

# Final Abstract

Final Report Approved on November 8, 2024

## M.L. 2020 Project Abstract

For the Period Ending June 30, 2024

**Project Title:** Storing Renewable Energy In Flow-Battery For Grid Use

**Project Manager:** Bryan Herrmann

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**Website:** <https://morris.umn.edu/>

**Funding Source:**

**Fiscal Year:**

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 07a

**Appropriation Amount:** \$250,000

**Amount Spent:** \$250,000

**Amount Remaining:** -

### Sound bite of Project Outcomes and Results

The project storing renewable energy in a rural area is demonstrating the use of advanced battery chemistries to focus use cases around load leveling, peak shaving, and market services. Expansion of the solar PV system and efforts to enhance grid stability and a foundation for renewable energy implementation in Minnesota.

### Overall Project Outcome and Results

The project was designed to improve renewable energy integration and grid stability at UMN Morris through the development of a large-scale demonstration of advanced battery chemistries and installation of a solar PV system. The primary objective is to optimize energy management within a community-scale grid by leveraging renewable energy sources like solar and wind.

The installation of the solar PV system will be completed soon. This enhancement enables more comprehensive research on integrating solar energy with battery storage, providing consistent power throughout the day and night. The near completion of this solar array represents a key milestone in our project, setting the stage for further studies on renewable energy management.

In parallel, significant progress has been made in the RFP and battery chemistry selection phase for advanced energy

storage systems. We have also leveraged OATI's analysis and insights from their report to guide our strategy. We have established connections with leading national labs, including Pacific Northwest National, Oak Ridge National, Sandia National, and the Department of Energy, to leverage their expertise in advanced battery chemistries. Additionally, we are evaluating battery options based on data analysis from our current generation assets, including solar and wind, as well as energy usage patterns. The preliminary use case for the battery system focuses on load leveling and peak shaving, which aligns with the university's needs and will be Otter Tail Power's default strategy. Additionally, Otter Tail Power is exploring the potential to leverage the battery in the MISO market for ancillary services and energy arbitrage. Overall, the project's outcomes are expected to provide valuable insights into renewable energy integration including experience for the utilities supporting Minnesota's energy transition efforts. The findings will inform future policy and management decisions, contributing to a more resilient and sustainable energy grid that is less carbon intensive.

### **Project Results Use and Dissemination**

Results of the project have been disseminated through university communication channels, social media, and industry forums. Hundreds of people have visited campus and learned about our battery project and the solar expansion. Key updates, including the solar PV system and progress on the RFP process for advanced battery chemistries, have been shared to inform and engage stakeholders; continuing as the project advances. A large sign announces the solar project including the ENRTF logo. The goal is to have the project's findings accessible to the public, industry stakeholders, and policymakers, contributing to the broader energy transition initiatives in Minnesota.



## Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

### General Information

**Date:** November 18, 2024

**ID Number:** 2020-073

**Staff Lead:** Michael Varien

**Project Title:** Storing Renewable Energy In Flow-Battery For Grid Use

**Project Budget:** \$250,000

### Project Manager Information

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### Project Reporting

**Final Report Approved:** November 8, 2024

**Reporting Status:** Project Completed

**Date of Last Action:** November 8, 2024

**Project Completion:** June 30, 2024

### Legal Information

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 07a

**Appropriation Language:** \$250,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota, on behalf of the Morris campus, to analyze the potential of adding a flow battery and solar energy generation to the University of Minnesota Morris's existing renewable-energy-intensive microgrid.

**Appropriation End Date:** June 30, 2024

## Narrative

**Project Summary:** Our project team will implement a rural, community-scale project, which demonstrates how a large flow-battery connected to solar and wind generation improves grid stability -- and enhances usage of renewables.

**Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

On a cost-per-unit-energy basis, Minnesota's wind and solar resources now outcompete traditional fossil fuel generation and prices continue to drop. Minnesota produces a lot of solar during the day -- and wind both day and night. These energy resources are intermittent and complementary. If we want to maximize the economic, environmental and social benefits of renewables for rural/farm-scale operations and urban-integration we will need to test storage solutions. With storage, utilities and consumers have the ability to store overproduction and time-shift the energy usage to when grid demand is highest and energy prices are highest. In high-tech states, universities work with regulators to improve their understanding of emergent technologies and how they would integrate them into the evolving power system. UMN Morris, as a nexus of research, implementation and outreach in renewable energy, is an ideal host site for this project. The campus has experience working successfully with various federal funding agencies (e.g., Department of Agriculture, National Energy Technology Laboratory (NETL) and the State of Minnesota, as well as with private partners, to help fund a vigorous energy research program. UMN Morris produces the most on-site energy per student in the entire United States.

