# 81 - City of Salamanca (Seneca Nation)

August 2016

# Notice

**SENECA NATION OF INDIANS**

# New York Prize Microgrid Feasibility Seneca Nation of Indians Evaluation Final Report

Prepared by:

Baker Tilly Virchow Krause, LLP

Seneca Energy

BAKER TILLY

SENECA ENERGY LLC

**SENECA NATION OF INDIANS**

TABLE OF CONTENTS

# EXECUTIVE SUMMARY

## Seneca Nation of Indians Allegany Territory Micro-Grid Feasibility Project

The Seneca Nation of Indians (SNI) in partnership with the Seneca Gaming Corporation (SGC), City of Salamanca and Salamanca Board of Public Utilities (BPU), proposes to conduct a feasibility analysis for developing a micro-grid in connection to be shared among critical facilities and planned economic development in SNI's Allegany territory. SNI and its partners undertake this effort in order to enhance community resiliency, create rate parity, develop renewable energy assets and empower a SNI owned and operated utility capable of sharing the costs and benefits of community self-sufficiency with its interconnected neighbors.

SNI and the City of Salamanca are unique among New York communities in that they share the distinction of being the only US municipality completely contained within an Indian Nation. The City leases its lands from the Nation and supplies most of its resident members and economic institutional end-users with electricity through Salamanca BPU. However SNI facilities and community members extend beyond the boundaries of the City and have interests that arise from the Nation's sovereign status and historical disparities. SNI has a necessity to be accountable to its members. Specifically SNI must address rate parity issues among Nation members who are part of the same community but pay very different electric bills depending on whether they are with National Grid (NG) or the BPU. Currently Nation members inside BPU territory pay approximately 6 cents/kWh while their neighbors in NGI territory pay 18 cents/kWh. This situation is exacerbated by the higher levels of poverty on SNI's territory and the higher percentage of income required to pay energy costs for those at or below poverty levels.

In addition SNI owned assets are uniquely dependent on economic enterprises that have emerged from historical under representation in the mainstream U.S. economy and from Federal support that continues to decline. These characteristics of dependence on Federal subsidies and gaming enterprises have moved the Nation toward economic development initiatives aimed at diversifying the assets already developed, while creating institutional forms that allow SNI to begin to participate as a peer with its neighbors.

With those purposes in mind SNI has begun to develop renewable energy assets in both its Cattaraugus territory and its Allegany territory. These assets are specifically being developed as community energy projects utilizing the aggregated net metering rules that have recently been put in place in NY. The intent of these projects is to displace high cost energy with renewable energy that produces a credit to SNI that in turn gets distributed equally to SNI rate-payers to create rate parity. SNI was awarded a Department of Energy (DOE) grant for a 2MW wind turbine community energy project in the Cattaraugus territory and is just beginning feasibility analysis of a 2MW solar project for the Allegany territory. The Allegany solar project, coupled with the unique challenges of providing uniform economic and reliable utility service across the Nation's territories are the principal reasons for investigating micro-grid feasibility.

There are six identified benefits that SNI hopes will emerge from a successful implementation of a micro-grid in the Allegany territory. These include:

1. Development of a 2MW solar project that will generate net metered benefit to the Nation
2. Distribution of the net metered credit to create rate parity for SNI members unable to interconnect with Salamanca BPU.
3. Securing critical facilities of economic, administrative and public safety importance by providing an SNI island loop of electric distribution tied to existing and planned biogas generation, planned storage and planned development of residential and commercial facilities.
4. Providing demand relief, ancillary services and grid support to the City of Salamanca and the BPU through renewable and other dispatchable resources while providing relief to wastewater facilities currently at 100% capacity in the Steamburg area.
5. Establishing a business model of a Tribal Utility that successfully and cooperatively integrates into the ecology of existing electric utility organizations and able to be replicated across 500+ other First Nation communities in the US.
6. Fostering development of a planned eco-tourist model of recreational camping in the Salamanca area tied to these concepts.

These goals will provide multiple economic, social and environmental benefits to the Nation, the City of Salamanca and New York State.

# 1.0 Task 1 Description Of Microgrid Capabilities

## 1.1 Minimum Required Capabilities

The Allegany Steamburg community was formed through a displacement of Native individuals from their traditional lands through construction of the Kinzua Dam. The community consists of a residential subdivision, a wastewater treatment plant and water pumping facility, a community center and health facility and satellite Tribal Police station along with a few assorted businesses. The residents of the community may or may not own their houses. These houses were constructed through the SNI Housing Authority. The Microgrid (MG) meets the following minimum criteria:

1) As designed, the MG will serve no less than four (4) physically separate, critical facilities. These are the waste water treatment plant, the water pumping station, the satellite Tribal Marshall's Office and the community health center.
2) The primary generation source of this MG will be a 1.8 MW solar generating station split into two different arrays. 300 kW will serve as the primary power source of the Steamburg loads, backed up by a battery bank with both renewable and fossil generator sets providing battery charging and black start capabilities.
3) This MG will operate primarily in island mode. Grid connection will only be established as a last resort under failure of the solar/battery system and the generator sets.
4) Under total failure the MG will automatically reconnect to the Grid.
5) Manufacturer recommended maintenance be included. A sample LTSA is attached. Because the MG will operate in an island mode most of the time, maintenance will be performed when diesel generation is run for monthly testing.
6) Charge controllers and inverters will deliver power as required during island mode operation. Battery banks will be continually charged through biogas generator and load following capabilities will be delivered through the inverters of the solar array. When the solar array and battery bank are down, the diesel generator will be capable of load following for the entire MG.
7) Single mode fiber or radio will provide two-way communication as shown in the network overview diagram attached as Diagram 1.

8) Power will be provided to community, residential and critical facilities as previously described.

9) Diesel generator will have two (2) weeks of fuel supply stored on site and battery bank will be backed up by 20 kW generator set with one month of fuel supply in the form of woodchip feedstock on site.

10) Because the MG will operate off of renewable fuel in island mode for most of the time it is resilient to grid interruption as a matter of course. Only catastrophic failure of renewable, battery and black start generation will cause the MG to reconnect to the grid. Grid supply is last resort.

*Figure 1 below, identifies the critical facilities and boundaries of the Seneca Nation of Indians as well as the City of Salamanca. The insets show the Steamburg loop area which would be the main location of the micro-grid.*

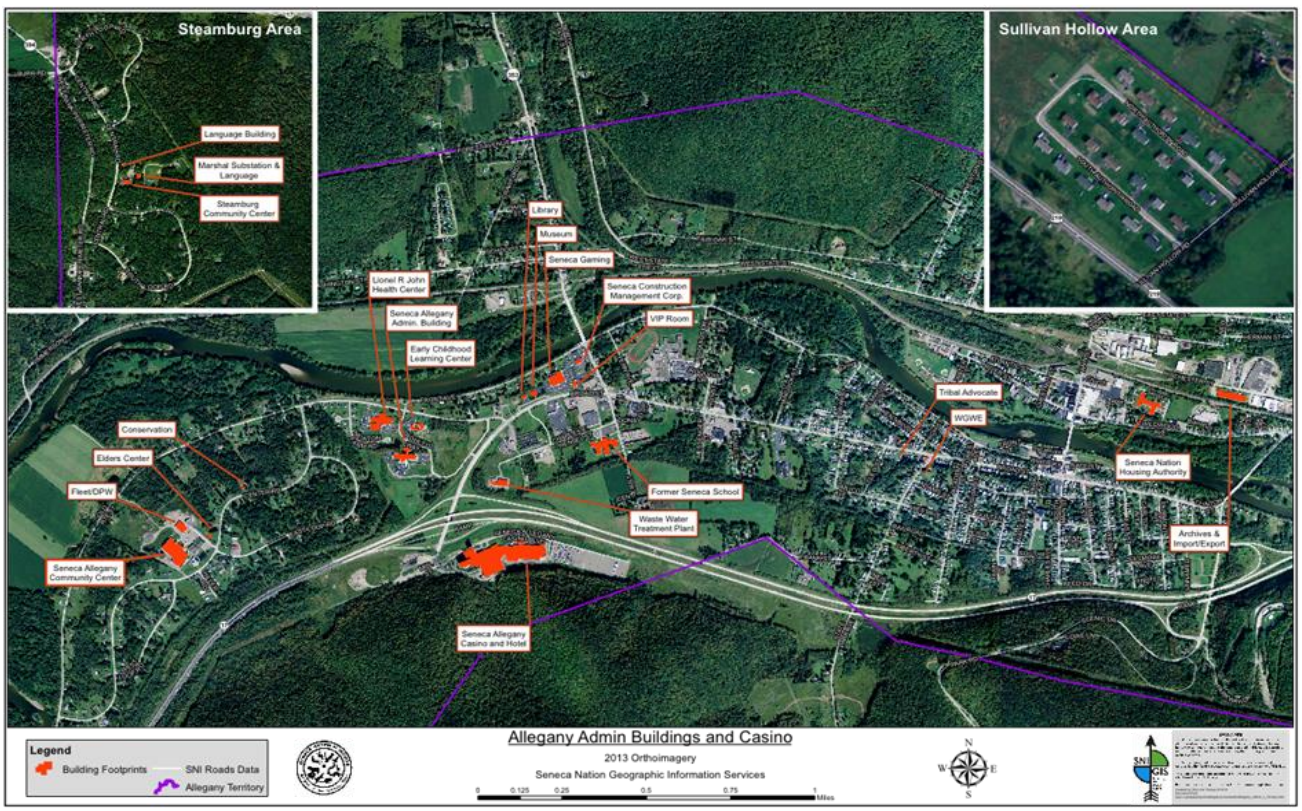



Figure 1

## 1.2 Preferable Capabilities of SNI MG

The SNI Allegany MG incorporates a number of preferred capabilities as shown on Diagram 1 and as previously described including:

1) An active network control system that optimizes demand, supply and other network functions within the MG.
2) An energy efficiency kit for each home in the MG sponsored by SNI Planning department. Demand response will be part of $2^{nd}$ phase in the Salamanca area.
3) An aggregated net metering credit to all accounts in the high cost Steamburg area creating rate parity between Steamburg and Salamanca end-users.
4) Clean renewable power for 100% of the load for 90% of operation time.
5) Tangible community benefits of self-sufficiency, resilience and cost savings.

