Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-340

Proposal Title: Agrivoltaics to Improve Agricultural Land Resiliency

Project Manager Information

Name: Eric Buchanan

Organization: U of MN - WCROC

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Project Basic Information

Project Summary: Optimizing methods to combine solar energy and crop production while improving resiliency for agricultural lands and rural farmers.

ENRTF Funds Requested: $2,405,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Land (F)

Project Location

What is the best scale for describing where your work will take place?

Region(s): SW

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

The proposed project is important for demonstrating dual benefit solutions to real and perceived barriers to large renewable energy projects in rural areas. One barrier to increased solar energy production is community opposition to multi-acre solar developments driven in part by a lack of local benefits and prime farmland being taken out of production. Co-locating solar panels with agricultural activities—agrivoltaics—can address these barriers to adoption and potentially improve the economics of farming by adding a new income stream.

Compromises are often made with agrivoltaic solar arrays by either modifying the standard design for an array focused only on energy, or by selecting the most benign agricultural activities to pair with the array. Modifying the array design reduces margins for the developer, and the typical agricultural activities employed, like pollinator habitat or sheep grazing, are not of sufficient scale in production agriculture to meaningfully address state clean energy goals. The design of a large scale solar array will be optimized and combined with a crop rotation/management strategy to demonstrate a feasible approach that could allow agrivoltaic solar arrays to scale profitably while providing environmental co-benefits, better use of limited land resources, and farm income resiliency.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

An approximately 500 kW agrivoltaic solar array will be mounted on single axis trackers and installed in an organic row crop field. Panels can be manually tilted to the maximum angle (~60 deg) when desired to accommodate field operations, but standard row spacing leaves too little space for crops with too much shade. The proposed array will use varied row spacing to determine the impact on crop and energy production while also monitoring environmental and soil conditions. Another part of the research will involve crop rotations – which crops are best in succession given the conditions - to determine an optimal rotation for agrivoltaic arrays. The un-farmed strips around array poles may be able to support perennial native plants like tall prairie grass which could provide some erosion control and conservation habitat. This field research will dovetail with current WCROC research using electric tractors and robots to perform fieldwork. Field data will be combined with energy production and array cost information to develop optimized agronomic/agrivoltaic models that can be replicated. Moreover, a cooperative business model will be created to develop and leverage best practices for agrivoltaic solar arrays spurring wider adoption and local ownership.

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?

Demonstrating ways to allow farming and energy production on the same land will help MN meet its clean energy goals without compromising natural lands or prime farmland. Opening the over 20 million acres of MN cropland to clean energy production will also lessen impacts that would otherwise be experienced from the expansion of fossil-fueled energy production. Moreover, creating new economic opportunities for rural farmers will help keep cropland in production and family farms on the land strengthening rural communities. This project will produce a proven model for farming with agrivoltaics and create a coop to foster local development and ownership.

Activities and Milestones

Activity 1: Design solar/crop test plot layout with buffer strip treatments.

Activity Budget: $160,000

Activity Description:
A unique agrivoltaic solar array (~500 kW) using bifacial solar panels mounted on single axis trackers in a traditional small grain field (~20 acres) will demonstrate how solar energy can be integrated into rural agricultural areas without taking land out of production while enhancing the reliability and resiliency of rural electric grids.
In an all-solar configuration panel rows are 22 to 24 feet (~7 meters) apart. Panels can be manually tilted to the maximum angle (~60 deg) when desired to accommodate field operations, but the standard row spacing would require farmers to use smaller equipment than usual. Test plots will be designed with the goal of finding an optimum solution maximizing the combined system including crops, energy, field equipment, environmental benefits, and total farm income. Another part of the research will involve crop rotations – which crops are best in succession given the conditions - to determine an optimal rotation for agrivoltaic arrays. The un-farmed strips around array poles may be able to support perennial native plants like tall prairie grass and pollinator habitat which could provide some erosion control and conservation habitat. Consideration will be given to minimizing additional weed pressure on crops.

Activity Milestones:

Description	Approximate Completion Date
Assessing stakeholder desires and constraints	October 31, 2027
Develop Statement of Work for contractors and field management plan	December 31, 2027
Release RFP for solar array	December 31, 2027

Activity 2: Install solar array and monitoring equipment, develop buffer zones, execute cropping plan, and collect data.

