Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 154-CH**

Living Laboratory for Community Education of Solar Energy

Category: H. Proposals seeking $200,000 or less in funding

Sub-Category: C. Environmental Education

Total Project Budget: $ 191,100

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

To create a showcase of solar power and battery technologies which will serve to educate students, homeowners and the general public about societal and economic aspects of clean energy.

Name: Ned Mohan

Sponsoring Organization: U of MN

Job Title: Professor

Department: College of Science and Engineering

Address: 200 Union Street SE, 5-111 Keller Hall

Minneapolis MN 55455

Telephone Number: (612) 625-3362

Email mohan@umn.edu

Web Address: z.umn.edu/nedmohan

Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Figure 1 shows rooftop solar; Figure 2 shows battery storage system; Figure 3 shows growing of plants indoors using LEDs

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Living Laboratory for Community Education of Solar Energy

I. PROJECT STATEMENT

Climate change is the greatest threat facing humanity today. The rapid increase in atmospheric CO2 levels is a result of fossil fuel based energy sources. Energy consumption in homes is becoming a dominant component of our energy consumption. According to the Energy Information Agency of the DOE, American homes consumed 9,114 trillion Btu of energy in 2015. Reducing home energy consumption will be an important step towards meeting state and national limits on greenhouse gas emission reduction and moving towards clean energy.

This proposal is intended to create a showcase of solar power and battery technologies which will serve to educate students, homeowners and the general public about clean energy, home energy use, and energy efficiency. We plan to partner with a fraternity at the University of Minnesota Campus and to use their residence as the location for implementing all the technologies mentioned above.

The three-year project will begin with identifying the energy consumption patterns, conducting an energy audit, and deploying sensors to determine electrical power use of various appliances. Next, a rooftop solar photovoltaic system will be installed. Recognizing that the variable nature of renewables needs storage, a battery system will also be installed (Tesla Power-Wall or equivalent).

The entire process of implementing these changes will be documented in detail on a website, along with video clips, articles, photos, and raw data as well. A "before-and-after" comparison will also be made to show the effects of all these interventions. The fraternity will periodically invite school students to visit and experience all these technologies first hand. They will also hold periodic "open-house" sessions where members of the public can visit, and learn about rooftop solar power and batteries for its technical, economic and societal aspects. Also, there will be an indoor LED-powered setup to grow herbs and vegetables for the fraternity kitchen.

Finally, all of the material generated will be developed into modules with the help of the five high schools science teachers who have adopted our course (z.umn.edu/ee1701) for teaching in their schools under the College in the Schools program of the University of Minnesota. The material will be included in their own classroom curriculum and will also be available to anyone else, free of charge and free of copyright to be used in any educational program.

If approved, this project would be the first of its kind to create a "real," living and live-in showcase of solar and battery powered residence that will encourage Minnesotans to make changes in their own homes to reduce their carbon footprint and improve their energy efficiency.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Acquiring home, conducting energy use studies – "Before" phase*
ENRTF BUDGET: $ 30,000

Outcome	Completion Date
1. Liaison with fraternities and identify building to be used	*Sept 2020*
2. Conduct Energy use audit, deploy sensors	*Dec 2020*
3. Create a website and begin documentation	*Dec 2020*

Activity 2: *Install Rooftop PV and Battery Storage Systems*
ENRTF BUDGET: $161,100

Outcome	Completion Date
1. Design and install a rooftop PV system based on energy use data	*Sep 2021*
2. LED setup for growing vegetables indoor	*Sep 2021*

3. Install Batteries	*Sept 2022*
4. Conduct "open-house" to disseminate the results and get feedback	*June 2023*

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Prof. Ned Mohan	**Professor of ECE**	**University of Minnesota**	**Lead-PI**
Prof. Paul Imbertson	**Professor of ECE**	**University of Minnesota**	**Co-PI**

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
N/A	-	-	-

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

The Plan for this proposal implementation is as follows:

Year 1:

1. Identify a fraternity house having a roof with southern unobstructed exposure for locating PV panels. This partner fraternity will agree to allow the energy efficiency improvements to be made and will make their premises open for open-house and informational sessions as described in the proposal.
2. Prior to any interventions, monitor all energy consumption including some summer and winter months.
3. Set up sensing, measurement and data logging equipment to record energy use, temperature, heating, cooling, etc.
4. Conduct energy audit with the help of the home energy squad and identify the need for improved insulation, etc
5. Create a data management plan and create a website and online repository to start collecting and curating all the collected data

Year 2:

1. Design rooftop PV system sizing based on energy use findings and install rooftop PV system.
2. Replace the existing incandescent and CFL lamps by energy-efficient dimmable LEDs.
3. Identify and install an in-home battery storage system
4. Install LEDs to grow vegetables and herbs indoors

Year 3:

1. Continue to monitor all energy usage and efficiency.
2. Document the changes in energy use as a result of each intervention and document the same on the website, along with the cost, and impact on the energy bill.
3. Conduct open-house and hold workshops to disseminate the results. Create modules for use in high school and university courses.

