



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2018 ENRTF Work Plan (Main Document)

Today's Date: February 15, 2018

Date of Next Status Update Report: January 31, 2019

Date of Work Plan Approval:

Project Completion Date: June 30, 2021

Does this submission include an amendment request? ☐

PROJECT TITLE: Demonstrations for Community-Scale Storage Systems for Renewable Energy

Project Manager: Ellen Anderson

Organization: University of Minnesota

College/Department/Division: Energy Transition Lab, Institute on the Environment

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Location: Statewide

Total Project Budget: \$550,000

Amount Spent: \$0

Balance: \$550,000

Legal Citation: M.L. 2018, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

I. PROJECT STATEMENT: More and more cities, campuses, nonprofit entities, and businesses across Minnesota are using wind and solar technology to produce cleaner energy. To reach high levels of renewable energy, significantly reduce their emissions, and achieve energy independence, they will need to include energy storage in their energy systems. Currently there are few examples of “community scale” energy storage projects, and often these entities lack the technical knowledge needed to select and optimize the best energy storage system. We propose a Community-Scale Energy Storage Guide and 3 exemplar Demonstration Projects to provide the tools and knowledge for community-scale energy customers to choose the best energy storage solutions. For this project, we will:

- 1) create a research-based, user-friendly print and web-based guide to energy storage in Minnesota;
- 2) select 3 representative small-scale local energy customers with renewable energy installation and provide them with a battery energy storage system;
- 3) assess results and share the results broadly through public engagement, site tours, and dissemination of web and print knowledge tools.

Our criteria for selecting the Demonstration Projects are:

- 1) geographically dispersed (1-northern MN, 1-rural agricultural MN, 1-metro),
- 2) on-site renewable energy,
- 3) local-scale, customer-controlled energy system (examples: hospital, municipal buildings, college campus);
- 4) project funds will cover the cost of a battery storage system up to approximately 50 kW (with market changes, prices may be lower, allowing larger system by the time of purchase in 2017).

The overall goal is to expand community-based, locally-produced renewable energy and reduce air emissions to improve the environment, under LCCMR funding priority E.

Energy storage is a linchpin to a more innovative, clean, and efficient energy system, but its many uses and technology choices are complicated. Only a few, mostly large-scale projects exist in Minnesota, and virtually all are utility-funded and utility-scale projects. Community-scale energy users need the knowledge tools created by this project to achieve important outcomes: 1) community-scale renewable energy projects will be more productive and valuable, 2) community-scale customers will understand how to use storage to reduce their energy costs and emissions (for example, by reducing peak demand), and 3) community-scale customers with high-ambition goals for carbon-neutrality or 100% renewable energy will have a crucial tool to achieve them. Many community-scale sites could be microgrids with the addition of storage. Our definition of microgrid for purposes of this project is that the community-scale sites are grid-connected, produce on-site renewable energy, and have the ability to “island” or function independently of the grid if needed.

Our goal is to use these 3 demonstration projects and the accompanying guide and knowledge advancement to create models that community-scale energy users across the state of Minnesota can adopt. Dissemination of the information and tools is a critical part of the project. Besides individual local energy customers and community members, we will invite stakeholders such as utilities, policymakers, regulators, and local governments to provide input and participate in site visits for these projects.

The Energy Transition Lab (ETL) founded and convenes the statewide Minnesota Energy Storage Alliance (MESA), which includes more than 100 stakeholders from the public, private, nonprofit, and community sectors along with University experts, with the mission of accelerating smart deployment of energy storage in Minnesota and the Midwest. ETL and MESA will provide expert advisors, host the web-based tool, and broadly disseminate results. Please see the Energy Transition Lab website for more information about ETL and MESA: www.energytransition.umn.edu.

II. OVERALL PROJECT STATUS UPDATES:

First Update June 30, 2019

Second Update June 30, 2020

Final Update June 30, 2020

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1:

Description: Community Scale Energy Storage Guide Preparation, Testing, & Publication Develop the Minnesota Energy Storage Guidebook, a plain English, user-friendly print and web-based information resource, including a decision-making flow chart tool for selecting the most appropriate, cost-effective technologies for energy users' proposed goals. The Beta version will be evaluated by an expert advisory group and focus groups and tested by users. The final version will be broadly disseminated and hosted on ETL's website.

