



## Environment and Natural Resources Trust Fund

### 2026 Request for Proposal

#### General Information

**Proposal ID:** 2026-428

**Proposal Title:** Cleaning Minnesota's Air with Plant-Based Protein

#### Project Manager Information

**Name:** Jason Hill

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

**Office Telephone:** (612) 624-2692

**Email:** hill0408@umn.edu

#### Project Basic Information

**Project Summary:** This project explores the potential for plant-based protein to clean Minnesota's air and reduce its greenhouse gas emissions, while providing an additional revenue source for our state's rural economic base.

**ENRTF Funds Requested:** \$248,000

**Proposed Project Completion:** June 30, 2028

**LCCMR Funding Category:** Small Projects (G)

**Secondary Category:** Land (F)

#### Project Location

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

Statewide

**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.**

Among the new and innovative practices to increase multiple, long-term environmental benefits on agricultural land is the production of plant-based protein. Recent research has shown that plant-based proteins can provide consumers with additional healthy dietary options while also diversifying the income base for farmers. Furthermore, plant-based protein production has the potential to reduce greenhouse gas emissions and improve air quality relative to other forms of production, further supporting its potential to be a win-win-win for consumers, farmers, and the environment. Global demand for plant-based proteins continues to grow, and Minnesota is well-positioned to take advantage of this trend, as a leader both in agricultural production and in environmental initiatives.

Nevertheless, the potential for Minnesota to contribute to the plant-based protein market is largely unknown, as are the potential environmental benefits. What is needed by stakeholders interested in leveraging these opportunities is a detailed accounting of Minnesota's potential for plant-based protein production, and its ability to improve air quality and reduce greenhouse gas emissions. Such an accounting does not yet exist.

**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.**

This project explores the potential for plant-based protein production in Minnesota to improve agriculture's environmental impacts on air quality and climate change while simultaneously providing a nutritious product. Our first goal is to provide an accounting of our state's potential for plant-based protein production, relying upon publicly-accessible data for crop yields and cropland availability. Our second goal is to quantify how increased plant-based protein production might reduce pollution emissions that degrade air quality and exacerbate climate change. Here, we will use computer models co-developed here at the University of Minnesota to quantify how increasing plant-based protein production in Minnesota might reduce levels of fine particulate matter and greenhouse gases in the air relative to other forms of production. In our assessment of potential air quality benefits, we will also determine the health and economic benefits that accompany this cleaner air. The greenhouse gas accounting we will perform will take a life-cycle approach in which we estimate changes in pollution emissions along the supply chain of plant-based protein production, including from fossil fuel and fertilizer use. Our scenario-based approach will consider both near- and long-term growth of plant-based protein production and its potential environmental effects.

**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?**

The specific outcome of this project is a report and associated materials to inform greater public understanding of the potential for plant-based proteins to help improve the environmental performance of Minnesota agriculture, and to contribute economic and health co-benefits. This project will provide actionable information for farmers, agribusiness, investors, non-governmental organizations, policymakers, regulators, and consumers. Our initial work in this area suggests that actions from these stakeholders to increase plant-based protein production may provide a win-win-win for food producers, consumers, and the public as a whole, keeping Minnesota competitive in this emerging industry while benefiting the health of its citizens.

## Activities and Milestones

### Activity 1: Conduct an accounting of the production potential of plant-based protein in Minnesota

**Activity Budget:** \$90,000

**Activity Description:**

The objective of this activity is to determine the potential for plant-based protein production in Minnesota. This will be accomplished by compiling data on plant-based protein options and their important production parameters (e.g., yield, range, and processing capabilities), and then using GIS modeling to place these options on the Minnesota landscape. Data will be sourced from publicly-available state and federal resources, and by communications with producers and other experts. Activity outcomes are two-fold: 1) input data for Activity 2, which focuses on understanding the potential environmental benefits of plant-based protein production; and 2) an accompanying database for inclusion in the final report constructed under Activity 3, which can be used directly by stakeholders to understand Minnesota's potential for plant-based protein production.