Activity Budget: $2,045,000

Activity Description:
A 20-acre crop field on the WCROC farm site will be partitioned into separate plots based on solar row spacing including control plots where no solar panels will be installed. A new transformer will be placed to allow interconnection of the new solar array to the electric co-op grid. Sensors and dataloggers will be purchased and installed to completely determine what affect solar array installation and operation has on soil and crop growing conditions. The un-farmed areas around solar array structures will be seeded with perennial crops selected to provide pollinator and wildlife habitat, erosion control, and minimal additional weed pressure to field crops. Collected data will be used to optimize a crop rotation plan that considers the entire system including energy/crop production, crop rotations, farm equipment compatibility, impacts to growing/soil conditions, and treatment of un-farmed areas around array structures. Data will also be used to validate energy/crop production models to provide accurate total revenue predictions for future agrivoltaic sites. This demonstration will provide crucial information, resulting in farmer confidence, to facilitate wider adoption through the co-op model described in activity 3.

Activity Milestones:

Description	Approximate Completion Date
Procure sensors and data loggers	December 31, 2027
Install solar arrays, sensors and data loggers	March 31, 2028
Monitor, collect, and analyze data	June 30, 2030

Activity 3: Create co-op structure to develop agrivoltaic solar arrays with local ownership

Activity Budget: $200,000

Activity Description:

Rural residents – especially farmers – are skeptical of large renewable energy projects that seem to be consuming farmland with most of the profits leaving the communities where projects are located to enrich large outside developers. Moreover, electricity generated by these projects also leaves the local community on high voltage transmission lines leaving local electric grids no better off in the face of increased electrification and weather-related outages.

SolarShare Wisconsin (https://solarshare.coop/) is a cooperative business allowing any Wisconsin resident to invest in solar projects, sized less than 5 MW, by purchasing shares in the co-op. The co-op board returns a dividend (5% target) to shareholders annually. We propose to create a similarly structured co-op in Minnesota but focusing on agrivoltaic energy systems optimized with results from this project. The new co-op may purchase land, raise capital, develop projects, and provide proven system designs and best practices to members.

Funding from this project will be used to hire co-op development consultant services and a co-op director for about 18 months to get the new venture up and rolling. It is anticipated that the new agrivoltaic co-op will be self-sustaining leading to a more distributed, locally owned, and resilient rural electricity grid.

Activity Milestones:

Description	Approximate Completion Date
Hire director for new Co-op	January 31, 2029
Develop Co-op structure with consulting services	June 30, 2029
Recruit Co-op members and initiate first project	June 30, 2030

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 WCROC will disseminate results from this project at its annual Agrivoltaic Field day, as well as the biennial Midwest Farm Energy Conference (2028 & 2030) as well as producing University of Minnesota Extension bulletins, and inclusion in periodic agrivoltaic webinars. Ongoing research will be continued with the array as part of WCROC renewable energy research program using future grant funding. We will also seek to feature this project on the Prairie Sportsman PBS program.

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 work be funded?
After project completion, revenue from electricity production will be used to maintain and expand agrivoltaic research at the WCROC. Agrivoltaics are a significant part of our outreach efforts and will continue to be with support of the created agrivoltaic co-op. Services will be contracted with Co-op Development Services and the Minnesota Farmers Union for development and dissemination of the co-op to local stakeholders and hire a co-op director. The co-op will provide opportunities for regular people to invest in local, community-scale solar farms and return dividends to investor members boosting local economies and sustaining agrivoltaic development going forward.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Agrivoltaics To Improve The Environment And Farm Resiliency	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 07c	$646,000
Improving Agricultural Ecosystems through Autonomous Weed Control	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 07c	$978,000
Agrivoltaics 2.0 Building a Resilient E-Farm	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 07b	$535,000

Project Manager and Organization Qualifications

Project Manager Name: Eric Buchanan

Job Title: Director, WCROC Renewable Energy Program

Provide description of the project manager's qualifications to manage the proposed project.
Mr. Buchanan earned a Bachelor of Science degree in Aerospace Engineering from Purdue University and has proven his leadership skills as an engineering supervisor and project manager with 36 years of experience in the aerospace, automotive, medical device, and renewable energy industries. Mr. Buchanan has been leading innovative projects incorporating renewable energy into agricultural systems since 2010 and now directs the renewable energy program. He has managed the installation and interconnection of 5 solar arrays on the WCROC farm site totaling 131 kW. The WCROC Renewable Energy Program has successfully completed over $30 million in previous grant funding and is currently managing over $15 million in funded research activity.

