Environment and Natural Resources Trust Fund

M.L. 2020 Approved Work Plan

General Information

ID Number: 2020-073

Staff Lead: Michael Varien

Date this document submitted to LCCMR: August 13, 2021

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

Project Budget: $250,000

Project Manager Information

Name: Bryan Herrmann

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Project Reporting

Date Work Plan Approved by LCCMR: August 13, 2021

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2024

Final Report Due Date: August 14, 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? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and 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: $250,000

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	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

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 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
Personnel								
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		$52,275
							Sub Total	**$83,366**
Contracts and Services								
TBD - Electrical Engineering Contract	Professional or Technical Service Contract	Contract for electrical grid design and installation for selected flow battery. Creation of diagrams for connection along with all necessary technical documentation for interconnection application with independent system operators. Engineering support for inverter determination and design.				0		$102,000
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		$60,000
							Sub Total	**$162,000**
Equipment, Tools, and Supplies								
							Sub Total	-
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								

							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Mileage, Lodging, Meals for 4 overnight trips per year, 8 day trips with only mileage charged. We will follow University of Minnesota, travel guidelines, rates and policies.	In-state travel for project engineer and economist to conduct outreach and attend meetings with partners.					$4,196
							Sub Total	**$4,196**
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.					$438
							Sub Total	**$438**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$250,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Contracts and Services - 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. **This is a single source contract.**

Non ENRTF Funds

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

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....

Optional Attachments

Support Letter or Other

Title	File
OATI - USA Microgrids Letter of Support	4dd18804-620.pdf
Otter Tail Power Company Letter of Support	3331eb1a-031.pdf
Background Check Certification Form	81925688-c3a.pdf

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?

N/A

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?

Yes, I agree to the UMN Policy.

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

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