**Activity Milestones:**

| Description   | Approximate Completion Date |
|---|-----------------------------|
| Compilation of a database of plant-based protein options and relevant production data | November 30, 2026           |
| Compilation of a landscape-level assessment of plant-based protein production         | February 28, 2027           |

### Activity 2: Conduct an accounting of the potential environmental benefits of plant-based protein production in Minnesota

**Activity Budget:** \$110,000

**Activity Description:**

The objective of this activity is to determine the potential for plant-based protein production in Minnesota to improve air quality and mitigate climate change. This will be accomplished by using the database developed in Activity 1 as an input to existing modeling platforms that estimate the potential air quality and life cycle climate change benefits of agricultural production scenarios. These models will account for changes in emissions of pollutants throughout the plant-based protein supply chain, and the eventual environmental impacts of those changes. Activity outcomes will consist of detailed environmental impact data to accompany the production data developed in Activity 1.

**Activity Milestones:**

| Description  | Approximate Completion Date |
|--|-----------------------------|
| Quantification of the potential climate change benefits of plant-based protein production in Minnesota | November 30, 2027           |
| Quantification of the potential air quality benefits of plant-based protein production in Minnesota    | February 28, 2028           |

### Activity 3: Prepare and present the results of the project to stakeholders and the public

**Activity Budget:** \$48,000

**Activity Description:**

The objective of this activity is to prepare the final report and public presentation. This will be accomplished by writing the final product and submitting it for peer comment and review. The outcome, a final report and accompanying database, can be used directly by stakeholders to understand Minnesota's potential for plant-based protein production and its potential to benefit air quality and state greenhouse gas reduction targets.

**Activity Milestones:**

| Description   | Approximate Completion Date |
|---|-----------------------------|
| Public release of a final project report and associated public engagement | June 30, 2028               |

## Project Partners and Collaborators

| Name         | Organization  | Role  | Receiving Funds |
|--------------|---|-------|-----------------|
| Dylan Millet | University of Minnesota - Dept. of Soil, Water, and Climate | co-PI | Yes             |

## 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?**

We will communicate our findings through publications and at conferences, by presenting to state and local elected officials, and by discussing results at state agencies including the Minnesota Departments of Agriculture and Health, and MPCA. We will collaborate with the Minnesota Climate Adaptation Partnership to ensure outcomes are disseminated to relevant policymakers and stakeholders. Modeling and analysis results will be permanently archived and made publicly available at the Data Repository for the University of Minnesota. No additional work will be needed for this project, but we anticipate seeking funding for follow-up studies from federal, state, and foundation sources.

## Project Manager and Organization Qualifications

**Project Manager Name:** Jason Hill

**Job Title:** Distinguished McKnight University Professor

**Provide description of the project manager's qualifications to manage the proposed project.**

Dr. Jason Hill is a Professor in the Department of Bioproducts and Biosystems Engineering at the University of Minnesota. He received his A.B. from Harvard College in 1997 and his Ph.D. from the University of Minnesota in 2004. Dr. Hill has been studying the environmental, human health, and climate impacts of energy and natural resource use for over 20 years. As a central part of this work, his group has completed multiple projects using life cycle analysis to compare the environmental effects of conventional versus alternative energy sources, and of agriculture, within Minnesota and beyond.

Dr. Dylan Millet is a Professor in the Department of Soil, Water, and Climate at the University of Minnesota. He received his B.Sc. from the University of British Columbia in 1997, his Ph.D. from U.C. Berkeley in 2003, and completed postdoctoral training at Harvard University in 2007. Dr. Millet has been studying air pollution and atmospheric chemistry for over 20 years. He has completed many research projects examining how human-caused and natural emissions affect air quality and climate change. As part of these studies, his research team has successfully used ambient measurements, satellite data, and atmospheric modeling to characterize emissions for a wide range of air pollutants and greenhouse gases across Minnesota.

Drs. Hill and Millet have worked together on successful grants before, including as project leads in the US-EPA funded Center for Air, Climate and Energy Solutions. If funded, Drs. Hill and Millet will work together to accomplish the research scope of this project and to co-supervise the project's postdoctoral researcher. They will be responsible for fulfilling project milestones and reporting requirements, and for working with relevant stakeholders to ensure that project findings are broadly and effectively disseminated.

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

**Organization Description:**

The University of Minnesota is one of the largest US universities and offers a rich research and academic infrastructure.

PI Hill is in the Department of Bioproducts and Biosystems Engineering, which has a mission to develop solutions for the sustainable use of renewable resources and the enhancement of the environment. The department discovers innovative solutions to advance sustainable production and consumption of energy, food, feed, fiber, materials, and chemicals through engineering, science, technology, and management.

Co-PI Millet is in the Department of Soil, Water, and Climate, which has a mission to advance understanding of Earth system processes and the interactions among land, atmosphere, and water. The department seeks to improve and protect the quality of soil, air, and water resources in natural and managed ecosystems; enhance agricultural and forest productivity and sustainability; predict and mitigate impacts of environmental change on ecosystems and society; and provide science-based knowledge for improved decision-making and a better-informed citizenry.

Drs. Hill and Dr. Millet have sufficient office and laboratory space, and computing resources, to conduct the proposed research. The project will also make use of the University of Minnesota Supercomputing Institute (MSI), which provides extensive software options and an array of high-performance computing systems.

## Budget Summary

| Category / Name                       | Subcategory or Type | Description  | Purpose | Gen. Ineligible | % Benefits | # FTE | Classified Staff? | \$ Amount        |
|---------------------------------------|---------------------|--|---------|-----------------|------------|-------|-------------------|------------------|
| <b>Personnel</b>                      |                     |  |         |                 |            |       |                   |                  |
| Lead PI - summer salary only          |                     | Direct all research and personnel                    |         |                 | 36.6%      | 0.16  |                   | \$42,256         |
| Co-PI- summer salary only             |                     | Collaborate with Lead PI and develop separate models |         |                 | 36.6%      | 0.16  |                   | \$43,684         |
| Post Doc                              |                     | Run calculations and experiments                     |         |                 | 25.9%      | 2     |                   | \$160,599        |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | <b>\$246,539</b> |
| <b>Contracts and Services</b>         |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |
| <b>Equipment, Tools, and Supplies</b> |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |
| <b>Capital Expenditures</b>           |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |
| <b>Acquisitions and Stewardship</b>   |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |
| <b>Travel In Minnesota</b>            |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |
| <b>Travel Outside Minnesota</b>       |                     |  |         |                 |            |       |                   |                  |
|                                       |                     |  |         |                 |            |       | <b>Sub Total</b>  | -                |

|                                 |             |                                  |                                  |  |  |  |                    |                  |
|---------------------------------|-------------|----------------------------------|----------------------------------|--|--|--|--------------------|------------------|
| <b>Printing and Publication</b> |             |                                  |                                  |  |  |  |                    |                  |
|                                 | Publication | Cost of publication in 1 journal | To share results and peer review |  |  |  |                    | \$1,461          |
|                                 |             |                                  |                                  |  |  |  | <b>Sub Total</b>   | <b>\$1,461</b>   |
| <b>Other Expenses</b>           |             |                                  |                                  |  |  |  |                    |                  |
|                                 |             |                                  |                                  |  |  |  | <b>Sub Total</b>   | -                |
|                                 |             |                                  |                                  |  |  |  | <b>Grand Total</b> | <b>\$248,000</b> |



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: \$248,000

This amount accurately reflects total project cost?

Yes

## Attachments

### Required Attachments

#### *Visual Component*

File: [15544eaf-b8a.pdf](#)

#### *Alternate Text for Visual Component*

This figure is an overview of the proposal and includes supporting images of a graphic of peas converted into a plant-based burger, a graphic showing the costs of protein sources, a photograph of a tofu dish, a photograph of seeds, and a graphic of an air quality model's operations....

### Supplemental Attachments

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

| Title                             | File                             |
|-----------------------------------|----------------------------------|
| Letter of Authorization to Submit | <a href="#">752ebd12-445.pdf</a> |
| Audit                             | <a href="#">296c70ea-e1d.pdf</a> |

## 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?**

N/A

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

No

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

N/A

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

N/A

**Does your project include original, hypothesis-driven research?**

Yes

**Does the organization have a fiscal agent for this project?**

No

**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:**

Sponsored Projects Administration of the University of Minnesota

**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**

N/A