17). Same for diesel fuel for the emergency generators as in Section 3.4.1 (Page 20). Also see Appendix H & I: Benefit Cost Analysis.

• How does the microgrid design provide resiliency to likely adverse weather and environment conditions that are the most likely to impact facilities (generation, delivery, and customer connections) at the specific location (community)? Where in the study has this been addressed?
  ✓ Section 4.5.3 (Pages 35-36), Section 4.6 (Page 37) and Section 4.3 (Pages 29-31)

• Does the microgrid design provide black-start capability? Yes. Where in the study has this been addressed?
  ✓ Section 4.5.3 (Page 36), Section 3.4.2 (Pages 20-21) and Appendix H

• Does the microgrid design consider energy efficiency options that minimize the need for additional generation assets? Yes. Where in the study has this been addressed?
  ✓ Section 2.1.1 (Page 15), Section 3.5.2 (Page 22) and Section 4.7.1 (Pages 39-40)

• Does the microgrid design address installation, operations, maintenance and communications for the electric system that serves all the generation and loads within the electrical boundary of the microgrid from commissioning of equipment and systems through system and operational testing of the microgrid controller and the distribution utility? Yes. Where in the study has this been addressed?
  ✓ Operations: Section 4.3 (Page 29-31), Maintenance: Section 3.4.4 (Page 21), Communications: Section 4.8 (Page 40), Section 5.4.2 (Pages 50-51), Appendix C

• To what extent does the microgrid design involve clean power supply sources that minimize environmental impacts, including local renewable resources, as measured by total percentage of community load covered by carbon-free energy generation? Where in the study has this been addressed?
  ✓ Executive Summary, Section 3.5.5 (Page 23), Section 4.5.2 (Page 35), Section 5.3 (Page 44) and Section 7 (Pages 61-63)

• To what extent does the microgrid design demonstrate tangible community benefits, including but not limited to, (e.g. jobs created, number of customers served, number of buildings affected, scale of energy efficiency retrofits, support for emergency management personnel during catastrophic events most likely to occur in the area)? Where in the study has this been addressed?
  ✓ Section 3.5.6 (Pages 23-24, Section 3.2 (Page 19) and Section 7.4 (Page 64) and Appendix H (Page H7)

• Does the microgrid design incorporate capabilities that improve the resiliency and reliability of the distribution system to which it is connected? Provide confirmation from the utility
improvement in resiliency and reliability are expected. Yes. Where in the study has this been addressed?

✓ Section 4.6 (Pages 37-38) and Section 4.5.3 (Pages 35-36) Also see Appendix H & I: Benefit Cost Analysis.

- Does the microgrid provide capabilities to expedite power system restoration in adjacent areas (for customers other than those in the microgrid)? Yes. Where in the study has this been addressed?
  ✓ Section 3.4.2 (Pages 20-21), Section 3.5.5 (Page 22) and Appendix H

- Are there proposed operational plans between the microgrid operator/owner and the distribution utility? Yes. Where in the study has this been addressed?
  ✓ Section 5 (Pages 41-55), Section 4.3 (Pages 29-31) and Section 4.8 (Page 40)

Technical Design

- Does the microgrid design provide an equipment layout diagram and a one-line diagram depicting new, updated or proposed equipment, including location of the distributed energy resources and utility interconnection point (Point of Common Coupling (PCC))? Yes. Where in the study has this been addressed?
  ✓ Appendix B

- Does the microgrid design take into account interconnection issues at the PCC? Upgrades to the substation? Feeder? Yes. Where in the study has this been addressed?
  ✓ Section 4.2.3 & 4.2.4 (Pages 27-29) and Appendix B

- Has the local utility evaluated the interconnection impact on the feeder? Yes. Where in the study has this been addressed?

  ✓ See Section 3.1 (Page 18), Section 4.2.4 (Page 29) and Section 4.7 (Pages 38-39). NYSEG has indicated that the proposed project is technically feasible and is subject to further load flow and short circuit coordination studies, among others deemed appropriate for the safe and reliable operation of the microgrid. NYSEG’s Distribution Engineering Department has reviewed the proposed operational sequences and one line diagram for the project.