ENRTF BUDGET: \$135,650

Outcome	Completion Date
1. Research completed on technology, economics, value streams of storage	Dec. 31, 2018
2. Beta version of guidebook with print and basic web version of user-friendly information resources and decision flow process graphics completed	March 31, 2019
3. Expert advisory group convened; expert review comments incorporated into guidebook	May 31, 2019
4. Representative energy customers focus groups convened; guidebook information and decision tools evaluated	Oct. 31, 2019
5. Print and Web-based guide and decision flow tools revised and published/online	Jan. 15, 2020

First Update June 30, 2019

Second Update June 30, 2020

Final Update June 30, 2020

ACTIVITY 2:

Description: Community Scale Energy Storage & Renewable Energy Demonstrations

Develop protocol for characteristics of 3 Exemplar Demonstration Projects, which will be examples of representative community scale energy customers with on-site renewable energy resources, control over their microgrid or local energy system, and widely replicable. The Guidebook's tool will help pick the appropriate technology type and applications, and technical assistance will be provided for proper installation and operation.

ENRTF BUDGET: \$414,350

Outcome	Completion Date
1. Potential sites for 3 Exemplar Demonstration Projects have been evaluated via research, site visits	Dec. 31, 2018
2. Exemplar Demonstration Projects hosts selected	April 30, 2019

3. Project team has met with Exemplar Demonstration Projects hosts, presented guidebook and decision tools information	July 31, 2019
4. Post-Doctoral fellow and Advisory Group provides technical support for installation of storage system and controls	May 31, 2020
5. Field Day site tours of 3 projects, presentations by customer and experts, completed	Feb. 28, 2021
6. Demonstration projects assessment report completed	May 31, 2021

IV. DISSEMINATION:

Description: Broad dissemination is an integral part of the project. Our tangible outcomes--the Energy Storage Guidebook, 3 Exemplar Demonstration Projects, and public "Field Days" will be designed and implemented to reach as many community-scale energy users as possible in Minnesota. In addition, the project work will be disseminated by the Advisory Group of key expert-stakeholders and the Minnesota Energy Storage Alliance, as part of MESA's efforts to accelerate understanding and deployment of energy storage in Minnesota for a cleaner and more efficient grid. We will highlight this project at ETL/MESA's annual Energy Storage Summit, host knowledge tools on our website, and share it with stakeholders and our many partners from across the Midwest. The experience and knowledge gained can be a replicable model for small-scale microgrids and community-based energy customers across our region, and inspire ongoing dissemination, implementation and further research.

First Update June 30, 2019

Second Update June 30, 2020

Final Update June 30, 2020

V. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview: See attached budget spreadsheet

Explanation of Capital Expenditures Greater Than \$5,000: Three community-scale sites will be selected (Northern MN, West/Southwest MN, and Metro); locations such as college campuses, municipal buildings, and nonprofit organizations) to install battery system. Each will be integrated into host site's energy system and evaluated during the project. After the project ends, the system will continue to be used for similar energy services, and we will request the sites continue to provide project data for interested researchers. Battery systems degrade over time depending on usage profiles, and our expectation of host sites will be for eventual upcycling or recycling of the components. The cost of the systems may be lower than estimated depending on market changes. Our goal is to provide the best system for the site within budget constraints.

Explanation of Use of Classified Staff:

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

Enter Total Estimated Personnel Hours: 5,449.6	Divide by 2,080 = TOTAL FTE: 2.62
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Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours: 104	Divide by 2,080 = TOTAL FTE: .05
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B. Other Funds:

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
Other Non-State \$ To Be Applied To Project During Project Period:			
McKnight Foundation	\$ 105,000	\$ 60,000	Secured grant for Energy Transition Lab energy storage work.
Other State \$ To Be Applied To Project During Project Period:			
	\$ 0	\$	
Past and Current ENRTF Appropriation: none			
	\$	\$	
Other Funding History:			
McKnight Foundation	\$ 55,000	\$55,000	Energy Storage project work funding.

VI. PROJECT PARTNERS:**A. Partners receiving ENRTF funding**

Name	Title	Affiliation	Role

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Past advisors in our energy storage work include Massoud Amin, Sairaj Dhople, Ned Mohan, Alison Hoxie. Affiliated faculty will be determined in 2018.	Engineering Professors	University of Minnesota	Advisors
Collaborators in our energy storage work include experts from MISO, Xcel Energy, Great River Energy, Connexus Energy, and others; IPS Solar, AES, GE, NextEra Energy, MNSEIA, Wind on the Wires, Mortenson Construction, Fresh Energy, Great Plains Institute, and many others.	Stakeholder experts	Various	Specific advisors will be determined in 2018.