The SNI MG uses an innovative business model of a Tribal Utility that distributes benefits in addition to actual energy through redistribution of net metered credits and a full-time island operation from renewable energy sources. Residential customers will have the option of having pre-payment meters that display monthly usage and avoid disconnection/reconnection charges while increasing cash-flow for the Tribal Utility.

# Task 2 Technical Design Costs and Configuration

## 2.1 Simplified Equipment Layout diagram and one-line diagram – See figures 2&3

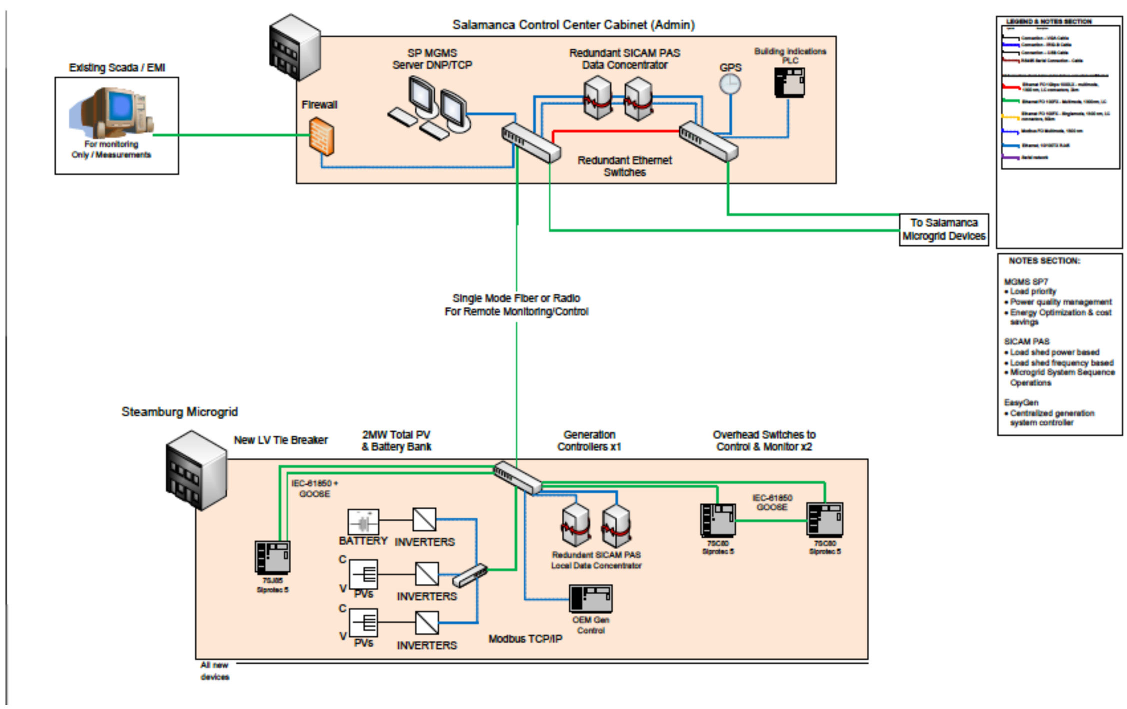



Figure 2

The SNI Allegany MG will be capable of operating primarily in island mode, with 300 kW of solar generation dedicated from a proposed 1.8MW solar generating station that has been solicited and contracted for in the Steamburg area. The PV system will be split into two arrays, a 300kW MG PV and the balance 1.6MW Utility PV. The MG currently has pad mounted transformers only up to 300KVA, not able to support an LV connected 1.9MW system. SNI will utilize approximately 300kW of solar in the MG, adding a new transformer which can handle 1.6MW of Solar directly connected to the utility to sell to National Grid at all times.  The current design does not link the MG and Utility PV in the same network. Based upon Steamburg area load profile, the 1.8MW solar array will be significantly underutilized. This suggested solution of splitting the solar arrays allows the SNI to sell a large portion of PV power to the utility under the aggregated net metering set up; while also utilizing PV power in the MG to support loads.

A battery bank capable of 500 kWh will be installed with advanced control logic for charging and discharging. This battery bank will provide power to the MG during night hours and cloudy days. This battery bank will be backed up by two generation sources. The first is a 20 kW gasification generator set, operating on wood chip bio-fuel. This generator will run whenever the battery needs charging. A substantial feedstock inventory equivalent to one month of operation will be kept between 10 and 30% moisture content nearby. A second natural gas or diesel generator with black start capability will be used in MG mode for entire system black start. It is recommended that this generator be 150kW to account for peak MG load when both battery and solar power are not generating power.

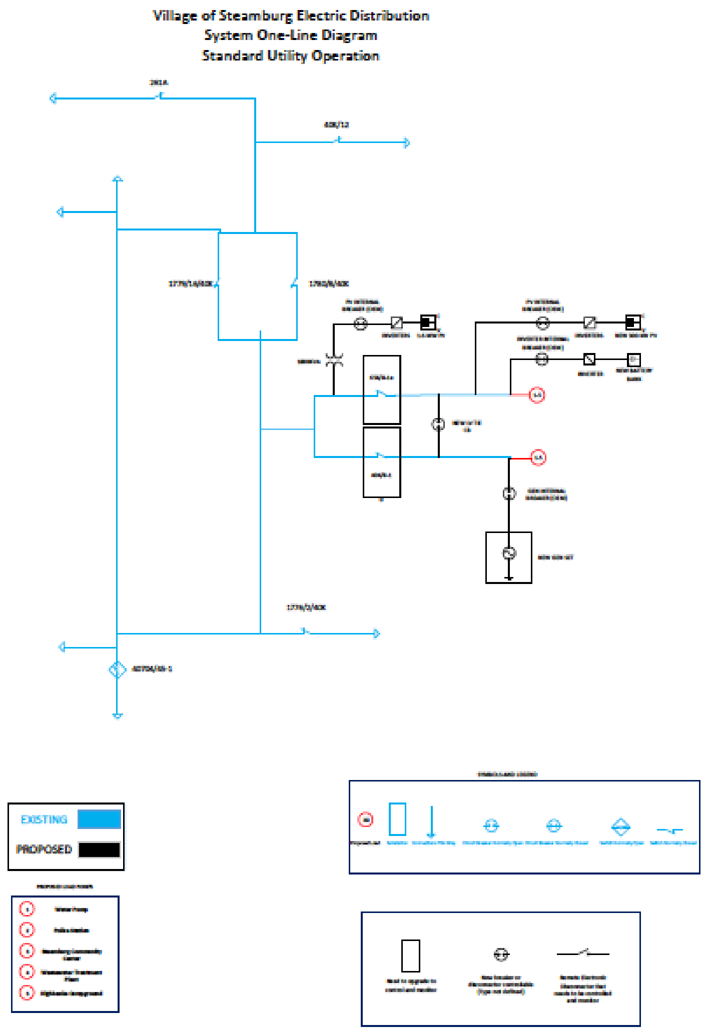



Figure 3

To initiate MG mode, MCS will first disconnect the MG from the distribution interconnection at the two overhead feeders, utilizing new controllable relays to operate the overhead switches. Using new generators' black-start capabilities, the MCS will commence island mode operation which will also close the LV tie breakers and bring online the solar PV system and Battery Bank.

Once the MG is isolated from the utility grid, it is envisioned that MG will be in Islanding operation all the time; unless there is an emergency where all three generating assets (battery, solar, generators) are not generating power.

During normal operation (islanding), excessive power generated by solar PV will be charging the battery bank. Battery will be deployed to support system load when PV is not generating power. Generator will only supply power when the battery is depleted.

In the emergency case that the Steamburg MG needs to connect back to the utility, the MCS will start a sequence of operations. If the MG Generator is not functioning, the MCS will temporarily disconnect the Generator, PV, Battery Bank, and Loads from the MG including opening up the tie breaker. The MCS will then reconnect all loads back to the utility via closing the two overhead utility switches. The MG PV Power and Battery Bank can then be connected back to the utility to limit utility usage. Battery controls will need to be adjusted in grid connected mode to either economically charge/discharge based on TOU pricing and solar output, or not function at all. This functionality can be managed by SP MGMS which will be considered separately from the Steamburg MG project.

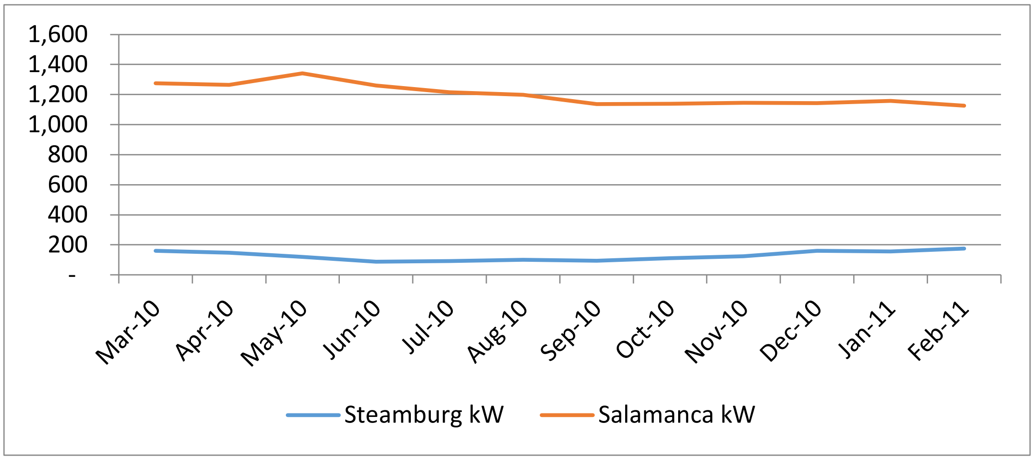
Fiber optic communication will be used to connect the pole mounted switch controllers and LV tie breaker to a local network switch at the Steamburg MG. This network switch will be located in an indoor facility designated to house the MCS controller, which can be assembled in an electrical enclosure or supplied loose at a desktop station.

