



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2020 ENRTF Work Plan

Today's Date: 10/31/2019

Date of Next Status Update Report: April 1, 2021

Date of Work Plan Approval:

Project Completion Date: June 30, 2022

Does this submission include an amendment request? __

PROJECT TITLE: Storing Renewable Energy in Flow-Battery for Grid Use

Project Manager: Bryan Herrmann

Organization: University of Minnesota Morris

College, Department, or Division:

Mailing Address: 600 East 4th Street

City, State, Zip Code: Morris, MN 56267

Project Manager Direct Telephone Number: 320-589-6038

Email Address: herrmanb@morris.umn.edu

Web Address: www.morris.umn.edu

Location: Statewide

Total Project Budget: \$250,000

Amount Spent: \$0

Balance: \$250,000

Legal Citation: M.L. 2020, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

PROJECT STATEMENT: Our project team proposes to implement a rural, community-scale project, investigating how a large flow-battery in combination with solar and wind generation can simultaneously improve the stability of the electrical grid and enhance the resilience of rural communities. On a cost-per-unit-energy basis, Minnesota's wind and solar resources now outcompete traditional fossil fuel generation. However, in the absence of energy storage technology to address the temporal mismatch between generation and demand, the intermittency of sun and wind has strongly constrained progress towards inexpensive, carbon-free electricity. Storage battery technologies have advanced greatly in recent years, both in technological and economic terms, such that integrating intermittent wind and solar generation with storage solutions has now become a highly promising avenue of investigation. Flow batteries hold the greatest potential for large-scale storage, as they 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. This project will analyze the potential of adding a 1MW/4MWh flow battery and 500 kW of solar PV generation to UMN Morris's existing unique, renewable-energy-intensive microgrid, in a research/demonstration project aimed at accelerating the pace of Minnesota's transition to clean, reliable, and local energy. The project will evaluate batteries on the market, develop test cases and evaluate the current energy usage and production on campus to provide data for the implementation phase.

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. The UMN Morris microgrid implementation is an ideal test bed with which to explore optimization of battery charging and dispatch as part of a dynamic, intermittent system, the efficiency of which will be a major determinant of the economic viability of an installation. The campus is a member of the award-winning community initiative called the Morris Model, designed to enhance energy efficiency and community resilience and inspired in part by our close alliance with the carbon-negative village of Saerbeck, Germany. Other 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 Power Co. There is large potential in rural microgrids for islanding and balancing power, but the information requirements for operating such systems may introduce more uncertainty than communities are willing to bear. This demonstration project is situated to resolve much of that uncertainty, and to provide rural communities with the data to move new projects forward.

II. OVERALL PROJECT STATUS UPDATES:

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Final Report between project end (June 30) and August 15, 2022

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1 Title: Evaluate battery options, analyze energy usage and develop test cases

Description: UMN Morris, Ottertail Power Company (OTPCO) and Open Access Technology International, Inc. (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. 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 1 ENRTF BUDGET: \$250,000

| Outcome | Completion Date |
|---|------------------------|
| 1. Hire project engineer | <i>December 2020</i> |
| 2. Evaluate options from battery suppliers and prepare request for proposal | <i>May 2021</i> |
| 3. Develop test cases and study economic models | <i>July 2021</i> |

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Final Report between project end (June 30) and August 15, 2022

IV. DISSEMINATION:

Description:

Plans to communicate the data gathered and critical information about project will be at public presentations, submissions to conferences and through a webpage on the University of Minnesota Morris website. The team working on the project will propose presentations at energy or storage focused conferences in Minnesota to share the information gained during the project and its applicability for grid infrastructure.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the [ENRTF Acknowledgement Guidelines](#).

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Final Report between project end (June 30) and August 15, 2022

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000:

Should the project be funded at a higher amount, the explanation of capital expenditures follows:

- Power Conversion System – 10 Inverters: Equipment will stay with the battery and will be used for the useful life of the battery or useful life of the Inverters.
- Site Controller for Battery Integration - Equipment will have a useful life similar to the battery and will be used during the entire useful life.
- 500kW Solar Array - Useful life of the solar array will be 25 years. The system will be in use for a similar time to the battery.
- 10% of Battery Purchase - This is a partnership with Otter Tail Power Company - the battery will have a 20 year useful life. The 10% portion will support the project and data collection.

If any of these assets are sold after the project, residual value will be returned to the LCCMR.