VII. LONG-TERM- IMPLEMENTATION AND FUNDING: Our state's transition to clean energy depends upon broad adoption of local renewable energy resources, but small-scale energy users often lack the resources or knowledge to vet complex technology choices. Community-scale renewable energy producers can add value to

their energy production and reduce their grid energy costs if they add an energy storage system. This project will help these community-scale renewable energy generators gain the technical expertise to deploy energy storage, as well as understand how to make the projects cash flow and how to optimize benefits. The projects will be designed to illustrate valuable use cases for energy storage, and where possible, to “stack” multiple value streams to improve the projects’ return on investment. For example, the projects will show how to get more value from variable renewable energy generation, by extending or shifting the hours wind or solar energy is available. This project is structured to learn from demonstration projects with community-scale energy customer-producers and to share that knowledge broadly so it can be adopted by many others across Minnesota. Once we can demonstrate the viability of these projects, project financing becomes easier for future projects. With new technology adoption, it’s important to have successful, replicable models to help attract financing, develop a robust market, and eventually reach economies of scale. Ultimately, if energy storage is deployed broadly and intelligently across Minnesota in conjunction with distributed renewable energy projects, this will help to expand community-based renewable energy, reduce emissions, and improve air quality.

VIII. REPORTING REQUIREMENTS:

- **The project is for 3 years, will begin on July 1, 2018 and end on June 30, 2021.**
- **Periodic project status update reports will be submitted January 31 and June 30 of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2021.**

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet (attached)**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet**
- D. Acquisition, Easements, and Restoration Requirements**
- E. Research Addendum**

Please see Energy Transition Lab publications:

Modernizing Minnesota’s Grid: An Economic Analysis of Energy Storage Opportunities

<http://energytransition.umn.edu/wp-content/uploads/2017/07/Workshop-Report-Final.pdf>

Energy Storage 101: A Quick-Reference Handbook, 2nd Edition

<http://energytransition.umn.edu/wp-content/uploads/2017/07/Energy-Storage-101-2nd-Ed.-FINAL-2.0.pdf>

Environment and Natural Resources Trust Fund
M.L. 2018 Budget Spreadsheet



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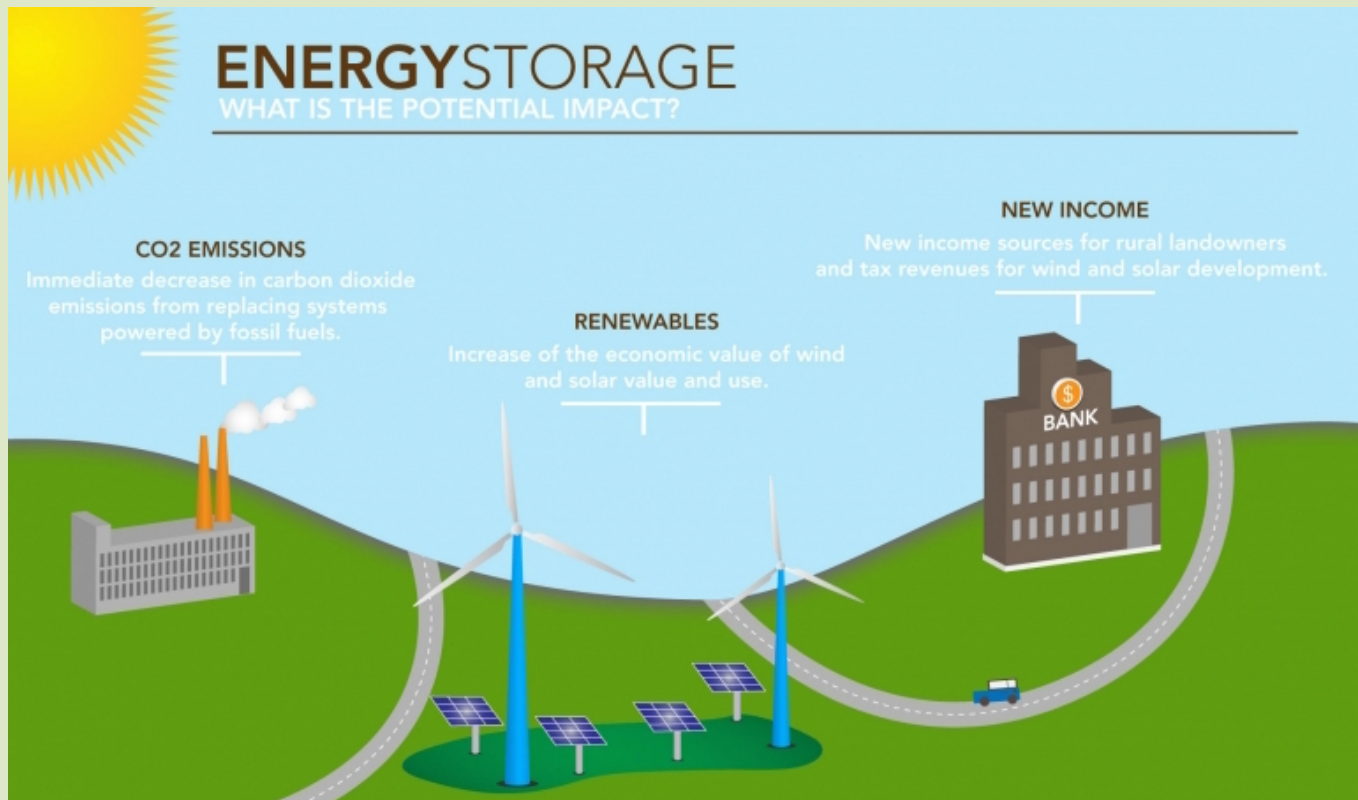
M.L. 2018 ENRTF Appropriation: \$550,000