Depending on the location of the Steamburg inverters and generation controllers, Cat5 Ethernet cable may be used to connect these controllers to the local network switch/MCS. Ideally, the inverters and generator controller will be located in close proximity to the MCS/network switch location, or the MCS/network switch can be located in the generator control or inverter control rooms if available.

## 2.2 Load Characterization

Loads for both the Steamburg area and the Salamanca area were obtained for monthly and daily requirements. Hourly data for Salamanca load is available to a limited degree but is not required under the phasing of this project. The priority is on the high cost Steamburg area and monthly and daily information is adequate for our purposes. Below are graphs (figure 4, 5) showing monthly and daily usage for the Steamburg and Salamanca areas and all the data summarized.

**SENECA NATION OF INDIANS**



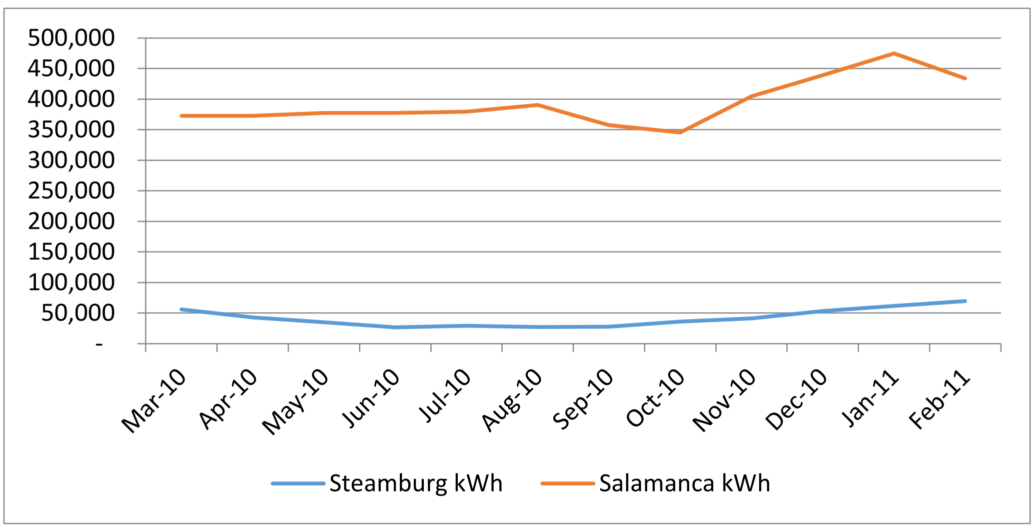
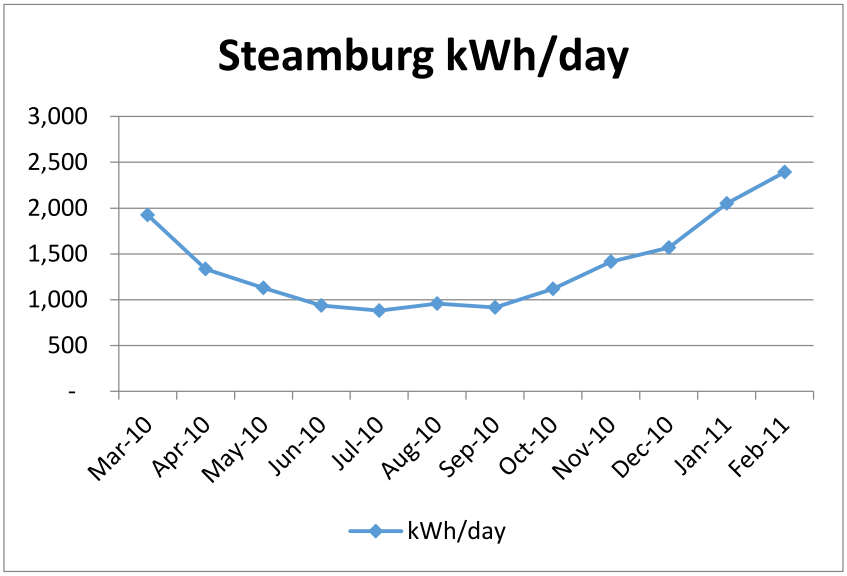
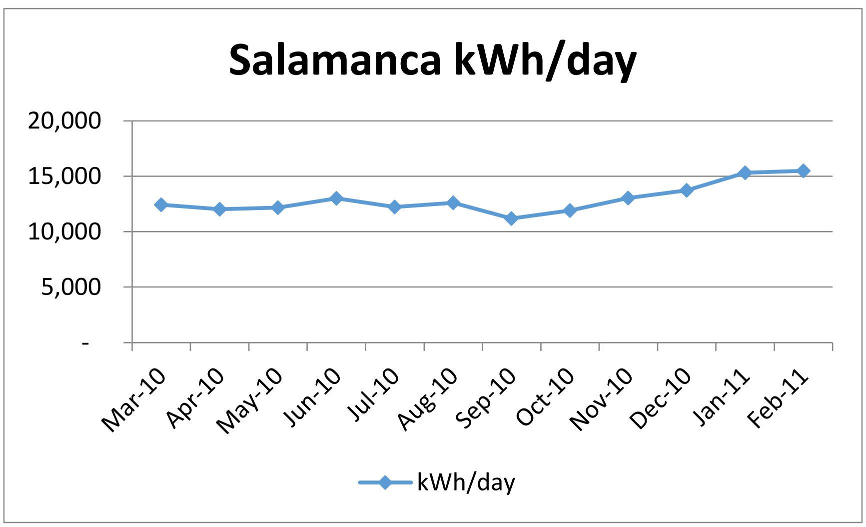
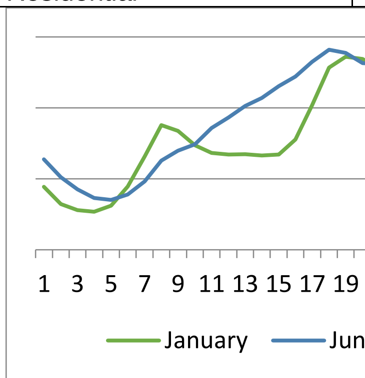
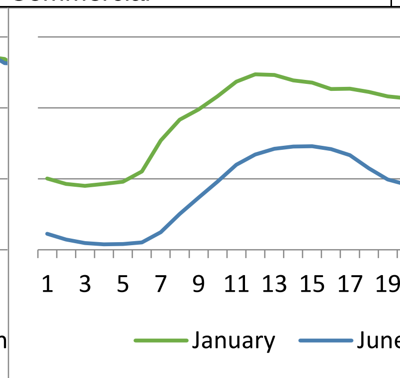
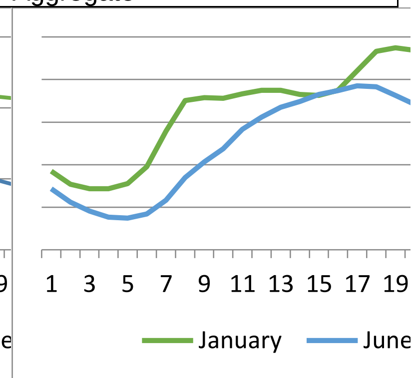
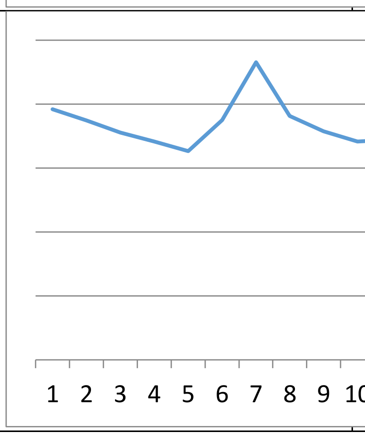
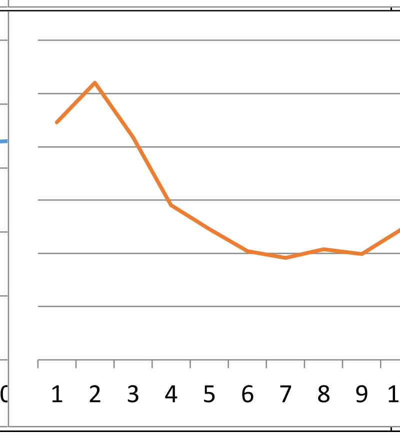
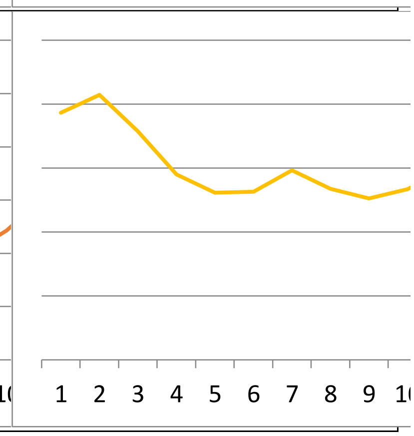




Figure 4

**SENECA NATION OF INDIANS**



| | Residential | Commercial | Aggregate |
|---|---|---|---|
| Daily (Week-day) |   |   |   |
| Yearly |   |   |   |