Explanation of Use of Classified Staff:

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:

| | |
|---|---|
| Enter Total Estimated Personnel Hours for entire duration of project: 3,541 | Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE:1.7 |
|---|---|

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

| | |
|--|---|
| Enter Total Estimated Contract Personnel Hours for entire duration of project: 300 | Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: .14 |
|--|---|

VI. PROJECT PARTNERS:

A. Partners outside of project manager’s organization receiving ENRTF funding – N/A

| | | | |
|--|--|--|--|
| | | | |
| | | | |
| | | | |
| | | | |

B. Partners outside of project manager’s organization NOT receiving ENRTF funding

| Name | Title | Affiliation | Role |
|----------------|---------------------------------|--------------------------|--------------------|
| Jason Grenier | Manager, Market Planning | Otter Tail Power Company | Utility Partner |
| Ellen Anderson | Director, Energy Transition Lab | University of Minnesota | Project Consultant |
| Blaine Hill | City Manager, Morris Model Team | City of Morris | Project Consultant |
| David Heim | Chief Strategy Officer | OATI/USA Microgrids | Controls Partner |

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

This 18 month project is the first part of a multi-stage project, testing the feasibility and performance of flow batteries in a Minnesota climate and how they can integrate with renewable energy sources, resulting in a thorough, publicly available cost-benefit analysis and system integration study.

The project team does not anticipate patent potential for this project.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted April 1 and October 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 15, 2022

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

A. Budget Spreadsheet

B. Visual Component or Map

C. Parcel List Spreadsheet

D. Acquisition, Easements, and Restoration Requirements

E. Research Addendum

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet
 Legal Citation: Regents of the University of Minnesota (Morris campus)
 Project Manager: Bryan Herrmann
 Project Title: Storing Renewable Energy in Flow-Battery for Grid Use
 Organization: University of Minnesota Morris
 Project Budget: \$3,271,229
 Project Length and Completion Date: 2 years, June 30, 2022
 Today's Date: October 31, 2019



| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | | Budget | Amount Spent | Balance | |
|---|---|---------------|--------------|----------------|-----------|
| BUDGET ITEM | | | | | |
| Personnel (Wages and Benefits) | | \$ 185,366 | \$ - | \$ 185,366 | |
| \$154,275 to fund a Project Engineer for three years as follows (1 FTE, 1.5 years, 36% fringe benefit rate, 2.5% cost of living adjustment): \$102,000 in Year 1, \$52,275 in Year 2 | | | | | |
| \$31,091 to fund a Project Economist Part-Time Appt for three years as follows (.20 FTE, 1 years, 36% fringe benefit rate, 2.5% cost of living adjustment): \$31,091 in Year 1 | | | | | |
| Professional/Technical/Service Contracts | | | | | |
| Microgrid controls contract for planning Microgrid and grid tie optimization, 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. 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. Single Source Contract selected because of OATI's prominence in the market and understanding of Minnesota infrastructure and their commitment to provide in-kind contributions to this project. | | \$ 60,000 | | \$ 60,000 | |
| Equipment/Tools/Supplies | | | | | |
| Capital Expenditures Over \$5,000 | | | | | |
| Printing | | | \$ - | \$ - | |
| \$438 for printing diagrams, posters, and materials to describe the project for collaborators and visitors to the future site. | | \$ 438 | \$ - | \$ 438 | |
| Travel expenses in Minnesota | | | | | |
| In-state travel for project engineer and economist to conduct outreach and attend meetings with partners. \$1,949 for mileage (12 trips per year (8 average round trip of 120 miles, 4 average round trip of 320 miles) x 1.5 years x \$.58/mile); \$1,200 lodging (4 nights per year x 2 employees x 1.5 years x \$100 per room); and \$1,047 for employee meals (4 overnight trips, 1st/1st day @\$41.25 * 2 people; 8 day trips over 12 hours @\$23 for dinner for 2 people per year x 1.5 years) The team working on the project will propose presentations at energy or storage focused conferences in Minnesota to share the information gained during the project and its applicability for grid infrastructure. | | \$ 4,196 | \$ - | \$ 4,196 | |
| COLUMN TOTAL | | \$ 250,000 | \$ - | \$ 250,000 | |
| SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT | | | | | |
| | Status (secured or pending) | Budget | Spent | Balance | |
| State: | | | | | |
| In kind: Unrecovered U of M indirect costs | | secured | \$ 82,500 | \$ - | \$ 82,500 |
| Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS | | | | | |
| | Amount legally obligated but not yet spent | Budget | Spent | Balance | |
| | | \$ - | \$ - | \$ - | |