- Does the microgrid design meet with the local utilities requirements for communications? Yes. Where in the study has this been addressed?
  ✓ Section 3.4.5 (Page 21), Sections 4.7 (Pages 38-39) and Section 4.8 (Page 40)

- Does the microgrid design identify the locations of new and existing microgrid and building controls on the simplified equipment layout diagram? Yes. Where in the study has this been addressed?
  ✓ Appendix B

- Does the microgrid design identify the electrical and thermal infrastructure on the simplified equipment layout and one-line diagrams and differentiate between new, updated and existing infrastructure? Yes. Where in the study has this been addressed?
  ✓ Appendix B

- Does the microgrid design identify the new and existing information technologies and telecommunications infrastructure on the equipment layout diagram? Yes. Where in the study has this been addressed?
  ✓ Appendix B

- Does the microgrid design provide approximate location and space available for microgrid equipment/resources? Yes. Where in the study has this been addressed?
  ✓ Appendix B
• Does the microgrid design fully describe the electrical infrastructure (feeders, lines, relays, breakers, switches, current and potential transformers (CTs and PTs) and thermal infrastructure (steam, hot water, cold water pipes) that are a part of the microgrid? Yes. Where in the study has this been addressed?
  ✓ Appendix B

• Does the microgrid design describe how the proposed microgrid will operate under normal and emergency conditions? Yes. Where in the study has this been addressed?
  ✓ Section 4.2 (Pages 26-27), Section 4.3 (Pages 29-31)

• Does the design include operating agreements, decisions rules and communication procedures between the microgrid operator and the utility necessary to operate the microgrid? Yes. Where in the study has this been addressed?
  ✓ Section 4.3 (Pages 29-31)

• Does the microgrid design describe the electrical and thermal loads served by the microgrid when operating in islanded and grid parallel modes? Yes. Where in the study has this been addressed?
  ✓ Appendix B, Appendix F and Section 4.3 (Pages 29-31)

• Does the microgrid design provide hourly load profile of the loads included in the microgrid and identify the source of the data? If hourly loads are not available, best alternative information shall be provided? Yes. Where in the study has this been addressed?
  ✓ Section 4.4 (Page 32) and Appendix F

• Does the microgrid design provide a description of the sizing of the loads to be served by the microgrid including a description of any redundancy opportunities (ex: n-1) to account for equipment downtime? Yes. Where in the study has this been addressed?
  ✓ Appendix F and Section 4.2.2 (Page 27)

• Does the microgrid design provide the distributed energy resources and thermal generation resources to continuously meet electrical and thermal demand in the microgrid? Yes. Where in the study has this been addressed?
  ✓ Section 4.5.3 (Pages 35-36) and Section 4.5.4 (Page 36)

• Does the microgrid design take into account providing the resiliency of the electrical and thermal infrastructure to the forces of nature that are typical to and pose the highest risk to the location/facilities? Describe how the microgrid design provides resiliency to disruption caused by such phenomenon and for what duration of time? Discuss the impact of severe weather on the electrical and thermal infrastructure? Yes. Where in the study has this been addressed?
  ✓ Section 4.5.3 & 4.5.4 & 4.5.5 (Pages 35-37), Section 4.6 (Pages 37-38) and Section 4.3 (Pages 29-30)

• Does the microgrid design provide what additional investments in utility infrastructure may be required to allow the proposed microgrid to separate and isolate from the utility grid? Yes. Where in the study has this been addressed?
  ✓ Section 4.2.3 (Pages 27-29) and Appendix C.

• Does the microgrid design provide the basic electrical system protection mechanism within the microgrid boundaries? Yes. Where in the study has this been addressed?
  ✓ Section 4.3.3 (Page 31) and Section 4.7 (Pages 38-39) and Appendix B