Project Length and Completion Date: 3 years, June 2021

Date of Report: 02.16.18

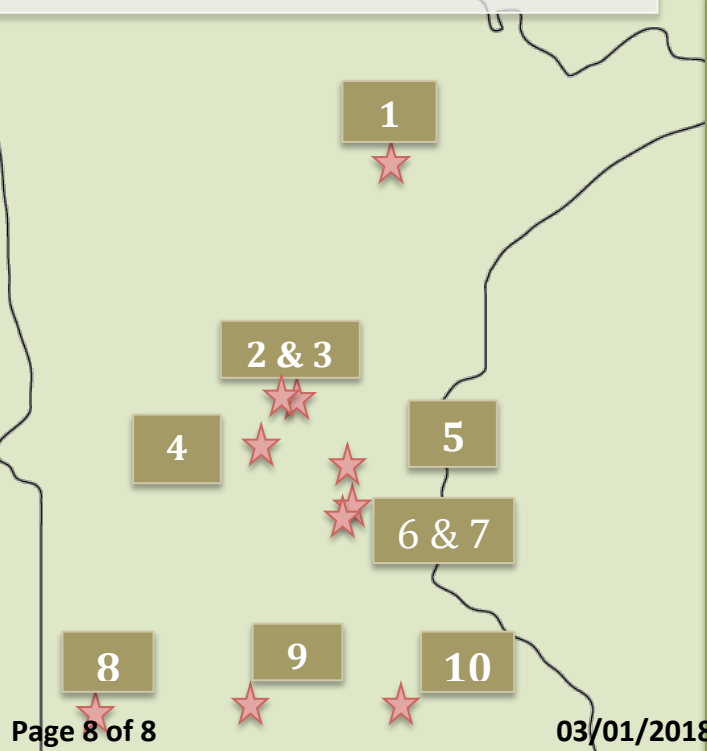
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits) - Overall	\$262,846	\$0	\$262,846
Project Manager: 20% FTE years 1, 2, 3 (Total estimated amount \$80,562)			
Graduate Research Assistant 50% FTE year 1 & 2; 12% year 3 (Total estimated amount \$112,144)			
Post Doc Research Fellow 100% year 3 (Total estimated amount \$70,140)			
Professional/Technical/Service Contracts	\$4,000	\$0	\$4,000
Equipment/Tools/Supplies	\$300	\$0	\$300
Materials for meetings & Field Days			
Capital Expenditures Over \$5,000	\$260,908	\$0	\$260,908
3 Energy Storage Systems - One for each of three Demonstration Projects			
Printing	\$3,861	\$0	\$3,861
Printing/copying Guidebook (drafts + final)			
Travel expenses in Minnesota	\$18,085	\$0	\$18,085
Overnight for travel by project team to demonstration host sites, and for outstate advisory group members - U of MN reimbursement plan			
COLUMN TOTAL	\$550,000	\$0	\$550,000

Community-Scale Energy Storage Guide for Clean Energy



Source: energy.gov

MN Energy Storage Projects



1. Mesabi Range Pumped Hydro (PHES)
2. Wright-Henn. Solar + Storage
3. National Rural Electric Co-Op - Rockford
4. National Rural Electric Co-Op - Litchfield
5. National Rural Electric Co-Op - Shakopee
6. National Rural Electric Co-Op - Jordan
7. National Rural Electric Co-Op
8. XCEL Wind to Battery
9. National Rural Electric Co-Op - Jackson
10. Austin Utilities ES Pilot