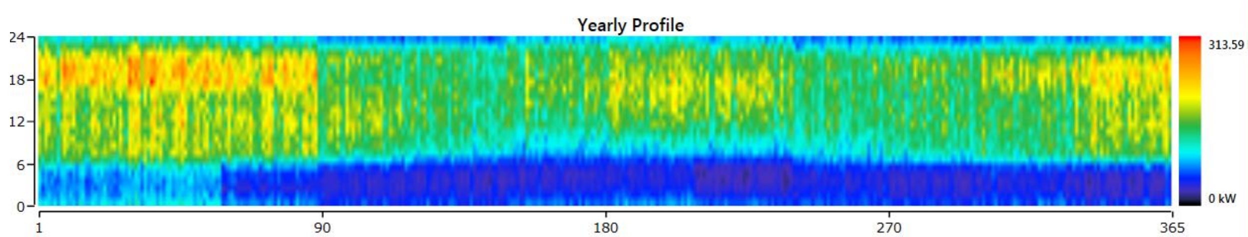



Figure 5

## 2.3 DER Characterization

Seneca Energy conducted an RFP for a potential 2 MW solar project installed in the Steamburg area that will provide both power and net-metered credit to the high cost Steamburg location. This solar installation was specified in the RFP documents. Six proposals were provided and interviews were conducted with the three lowest bids. Sustainable Energy Developments provided the winning bid and will be responsible for the installation of the array. Contract negotiations are currently underway. A one-line diagram and site layout are provided in the Appendices. Figures 6 below is a table showing back-up generation available to the Nation in the Salamanca area. SNI is still considering how to incorporate the abundant back-up resources into the overall micro-grid strategy.

| SNI Admin Bldg | Brand | Capacity kW | Fuel | ATS Brand | Serial # | Tank Capacit |
|---|---|---|---|---|---|---|
| 20-154190-01 | Cummings | 50 | Fuel Oil | ? | | ? |
| | | | | | | |
| SNI Healthcare | | | | | | |
| 20-155100-00 | Kohler | 125 | Ngas | Kohler | | |
| | Onan | 100 | Ngas | ASCO 5200 | | |
| | | | | | | |
| SNI Comm Ctr | | | | | | |
| 20-155020-00 | Caterpiller | 450 | Ngas | ASCO 7000 | | |
| | | | | | | |
| SNI Housing | | | | | | |
| 20-154100-00 | Detroit Diese | 350 | Fuel Oil | Detroit Diesel | | 1,000 |
| | | | | | | |
| SNI WWTP | | | | | | |
| 20-154370-00 | Caterpiller | 1500 | Fuel Oil | Russelectric 2000 | | 10,000 |
| | | | | | | |
| | | | | | | |
| | | 2,575 | | | | |
| | | Capacity | | | | |
| | | | | | | |
| | | 1,209.24 | | | | |
| | | Peak Load | | | | |
| | | | | | | |
| | | 1,365.76 | $ 9.20 | 12,564.99 | 25,129.98 | |
| | | Available | DR Payment | Rev/season | Rev/yr | |

Figure 6

Figure 7 below is a table showing the proposed distributed resources dedicated specifically to the Steamburg MG.

| Type | Rating kW | Fuel |
|---|---|---|
| PV | 1,500 | Solar |
| PV | 300 | Solar |
| CHP | 20 | Wood Chips |
| DG | 150 | Diesel |

Figure 7

## 2.4 Electrical Thermal Infrastructure

The village of Steamburg Electric Distribution System One-Line diagram shows the feeders, lines, relays and breakers for both existing and proposed systems. As noted above, this MG will operate in island mode as normal operation and will only be in grid connect mode if all other systems fail.

## 2.5 MG and Building Controls Characterization

See 2.1 high level description

## 2.6 IT Infrastructure Characterization

Fiber optic communication will be used to connect the pole mounted switch controllers and LV tie breaker to a local network switch at the Steamburg MG. This network switch will be located in an indoor facility designated to house the MCS controller, which can be assembled in an electrical enclosure or supplied loose at a desktop station.

Depending on the location of the Steamburg inverters and generation controllers, Cat5 or Cat6 Ethernet cable may be used to connect these controllers to the local network switch/MCS.

Ideally, the inverters and generator controller will be located in close proximity to the MCS/network switch location, or the MCS/network switch can be located in the generator control or inverter control rooms if available.

It is envisioned that MCS will be located in the Salamanca area. The Steamburg MG will be remotely controlled by the MCS. The communication between the central MCS and the local devices at the Steamburg area will be done either via Siemens WiMax smart communication technology or via Windstream high speed commercial internet provider.

## High Level Cost Estimate for SNI Steamburg MG

| MG Component | $ Watt installed | Total Cost |
|---|---|---|
| MG PV 300 kW | $1.70 | $510,000 |
| Grid PV 1.5 MW | $1.70 | $2,550,000 |
| Biogas CHP 20 kW | $2.50 | $50,000 |
| Diesel Genset 150 kW | $.50 | $75,000 |
| MG Equip Controls | + 25% | $200,000 |
| Battery Bank 6000kWh | N/A | $56,000 |
| | | $3,401,000 |

Figure 8

## 3.0 Commercial Financial Viability

The primary rationale for the Allegany MG is to extend the efforts associated with creating a Tribal Utility organization with distribution capability across the territories of the Seneca Nation. Because that is the primary rationale, commercial and financial viability is only a marginal concern for the MG itself although relative to the entire enterprise, financial viability is a very important concern. The key to economic viability is to include the MG within the overall scope of activities associated with electric procurement for the Nation. To that end we will identify the customers, project team and value delivery of this enterprise and provide an opinion of its financial viability over all.

## 3.1 Customers

The customers of the Steamburg MG consist of 95 households representing approximately 400 individuals. There are also five community facilities including: a water pumping station, a wastewater treatment plant, a community center that includes a satellite police station and a cultural/ceremonial center. As noted, these entities are served by National Grid. This is a "displaced community" with all that is implied in that description. Fifty years ago their ancestral lands were flooded and they were forcibly relocated. This has left a negative legacy of poverty and isolation but has also provided a sense of a community and cultural resistance to outside intervention. In this sense the community is predisposed toward a MG in a way that other communities would not be. The value to the community is that the MG is an infrastructural reinforcement of the actual situation that they have endured. It is an expression of sovereign independence.

With respect to financial consideration, a key element of the MG is to facilitate a reduction in electric energy spending. This reduction is both an absolute reduction in price per kWh but also a reduction in the percentage of household income devoted to energy payments. For households at the threshold or below the poverty line (which constitute 40% of households in Steamburg) the percentage of household income spent on energy is between 20% and 70%.

## 3.2 Value Proposition

The key financial element providing value for this project is integrating the MG with the planned 1.8 MW solar project adjacent to it. By carving out a portion of the 1.8 MW array (approximately 300 kW) for MG purposes, but then using the remaining 1.5MW in an aggregated net metering scenario, significant income will be generated that will help pay approximately 70% of the annual operational cost of the MG. The rest of the cost will be recovered by charging the community at a cost well below their current rates and closer to parity with the rest of the Allegany territory.

*Below is a summary table of operational costs of the MG (Figure 9) and income statement (figure 10) assuming aggregated net metering and cost recovery at Parity with Salamanca BPU rates.*

| System Component | Size | Unit | Normalized yearly cost/unit | Unit | Yearly fuel consumption (L) | Fuel costs ($/L) | Yearly cost |
|---|---|---|---|---|---|---|---|
| Solar Array | 300 | kW | 20 | $/kW | | | $6,000 |
| Diesel Generator | 300 | kW | 16.68 | $/kW/yr | 212,914 | 0.75 | $164,691 |
| MG Control System | 1 | systems | 0 | $/sys/yr | | | $0 |
| Batteries | 500 | kWh | 10 | $/kWh | | | $5,000 |
| Standby charges | 250 | kW | 5.55 | $/.85kW/month | | | $14,160 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Replacement Reserve | 1 | systems | 7413.90 | $/sys/yr | | | $7,414 |

Figure 9

| | |
|---|---|
| Based on 1.5 MW @ 14% Capacity Factor | |
| Annual Array Output (kWh): | 1,960,500 |
| Expected aggregated net meter Avoided Cost: | 0.1000 |
| Income expected from regional sale of SRECs: | 29,400 |
| Weighted cost recovery from MG residents and businesses at parity with SBPU @ $71 X 1,204 MWh: | 85,484 |
| Revenue: | 310,934 |
| | |
| Micro-Grid OpEX: | 197,265 |
| Expense: | 219,446 |
| Debt service of 26% of total cost for 3.4 M loan: | 32,425 |
| Annual Income | 59,063 |

Figure 10

## 3.3 Project Team

The project team for this project consists of personnel employed by the Seneca Nation, EPC contractors involved in the solar arrays, MG control vendors involved in overall system design and controls procurement and SNI's trusted energy advisor.

*The following table (Figure 11) lists the project team members, their company and their role.*

| ***Team Member*** | ***Company*** | ***Role*** |
|---|---|---|
| **Jim Yockey** | Baker Tilly | Trusted Advisor |
| **Kevin Schulte** | SED Inc. | Solar EPC Contractor |
| **Maggie Clout** | Siemens | Systems Integrator |
| **Marlene Wakefield** | Seneca Nation | Project Manager |
| **Anthony Giacobbe** | Seneca Nation | General Manager |

Figure 11

## 3.4 Value delivery

*Below (Figure 12) is the transaction diagram to illustrate the manner in which the aggregated net meter benefits and MG independence will be delivered to the community of Steamburg and the Nation.*