• Does the microgrid design provide the microgrid control architecture and how it interacts with distributed energy resources controls and building energy management systems, if applicable? Yes. Where in the study has this been addressed?
  ✓ Section 4.7 (Page 38), Section 4.8 (Page 40) and Appendix B
• Does the microgrid design provide for a controller to manage the microgrid functions? Yes. Where in the study has this been addressed?
  ✓ Section 3.5.1 (Pages 21-22), Section 4.2.4, Page 29 and Appendix B
• Does the microgrid design provide a brief written description of the services that could be provided by the microgrid controls including, but not limited to the following: Yes. Where in the study has this been addressed?
  • Automatically connecting to and disconnecting from the grid
  • Load shedding schemes
  • Black start and load addition
  • Performing economic dispatch and load following
  • Demand response
  • Storage optimization
  • Maintaining frequency and voltage
  • Photovoltaic information and controllability; forecasting
  • Coordination of protection settings
  • Selling energy and ancillary services
  • Data logging features
  ✓ Section 4.7 (Page 38), Section 3.5.1 (Pages 21-22), Section 4.3 (Pages 29-31) and Appendix B
• Does the microgrid design provide the information technologies and telecommunications infrastructure and protocols required for the microgrid? Yes. Where in the study has this been addressed?
  ✓ Section 4.7 (Page 38) and Section 4.8 (Page 40)
• Does the microgrid design provide the communications infrastructure required to support microgrid operations with the utility? Yes. Where in the study has this been addressed? Can the utility monitor the microgrid activity at the PCC? Does the communications allow for disconnection by the utility during emergencies or risk to the stability of the interconnected distribution system? Yes. Where in the study has this been addressed?
  ✓ Section 4.7 (Page 38) and Section 4.8 (Page 40)
• How vulnerable are the information technologies and telecommunications infrastructure to catastrophic events that are most likely to impact the microgrid? Where in the study has this been addressed?
  ✓ Section 4.7 (Page 38) and Section 4.8 (Page 40)

Commercial, Financial and Legal Viability

Commercial Viability

• To what extent does the microgrid business plan leverage private capital to the maximum extent possible as measured by total private investment in the project and the ratio of public to private dollars invested in the project? Where in the study has this been addressed?
✓ Section 5.4 (Pages 47-51)

• Does the microgrid business plan identify the number of individuals affected by/associated with
critical loads should these loads go unserved? Yes. Where in the study has this been addressed?
✓ Section 5.2.1 (Page 43) and Appendix I

• Does the microgrid business plan identify any direct/paid services generated by microgrid
operation? Yes. Where in the study has this been addressed?
✓ Section 5.2.2 and Section 5.2.3 (Pages 43-44)

• Does the microgrid business plan identify each of the microgrid customers expected to purchase
services from the microgrid? Yes. Where in the study has this been addressed?
✓ Section 5.2 (Pages 43-44) and Section 3.3 (Page 20)

• Does the microgrid business plan identify other microgrid stakeholders; what customers will be
directly or indirectly affected (positively or negatively) by the microgrid? Yes. Where in the
study has this been addressed?
✓ Section 5.4 (Pages 47-48), Section 5.2 (Pages 43-44) and Section 3.3 (Page 20)

• Do the microgrid design and business plan take into account the relationship between the
microgrid owner and the purchaser of the power? Yes. Where in the study has this been
addressed?
✓ Section 5, Pages 41-55, Section 3.3 (Page 20)

• Does the microgrid business plan indicate which party/customers will purchase electricity during
normal operation? During islanded operation? Yes. Where in the study has this been
addressed?
✓ Section 5.2.2 and Section 5.2.3 (Pages 43-44)

• Does the microgrid business plan identify necessary contractual agreements with critical and
non-critical load purchasers? Yes. Where in the study has this been addressed?
✓ Section 5.2.2 and Section 5.2.3 (Pages 43-44)

• How does the microgrid business plan to solicit and register customers (i.e. purchasers of
electricity) to be part of their project? Where in the study has this been addressed?
✓ Section 5.2.1 (Page 43) and Section 5.2.2, Section 5.2.3 (Pages 43-44) and Figure 9
(Page 46)

• Does the microgrid business plan provide any other energy commodities (such as steam, hot
water, chilled water) that the microgrid will provide to customers? Yes. Where in the study has
this been addressed?
✓ Section 5.2.1 (Page 43), Section 5.2.2 and Section 5.2.3 (Pages 43-44) and Table 16,
Page 54

• How does the microgrid business plan provide value to its participants, to the community at
large, the local electric distribution utility and the state of New York? Where in the study has
this been addressed?
✓ Section 5.3 (Pages 44-46) and Section 5.3.2 (Pages 46-47)

• What benefits and costs will the community realize by the construction and operation of this
microgrid? Where in the study has this been addressed?
✓ Section 3.5.5 and 3.5.6 (Pages 23-24), Section 5.3 (Pages 44-46), Section 5.2.1 (Page
43), Section 3.3 (Page 20) and Appendix H.