**What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.**

Flow batteries hold the greatest potential for large-scale storage. Flow batteries use less expensive materials than lithium-ion batteries; need significantly less energy for ventilation and cooling; perform better at low-temperature; and can cycle continuously without degradation. In short: they have great potential to be adapted to Minnesota's punishing temperature extremes. This analyzes and plans for a proposed addition of a 1MW/4MWh flow battery and 175 kW of solar PV generation to UMN Morris's unique, renewable-energy-intensive microgrid, in a research-and-demonstration project aimed at accelerating the pace of Minnesota's transition to clean, reliable, and local energy. The UMN Morris microgrid is an ideal test-bed to explore the optimization of battery-charging and dispatch as part of a dynamic, intermittent system - the optimizing multiple benefits will be a major determinant of the economic viability of an installation. The campus is a member of the award-winning initiative called the Morris Model. Our community partnership focuses on clean energy, energy-efficiency and community resilience, and was inspired by our close partnership with the rural town of Saerbeck, Germany. Morris Model partners include the city of Morris, UMN West Central Research Outreach Center, Morris Area School District, Stevens County, Stevens Community Medical Center, and Otter Tail.

**What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?**

Wind and solar are strategic resources. We are not maximizing the potential of these resources in Minnesota to provide clean energy. Pollution from power plants has human and environmental impacts. For example, increased rates of asthma makes people vulnerable to respiratory diseases. Energy storage is a key enabling-technology that will provide an enhancement of our ability to utilize wind and solar. Renewables and storage can be paired to stack benefits. On less than 10 acres, you can install 1000kW solar, and generate over 1M kWh. Solar-storage installations on-farm can provide shading for animals, increase pollinator habitat, and time-shifted electricity production.

## Project Location

**What is the best scale for describing where your work will take place?**

Statewide

**What is the best scale to describe the area impacted by your work?**

Statewide

**When will the work impact occur?**

During the Project

## Activities and Milestones

### Activity 1: Evaluate battery options, analyze energy usage and develop test cases

**Activity Budget:** \$145,004

**Activity Description:**

UMN Morris, OTPCO and OATI will work to evaluate battery suppliers on the market to determine the best in class selection that will allow the implementation phase to be ready for a Request For Proposal. Professional engineering services will be hired to develop connection details and required documentation for interconnection request. Data will be collected from the on-campus usage and production along with grid data to evaluate the most important attributes for battery selection. Test cases from research and conversations with experts and grid operators will be used to determine critical needs from the battery.

**Activity Milestones:**

Description	Approximate Completion Date
Hire Technical Engineering Expertise	December 31, 2021
Evaluate options from battery suppliers and prepare specifications for purchase	June 30, 2022
Create documentation for connection details and interconnection applicaiton	July 31, 2022
Develop test cases and study economic models	December 31, 2023

### Activity 2: Evaluate Solar Options, plan and install solar

**Activity Budget:** \$104,996

**Activity Description:**

UMN Morris will plan, select and install a 175kW solar PV system connected to the UMN Morris microgrid. UMN Morris has the capacity to implement a Request-For-Proposal (RFP) process to solicit competitive bids for equipment. A system of this size will allow our team to research how wind and solar work integrate with battery storage on a community-scale grid. Wind is stronger at night and solar is strong in the daytime allowing battery storage across a 24-hr period. Planning and procurement of the solar PV system will be the critical component of this activity.