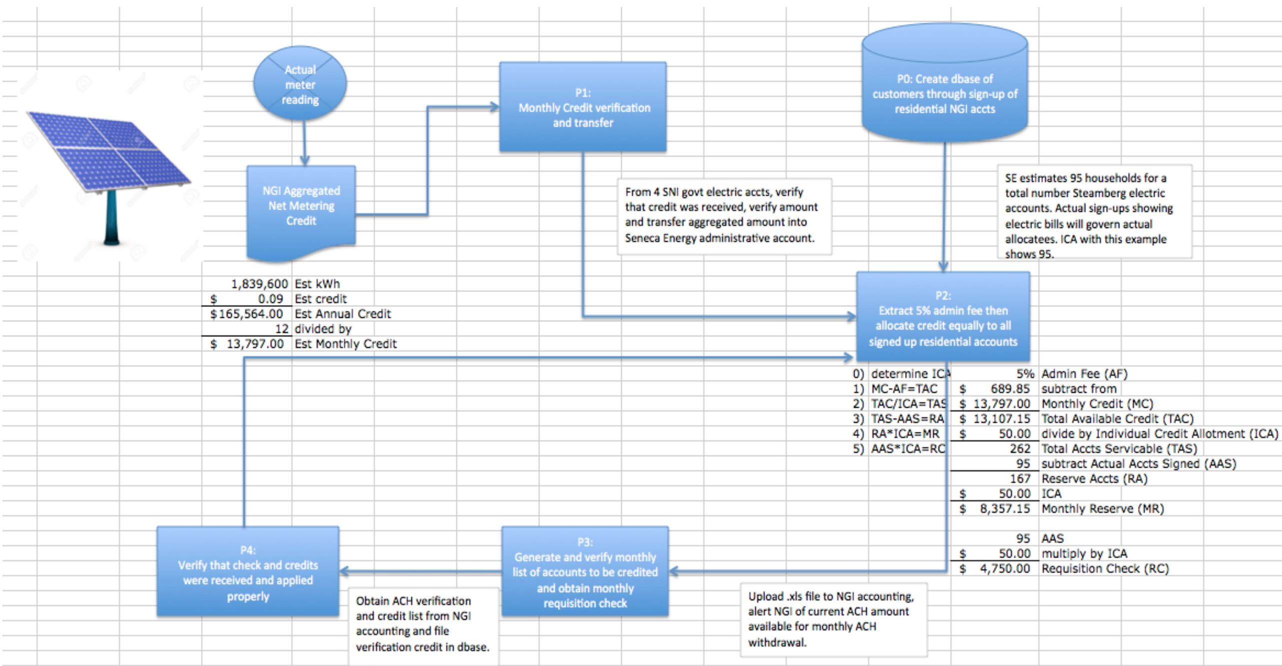



Figure 12

**SENECA NATION OF INDIANS**

These transaction diagrams show how the value of aggregated net metering and the configuration of the tribal utility will be delivered to the Steamburg community. Credits will be accumulated on a monthly basis and flow through Seneca Energy which will recover costs from the community while providing capital fund dollars to the utility. This capital fund will initially be created through an SNI appropriation. However the plan is to ultimately reimburse that appropriation with USDA Rural Utility Services direct loan.

**SENECA NATION OF INDIANS**

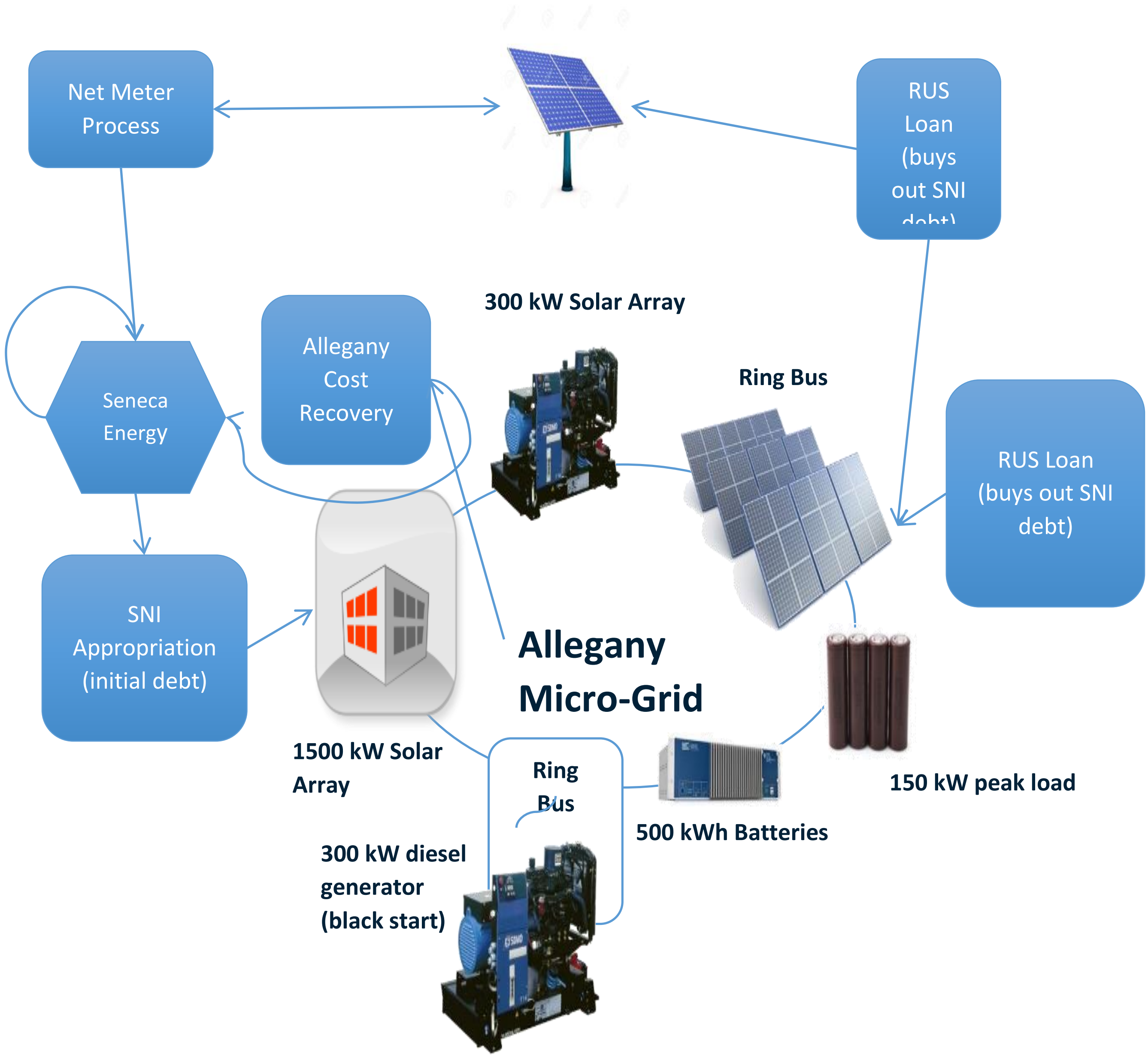



Figure 13

## 3.5 Financial Viability

The following financial sensitivity analysis was developed to assess the financial viability of the Steamburg Micro-grid. The basic economics of this project are as follows: The power produced by the MG (1,195 MWh/year) is assumed be sold to the tribal residential and commercial customers within the MG at an average rate of $0.071 per kWh. Additionally, the Solar Renewable Energy Credits from the 1.5MW system co-located with the MG will provide the MG project with an annual benefit of $29,400. These two revenue sources are exclusive to providing financial benefits and amount to $114,245 per year. These revenue streams are offset by the cost of running the system, the net cost to the Nation of running the MG is anticipated to be $91,536 per year. This corresponds to a $0.077/kWh subsidy to the rate-payers. Therefore there is a net revenue of $22,709. However, the cost to operate is highly dependent on fuel costs. The following table (Figure 14) shows the sensitivity of operational costs based on cost of fuel.

| | Yearly Cost to the Tribe sensitivity to cost paid by customers and fuel cost | | | | | |
|---|---|---|---|---|---|---|
| Fuel Costs$/gallon | **0.00** | **36.00** | 71.00 | **106.00** | **141.00** | **176.00** |
| **1.02** | 115,137 | 72,117 | 30,292 | -11,533 | -53,358 | -95,183 |
| **1.46** | 139,863 | 96,843 | 55,018 | 13,193 | -28,632 | -70,457 |
| **2.09** | 175,185 | 132,165 | 90,340 | 48,515 | 6,690 | -35,135 |
| 2.99 | 225,646 | 182,626 | 140,801 | 98,976 | 57,151 | 15,326 |
| **3.88** | 276,107 | 233,087 | 191,262 | 149,437 | 107,612 | 65,787 |
| **5.05** | 341,705 | 298,685 | 256,860 | 215,035 | 173,210 | 131,385 |
| **6.56** | 426,984 | 383,964 | 342,139 | 300,314 | 258,489 | 216,664 |

Figure 14

If fuel costs go very high the MG is not viable since it relies upon generation from diesel to cover the shoulder periods on and off peak.

Another key parameter for financial viability is the cost of capital to build the MG (Figure15). This demonstrates at what interest rate the project can accept and still cover debt service. The following table begins with the expected interest rate from a RUS direct federal loan of 2.5% and shows debt service at various interest rates. The result of this sensitivity analysis is that financial viability or the ability to provide net margin by the project is highly dependent of fuel costs and cost of capital.

| Debt Rate | Yearly Cost to the Tribe sensitivity to debt rate and debt as a percentage of the capital stack | | | | | |
|---|---|---|---|---|---|---|
| **Percent Debt** | **0%** | **20%** | **40%** | **60%** | **80%** | **81%** |
| **Equity ($)** | $ 780,000 | $ 588,000 | $ 396,000 | $ 204,000 | $ 12,000 | $ - |
| **0.0%** | $ 91,536 | $ 101,136 | $ 110,736 | $ 120,336 | $ 129,936 | $ 139,536 |
| **0.5%** | $ 91,536 | $ 101,648 | $ 111,760 | $ 121,872 | $ 131,984 | $ 142,096 |
| **1.5%** | $ 91,536 | $ 102,719 | $ 113,902 | $ 125,086 | $ 136,269 | $ 147,452 |
| **2.5%** | $ 91,536 | $ 103,852 | $ 116,169 | $ 128,485 | $ 140,801 | $ 153,117 |
| **3.5%** | $ 91,536 | $ 105,045 | $ 118,555 | $ 132,064 | $ 145,573 | $ 159,083 |
| **4.5%** | $ 91,536 | $ 106,296 | $ 121,056 | $ 135,817 | $ 150,577 | $ 165,337 |
| **5.5%** | $ 91,536 | $ 107,602 | $ 123,669 | $ 139,735 | $ 155,802 | $ 171,868 |

Figure 15

## 3.6 Legal Viability

Federal Law affirms the sovereignty of Indian Nations to provide self-determination with respect to essential governmental functions. Seneca Nation law does as well. Key to self-determination is the ability of the Nation to exercise certain rights to deal with encumbrances and right of ways on their sovereign land. Among those rights, eminent domain stands out as a key right that is required to provide legal viability for creating the Steamburg MG. The question for purposes of this report then, is whether the Seneca Nation Possesses a Right to Exercise Eminent Domain as Part of its Inherent Sovereignty.