• How would installing this microgrid benefit the utility? Its customers? What costs would the
utility incur as a result of this microgrid? Are these covered in the interconnection agreement
with the utility? Where in the study has this been addressed?
What is the proposed business model for this microgrid? Where in the study has this been addressed?
- Section 4.6 (Pages 37-38), Section 5.3 (Pages 44-46), Appendix H, Section 3.5.5 and 3.5.6 (Page 23-24), Section 4.7.1 (Pages 39-40) and Table 7 (Page 29)

Does the business plan include an analysis of strengths, weaknesses, opportunities and threats (SWOT)? Yes. Where in the study has this been addressed?
- Section 6 (Pages 56-60) and Appendix H

What makes this project replicable? Scalable? Where in the study has this been addressed?
- Section 5.5 (Pages 51-52) and Section 1.1 (Page 11)

What is the purpose and need for this project? Where in the study has this been addressed?
- Section 1 (Pages 6-8)

Why is reliability/resiliency particularly important for this location? Will it meet a disaster recovery or unmet infrastructure need? Where in the study has this been addressed?
- Section 4.6 (Pages 37-38), Section 2.2.2 (Page 17) and Section 3.4.1 (Page 20)

Does the microgrid system provide an overall value proposition to each of its identified customers and stakeholders? Yes. Where in the study has this been addressed?
- Section 5.3 (Pages 44-46), Section 1.1 (Page 11) and Appendix C

Does the microgrid system provide added revenue streams, savings, and/or costs for the purchaser of its energy? Yes. Where in the study has this been addressed?
- Section 5.6, Pages (52-55) and Appendix C

Does this microgrid system promote new technologies? Yes. Where in the study has this been addressed?
- Section 3.4.2 (Pages 20-21), Section 3.5.1 (Pages 21-22), Section 3.5.6 (Pages 23-24)

Does the microgrid system promote any public/private partnerships? Yes. Where in the study has this been addressed?
- Section 5.4.1.1 (Pages 48-49)

Are any project financiers or investors identified in the microgrid team? Yes. Where in the study has this been addressed?
- Section 5.4 (Pages 47-51)

Are any legal and/or regulatory advisors part of the microgrid team? Yes. Where in the study has this been addressed?
- Section 5.4.1.1 and Section 5.7 (Page 55)

Are the benefits and challenges of employing any new microgrid technologies listed? Has the microgrid design addressed the permitting and/or special permissions required to construct this project? Are they unique or would they be required of any microgrid? Where in the study has this been addressed?
- Section 5.7 (Page 55) and Section 5.5 (Pages 51-52) also see Section 3 (18-22)

What is the proposed approach for developing, constructing and operating the microgrid system? Where in the study has this been addressed?
- Section 5.4 (Pages 47-51), Section 5.5 (Pages 51-52) and Operation: Section 4.3 (Page 29-31)

How are benefits of the microgrid passed to the community? Where in the study has this been addressed?
- Section 3.5.6 (Pages 23-24), Section 5.3 (Pages 44-47), Section 5.2.1 (Page 43) and Section 3.3, Page 20
• Is a project operational scheme (including, but not limited to, technical, financial, transactional and decision making responsibilities) developed that will be used to ensure this system operates as expected? Where in the study has this been addressed?
  ✓ Section 4.3 (Page 29-31), Section 5.4 (Pages 47-51) and Appendices B & C & D

• How does the project owner plan to charge the purchasers of electricity services? How will the purchasers' use be metered? Where in the study has this been addressed?
  ✓ Section 5.2.2 and Section 5.2.3 (Pages 43-44)

• Are there business/commercialization and replication plans appropriate for the type of project? Yes. Where in the study has this been addressed?
  ✓ Section 5.5 (Pages 51-52)

• How significant are the barriers to market entry for microgrid participants? Where in the study has this been addressed?
  ✓ Section 5.5 (Page 52)

• Does the proposer demonstrate a clear understanding of the steps required to overcome these barriers? Yes. Where in the study has this been addressed?
  ✓ Section 5.5 (Page 52)

Financial Viability

• Does the microgrid design address the categories and relative magnitudes of the revenue streams and/or savings that will flow to the microgrid owner? Will they be fixed or variable? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53) and Appendix C & D

• Does the microgrid system provide other incentives? How does the timing of those incentives affect the development and deployment of this project? Yes. Where in the study has this been addressed?
  ✓ Section 7 (Pages 61-64)