**Activity Milestones:**

Description	Approximate Completion Date
Project Planning for solar array	June 30, 2023
Request for proposal for solar array	September 30, 2023
Solar Array Install Completion	June 30, 2024

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Arne Kildegaard	Professor of Economics, University of Minnesota, Morris	Kildegaard has extensive experience in energy systems analysis and modeling particularly with respect to integrating distributed energy resources (DERs). He will work with the project team to take actual demonstration data to model implementation of the project and economic benefit to the overall grid, small communities and utilities.	Yes
David Heim	Chief Strategy Officer, OATI	Heim holds the positions of Associate Vice President and Chief Strategy Officer at USA Microgrids (USA MG) and Open Access Technology International, Inc. (OATI). Heim will be the lead on implementing controls to understand the best approach to maximize the utilization to meet the demonstration goals of the project.	Yes
Blaine Hill	City Manager, City of Morris	Hill leads the climate protection partnership agreement with the city of Saerbeck, Germany and has begun implementing projects to reduce energy use, identify renewable energy sources and ways to protect the environment. Hill will collaborate on the Flow-Battery project along with the demonstration as part of the Morris Model.	No
Jason Grenier	Manager, Market Planning, Otter Tail Power Company	Grenier has over 16 years in the electric utility industry, including 12 years with OTPCO. He oversees the development and marketing of OTPCO's energy conservation, demand response, e-business, small-scale solar, and electric vehicle customer offerings. Grenier will provide leadership in connection to OTPCO including the acquisition of the battery.	No

## Dissemination

**Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.**

The Morris Campus hosts many tours from visitors from across the world. We plan to present this information at conferences, through webinars, and campus website information. The goal will be to add data to the website to allow students, industry and curious citizens the opportunity to learn about the project and benefits. As part of the Morris Model, we participate in outreach across the state to serve as a demonstration platform for people to learn about these projects, including local conferences and visitors. The project will be shared through our regular University news service. The economic analysis has potential for publication. In all of these efforts we will acknowledge the support of the Environment and Natural Resources Trust Fund.

## Long-Term Implementation and Funding

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?**

This 3-year project is another step in a multi-stage project. This project is focused on testing the feasibility and performance of flow batteries in our Minnesota climate. We will learn how batteries can integrate with renewable energy sources, resulting in a thorough, publicly-available, cost-benefit analysis and system-integration study. As described above, UMN Morris is a national leader in working with partners to demonstrate community-scale energy solutions for the 21st-century. After project completion, we will continue to advance this effort as part of our overall goal of being a model clean-energy-and-storage, research-and-demonstration site in the United States.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount	\$ Amount Spent	\$ Amount Remaining
<b>Personnel</b>										
Project Economist		Part-time role to provide economic analysis of the project for consideration of fiscal benefits to the grid.			36.5%	0.2		\$31,091	-	-
Technical Engineer		Lead the technical analysis and documentation of the project			36.5%	0.5		\$52,516	-	-
							<b>Sub Total</b>	<b>\$83,607</b>	<b>\$83,607</b>	-
<b>Contracts and Services</b>										
USA Microgrids - an OATI Company	Professional or Technical Service Contract	Microgrid controls contract for planning for Microgrid and grid tie optimization. USA Microgrids, an OATI company, provides a broad array of professional services related to DER and microgrid project development and implementation including DER/microgrid controls design expertise and integration.		X		0		\$61,200	\$61,200	-
							<b>Sub Total</b>	<b>\$61,200</b>	<b>\$61,200</b>	-
<b>Equipment, Tools, and Supplies</b>										
							<b>Sub Total</b>	-	-	-
<b>Capital Expenditures</b>										
		175 KW Solar Array	Demonstrate large scale solar supply to flow battery storage.	X				\$104,996	\$104,996	-
							<b>Sub Total</b>	<b>\$104,996</b>	<b>\$104,996</b>	-
<b>Acquisitions and Stewardship</b>										



							Sub Total	-	-	-
Travel In Minnesota										
							Sub Total	-	-	-
Travel Outside Minnesota										
							Sub Total	-	-	-
Printing and Publication										
	Printing	Printing diagrams, posters, and materials to describe the project for collaborators and visitors to the future site.	Produce a guide for "Storing Renewable Energy in Flow-Battery for Grid Use and Resiliency" guide targeted at communities, researchers and utilities. Large printed posters to present research at public events. Printing educational diagrams and banners on the battery to describe the project for visitors to the site.					\$197	\$197	-
							Sub Total	\$197	\$197	-
Other Expenses										
							Sub Total	-	-	-
							Grand Total	\$250,000	\$250,000	-

## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<b>Contracts and Services</b> - USA Microgrids - an OATI Company	Professional or Technical Service Contract	Microgrid controls contract for planning for Microgrid and grid tie optimization. USA Microgrids, an OATI company, provides a broad array of professional services related to DER and microgrid project development and implementation including DER/microgrid controls design expertise and integration.	OATI selected as leading provider in Minnesota and partner on project. Founded in Minnesota and operating since 1995, OATI has provided technology and software solutions to the energy industry in transmission and reliability management, energy trading and risk management, and smart grid applications. More than 98% of North American energy industry organizations use OATI solutions. OATI is the leader in this area and providing a single source contract will make sure we have the best success in this project. In our research, the comparable vendors are limited in the ability to make this project successful. OATI is also providing in-kind resources on this project.
<b>Capital Expenditures</b>		175 KW Solar Array	Solar Array will continue to be used after the project period for continued demonstration of this project and future demonstration renewable energy work on campus. <b>Additional Explanation :</b> The useful life of the solar array will be 20-25 years. The power will be supplied to the campus grid and will last as long as the battery if not longer.

## Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount	\$ Amount Spent	\$ Amount Remaining
<b>State</b>						
In-Kind	Unrecovered U of M indirect costs	Support provided to the project by Project Manager, overhead from the University.	Secured	\$82,500	\$82,500	-
			<b>State Sub Total</b>	<b>\$82,500</b>	<b>\$82,500</b>	<b>-</b>
<b>Non-State</b>						
			<b>Non State Sub Total</b>	<b>-</b>	<b>-</b>	<b>-</b>
			<b>Funds Total</b>	<b>\$82,500</b>	<b>\$82,500</b>	<b>-</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [53218970-7b2.pdf](#)

#### *Alternate Text for Visual Component*

Representation of wind and solar power feeding a flow battery for campus demand or Morris community grid. Two images of flow batteries in production. Map representing potential location of battery and solar on the University of Minnesota, Morris campus....

### Supplemental Attachments

#### *Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other*

Title	File
OATI - USA Microgrids Letter of Support	<a href="#">4dd18804-620.pdf</a>
Otter Tail Power Company Letter of Support	<a href="#">3331eb1a-031.pdf</a>
Background Check Certification Form	<a href="#">81925688-c3a.pdf</a>

### Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

Adjusted budget to meet allocation and activities to match adjusted timeline.

## Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

**Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?**

Yes

**Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?**

N/A

**Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?**

No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**

N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**

N/A

**Does your project include original, hypothesis-driven research?**

Yes

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

## Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Explanation & justification for Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Amendment Request	<ul style="list-style-type: none"> <li>• Other</li> <li>• Budget - Professional / Technical Contracts</li> <li>• Budget - Travel and Conferences</li> <li>• Activities and Milestones</li> <li>• Budget - Capital, Equipment, Tools, and Supplies</li> </ul>	As a result of the delays on the 2021-169 larger battery project, the need for the technical engineering was better added to that project. The solar portion of the project was able to move forward and has been contracted to be completed this spring. There was slight adjustment to the contract with OATI because of an increase in work scope. The travel was removed as almost all meetings were able to be held virtually.	February 5, 2024	Yes	February 5, 2024
2	Amendment Request	<ul style="list-style-type: none"> <li>• Budget</li> <li>• Other</li> <li>• Budget - Personnel</li> <li>• Budget - Printing and Publication</li> </ul>	A small budget adjustment of \$241 from printing and publications budget to the personnel budget. The signage that was purchased and displayed was less expensive than budgeted. The \$241 was spent on staff personnel on the project.	November 4, 2024	Yes	November 4, 2024

# Status Update Reporting

## Final Status Update August 14, 2024

**Date Submitted:** November 3, 2024

**Date Approved:** November 4, 2024

### Overall Update

The team has achieved the objectives in planning for the large scale battery and solar PV installation. During the planning phase the advanced stages of the Request for Proposal (RFP) for battery procurement and chemistry selection were achieved. Connections with National Labs, companies, and leaders in the long duration storage industry in advanced chemistries beyond lithium were established. We have leveraged OATI's analysis and insights from their report to inform our approach. We are evaluating battery options based on data analysis from our current generation assets of solar and wind, and our energy usage patterns. The RFP is scheduled for release soon, with the bid award targeted by the end of November.

The preliminary use case for the battery system, focusing on load leveling and peak shaving, aligns with the university's needs and will serve as Otter Tail Power's default strategy. Otter Tail Power is analyzing this battery asset for use in the MISO market for ancillary services and energy arbitrage. These developments collectively advance our efforts for renewable energy integration and grid stability in Minnesota. The solar PV system is in the final stages of installation and will facilitate research in integration of solar for energy storage systems.