As referenced above, to successfully implement a Tribal Utility, it is essential that the Tribal government, and eventually the Tribal Utility itself, possess certain powers. These powers include the ability to negotiate with other governments and private stakeholders, to potentially challenge the encumbrance of tribal lands or interests in lands by existing utility providers, to adopt resolutions governing the provision of energy services, and, finally, to exercise eminent domain. These powers are important because they directly implicate a Tribal Utility's ability to do business whether that involves regulating non-tribal entities (like the Nation's existing energy providers), calling into question the validity of rights of way and encumbrances purportedly on Nation land, entering into business agreements, or negotiating rights of ways with landowners for the future provision of power services.

Several of these critical governmental powers are explicitly set forth in the Nation's Constitution. See Constitution, Art. IV, §§ 1 (a), (c), (g) and (h) (explaining that the Tribal government has the authority to negotiate with local, state and federal governments, veto the sale or encumbrance of tribal lands, and organize tribal entities for economic development). However, there are certain powers, like the ability to exercise eminent domain, which are not expressly referenced in the Nation's Constitution. The fact that the Nation's authority to exercise condemnation powers is not delineated in its Constitution is not problematic. This is because the ability to exercise eminent domain is part of the Nation's retained inherent sovereign powers.

The United States Supreme Court explained,

[The] right of every state to authorize the appropriation of every description of property for a public use is one of those inherent powers which belong to state governments, without which they could not well perform their great functions. It is a power not surrendered to the United States, and is untouched by any of the provisions of the Federal Constitution, provided there be due process of law, that is, a law authorizing it, and provision made for compensation. This power extends to tangibles and intangibles alike. A choice in action, a charter, or any kind of contract, are, along with land and movables, within the sweep of this sovereign authority.

City of Cincinnati v. Louisville & Nashville R.R. Co., 223 U.S. 390, 400 (1912). Similarly, with regard to tribal governments, it is well-established that one aspect of retained inherent sovereignty is the power of eminent domain. See Grand Canyon Skywalk Dev., LLC v. 'Sa' Nyu Wa, Inc., 923 F.Supp.2d 1186, 1200 (D. Ariz. 2013); see also Dennison v. Tucson Gas & Elec. Co., 1 Navajo Rptr. 95 (Navajo 1974).

In fact, a review of the Indian Civil Rights Act ("ICRA"), federal legislation enacted in 1968, demonstrates that Congress wanted to protect the rights of individuals from tribal governments taking their land without appropriate compensation. In so doing, ICRA provides, "No Indian Nation exercising powers of self-government shall...take any private property for public use without just compensation." 25 U.S.C. § 1302(a)(5). By including this provision in ICRA, Congress implicitly recognized the retained authority by tribal governments to condemn land for public purposes. It is also worth noting that the Internal Revenue Service ("IRS") recognizes the power of eminent domain as an essential retained tribal governmental power when assessing the tax status of tribal governments and their related enterprises. See I.R.S. P.L.R. 200029039 (July 21, 2000) (acknowledging that a tribal resolution effectively delegated the Tribe's authority to exercise eminent domain to a political subdivision of the Tribe). Therefore, based on a review of the Nation's Constitution, By-Laws, and related Resolutions, SNI clearly has the authority to establish a Tribal utility in Steamburg to promote the Nations general welfare, self-governance and economic advancement. As such this MG is legally viable.

## 4.0 Develop Information for Cost Benefit Analysis

## 4.1 Facility and Customer Description

The microgrid includes 5 critical facilities. These facilities are listed in the table below. In addition to these critical facilities are 95 residents who are served by the critical facilities.

| Facility Name | Rate Class | Facility/Customer Description (Specify Number of Customers if More Than One) | Economic Sector Code | Average Annual Electricity Usage Per Customer (MWh) | Peak Electricity Demand Per Customer (MW) | Percent of Average Usage Microgrid Could Support During Major Power Outage | Hours of Electricity Supply Required Per Day During Major Power Outage |
|---|---|---|---|---|---|---|---|
| Wastewater Plant | *Large Commercial/Industrial (>50 annual MWh)* | 1 | | *183.94* | *0.059* | *100%* | *24* |
| Water Pump | *Large Commercial/Industrial (>50 annual MWh)* | 1 | | *63* | *0.026* | *100%* | *24* |
| Police Outpost | *Large Commercial/Industrial (>50 annual MWh)* | 1 | | 55.896 | 0.042 | 100% | 24 |
| Community Center | *Large Commercial/Industrial (>50 annual MWh)* | 1 | | 169.44 | 0.055 | 100% | 24 |
| Longhouse | Small Commercial/Industrial (<50 annual MWh) | 1 | | 31.78 | 0.012 | 100% | 24 |
| Residences | Residential | 95 | | 6.351 | 0.0018 | 100% | 24 |

Figure 16

## 4.2 Characterization of Distributed Energy

The microgrid contains 4 distributed energy resources listed below (Figure 17).

| Distributed Energy Resource Name | Facility Name | Energy Source | Nameplate Capacity (MW) | Average Annual Production Under Normal Conditions (MWh) | Average Daily Production During Major Power Outage (MWh) | Fuel Consumption per MWh | |
|---|---|---|---|---|---|---|---|
| | | | | | | Quantity | Unit |
| *Solar - Small* | *Solar - Small* | *Solar* | *0.3* | *437.484* | *1.198586301* | | |
| *Diesel Generator* | *Diesel Generator* | *Diesel* | *0.3* | *756.381* | *2.072276712* | *9.436* | *MMBTU* |
| Battery | Battery | Battery | 0.5 | 0 | 0 | | |
| Solar - Large | *Solar - Small* | *Solar* | 1.5 | 1839.6 | *5.04* | | |

Figure 17

## 4.3 Capacity Impacts and Ancillary Services

The following table (Figure 18) illustrates the provision of peak load support. It includes a combined available capacity of 1.16 MW/Year. The distributed energy resources which compile this capacity include:

| Distributed Energy Resource Name | Facility Name | Available Capacity (MW/year) | Does DER currently provide peak load support? |
|---|---|---|---|
| Diesel generator | | 0.3 | No |
| Battery | | 0.5 | No |
| Solar - Small | | 0.06 | No |
| Solar - Large | | 0.3 | No |

Figure 18

## Impact of Microgrid on Utility Transmission Capacity Requirements (Figure 19)

| Impact of Microgrid on Utility Transmission Capacity | Unit |
|---|---|
| 0 | MW/year |

Figure 19

*Note: Transmission capacity impacts are already incorporated into energy prices and generation capacity prices. We therefore do not value this impact separately in the model.*

## Impact on Distribution Capacity Requirements (Figure 20)

| Impact of Microgrid on Utility Distribution Capacity | Unit |
|---|---|
| 0.3 | MW/year |

Figure 20

## Ancillary Services to the Local Utility (Figure 21)

Ancillary Services

| Ancillary Service | Yes | No |
|---|---|---|
| Frequency or Real Power Support | | X |
| Voltage or Reactive Power Support | | X |
| Black Start or System Restoration Support | x | |

Figure 21

## Project Annual Energy Savings from Development of New CHP N/A

## Environmental Regulations Mandating the Purchase of Emissions Allowance for the Microgrid

*A net decrease in regional emissions should result as follows (Figure 22).*

| Emissions Type | Emissions per MWh | Unit |
|---|---|---|
| $CO_2$ | 0.203738745 | Short Tons |
| $SO_2$ | 0.000409133 | Short Tons |
| $NO_x$ | 0.004487418 | Short Tons |
| PM | 3.79118E-05 | Short Tons |

| Emissions Type | Emissions (kg) | Emissions (short tons) |
|---|---|---|
| Carbon Dioxide | 560,672.00 | 618.0343523 |
| Sulfur Dioxide | 1,125.90 | 1.241090829 |
| Nitrogen Oxides | 12,349.00 | 13.61242619 |
| Particulate Matter | 104.33 | 0.115004002 |
| Note: Emissions in kg from respondent questionnaire. | | |

| Conversion Factors | |
|---|---|
| 2.20462 | lb/kg |

| | |
|---|---|
| 2000 | lb/ton |
| 3033.465 | annual MWh |

Figure 22

## 4.4 Project Cost

### Installed Costs and Engineering Life Span of all Capital Equipment

*The grand total of all capital costs is $3,510,000. This calculation includes:*

| Capital Component | Installed Cost ($) | Component Lifespan (round to nearest year) | Description of Component |
|---|---|---|---|
| Solar - small | $600,000 | 20 | Solar panels |
| Microgrid controls | $160,000 | 20 | Control hardware |
| LiON Battery | $200,000 | 20 | Batteries |
| Solar - large | $2,550,000 | 20 | Solar panels |
| | $3,510,000 | | |

Figure 23

### Initial Planning and Design Costs

| Initial Planning and Design Costs ($) | What cost components are included in this figure? |
|---|---|

| | |
|---|---|
| $500,000. | |

Figure 24

## Fixed Operations and Maintenance Costs

The project would operate with fixed operations and maintenance costs. These costs include $41,000 annually.

| Fixed O&M Costs ($/year) | What cost components are included in this figure? |
|---|---|
| 41,000 | Annual solar and battery maintenance. |

| | O&M Unit Costs | | Quantity | |
|---|---|---|---|---|
| Solar | 20,000 | $/Mw | 1.80 | MW |
| Battery | 10,000 | $/MWh | 0.50 | MWh |

Figure 25

## Variable O&M Costs (Excluding Fuel)

The following table shows estimated costs associated with operations and maintenance that are likely to vary with the amount of energy the system produces each year.

| Variable O&M Costs ($/Unit of Energy Produced) | Unit | What cost components are included in this figure? |
|---|---|---|
| 2.493455504 | MWh | Diesel generator maintenance costs. |

*0.1 $/kWh Adjusted by percent of annual electricity generated by the diesel generator.*

Figure 26

## Ability to Operate in Islanded Mode without Replenishing Fuel Supply

*Note: This question is not used in the model.*

## 4.5 Costs to Maintain Service during a Power Outage

Because it is assumed that the MG will be operating in island mode most of the time, the cost to maintain service is equal to the cost of MG operation. These costs are detailed in the previous section 4.4.