• Does the microgrid design identify categories and relative magnitudes of the capital and operating costs that will be incurred by the microgrid owner? Will they be fixed or variable? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53) and Appendix C & D

• Does the business model for this project ensure that it will be profitable? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53) and Appendix C & D

• Does the microgrid design include a description of a potential financing structure during development, construction and operation of the microgrid? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53) and Appendix C & D

• Is the financial viability of the microgrid dependent on investment credits and subsidies? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53), Appendix D and Section 11 (Page 11)

• Is the operational viability of the microgrid dependent on special tariff arrangements? Yes. Where in the study has this been addressed?
  ✓ Section 5.1.2 (Pages 41-42)

• Does the financial viability of the microgrid depend on subsidies from the local utility or government or operating arrangements with customers served by the microgrid? Yes. Where in the study has this been addressed?
  ✓ Section 5.6 (Pages 52-53), Appendix D and Section 11 (Page 11)
Legal Viability

- Does the microgrid design list the legal terms/conditions/requirements necessary to develop and operate the microgrid? Yes. Where in the study has this been addressed?
  - **Section 5.7 (Page 55)**

- Does the microgrid design describe the potential project ownership structure and project team members that will have a stake in the ownership? Yes. Where in the study has this been addressed?
  - **Section 5.4 Page (47-51)**

- Has the project owner been identified? Yes. Where in the study has this been addressed?
  - **Section 5.4 (Page 47-51), Stage II has initially identified ownership as City of Ithaca**

- Does the project owner (or owners) own the site(s) where microgrid equipment/systems are to be installed? If not, what is the plan to secure access to that/those site(s)? Yes. Where in the study has this been addressed?
  - **Section 5.4 (Page 47-51)**

- What is the approach to protecting the privacy rights of the microgrid customers, e.g. with respect to meter data? Where in the study has this been addressed?
  - **Section 5.7 (Page 55)**

- Does the microgrid design describe any known, anticipated, or potential regulatory hurdles, as well as their implications that will need to be evaluated and resolved for this project to proceed? Yes. Where in the study has this been addressed?
  - **Section 5.7 (Page 55)**

Benefit and Cost Analysis

- Does the cost/benefit analysis provide information from the community, utility and developer’s perspective? Yes. Where in the study has this been addressed?
  - **Appendix H and Appendix I**

- Does the cost/benefit analysis indicate the facility’s average annual electricity demand and peak electricity demand? Yes. Where in the study has this been addressed?
  - **Appendix H, Appendix F and Section 4.4 (Page 32)**

- Does the cost/benefit analysis indicate the percentage of the facility’s average demand the microgrid would be designed to support during a major power outage? Yes. Where in the study has this been addressed?
  - **Appendix H (Page H1) and Table 5 (Page 26)**

- Does the cost/benefit analysis indicate the number of hours per day on average; the facility would require electricity from the microgrid? Yes. Where in the study has this been addressed?
  - **Appendix H (Pages H7), Section 4.6 (Pages 37-38) and Appendix F**

- Does the cost/benefit analysis indicate the impact of the expected provision of peak load support on generating capacity requirements? Yes. Where in the study has this been addressed?
  - **Section 4.5.3 Pages (35-36)**

- Does the cost/benefit analysis indicate capacity of demand response that would be available by each facility the microgrid would serve? Yes. Where in the study has this been addressed?
  - **Table 5 and 6 (Pages 26-27) and Appendix H**

