Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 188-E**

Self-Cleaning Solar Cell Coatings in Minnesota

Category: E. Air Quality, Climate Change, and Renewable Energy

Sub-Category:

Total Project Budget: $ 381,205

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

This project will study the performance of new coatings designed to enhance the performance of solar cells to determine if they are appropriate for the Minnesota climate.

Name: Robert Sleezer

Sponsoring Organization: Minnesota State University - Mankato

Title: Assistant Professor

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Web Address

Location

Region: Central

County Name: Hennepin

City / Township: Bloomington

Alternate Text for Visual:

The top is a solar cell covered with snow. Lower left is a diagram of an uncoated solar panel with contamination falling on, sticking to, and reducing the electrical output. The lower right is a diagram of contamination falling on, not sticking to, and not reducing the output of a coated solar cell.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Self-Cleaning Solar Cell Coatings in Minnesota

I. PROJECT STATEMENT

This work will assess the effectiveness of solar cells with self-cleaning coatings. These are a new a new class product claiming to increase energy production by reducing the amount of contamination such as dirt, bird droppings, or snow on the panels. However like many other products, real world performance will unlikely meet the advertised performance as determined by manufactures in a laboratory. Further, unlike the biological surfaces that inspired them, artificial self-cleaning coatings are not inherently self-regenerating and may suffer from wear and aging which depends on local weather and climate conditions. This is similar to the way non-stick pans, which use a related coating, perform differently depending on age and care. Measuring the performance of these products in a real world photovoltaic installation in Minnesota will reduce dependence on marketing puffery and empower both large commercial installers and consumers to make better choices concerning the use, installation, and maintenance of solar cells. Coating performance will be determined using an approximately 60kW installation on the Normandale Community College parking garage consisting of both coated and uncoated panels. The power produced is expected to provide for roughly 5% of the college electricity needs. Each panel will be independently connected to the grid using a microinverter capable of logging and reporting energy production. The performance of each treatment will be compared and the value of the coating in the Minnesota climate will be established. Although the funding of the project expires in 2022, data collection, analysis, and publication is expected to continue for the lifetime of the system (~20 years). Synergistic benefits of the installation include high visibility, connection to academic course work, and the meaningful development of a relationship between Minnesota State schools (Normandale Community College and Minnesota State University, Mankato) in the area of environmental sustainability.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Install grid connected solar cells with different surface treatments such that power is produced for a state facility and there is an opportunity to study performance of the coatings. Installation will be done with microinverters capable of reporting production results for individual panels in real time.

Activity 2: Measure and report the side by side performance of the different treatments for two years and a half years. Ongoing reporting to the community will engage population as citizen scientists. The result of this activity is a determination of coating impact on solar cell performance.

Activity 3: Disseminate results to the general public and to academic audiences through an online presence, embedding the work in existing outreach efforts, signage on the installation, and publishing in scholarly journals.

ENRTF BUDGET: $

Outcome	Completion Date
1. A permanent physical installation for the study surface coating effectiveness, with the secondary benefit of energy production for a state facility.	*September 2019*

2. Statistically significant statement supported by real world measurements concerning the performance of self-cleaning anti-reflective coatings. Submission of this result to popular press and academic forums for publication or presentation.	*June 2022*
3. Dissemination of study results through popular press and academic forums for publication or presentation.	*June 2022*

III. PROJECT PARTNERS: This project is being proposed by Twin Cities Engineering, an extended campus program of Minnesota State University, Mankato physically located in the Partnership Center of Normandale Community College. Normandale Community College will serve as a partner for this project by providing the space and maintenance. They will receive resources from this funding to support the installation costs and have agreed to support the infrastructure beyond the initial installation.

A. Partners receiving ENRTF funding: Normandale Community College will receive ENRTF funding to support the installation and facilities management of solar panels.

IV. LONG-TERM- IMPLEMENTATION AND FUNDING: After installation this project will require very little maintenance. The maintenance that is required beyond the timeline of this project will be paid for by Normandale Community College. The ongoing data collection, analysis, and publication will be supported by the Twin Cities Engineering Program of Minnesota State University, Mankato.

V. TIME LINE REQUIREMENTS: This project will extend over the course of three years. Most of the funds will be deployed in the early stage installation with a small amount ongoing to pay students and principal investigators for research and a small amount reserved for dissemination of the information at the conclusion of the project. The installation is expected to take up to six months leaving two and a half years for the study of the system while under the terms of this grant. This timeline will likely allow for enough weathering to determine the impact of the coating in a statistically significant way. Further, once procedures are well established the ongoing data collection, analysis, and dissemination will be sufficiently low cost as to be absorbed into routine Twin Cities Engineering actives so will continue for the life of the installation.