## 4.6 Services Supported by the Microgrid

The services supported by the MG are the following:

- A wastewater treatment plant, a water treatment plant, and a police outpost, all of which serve a population of 400 people;
- The Steamburg Community Center, which could be used as an emergency shelter during a major power outage; and

- The Coldspring Longhouse, a building of cultural significance for the Seneca Nation of Indians.

## Benefit-Cost Analysis Summary Report

### Site 81 – City of Salamanca

## PROJECT OVERVIEW

As part of NYSERDA's NY Prize community microgrid competition, a team led by the Seneca Nation of Indians has proposed development of a microgrid project that would contribute to the sovereign independence of the Seneca nation of Indians by enhancing the resiliency of electric service for 95 residences in the city of Salamanca and six important community facilities, including:

- A wastewater treatment plant, a water treatment plant, and a police outpost, all of which serve a population of 400 people;
- The Steamburg Community Center, which could be used as an emergency shelter during a major power outage; and
- The Coldspring Longhouse, a building of cultural significance for the Seneca Nation of Indians.

The microgrid would be powered primarily by a solar distributed energy resource (DER), composed of both a large (1.5 MW) solar generator and a small (0.3 MW) solar generator. These generators would be supported by a 500 kWh battery. In addition, the microgrid would make use of a 0.3 MW diesel generator that is already owned by the nation but is not currently in use. The project's proponents anticipate that the microgrid's DERs would meet all of the served facilities' electricity demand during normal operations while also generating surplus electricity that could be sold to generate revenue. In addition, the system would have sufficient generating capacity to fully support all facilities on the microgrid during a major power outage. They also indicate that the system would be capable of providing ancillary services 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.

## METHODOLOGY AND ASSUMPTIONS

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

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

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

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

---

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

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

The BCA considers costs and benefits for two scenarios:

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

## 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 estimated benefits to outweigh its costs, the average duration of major outages would need to equal or exceed 3.6 days per year (Scenario 2). The discussion that follows provides additional detail on these findings.

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

| ECONOMIC MEASURE | ASSUMED AVERAGE DURATION OF MAJOR POWER OUTAGES | |
|---|---|---|
| | **SCENARIO 1: 0 DAYS/YEAR** | **SCENARIO 2: 3.6 DAYS/YEAR** |
| Net Benefits - Present Value | -$3,550,000 | $55,200 |
| Benefit-Cost Ratio | 0.6 | 1.0 |
| Internal Rate of Return | -8.8% | 8.6% |

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

## *Scenario 1*

Figure 1 and Table 2 present the detailed results of the Scenario 1 analysis. Figure 1. Present Value Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)

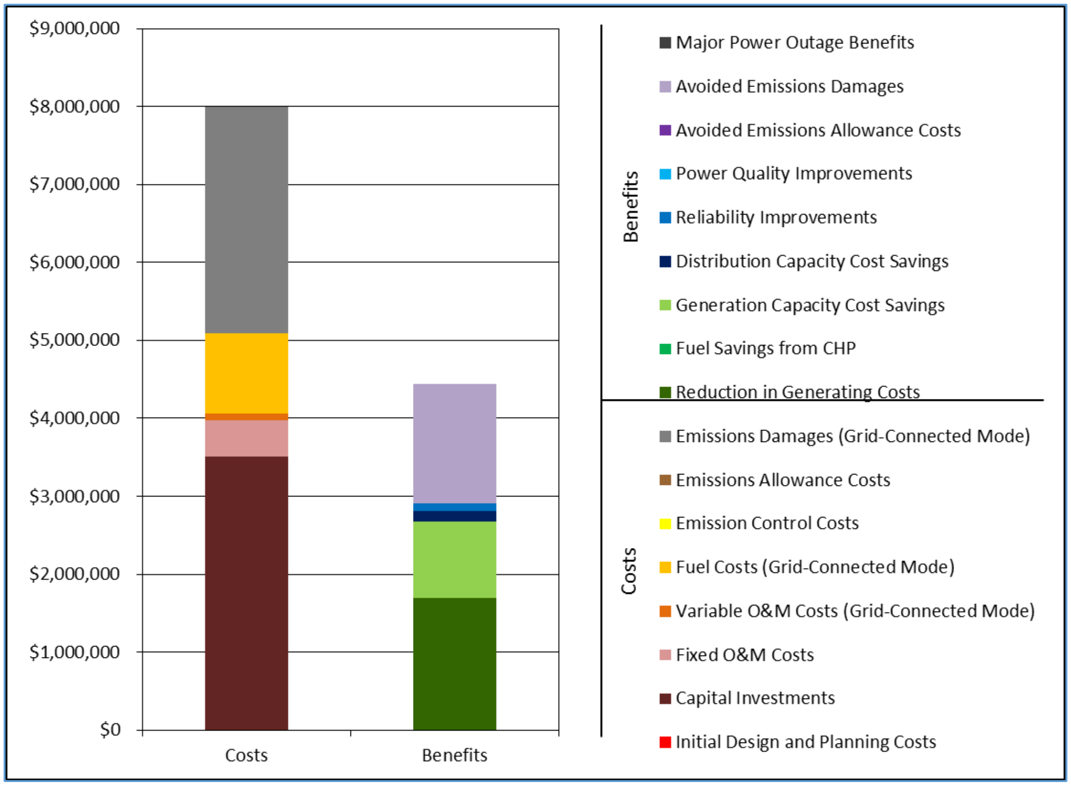


**Table 2. Detailed BCA Results, Scenario 1 (No Major Power Outages; 7 Percent Discount Rate)**

| COST OR BENEFIT CATEGORY | PRESENT VALUE OVER 20 YEARS (2014$) | ANNUALIZED VALUE (2014$) |
|---|---|---|
| **Costs** | | |
| Initial Design and Planning | $0 | $0 |
| Capital Investments | $3,510,000 | $310,000 |
| Fixed O&M | $465,000 | $41,000 |
| Variable O&M (Grid-Connected Mode) | $85,700 | $7,560 |
| Fuel (Grid-Connected Mode) | $1,030,000 | $91,000 |
| Emission Control | $0 | $0 |
| Emissions Allowances | $0 | $0 |
| Emissions Damages (Grid-Connected Mode) | $2,900,000 | $189,000 |
| **Total Costs** | **$7,990,000** | |
| **Benefits** | | |
| Reduction in Generating Costs | $1,690,000 | $149,000 |
| Fuel Savings from CHP | $0 | $0 |
| Generation Capacity Cost Savings | $986,000 | $87,000 |
| Distribution Capacity Cost Savings | $124,000 | $11,000 |
| Reliability Improvements | $107,000 | $9,450 |
| Power Quality Improvements | $0 | $0 |
| Avoided Emissions Allowance Costs | $1,030 | $91 |
| Avoided Emissions Damages | $1,530,000 | $99,800 |
| Major Power Outage Benefits | $0 | $0 |
| **Total Benefits** | **$4,440,000** | |
| **Net Benefits** | **-$3,550,000** | |
| **Benefit/Cost Ratio** | **0.6** | |
| **Internal Rate of Return** | **-8.8%** | |

## Fixed Costs

The BCA relies on information provided by the project team to estimate the fixed costs of developing the microgrid. The project team estimates that the project's capital costs (which include initial design and planning costs) have a present value of approximately $3.51 million. These costs include the fully installed costs of the small and large photovoltaic generators, the LiON battery storage, and microgrid controls. The present value of fixed operation and maintenance (O&M) costs over a 20-year operating period, including maintenance of the solar generator and battery, is estimated to be approximately $465,000.

## Variable Costs

The most significant variable cost associated with the proposed project is the cost of fuel for the system's diesel generator. To characterize this cost, the BCA relies on estimates of fuel consumption provided by the project team and projections of fuel costs from New York's State Energy Plan (SEP), adjusted to reflect recent market prices.[3] The present value of the project's fuel costs over a 20-year operating period is estimated to be approximately $1.03 million. The model also estimates variable O&M costs (i.e., costs that depend on the quantity of electricity generated by the microgrid's DERs). For this project, the model estimates that variable O&M costs, which include maintenance of the diesel generator, have a present value of approximately $85,700.

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 diesel generator would not be subject to emissions allowance requirements. In this case, the damages attributable to emissions from the diesel generator are estimated at approximately $189,000 annually. The majority of these damages are attributable to the emission of $NO_x$. Over a 20-year operating period, the present value of emissions damages is estimated at approximately $2.9 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 microgrid proposed by the Seneca Nation of Indians, the primary source of cost savings would be a reduction in demand for electricity from bulk energy suppliers (including both reduced demand from the supported facilities as well as from those that would be purchasing the electricity generated in excess of local demand), with a resulting reduction in generating costs.[4] The BCA estimates the present value of these savings over a 20-year operating period to be approximately $1.69 million; this estimate uses average electricity prices to value the reduced demand for electricity from bulk energy suppliers, 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 $CO_2$ and

[3] 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.