This project will continue beyond the three-year project funding as the living laboratory, for education in the University of Minnesota courses and courses at various high schools. The same will be true of the "open houses" for community education.

We are confident that one of the fraternities we contact will agree to participate because of their reduced electricity bill. In exchange, however, they have to agree to make their fraternity available to students and community visitors. Beyond the three-year funding of the project by LLCMR, the maintenance of the website will be performed by students in the EE1701/1703 course as their assigned tasks, in collaboration with the members of the chosen fraternity.

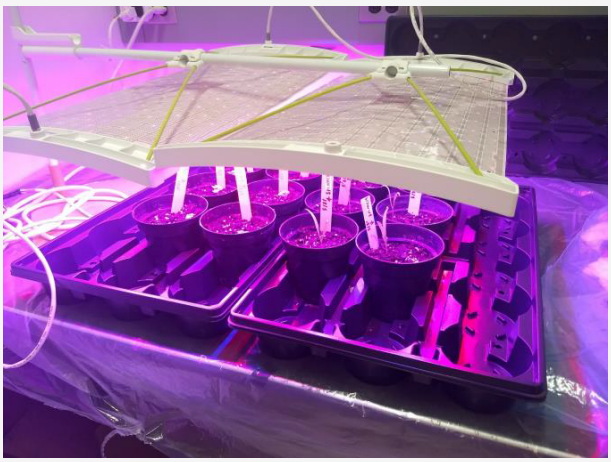
Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Ned Mohan
Project Title: Living Laboratory for Community Education of Solar Energy
Organization: Regents of the University of Minnesota
Project Budget: $191,100
Project Length and Completion Date: July 1, 2020 - June 30, 2023
Today's Date: 4/11/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 128,100	$ -	$ 128,100
To Be Named, Graduate Research Assistant (GRA) Funds are requested for one GRA to be appointed to a 9-month 50% appointment in each academic year of the project (20 hours per week). Salary is $27.79 per hour, fringe benefits include health insurance for the full 12 months and tuition reimbursement benefits for the nine month academic year only. Fringe is calculated 16.1% of salary, plus tuition reimbursement of $20.50 per hour worked (academic year = 780 hrs; summer = 260 hrs.).			
Professional/Technical/Service Contracts			
	$ -	$ -	$ -
Equipment/Tools/Supplies			
Equipment - Led Panels For Indoor Agriculture ($3,000) Supplies - Sensors And Measurement Hardware ($5,000)	$ 8,000	$ -	$ 8,000
Capital Expenditures Over $5,000			
Rooftop Solar Power System ($40,000) Battery System ($15,000)	$ 55,000	$ -	$ 55,000
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
	$ -	$ -	$ -
Travel expenses in Minnesota			
	$ -	$ -	$ -
Other			
	$ -	$ -	$ -
COLUMN TOTAL	$ 191,100	$ -	$ 191,100

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind:		$ -	$ -	$ -

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -


MAIN
PANEL
BACKUP
GATEWAY
SOLAR
INVERTER
UTILITY
METER
TESLA
POWERWALL



Prof. Ned Mohan (Project Lead PI) is with the University of Minnesota since 1975, where he is Oscar A. Schott Professor of Power Electronic Systems and Morse-Alumni Distinguished Professor. He received his Bachelor's degree from the Indian Institute of Technology-Kharagpur in 1967. His PhD in Electrical Engineering and Master's in Nuclear Engineering are from UW-Madison. He has written 5 textbooks, cumulatively they have been translated into eight languages. He has graduated 46 PhDs.

Prof. Mohan is a fellow of the IEEE. He received the 2008 IEEE-PES Outstanding Educator Award, 2010 IEEE Undergraduate Teaching Award, 2010 UWIG Achievement Award from Utility Wind Integration Group, 2011 Distinguished Alumnus Award from IIT-Kharagpur (India), 2012 IEEE Power & Energy Society Ramakumar Family Renewable Energy Excellence Award. He is a member of the National Academy of Engineering.

Organisation:

The University of Minnesota, Twin Cities