### Activity 1

Since the previous update, we have progressed with the RFP for the battery supplier and battery chemistry selection for energy storage systems. We have established connections with Pacific Northwest, Oak Ridge, Sandia National Labs, and the Department of Energy's Long Duration Energy Storage initiative. These collaborations are critical as these labs are working on advanced chemistries beyond lithium, and their guidance is helpful as we move forward. We have also leveraged OATI's analysis and insights from their report to inform our decision-making process. Regular communication with battery manufacturers and national labs has been maintained, and our evaluation process includes analyzing data from our current generation assets (solar and wind) and our energy usage. The RFP is scheduled for release in the near future, with the bid process expected to culminate in an award by the end of November, followed by the final battery selection. The focus remains on selecting a system that effectively supports load leveling and peak shaving, with additional potential for ancillary services and energy arbitrage in the MISO market. The engineering team in collaboration with Otter Tail Power company has developed the technical specifications to ensure the battery technology is able to connect to the grid.

*(This activity marked as complete as of this status update)*

### Activity 2

The installation of the solar PV system at UMN Morris is nearly complete. The team is adding the final row of panels this week. The panels are locally sourced from Minnesota so we encountered a small delay because of demand for domestic panels. The portion of the project covered by the activity has been completed. The interconnection application has been submitted to Otter Tail Power Company and they are evaluating the additional capacity as part of the overall renewable energy generation for the campus. The increase in solar capacity enables more comprehensive research on the integration of solar energy with the microgrid and battery storage systems. This solar array marks a critical milestone in the project, providing a foundation for further research into renewable energy management and its implications for grid stability. After approval for the interconnection we will be able to monitor the production and utilize that data for measurement and understanding of how solar complements the wind also produced on site. The array is elevated above the pasture that houses the University of Minnesota West Central Research and Outreach Center's cattle, providing a

good demonstration of land use as well as shade for the cattle.

*(This activity marked as complete as of this status update)*

### **Dissemination**

Our dissemination activities have continued to ensure that the progress and outcomes of the project are communicated effectively to a broad audience. Since the last update, key milestones have been shared through social media, university newsletters, and industry forums. The near completion of the solar PV system and ongoing progress with the energy storage project have been highlighted, demonstrating the potential for renewable energy integration at a community-scale level. We created a large sign that can be seen from US Highway 59, near the entrance to campus, that includes the ENRTF logo. The Midwest Farm Energy conference was held in June and the array was included as part of the research discussions.

Engagement with industry partners and stakeholders, including battery manufacturers and national labs, has been an ongoing opportunity to share insights and receive feedback. These interactions have been critical in refining our approach and aligning our project with broader industry trends. Photos of the solar installation nearing completion, along with updates on the RFP process, have been made available through UMN Morris's communication platforms. We will continue these dissemination efforts as the project advances, ensuring that our findings contribute to and lift up Minnesota's broader energy transition initiatives.



# Status Update Reporting

## Status Update April 1, 2024

**Date Submitted:** November 3, 2024

**Date Approved:** November 4, 2024

### Overall Update

There has been significant progress on our battery and solar initiatives at UMN Morris since our last update. After the departure of our first project manager, a new project manager was hired with Masters Degree level energy experience . Preparations for the solar PV system installation to begin in June are well underway. Energy Concepts has been selected as our solar provider, and we are prioritizing quality and local support by using US-made steel and Minnesota-made panels, enabling more extensive research on integrating solar energy with our microgrid and battery storage systems. In parallel, we are actively evaluating battery options and developing test cases to ensure the best-in-class selection. Professional engineering services have been hired to develop connection details and required documentation for interconnection requests. Data collection from on-campus usage, production, and grid data is ongoing to identify critical attributes for battery selection. Additionally, we are developing test cases based on research and consultations with experts and grid operators to pinpoint essential requirements. These efforts collectively advance our research on the effective integration of solar and wind energy, improving grid stability and performance.