2019 Proposal Budget Spreadsheet

Project Title: Self-Cleaning Solar Cell Coatings in Minnesota (dissemination of results)

IV. TOTAL ENRTF REQUEST BUDGET *3* **years**

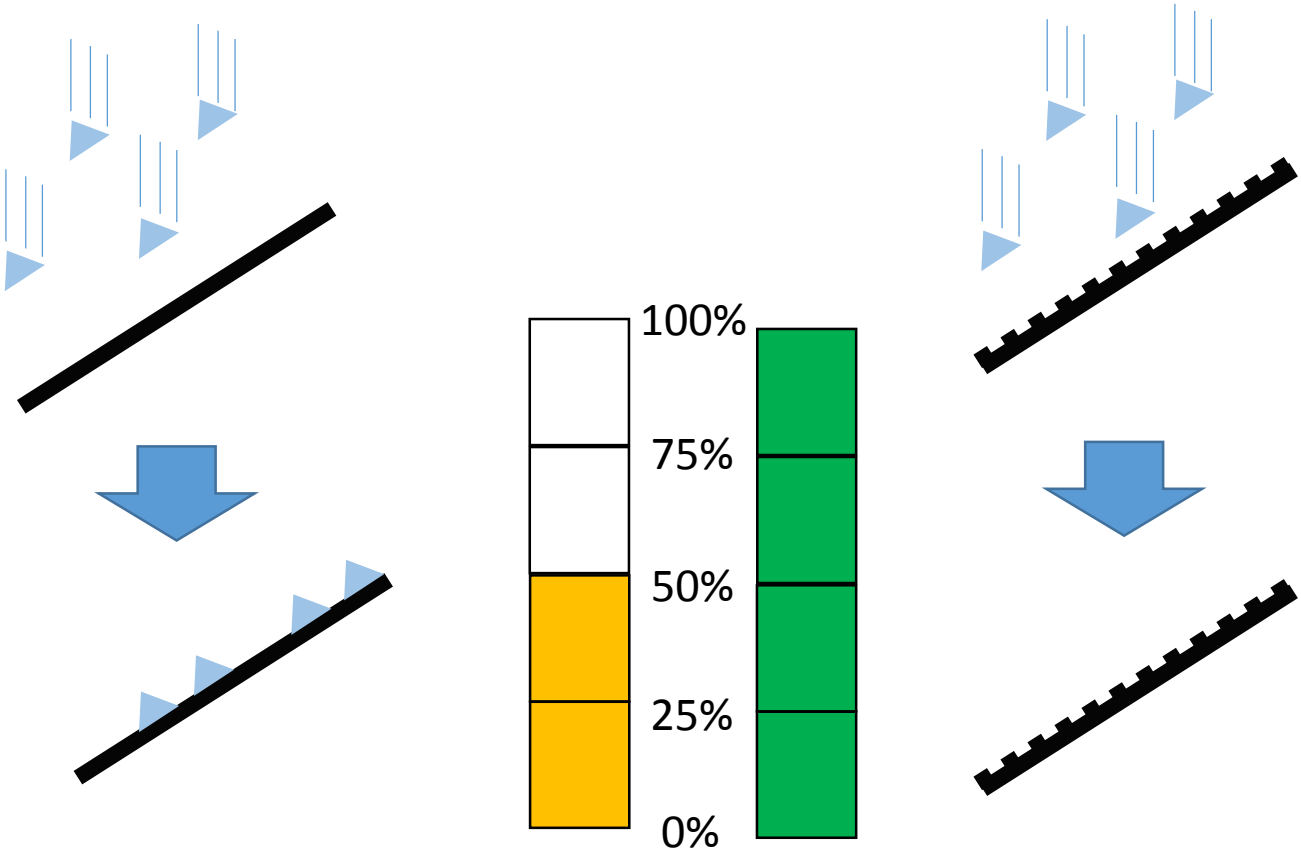
BUDGET ITEM (See "Guidance on Allowable Expenses")	**AMOUNT**
Personnel: No personel costs are associated with desimination because of alignment with the University mission and because development of the result is preparation for publication or presentation.	NA
Professional/Technical/Service Contracts:	NA
Equipment/Tools/Supplies:	NA
Acquisition (Fee Title or Permanent Easements):	NA
Travel:	NA
Additional Budget Items:	NA
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ -

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period: In-kind Services To Be Applied To Project During Project Period: Minnesota State University, Mankato contribution for overhead.	NA	
Past and Current ENRTF Appropriation:	NA	
Other Funding History:	NA	

Minnesota solar panels experience contamination from dirt, bird droppings, and… snow.

Studying the robustness of self-cleaning coating in the real world will empower good green energy choices without reliance on marketing puffery.



Contamination falling on untreated panels sticks and reduces electrical output.

Less contamination sticks to self cleaning panels so they maintain their output.

Robert Sleezer, Ph.D.
Minnesota State University, Mankato, Assistant Professor (2014-present)
University of Arkansas, Post-Doctoral Fellow (2013-2014)

Ph.D., Microelectronics and Photonics, University of Arkansas, 2012
M.S., Electrical Engineering, Oklahoma State University, 2006
B.S., Computer Science, Oklahoma State University, 2004
B.S., Electrical Engineering, Oklahoma State University, 2004

American Association for the Advancement of Science, Member
American Society for Engineering Education, Member
Institute of Electrical and Electronic Engineers, Member

Minnesota State University, Mankato
A Minnesota State Colleges and Universities school with an extended campus physically located at Normandale Community College in Bloomington, MN. The work proposed will be done through Minnesota State University, Mankato in Partnership with Normandale Community College.