

**Recipient Organization:** Bad River Band of Lake Superior Chippewa Indians

**Project Title:** Ishkonige Nawadide- Solar Project

**Date of Report:** September 27, 2022

**Award Number:** Award No. DE-IE0000115

**Total Project Costs:** \$1,997,931.81

**Technical Contact:** Daniel Wiggins Jr  
72682 Maple Street  
Odanah, WI 54861  
Ph: 715-682-7123 x1553  
[Air1@badriver-nsn.gov](mailto:Air1@badriver-nsn.gov)

**Business Contact:** Mike Wiggins Jr  
72682 Maple Street  
Odanah WI 54861  
Ph: 715-682-7111  
[MikeW@badriver-nsn.gov](mailto:MikeW@badriver-nsn.gov)

**Project Partner:** Madison Solar Consulting:  
Niels Wolter, Owner  
Madison, WI  
Ph: 608-216-4452  
[Madison.Solar@me.com](mailto:Madison.Solar@me.com)

muGrid Analytics:  
Amy Simpkins, CEO & Travis Simpkins, CFO/Founder  
Golden, CO  
Ph: 617-501-3287  
[travis@mugrid.com](mailto:travis@mugrid.com) & [amy@mugrid.com](mailto:amy@mugrid.com)

Cheq Bay Renewables:  
William Bailey, President  
Bayfield, WI  
Ph: 715-779-3231  
[cheqbayrenewbales@gmail.com](mailto:cheqbayrenewbales@gmail.com)

Faith Technologies Inc  
Dan Nordloh, Senior Vice President  
Menasha, Wisconsin  
Ph: 920-225-6737  
[Dan.Nordloh@faithtechinc.com](mailto:Dan.Nordloh@faithtechinc.com)

**ACKNOWLEDGMENT**

This material is based upon work supported by the Department of Energy, Office of Indian Energy Policy and Programs, under Award Number DE-IE0000115.

**DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

1. **Table of Contents:**
  - a. **Executive Summary**
  - b. **Project Objectives**
  - c. **Description of Activities Performed**
  - d. **Conclusions and Recommendations**
  - e. **Lessons Learned**

2. **Executive Summary:**

The Tribe's mission is to work towards a more progressive, financially stable government, to maintain tribal sovereignty, and enable members to progress individually, toward a more fulfilling life culturally, spiritually, and economically. Through this mission, the Tribe has explored numerous avenues to assure resiliency and sovereignty into the next seven generations. The Tribe energy vision is, "To empower and enable the community to move toward energy independence."

In 2016 this vision was highlighted when northern Wisconsin experienced a 500-year flood, in which the Tribe was one of the most impacted communities in the region with utility outages and transportation disruptions. This event highlighted major gaps in the Tribe Emergency Response, but also the Tribe's lack of ability to support the tribal community through an event of this nature. Critical infrastructure such as the H&WC, the Tribe's Clinic and the Chief Administration Buildings, the Tribe's primary building for government functions were compromised due to electrical, gas, and water utility outages. In response the Tribe revisited and adopted a new Emergency Response Plan and an updated Strategic Energy Plan.

The Bad River Band of Lake Superior Chippewa (the Tribe) implemented its first phase of energy independence through the installation of approximately 520 kW DC of solar photovoltaic (PV) at three tribal buildings: 200kW DC at the Wastewater Treatment Plant (WWTP), 300 kW DC at the Health & Wellness Center (Health Clinic), and 20 kW AC at the Chief Blackbird Administration Building (Administration Building). The solar PV systems were integrated with the existing utility grid and can operate independent of the grid using Battery Energy Storage Systems (BESS) in combination with solar and existing back-up gas generators. The BESS also creates resiliency, providing power when the grid is down. All three buildings are essential Tribal buildings.