### Activity 1

Our team, consisting of UMN Morris, Otter Tail Power Company (OTPCO), and OATI, has made significant progress in evaluating battery suppliers. We are on track for the implementation phase and preparing for the Request for Proposal (RFP). We have successfully hired an engineering, procurement, and construction (EPC) contractor in partnership with OTPCO to develop connection details and required documentation for the interconnection request. The new energy storage project manager has also had many conversations with storage leaders and national labs and they have shown interest in this project as well as provided outstanding advice about the current battery market. We are developing test cases based on research and expert consultations, including insights from grid operators, national labs and OATI to identify the essential requirements for the battery system. This process will ensure that we select the most suitable battery technology to meet our project's needs. The cold climate of Minnesota provides the opportunity to have discussions with vendors and national lab staff to understand unique concerns that may arise. Consultation with a national lab indicated that there are no known large battery installations in the Upper Midwest. This project will be a valuable demonstration for this region.

### Activity 2

The installation is set to commence at the end of June. We have partnered with Energy Concepts, a reputable company known for their high-quality solar installations. To support local businesses and ensure top-tier quality, we have opted for US-made steel and Minnesota-made panels for the project. This caused a slight delay but all of the steel materials are on-site and the panels have a ship date later in June. This decision supports local manufacturing and adheres to stringent quality standards. This enhancement will facilitate more comprehensive research on integrating solar energy with our microgrid and battery storage systems. By utilizing quality equipment, we are well-prepared to advance our research on the effective storage and use of solar energy, alongside wind energy, to improve grid stability and performance. This project will act as a crucial testbed for future renewable energy initiatives. We are currently on pace to complete the portion of this activity funded by this project by the end of June.

### Dissemination

UMN Morris is maintaining relationships with battery manufacturers and national labs, including giving periodic updates to other contacts that have been made in the past about our project. This project with OATI has also been helping us give this project more visibility. We also are attending periodic webinars and sent a staff member to a conference with

national organizations that focus on energy storage technologies and engaging with the organizers of those events. We continue to give tours of our renewable energy assets, educating leaders from many areas across the state on the impact of this battery project and the importance of ENRTF funds to make it a reality. Otter Tail Power company has also been discussing this project with their leadership, involving and educating more employees within their company about these technologies.

# Status Update Reporting

## Status Update October 1, 2023

**Date Submitted:** February 5, 2024

**Date Approved:** February 5, 2024

### Overall Update

The team has been working on finalizing planning and moving into procurement stage of the battery project. We worked with Open Access Technology Inc (OATI) since our last report to identify locations for the battery, size of the battery as well as thinking about the controls for the battery. This report also looked at some modeling that was compared and evaluated with that done by the faculty member on our project team to identify the optimal size for the battery. The team has stayed in contact with the potential battery vendors to ensure our project is meeting current technology. The request for proposal is nearly complete and we are working closely with Otter Tail Power Company to work on the logistics of procurement and interconnection. The solar phase of the project has move forward with a request for proposal that received bids from vendors on September 28. A contract has has been signed with a solar installer and with the budget amendment we will be able to complete the work before the end of the project timeframe. Project Engineer took a different role in December 2023, a new staff member is slated to start by the end of February 2024.

### Activity 1

The request for proposal for the solar array has been submitted and we have response from vendors. The team is in the final stages of evaluation of the proposals and will finalize to begin construction in the near future. This of course will be weather dependent. The request for proposal for the battery has been constructed and we are having final discussions with the team partners Otter Tail Power Company and Open Access Technology about how the operations of the battery will work and how the interconnection will happen. These are complicated discussions because of the regulatory pieces that Otter Tail needs to work through and the processes that the University of Minnesota follows in the procurement process to ensure the best outcome possible for the project. The team is excited to be at this step where we will be able to get a proposal out to the vendor community to see what the results will be. We know this next process of evaluation will have challenges as we compare the multiple technologies. We have strong partners on this project and everyone has the same goal of the ability to demonstrate this technology in Minnesota with our wide temperature range.

### Dissemination

The team continues to discuss the project at any opportunity with leaders who visit to Morris. We have had many important leaders across the state visit Morris and we have discussed this project and informed them of the goals for the battery and solar project. We have local and statewide media who are interested in this project as we move to the next steps for installation. Otter Tail Power company has discussed this project in many areas as they are thinking about how this project will impact the grid.