[4] Because the model focuses on social costs and benefits, it estimates the value of the reduction in electricity demanded from bulk energy suppliers, rather than the revenue that the microgrid would generate by selling excess electricity to others.

particulate matter, and produce a shift in demand for $SO_2$ and $NO_x$ emissions allowances. The present value of these benefits is approximately $1.53 million.[5]

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.[6] Based on the project team's application of standard capacity factors for PV systems, batteries, and diesel generators, the analysis estimates the present value of the project's generating capacity benefits to be approximately $986,000 over a 20-year operating period.[7] Similarly, the project team estimates that the microgrid project would reduce the need for local distribution capacity by approximately 0.3 MW. Over a 20-year period, the present value of this benefit is estimated to be approximately $124,000.

The project team has indicated that the proposed microgrid would be capable of providing black start/system restoration support services 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 $9,450 per year, with a present value of $107,000 over a 20-year operating period. This estimate is calculated using the U.S. Department of Energy's Interruption Cost

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

[6] 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.

[7] The project team did not specify the minimum amount of time required for the 500 kWh battery to fully discharge. The analysis assumes that it would fully discharge in an hour, meaning that it has an equivalent generating capacity of 0.5 MW.

Estimate (ICE) Calculator, and is based on the following indicators of the likelihood and average duration of outages in the service area:[8]

- System Average Interruption Frequency Index (SAIFI) – 0.96 events per year.
- Customer Average Interruption Duration Index (CAIDI) – 116.4 minutes.[9]

The estimate takes into account the number of 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.[10] 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 0.6; i.e., the estimate of project benefits is approximately 60 percent that of project costs. Accordingly, the analysis moves to Scenario 2, taking into account the potential benefits of a microgrid in mitigating the impact of major power outages.

## *Scenario 2*

## Benefits in the Event of a Major Power Outage

As previously noted, the estimate of reliability benefits presented in Scenario 1 does not include the benefits of maintaining service during outages caused by major storm events or other factors generally considered beyond the control of the local utility. These types of outages can

[8] www.icecalculator.com.

[9] The analysis is based on DPS's reported 2014 SAIFI and CAIDI values for National Grid.

[10] http://www.businessweek.com/articles/2012-12-04/how-to-keep-a-generator-running-when-you-lose-power#p1.

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.[11,12]

As noted above, the City of Salamanca's microgrid project would serve 95 residences and six facilities, including a wastewater treatment plant, a water treatment plant, a police outpost, the Steamburg Community Center, and the Coldspring Longhouse. The project's consultants indicate that at present, only the Steamburg Community Center is equipped with backup generators. It is our understanding that if an extended outage were to occur, the other facilities would not rent generators but would instead experience a complete loss in operating capabilities.

The information provided above serves as a baseline for evaluating the benefits of developing a microgrid. In addition, the assessment of Scenario 2 makes the following assumptions to characterize the impacts of a major power outage in the absence of a microgrid:

- During an extended outage, the police outpost would experience a 75 percent reduction in crime fighting effectiveness.
- During a major outage, the supply of fuel necessary to operate the backup generator at the Steamburg Community Center would be maintained indefinitely.
- There is a 15 percent chance that the backup generator would fail, in which case, the Steamburg Community Center would be left without power.

To estimate the lost value of service of each of the supported facilities, the analysis employed both methodologies developed by the Federal Emergency Management Agency (for the residences, the wastewater treatment plant, the water treatment plant, and the police outpost) and the ICE Calculator (for the Steamburg Community Center and the Coldspring Longhouse). It

[11] 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.

[12] 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.

is important to note that these methodologies do not assign a monetary value to the cultural significance of the Coldspring Longhouse, nor do they assign a monetary value to the contribution a microgrid would make to the sovereign independence of the Seneca Nation. These considerations cannot be monetized, and must be considered in addition to the impacts the analysis quantifies.

## Summary

Figure 2 and Table 3 present the results of the BCA for Scenario 2. The results indicate that the quantified 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 3.6 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 quantified benefits.

### Figure 2. Present Value Results, Scenario 2 (Major Power Outages Averaging 3.6 Days/Year; 7 Percent Discount Rate)

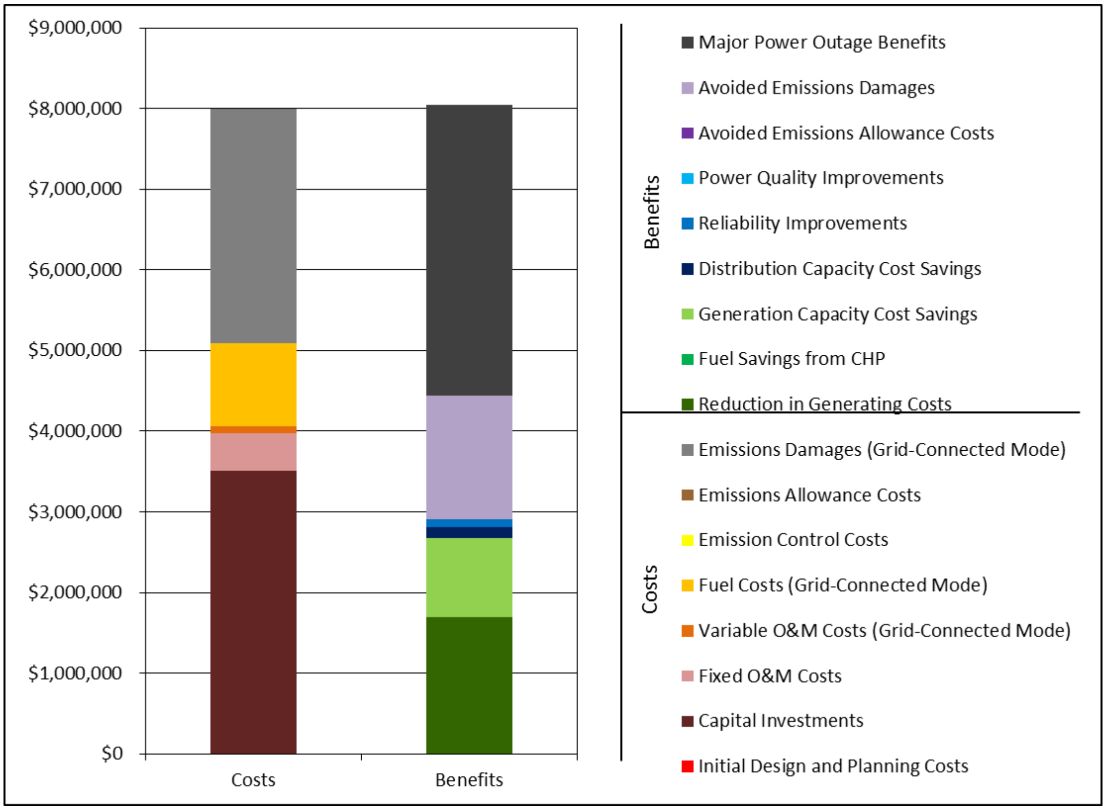


**Table 3. Detailed BCA Results, Scenario 2 (Major Power Outages Averaging 3.6 Days/Year; 7 Percent Discount Rate)**

| COST OR BENEFIT CATEGORY | PRESENT VALUE OVER 20 YEARS (2014$) | ANNUALIZED VALUE (2014$) |
|---|---|---|
| **Costs** | | |
| Initial Design and Planning | $0 | $0 |
| Capital Investments | $3,510,000 | $310,000 |
| Fixed O&M | $465,000 | $41,000 |
| Variable O&M (Grid-Connected Mode) | $85,700 | $7,560 |
| Fuel (Grid-Connected Mode) | $1,030,000 | $91,000 |
| Emission Control | $0 | $0 |
| Emissions Allowances | $0 | $0 |
| Emissions Damages (Grid-Connected Mode) | $2,900,000 | $189,000 |
| **Total Costs** | **$7,990,000** | |
| **Benefits** | | |
| Reduction in Generating Costs | $1,690,000 | $149,000 |
| Fuel Savings from CHP | $0 | $0 |
| Generation Capacity Cost Savings | $986,000 | $87,000 |
| Distribution Capacity Cost Savings | $124,000 | $11,000 |
| Reliability Improvements | $107,000 | $9,450 |
| Power Quality Improvements | $0 | $0 |
| Avoided Emissions Allowance Costs | $1,030 | $91 |
| Avoided Emissions Damages | $1,530,000 | $99,800 |
| Major Power Outage Benefits | $3,610,000 | $319,000 |
| **Total Benefits** | **$8,050,000** | |
| **Net Benefits** | **$55,200** | |
| **Benefit/Cost Ratio** | **1.0** | |
| **Internal Rate of Return** | **8.6%** | |

## 5.0 Summary

A high degree of political and economic autonomy is the greatest benefit of a micro-grid in Steamburg for the Seneca Nation. Unfortunately neither the benefit of autonomy, nor the cost of a lack thereof, is captured in the CBA worksheet. The underlying assumption for the cost benefit analysis is that the micro-grid provides islanding capability in an otherwise grid connected mode. Based on that assumption, the cost benefit analysis clearly shows more cost than benefit.

However, for the Seneca Nation, the opposite is true. It was a lack of political and economic sovereignty which facilitated the forced re-location of the residents of Steamburg. The cost to the people, their culture and their identity from this relocation is nearly unmeasurable. The Steamburg micro-grid presupposes island operation as the primary mode. This provides a credible bypass for the Steamburg community with regard to the incumbent utility serving that community.

The key benefit centers around being able to disconnect from National Grid and operate without that intervention. While the cost to do that exceeds current operational costs, the benefit of achieving Nation sovereignty outweighs the costs but cannot be incorporated into the CBA spreadsheet. The final goal of this bypass is ultimately to re-connect to Salamanca BPU under a tribal utility authority incorporating the Steamburg micro-grid into the larger utility territory of the Nation. This will provide both the economic benefit of lower cost power with a peer to peer relationship of the Nation to the BPU and National Grid. Only a credible bypass threat will allow the Nation to actually accomplish this goal. There is unfortunately no way to quantify these values.