The project addressed and accomplished all the objectives it set out for in the beginning of the project. Project objectives primarily included the following:

- a. Install 3 pilot solar PV projects using BESS and smart controls
- b. Reduce utility bills
- c. Create tribal jobs in solar PV installation

The microgrids at each site have proved to work through small (under an hour) outages and on several quarterly system inspections and tests. The Tribe has not experienced outages like the 500- year flood event. In addition to resilience the project has provided savings. From the date of commissioning in May of 2021 to June of 2022 the project has saved the Tribe over \$47,000.

### **3. Project Objectives:**

The Bad River Band of Lake Superior Chippewa (the Tribe) primary objective was to implement its first phase of energy independence through the installation of approximately 520 kW DC of solar photovoltaic (PV) at three tribal buildings: 200kW DC at the Wastewater Treatment Plant (WWTP), 300 kW DC at the Health & Wellness Center (Health Clinic), and 20 kW AC at the Chief Blackbird Administration Building (Administration Building). The solar PV systems were integrated with the existing utility grid and can operate independent of the grid using Battery Energy Storage Systems (BESS) in combination with solar and existing back-up gas generators. This addressed other objectives around reducing utility bills. The BESS also creates resiliency, providing power when the grid is down. The project addressed all the objectives it set out for in the beginning of the project. Project objectives included the following:

- a. Install 3 pilot solar PV projects using BESS and smart controls
- b. Reduce utility bills
- c. Create tribal jobs in solar PV installation

### **4. Description of Activities Performed:**

#### **a. Economic and Technical Analysis**

The Bad River Tribe brought on muGrid Analytics to assist with the economic and technical analysis. This was done primarily in the preliminary interconnection documents to Bayfield Electric Cooperative and preliminary design documents to the contractors and included in the request for proposals.

#### **b. Interconnection with Bayfield Electric Cooperative (BEC)**

Interconnection with BEC was completed successfully in May of 2021 with some restriction. The H&WC Microgrid did not pass one test that would allow for sell back of power to the Utility. Faith Technologies, the installation contractor, was able to rectify and pass the test and to date all three systems are fully operational with both the WWTP and H&WC with capabilities of selling power back to the utility.

#### **c. Request for Proposal (RFP) and RFP Process for the PV Systems' Installation**

RFP process was initiated in November of 2020 and concluded in March of 2020, selecting Faith Technologies as the installer.

#### **d. Request for Proposals (RFP) for Investor Funding**

RFP process was initiated in November of 2020, included with the Install RFP, and concluded in March of 2020, selecting Faith Technologies as the investor. The Tribe chose this route as many of the major installers expressed interest in investing, as well. This provided consistency with both the install and financing and allowed the Tribe to lean more on Faith Technologies' to get the project complete within the financial terms and conditions of the project.

#### **e. Acquisition of Permits**

The Tribe acquired all tribal and federal permits needed under this project. The Tribe's and the Federal NEPA both triggered environmental reviews, which required public review and posting, along with Tribal approval before moving forward.

**f. Project Implementation**

The Project was implemented in 2019 when the USDOE awarded the Tribe. The Project lead immediately worked with USDOE staff and the Team immediately scheduled a kick-off meeting. Other milestones related to the project implementation included:

- a. 2019: Techno-economic feasibility study performed by muGrid Analytics
- b. 2020: Application for DOE Tribal Energy Grant
- c. Feb 2020: RFP posted
- d. May 2020: Contractor selected
- e. September 2020: Construction started
- f. May 2021: Systems commissioned

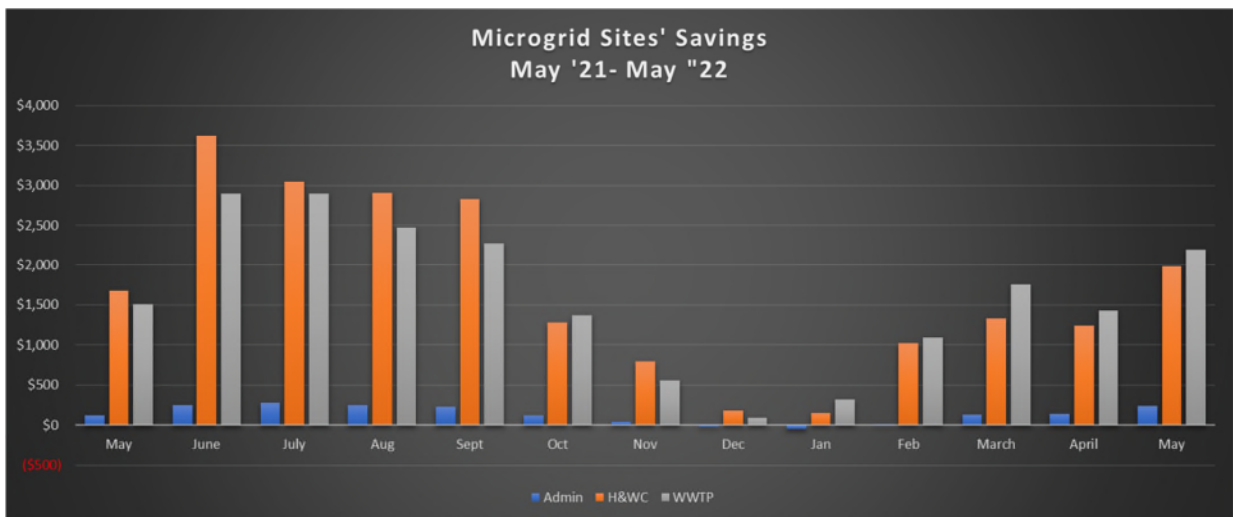
**g. Education and Community Relations**

Outreach and education, along with community relations were done throughout the project. The Project Lead was happy to provide details and project updates whenever and wherever he was invited. Status updates of the project, along with preset day operation savings were both topics included into the departments Common Ground quarterly newsletter. Other activities included:

- a. Tribal Council Working Sessions
- b. Utility Task Force Meetings with Department Heads and Facility Managers
- c. Public Virtual Meetings on Project Award and Status
- d. Virtual Commissioning Event May of 2021
- e. Interviews and conversations with energy panels and public radio interviews.
- f. Several presentations given on the tribal, state, and federal level
  - i. Approximately 20 presentations were given during this project period

**h. Post installation Monitoring, Analysis and Reporting**

Post monitoring has been interesting and has been completed by muGrid Analytics, the preliminary designer and expert in data analysis. The Tribe and muGrid placed meters at all the sites to assure that the information the contractors and the utility were providing were consistent and accurate. Charts and table below show savings.



<b>Microgrid (May '21-May '22)</b>	<b>KWh Produced</b>	<b>Total Savings</b>
Health & Wellness Center	215,938	\$22,076
Wastewater Treatment Plant	199,698	\$20,850
Administration Building	17,832	\$1,749

## 5. Conclusions and Recommendations:

There could be many recommendations to other Tribes on the topics of renewable energy and microgrids. The one recommendation I have for anyone planning, developing, and/ or investing into a microgrid is to identify your resiliency goals, along with your financing goals. If your goal is to support an entire building load fully through outages then you need to consider resiliency as the primary objective and leave financing goals aside, until you have fully addressed the resiliency factor. This may increase upfront costs but the project will meet the resiliency goal(s) that you have set.

The Tribe is very happy with the project and the microgrids in place. The project has created interest around solar but also batteries. Many homeowners are enquiring about storage for their homes and are very interested in supporting their home. Staff are also very happy and supportive and have had great communications with the contractors towards staff training and future maintenance.

## 6. Lessons Learned:

There were many lessons learned and the Team continued to identify gaps within the Tribe, utility, and contractors towards microgrid expansion and optimizing of operations. The team continues to work with all parties and was awarded another project through the State of Wisconsin's Public Service Commission and specifically on the topic of developing the microgrids into a smaller Minigrid. This project was just completed in 2022 and the reports have not been published. Reports developed were *Bad River Band of Lake Superior Chippewa Ojibwe Hybrid Microgrid (OHM) Feasibility Study & Opportunities for De-Carbonizing the Bad River Band of Lake Superior Tribe of Chippewa Indians' Electricity Resources*. Below are the lessons that were learned from this project and extending from the USDOE work:

- a. Before pursuing additional generation, we recommend that the Tribe conduct energy efficiency audits, implement load scheduling, and implement additional energy efficiency measures across their portfolio of buildings.
- b. The dynamics of meeting the resilience requirements for this microgrid project are more about energy sufficiency than about power.
- c. The Tribe will need to decide on a strategy going forward in the near term: whether to continue deploying individual microgrids at each building, which can be aggregated together, or to take a more central-plant approach with a single feeder-level solar plus storage plant that can back up the entire feeder. We generally think a consolidated front-of-meter central plant microgrid makes sense.
- d. When considering a larger Minigrid and if considering a single feeder level solar plus storage installation, the Tribe should consider battery inverter sizes of at least 500 kW to meet power requirements, given the sizing of existing generators already located on the feeder. Larger battery inverter sizes will allow for more load growth in the future, and we generally recommend a battery inverter of 1 MW for both the East Branch microgrid and the full New Odanah microgrid.

- e. If considering individual microgrids at each building to aggregate later, we will need to pay close attention to the aggregation to ensure adequate peak coverage as well as synchronization between dispersed battery systems.
- f. To meet the energy needs of the microgrid and the resilience duration, there is a clear trade between the battery capacity / solar PV plant size and generator tank size. Enlarging the generator fuel tank will always be less expensive, but the Tribe may value the benefits of solar and storage more highly. This is a trade that should be made with community discussion. There is no apparent “knee in the curve” for meeting the resilience requirements as written. These options are also not mutually exclusive – the generator fuel tanks could be enlarged along with adding additional solar.
- g. Solutions that favor more solar and storage generally have better resilience performance at durations longer than 1 week versus those with a larger fuel tank. Higher confidence at longer durations may be of interest to the Tribe, along with greater sustainability from renewable generation.
- h. The revenue potential of a front-of-meter solar plus storage system will depend on selling electricity back to the grid and being compensated at the day-ahead spot price. Strategic control of the battery discharge will allow the Tribe to maximize revenue potential by time-shifting some of the solar energy to more lucrative hours of the day (such as the evening.) Other revenue streams for the battery may include providing demand response or other grid services and being compensated for doing so. These opportunities are not yet available with BEC and Dairyland but may soon be an option.
- i. When the Tribe eventually forms a Tribal Utility Authority, they will be generating their own power on the reservation and importing additional power as needed that they buy on the wholesale market. This front-of-the-meter microgrid project would then be located inside the TUA but would still be offsetting wholesale rate electricity that the Tribe would otherwise purchase on the market.
- j. While we were able to install a fleet of data loggers to collect actual operating data for this study, due to the time constraints of the study, we only collected a few months of data. It would be beneficial to revisit the study results after a full year of high-resolution interval load data has been collected.
- k. Additionally, data transfer processes for the existing microgrids from EnTech/Faith Tech to the Tribe and to the analysis team have not been fully developed. We believe the Tribe would benefit from a smoother, more consistent data transfer process.
- l. To move this study forward into implementation, especially as the Tribe considers forming a Tribal Utility Authority, we acknowledge that basing analysis on load data from a single year may have limitations. We recommend statistically varying load and production estimates to ensure coverage of outliers in future studies.
- m. In addition to the deployment of data loggers, other advanced metering technology would also be helpful. Bayfield Electric Cooperative has begun the roll out of smart meters at tribal facilities, but it has not been completed at the time of this writing. Smart meter installation would provide validation to the load data itself as well as to billing.
- n. One of the biggest lessons learned was making it through pandemic and the continued importance of projects to be completed. COVID-19 made its way through

the Bad River community in early 2020 and just as the Tribe brought on the contractor. The Tribe issued a Stay-At-Home order which is still in March of 2020, which was in full affect for the 2020 year. COVID-19 created a different working environment, but the Bad River team continued to complete objectives through the continued epidemic. The pandemic in a way drove us harder to complete the project.