# Status Update Reporting

## Status Update April 1, 2023

**Date Submitted:** March 31, 2023

**Date Approved:** May 12, 2023

### Overall Update

Open Access Technology International (OATI) was hired by the University to conduct a grid analysis to better understand the capabilities and limitations of the grid when adding the flow battery and additional solar. This analysis will be completed in the next three weeks. The final product will include a design narrative, one-line diagram, site layout, and network diagram. This information will be the backbone to construct the Request for Proposal for the flow battery. The coordination and discussion with Otter Tail Power company has helped develop a more clear picture of the use cases and the structure of the operation of the battery. The team has also been developing an RFP for the solar addition. There will be an additional analysis as we add solar to ensure the current capacity of the current overhead lines will support the connections.

### Activity 1

OATI will be providing the site layout which includes two possible locations on the UMN Morris campus for the battery, as well as a one-line diagram which will show all of the electrical connections of the flow battery and the additional storage to the grid. These items will be delivered from OATI so we are able to develop an the Request for Proposal soon after the analysis is complete. They are also constructing a list of criteria and technical requirements to look out for when are searching for and deciding the battery vendors. The design by OATI will be the foundation for the interconnection application which we will be submitting in the next few months as well to begin the implementation phase of the project.

### Dissemination

UMN Morris is maintaining relationships with battery manufacturers and giving periodic updates to other contacts that have been made in the past about our project. This project with OATI has also been helping us give this project more visibility. We also are attending periodic webinars with national organizations that focus on energy storage technologies and engaging with the organizers of those events. We have been giving tours of our renewable energy assets to leaders from many areas across the state as we normally do and continue to talk about how impactful this battery project will be and the importance of the ENRTF funds for this project. Otter Tail Power company has also been discussing this project with their leadership.

# Status Update Reporting

## Status Update October 1, 2022

**Date Submitted:** September 30, 2022

**Date Approved:** October 28, 2022

### Overall Update

The team has been researching current flow battery technology and developments in the industry. The Project Manager virtually attended the International Flow Battery Forum which included speakers from several different flow battery vendors. The Project Manager has been conducting interviews with entities that have already or in the process of implementing flow batteries from a variety of different vendors to gain more insight on the operations of the batteries. Interviews were also conducted with the flow battery vendors to gather more technical information on their products. The UMM Team, as well as our project partners at Otter Tail Power and OATI, have continued to meet regularly to discuss updates and develop the plans for how to interconnect to existing systems and what are the best use cases for the battery install. The team has also been analyzing the current energy usage on the campus and preparing that data for consideration in the use cases for the battery.

### Activity 1

The UMM Team is currently conducting a study to test the viability of several use cases for the flow battery energy storage system. We have been gathering electrical data from several databases which show data from the solar panels, wind turbines and overall load of the campus to be used for this study. We have been meeting with the developers of one of the software to better understand how to use it. We are also talking with engineers at Otter Tail Power to learn more about how the electrical metering is calculated to determine the campus demand to help us create a more accurate model. We are working with OATI to develop a plan for interconnection to more efficiently leverage an electrical engineering firm when they are hired on. OATI will be providing a wider scope of how the battery will interact with the grid and the campus once it is installed.

### Dissemination

The project team has continued to grow our list of contacts in the flow battery industry. This includes flow battery vendors, companies and organizations that already have or are in the process of implementing a flow battery storage system as well as other interested parties. Team members continue to discuss the project with multiple people throughout Minnesota as they visit the Morris area learning about the sustainability work that is happening here. This has increased awareness of this project.

# Status Update Reporting

## Status Update April 1, 2022

**Date Submitted:** April 29, 2022

**Date Approved:** May 19, 2022

### Overall Update

We have hired a project manager who started recently and will work directly on project number 2020-073 and 2021-169. The project manager will support the work of the combined efforts of the team from partners Ottertail Power Company and OATI. The team has met and is working to structure the work of the project around the use cases for the battery and the understanding of the best way to leverage this technology in a rural setting with grid scale.

### Activity 1

The team has begun working on the use cases and exploring the current market of batteries available. Within the partnership with utilities and the University, we are exploring all of the use case possibilities and then will evaluate the priority level of the different use cases. This work and research will be the foundation for the next step of evaluation and working toward procuring the battery technology.

### Dissemination

We have announced the project award publicly with press releases and continue to talk about the work with anyone who visits our campus and is interested in the renewable energy work of the campus. We have plans to communicate about this project and what we are learning as we explore and develop this project.