- Does the cost/benefit analysis indicate impact (deferral or avoidance) on transmission or distribution capacity requirements? Yes. Where in the study has this been addressed?
  - **Appendix H and Section 6.2 (Page 58)**
• Does the cost/benefit analysis indicate ancillary services to the local utility (e.g., frequency or real power support, voltage or reactive power support, black start or system restoration support)? Yes. Where in the study has this been addressed?
  ✓ Section 6.2 (Page 58) and Appendix H (Page H7)
• Does the cost/benefit analysis estimate annual energy savings from development of a new distributed energy resource system relative to the current heating system and current type of fuel being used by such system? Yes. Where in the study has this been addressed?
  ✓ Section 6.3 (Pages 58-61)
• Does the cost/benefit analysis provide environmental regulations mandating the purchase of emissions allowances for the microgrid (e.g., due to system size thresholds)? Yes. Where in the study has this been addressed?
  ✓ Section 6.3 (Pages 58-61) and Appendix H (Pages H5-H6)
• Does the cost/benefit analysis provide emission rates of the microgrid for CO₂, SO₂, NOₓ, and PM? Yes. Where in the study has this been addressed?
  ✓ Section 6.3 (Pages 58-61) Incorporated in Excel to get costs and Appendix H (Pages H5-H6)
• Does the cost/benefit analysis provide the fully installed costs and engineering lifespan of all capital equipment? Yes. Where in the study has this been addressed?
  ✓ Appendix H, Section 6.3 (Pages 58-61) and Appendix C
• Does the cost/benefit analysis provide for initial planning and design costs?
• fixed operations and maintenance costs?
• variable operations and maintenance costs?
• fuel/energy source of each existing backup generator?
• the average daily electricity production for each generator in the event of a major power outage, and the associated amount of fuel required to generate that electricity?
  ✓ Appendix H, Appendix C, Section 3.4.1 (Page 20), Section 4.5.2 (Page 35) and Section 4.5.5 (Pages 36-37)
• Does the cost/benefit analysis include any one-time costs (e.g., labor or contract service costs) associated with connecting and starting each backup generator? Yes. Where in the study has this been addressed?
  ✓ Appendix H (Pages H5-H6), Appendix I (Page I4, I7-I8) and Appendix C
• Does the cost/benefit analysis include any daily costs (e.g., maintenance costs) associated with operating each backup generator? Yes. Where in the study has this been addressed?
  ✓ Appendix I (I5-6), Appendix H and Appendix C
• Does the cost/benefit analysis provide an estimate of the costs of any emergency measures that would be necessary for each facility to maintain operations, preserve property, and/or protect the health and safety of workers, residents, or the general public? Yes. Where in the study has this been addressed?
  ✓ Appendix H (Page H6), Appendix I (Pages I3-I8) and Appendix C
• Does the cost/benefit analysis estimate the population served by each microgrid? Yes. Where in the study has this been addressed?
  ✓ Appendix I (Pages I9-I13) and Section 5.2.1 (Page 43)
• Does the cost/benefit analysis provide how a power outage would impact each facility’s ability to provide services? Yes. Where in the study has this been addressed?
  ✓ Section 4.5.3 (Pages 35-36) and Appendix I (Page I9)
Other

- To what extent does the proposer offer more than the minimum cost share? Where in the study has this been addressed?
  - ✓ Section 1.1 (Pages 11-12), Stage II will be 15% cost share

- Are the qualifications and roles of the proposing team and subcontractors clearly defined and demonstrate the capability to successfully complete a Stage 2 Detailed Engineering Design, Financial and Business Plan Assessment? Where in the study has this been addressed?
  - ✓ Section 5.4 (Pages 47-51)

- What are the potential utility distribution system benefits attributable to the projects planned operation relative to other competing projects in the utilities’ service territory? Does the proposer provide evidence that a broad coalition of public interests have teamed up in support of project development (e.g., Regional Economic Development Council(s), low- to- moderate income tenants associations, local/regional emergency management, etc.)? Where in the study has this been addressed?
  - ✓ Section 5.3.2 (Pages 46-47) and Section 5.4 (Pages 47-48), Section 4.2.3 (Pages 27-28)

- Have letters of commitment for project support that is necessary to carrying out the work plan been secured from project participants? Yes. Where in the study has this been addressed?
  - ✓ Section 5.4 (Page 47)

- Does the microgrid project demonstrate advances in practices for project planning and development? Are there any unique or creative technology vendor commitments/ participation, ownership options, operating agreements with the local utility, plans to implement energy efficiency, leverage existing incentive programs, or propose new and innovative ones? Yes. Where in the study has this been addressed?
  - ✓ Section 3.5.2 (Page 22), Section 5.4 (Page 47-51) and Section 5.6 (Pages 52-55)

- Does the microgrid design increase the amount of actionable information available to customers—providing a platform for customers to be able to interact with the grid in ways that maximize its value? Yes. Where in the study has this been addressed?
  - ✓ Section 3.5.6 (Pages 23-24), Section 2.5.3 (Pages 22-23) and Section 4.8 (Page 40)

- To what extent does the microgrid design satisfy or support the Reforming the Energy Vision (REV) objectives? Where in the study has this been addressed?
  - ✓ Section 3.5.3 (Pages 22-23)