Organization: U of MN - WCROC

Organization Description:

The WCROC is part of the University of Minnesota's College of Food, Agriculture, and Natural Science and is part of a network of agricultural experiment stations located around the state. The WCROC farm site is located in west central Minnesota, just outside the city of Morris, on just over 1000 acres including about 640 tillable acres (>300 acres certified organic) and 350 acres of certified organic pasture for about 300 milking cows.

We work with farmers, rural leaders, faculty from throughout the University of Minnesota system, other professionals from industry and academia, and citizens to provide research and educational programming. Working with these many partners is our greatest strength. These partnerships keep us connected to the varied and changing needs of the producers and citizens of Minnesota.

Faculty and staff at the WCROC develop solutions to real-world challenges and then share with local and global communities. Our primary research areas include agronomy and soil science; dairy; horticulture; renewable energy; and swine. Each year, we welcome several international scholars, producers and visitors to the WCROC including numerous tours with students from elementary school through college age.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Lead PI - Professional Researcher - FTE dependent on grant funds		Direct all research and personnel			36.6%	1.2		$141,904
Undergraduate interns		Collect and analyze field trial data			0%	1.29		$48,140
graduate student		Energy/crop prediction model validation. Benefits include fringe and tuition.			46%	0.75		$47,385
Faculty		Supervise grad student for energy/crop model validation			36.6%	0.36		$70,973
Professional researcher - FTE dependent on grants		Agronomic specialist to develop crop rotation plans			36.6%	0.75		$83,070
Professional Technician - FTE dependent on grant funds		Farm manager			36.6%	0.3		$33,595
Professional Research - FTE dependent on grants		Co-Op Director to develop articles of incorporation and business plan			36.8%	2.25		$171,370
Professional researcher - FTE dependent on grant funds		Support design and install solar/battery system			32.3%	2.4		$252,778
Professional Technician - FTE dependent on grant funds		Farm equipment operators to implement crop rotation plan			32.3%	0.6		$49,976
							Sub Total	**$899,191**
Contracts and Services								

Runestone Electric Association - electric co-op	Service Contract	Utility interconnection study, new transformer & interconnection fees				0		$19,000
tbd solar contractor	Service Contract	Solar contractor providing solar array (~500 kW) and installing to proscribed row spacing. Managing interconnection/permitting process and collaborating with any design changes to enhance farmability around array structure.				0		$1,400,000
Contractor specializing in native plants	Service Contract	Contractor providing expertise in plant selection, ground prep, seeding, and maintenance of buffer strip solutions around solar array structures.				0		$25,000
WCROC	Internal services or fees (uncommon)	seed lot fee waivers for dissemination at Farmfest				-		$6,000
WCROC	Internal services or fees (uncommon)	Modifications to farm equipment to adapt to non-standard row spacing and repairs to implements and tractors.				0		$6,000
							Sub Total	**$1,456,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	field implements	Various new or modified field implements to study farm operation optimization with nonstandard row spacing.					$15,000
	Tools and Supplies	seeds, planting supplies	to implement crop rotation experiments.					$8,000
	Tools and Supplies	environmental sensors and data loggers	data collection of all crop/energy/soil parameters for analysis and optimization of crop rotations and methodologies.					$6,500
	Tools and Supplies	monitoring & control hardware (solar balance of system)	Provide enhanced control and data collection from solar array, i.e., manually commanding solar panels to maximum tilt for field operations.					$7,500
							Sub Total	**$37,000**

Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	3 people, 3 nights annually to Farmfest, $254 mileage, $525 hotel, $306 per diem. 6 trips to Morris, 1 person, 1 night, $254 mileage, $175 hotel, 78 per diem.	Trips to farmfest are for project team to disseminate results at MN's largest farm show. Trips to Morris are for faculty and grad student researching energy/crop modeling.					$12,809
							Sub Total	**$12,809**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$2,405,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**-**

Total Project Cost: $2,405,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: eb96b953-de2.docx

Alternate Text for Visual Component

WCROC field site with proposed solar array location and typical solar array spacing...

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letter of Approval to Submit	95bb5915-850.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

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

Yes

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

Yes

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

No

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing $10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Wendy Moylan and Juer Liux, University of Minnesota CFANS

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand