



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-218

Proposal Title: Reducing Methane Emissions for Dairy Production Systems

Project Manager Information

Name: Bradley Heins

Organization: U of MN - WCROC

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Project Basic Information

Project Summary: The project team at the WCROC will model and evaluate nutritional and genetic strategies that will reduce methane emissions of dairy cattle.

Funds Requested: \$520,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Air Quality, Climate Change, and Renewable Energy (E)

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.

The dairy industry is an essential component of Minnesota's economy, making up nearly 10% of the state's total agricultural product sales with a total value of \$1.9 billion in milk sold. The 9 million dairy cows in the U.S. provide healthy and nutritious dairy products to people around the world. Approximately 8 million metric tons of methane gas are released into the environment by US dairy cows each year, primarily through enteric emissions (belching). Implementing strategies to reduce these emissions is not only good for the environment but can increase dairy herd resiliency and productivity. Methane not only contributes to total GHG, but also represents an energetic loss to the animal, and reduces feed efficiency. Because feed makes up over 50% of the total of total dairy farm expenses, reducing methane emissions are likely to help improve farm profitability. The GreenFeed gas monitoring system is the solution to global standardization for methane reporting requirements at the farm level.

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 will involve testing these new strategies for reducing methane emissions, which will allow us to make better recommendations to farmers. Generally, there are few options currently available for dairy production systems to reduce enteric methane emissions without feed supplementation. The type of production system and animal genetics may also be important factors. Continuous research and development are needed to develop mitigation strategies that are locally applicable to farms in Minnesota. Information is needed to evaluate the carbon footprints of intervention strategies on a regional basis to determine the impact of greenhouse gas emissions. Economically affordable solutions through a holistic approach are urgently needed. Successful implementation of safe and effective mitigation strategies will also require adequate support for producers, as well as consumer acceptance. Continuous research is needed for development of mitigation strategies that are locally applicable to farms in Minnesota. Information is needed to evaluate the carbon footprints of intervention strategies on a regional basis to determine the impact of greenhouse gas emissions. Successful implementation of safe and effective greenhouse gas mitigation strategies will also require buy-in from dairy producers, support from dairy manufacturers, and acceptance from consumers.

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 team will leverage current research by evaluating methane and GHG reducing strategies in dairy cattle and provide consumers with an evaluation of these technologies. By providing information on methane emissions to the public, we will help improve the image of the livestock industry to protect and preserve the state's natural resources that will enable Minnesota to meet greenhouse gas emissions and other current and future environmental regulatory requirements. Furthermore, demonstrating concurrent use of land and livestock production will help farmers and consumers appreciate the role of livestock as a sustainable and beneficial part of Minnesota's agricultural economy.

Activities and Milestones

Activity 1: Evaluate Holstein and crossbred dairy cattle for enteric methane emissions on Minnesota dairy farms.

Activity Budget: \$325,000

Activity Description:

Determining enteric methane emissions of individual cows is imperative in many different research applications. Accurate measurement of emissions is needed to determine the resiliency of livestock production systems by identifying nutritional, environmental, and genetic factors that contribute to reduced GHG emissions. At the WCROC Dairy, we will compare a 3-breed rotational crossbred dairy cattle of the Holstein, Viking Red, and Montbéliarde breeds (ProCross) a cross of Jersey, Normande, and Viking Red (GrazeCross) and pure Holstein dairy cattle for enteric methane emissions for 30 days during each of the 4 seasons (spring, summer, winter, fall) across the 2 years of the study. Currently, no other research herd in the world has the unique capability of studying purebred Holsteins, ProCross and GrazeCross crossbreds simultaneously. For the proposed research, individual methane emissions will be recorded from 30 cows from each of the 3 breed groups, each for 30 days during each season. Furthermore, Holstein, ProCross and GrazeCross cows will be compared for production, SCC in milk, fertility, survival, mortality, body condition score, and body weight. These traits will be combined within methane emissions to assess the resiliency of the three genetic groups of cows in reducing methane emissions.

Activity Milestones:

Description	Approximate Completion Date
Install GreenFeed System and record GHG and methane data	June 30, 2025
Evaluate SeaGraze™ technology to reduce GHGs in Dairy Cattle	June 30, 2025
On-farm evaluation of GHGs on Minnesota Dairy Farms	June 30, 2026
Genetic Evaluation of Methane and GHG Emissions	June 30, 2026

Activity 2: Evaluate the effect of genetic selection on maintenance requirements and nutritional strategies to reduce GHG emissions

Activity Budget: \$170,000

Activity Description:

It is likely that genetic selection has also altered pathways related to energy metabolism in the liver, but these effects have not been directly studied. Therefore, examining changes in the microbial populations of 1964 genetic control and contemporary Holsteins will provide insights to potential changes in energy metabolism. Determining maintenance requirements of animals requires them to be in a stable, non-growing, non-pregnant, non-productive physiological state. Therefore, at the St. Paul campus dairy, we will compare energy expenditure of mature (> 2 lactation), non-lactating contemporary and unselected cows (12 cows/genotype). Cows will be divided into blocks of 4 cows (2/treatment) based on dry-off date and body condition score. All cows will be fed the same far-off dry cow diet formulated to meet the maintenance energy and protein requirements of a non-pregnant, non-lactating dairy cows. Feed and individual feed ingredients will be sampled and analyzed for composition of fiber, starch, protein, fatty acids, and ash. When cows are over 28 days dry, total fecal and urine output will be collected during days 1 to 3. Additionally, lactating dairy cows will also be compared for energy metabolism to reduce methane emissions of dairy cattle.

Activity Milestones:

Description	Approximate Completion Date
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Investigate various Holstein genotypes for methane emissions	June 30, 2025
Complete Methane emissions analysis for field testing at the St Paul Dairy	June 30, 2025
Utilize the Greenfeed system to evaluate long-term reduction of GHG emissions	June 30, 2026
Evaluate economic and ecological benefits of reducing methane emissions of dairy cattle	June 30, 2026

Activity 3: Educate consumers, industry representatives, farmers and the general public about GHG and methane mitigation strategies of dairy cattle.

Activity Budget: \$25,000

Activity Description:

The results from all activities will be used to demonstrate the potential of reducing enteric methane emissions for dairy cattle and the impact of genetics and the interaction of nutrition and genetics on the efficiency of dietary energy utilization. We will develop a comprehensive extension program to educate producers, dairy industry professionals, and other stakeholders on the implementation of technologies for to reduce enteric methane emissions in dairy cattle, through the following activities: 1) Maintaining a web page within the University of Minnesota Dairy Extension websites and University of Minnesota WCROC dairy webpage (<http://wcroc.cfans.umn.edu/research-programs/dairy>) throughout the project and beyond dedicated to dissemination of electronic information and decision tools necessary to improve dairy farming across the globe, 2) Disseminate results and educational information via social media (Facebook, WCROC Dairy Instagram, and YouTube) and national popular press periodicals (Dairy Star, Hoard’s Dairyman, Progressive Dairyman), 3) Present study results at extension and professional conferences (MN Nutrition Conference, the I-29 Dairy Conference, and the 4-State Dairy Expo; and at national ADSA), and 4) Host a dairy day at the University of Minnesota WCROC to showcase research for farmers and stakeholders.

Activity Milestones:

Description	Approximate Completion Date
Host a tour and demonstration of the site during our WCROC Dairy Day	December 31, 2024
Conduct dairy GHG workshops and webinars and present results at conferences	June 30, 2025
Submit semi-annual reports and a comprehensive final report	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Researcher 3 - Technician - TBD	University of Minnesota WCROC	Data collection, system testing, data collection and management	Yes
PhD Graduate Research Assistant - TBD	University of Minnesota WCROC	Assist with all aspects of the project in data collection, monitoring and analysis.	Yes
Isaac Salfer	University of Minnesota	Dr. Isaac Salfer, U of MN Dairy Scientist, will be co-investigator and manage the activities and outreach within his respected specialty. Dr. Salfer has previous experience with reducing environmental footprints of dairy production through nutritional strategies.	Yes
Isaac Haagen	University of Minnesota	Isaac Haagen, University of Minnesota Dairy Scientist, will be assist in the design, installation, testing, and genetics strategies for reducing methane emissions of dairy cattle. He will also assist with the outreach and dissemination of results.	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?

The WCROC has a 10-year strategic plan to reduce fossil energy consumption and the carbon footprint within dairy production systems. This collaborative project will build on dairy production research, genetics, and nutritional activities of the project investigators. Previous funding has been received through the ENRTF fund to evaluate Agrivoltaics, measure energy consumption within the WCROC dairy and test clean thermal energy systems. This proposed project will facilitate and demonstrate the need for reducing methane and GHG of dairy cattle. Additional long-term funding will be sought to conduct research with dairy and beef cattle.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Utilization of Dairy Farm Wastewater for Sustainable Production	M.L. 2016, Chp. 186, Sec. 2, Subd. 07d	\$475,000
Generation, Storage, and Utilization of Solar Energy	M.L. 2017, Chp. 96, Sec. 2, Subd. 07c	\$500,000
Agrivoltaics To Improve The Environment And Farm Resiliency	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 07c	\$646,000

Project Manager and Organization Qualifications

Project Manager Name: Bradley Heins

Job Title: Professor

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

Dr. Heins a Professor of Dairy Management at the University of Minnesota West Central Research and Outreach Center – Morris. He has overseen the development of the dairy program at Morris and has participated as Principal Investigator on over \$30 million of research projects including grazing and pasture management, profitability of organic dairies, livestock efficiency, and renewable energy systems for dairy farms. Specifically, Dr. Heins has overseen the development of the University of Minnesota's organic dairy production system and is the Principle Investigator for numerous USDA NIFA grants that enhance organic and grazing dairy farm efficiency, productivity, and profitability. He is

also principle investigator on an Environmental Natural Resources Trust Fund project that is Agrivoltaics on Minnesota dairy farms that will make recommendation to farmers to reduce their environmental footprint. Dr. Heins has also trained 20 graduate students in the areas of dairy cattle management and livestock farm efficiency. He has been an invited speaker for numerous national and international conferences and workshops on the topic of dairy cattle management. Dr. Heins serves on the Minnesota Organic Advisory Task Force and Board of Directors for the Minnesota Institute of Sustainable Agriculture. In addition to Dr. Heins, the project team include faculty with over 20 years of experience in livestock production research and outreach.

Organization: U of MN - WCROC

Organization Description:

The primary organization is the University of Minnesota with researchers from the WCROC and Animal Science departments. The WCROC, located near Morris, will serve as the primary project location. The WCROC is a 1,100-acre agricultural experiment station that focuses on applied research. The WCROC has several relevant program areas including dairy and renewable energy. The WCROC is ideally positioned to address critical dairy production and agricultural environmental issues. The faculty and staff have considerable experience in developing and effectively implementing applied research, outreach, and extension programs at the applied farm-level. The WCROC has nationally unique facilities and programs that compare conventional and organic crop and livestock production systems. The dairy program has the only side-by-side comparison of organic and conventional systems in the nation. In addition to agricultural production systems, the WCROC has a robust renewable energy program with farm-scale production systems. A primary goal for the dairy program is to decrease the environmental footprint of dairy production systems in the agricultural sector. The project team strives to optimize methane efficiency, develop effective clean water and air strategies, and improve long-term profitability for producers.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Farm Animal Attendant		Farm management to assist with labor of project, i.e. fencing, moving cattle			31.8%	0.3		\$5,000
Undergraduate Student Internships		Methane and GHGS Emissions on Minnesota Farms			0%	0.5		\$14,000
Assistant Professor		Dr. Salfer is 9-month faculty appointment and this is for summer salary.			36.8%	0.4		\$10,000
Researcher 3		Technician for data collection, system testing, data collection and management			32%	2		\$100,000
PhD Graduate Research Assistant		Data collection, monitoring and analysis			24.1%	2.5		\$106,000
Assistant Professor		Dr. Haagen is 9-month faculty appointment and this is for summer salary.			36.8%	0.4		\$10,000
							Sub Total	\$245,000
Contracts and Services								
Forage Sample and Analysis	Professional or Technical Service Contract	Analysis of forage and crop quality for crops and forages of dairy cattle utilizing GreenFeed System.				0.4		\$15,000
WCROC Dairy	Internal services or fees (uncommon)	This is for WCROC dairy for services that include planting forages and crops, and use of dairy cattle for projects. This is internal to the U of MN WCROC.				0.3		\$10,000
Energy Analysis	Professional or Technical Service Contract	Energy composition of feed, feces, and urine will be measured using bomb calorimetry				0.2		\$8,000
St Paul Dairy	Internal services or fees (uncommon)	This is for St Paul dairy for services that include use of dairy cattle for projects. This is internal to the U of MN. Per Diem for use of Holstein dairy cattle in the Tie-stall barn at the St. Paul Campus Dairy.				0.2		\$15,000
							Sub Total	\$48,000

Equipment, Tools, and Supplies								
	Tools and Supplies	Fencing Supplies	This will require purchasing fiberglass fence posts, insulators, poly wire and additional fence energizers.					\$4,000
	Tools and Supplies	Field, Lab, and Feed Supplies	All objectives will require supplies that include: plot markers, sample bags, laboratory reagents, assays, and other supplies. The sampling supplies include milk sample tubes, gloves, protective clothing and a freezer.					\$10,000
							Sub Total	\$14,000
Capital Expenditures								
		Green Feed and Smartfeed System	GreenFeed System for measuring GreenHouse Gas Emissions for Dairy Cattle					\$200,000
							Sub Total	\$200,000
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Travel	Travel, Lodging and meals for WCROC project team at Minnesota Workshops These expenses will be to participate in formal presentation of project findings at workshops and seminars within Minnesota.	X				\$5,000
							Sub Total	\$5,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								

	Printing	Extension Supplies and Printing	Printing for Extension Workshops, Field Days, and Printing					\$5,000
	Publication	Peer Reviewed Publications	Publication of research in Open Access Journals					\$3,000
							Sub Total	\$8,000
Other Expenses								
							Sub Total	-
							Grand Total	\$520,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel In Minnesota	Conference Registration Miles/Meals/Lodging	Travel	These expenses will be to participate in formal presentation of project findings at workshops and seminars within Minnesota. These will be for either the Project investigator or the graduate student to present on the project. We feel it is very important to attend in state conferences and workshops to disseminate the project findings throughout the project.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	In-Kind services from the University of Minnesota	The foregone federally negotiated ICR funding constitutes the University of Minnesota's cost share to the project. Additionally, PI Heins is unpaid effort and not requesting funds for himself. ICR is 55%	Pending	\$286,000
			State Sub Total	\$286,000
Non-State				
			Non State Sub Total	-
			Funds Total	\$286,000

Attachments

Required Attachments

Visual Component

File: [e75d439a-00d.docx](#)

Alternate Text for Visual Component

Our concept is to evaluate the nutritional, genetics, and environmental strategies to reduce methane emissions of dairy production systems. We will help improve the image of the livestock industry to protect and preserve the state's natural resources that will enable Minnesota to meet greenhouse gas emissions reductions....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
BackGround Check Document	edb2fce0-2dc.pdf
UMN Authorization of Proposal	76e205b7-fe5.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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?

Yes, Sponsored Projects Administration

Does your project include the design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?

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?

No