Supercharged Pastures: Increasing the sun-capturing capacity of pastures
UW MARS LASSO Project Submission
March 5, 2025

Lead Competitor: The LASSO Prize project will focus on integrating solar photovoltaic (PV) technology and cattle grazing at the University of Wisconsin - Marshfield Agricultural Research Station (MARS). This agrivoltaics initiative, UW MARS LASSO, aims to demonstrate the feasibility and benefits of co-locating solar energy production with agricultural practices, contributing to energy sustainability and enhancing grazing cattle welfare. MARS is partnering with Ecojiva, LLC. for this prize. Ecojiva, LLC a solar developer located at 100 West Long Lake Rd, Suite 200, Bloomfield Hills, Michigan, has been installing solar with commercial and agricultural properties, and governmental and educational institutions since 2009. Ecojiva, LLC has recognized experience working throughout the United States partnering with utilities to accomplish the needs of their customers. Ecojiva, LLC is trained in dealing with township bylaws and critical operations infrastructure. As a solar solutions provider, Ecojiva, LLC specializes in designing and installing grid-tied solar photovoltaic systems for agricultural and commercial customers throughout the Midwest and Northeast.

The title of this project is *Supercharged Pastures: Increasing the sun-capturing capacity of pastures*. Well-managed grazing is based on the following three principles: rotation, rest, and residual. A healthy forage base requires livestock to be rotated through sections of pasture (paddocks), to rest pastures between grazing events, and to maintain sufficient residual after grazing, all to stimulate quick regrowth and replenishment of nutrients. These principles ensure that the plants' ability to harness sunlight and transform it into energy is never interrupted, and the system of transforming sunlight into meat or milk through well-managed grazing is complete. By integrating solar panels into these well-managed pastures to collect sunlight and transform it into electricity will double the pasture's ability to collect sunlight and transform it into energy.

This narrative outlines project collaboration, technical design, project site details, data collection strategy, scalability, and replication potential for the proposed solar array system. The primary objective is to establish a robust framework for Phase 1 of the LASSO Prize competition, setting the groundwork for subsequent development and implementation phases.

The site selected for the LASSO prize is the University of Wisconsin - Marshfield Agricultural Research Station, located at 208356 Drake Avenue, Stratford, Wisconsin. The MARS station is one of twelve research stations supporting research, faculty, students, and outreach within the College of Agricultural and Life Sciences at the University of Wisconsin-Madison. The mission of the MARS station is to support, facilitate, and conduct research and outreach activities contributing to advances in agriculture while protecting the natural resources in an area of Wisconsin containing some of the most difficult-to-manage, poorly drained soils. MARS is located in a region near the geographical center of Wisconsin, in an area containing the highest concentration of dairy farms. MARS station works to foster environmentally sound agricultural practices and maintain agricultural productivity and profitability while protecting the area's natural resources.

The MARS station was established in Central Wisconsin in March 1912 on the south side of the city of Marshfield. At its height, the MARS farm was home to 65 lactating cows, 65+ youngstock, and 350-acres. Realizing farm buildings were outdated, acreage and cattle numbers required to keep up with contemporary research were not sufficient, and city development was beginning to encroach on the farm thus limiting research capabilities, a bold plan was conceived; build an entirely new

facility. Under the leadership of the UW College of Ag and Life Sciences, the UW Department of Dairy Science, and Agricultural Research Stations, construction began on a new, innovative facility. Expansion occurred in the late 1990's with substantial support from the University of Wisconsin, Wood County, the City of Marshfield, and numerous industry donors. The station acquired farmland south of Stratford, Wisconsin and constructed a state-of-the-art heifer research facility, more than doubling the acres and animal holding capacity. In early 2000, Congress appropriated funds to establish the USDA Environmentally Integrated Dairy Management Research Unit at the new MARS farm significantly adding more research potential. Additional buildings, including a heifer barn, milking parlor, calving and hospital barn, manure storage and processing facilities, and a lactating cow barn were part of the addition.

The MARS animal research facility is currently home to over 500 dairy heifers and 125 lactating dairy cows, as part of the UW-Madison Allenstein Dairy Herd. Cows are housed in a 128-stall, four row dairy barn. Heifers are housed in one of four barns and group-housed in pens of 8 animals, for optimal research capability. The MARS animal program is accredited, as part of the University of Wisconsin College of Agricultural and Life Sciences by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) International. AAALAC promotes the humane treatment of animals in science through a voluntary accreditation program. AAALAC accreditation places UW CALS among the top tier of agricultural and life science colleges with respect to standards of animal care. This assures continued animal research credibility with funding sources and the general public. It is a sign of the high level of competence and performance of the UW-Madison research enterprise.

MARS livestock facilities are designed to enable large-scale animal research. Ninety-five Calan individual gate feeders are installed in the USDA cow barn (n=32) and USDA heifer barn (n=63). The station owns three portable livestock restraint chutes, fitted with load cells and used for animal healthcare procedures, data collections and measurements. Four C-Lock GreenFeed units are available to research teams at MARS. The GreenFeed unit is a system designed to measure gas fluxes of methane, carbon dioxide, oxygen, and hydrogen from individual animals. One unit is permanently installed in a cow barn pen. Three units contain the pasture package, including solar panels, a charging system and batteries. All units can be plugged into any AC power source to recharge and maintain the batteries.

Of the 955 acres operated at MARS, over one hundred acres are dedicated to field plots and trials. The remaining tillable acreage is used to grow and harvest feedstuffs for the herd. MARS provides land to support the research needs for UW researchers and students, and scientists and scientific programs in the USDA Environmentally Integrated Dairy Management Research Unit. The USDA has been a collaborative partner with MARS since 2006. Research capacity is gained through this partnership with the sharing of cropland, cattle facilities, research equipment, and knowledge. Goals of USDA research are to improve nutrient management systems (crop and cropping patterns; livestock feeding managements systems; manure treatment, handling, storage, and application strategies); to reduce air, water, and soil from livestock waste; to control pathogen transmission between livestock, wildlife, humans and the environment; and to disseminate and apply the knowledge to the dairy industry.

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The lead competitor for the LASSO project is Nancy Esser. Since 2010, Esser has served as superintendent of the Marshfield station, managing the UW livestock program and supporting the research needs of the USDA's Environmentally Integrated Dairy Management Research Unit. Esser is responsible for overseeing a staff of over 28 employees. Esser coordinates animal research trials and conducts station outreach and tours. She manages employee training and compliance with all federal, state, and university protocols, laws, and regulations. Esser manages station certification with UW Occupational Health Program, Institutional Animal Care and Use Committee standards and protocols, Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) certification, and state and federal dairy inspections.

Under her directorship of MARS, the station has undergone a significant growth in instructional activities, research, and outreach programming. She has navigated program expansion, including multiple building projects, an increase in labor, and land acquisitions and sales. In addition, Esser has fostered program growth in employing youth apprentices, hosting high school technical credit classes, and developing high school and technical college students through on-site classes, student internships and employment, and job shadow opportunities.

Over the past 15 years, the station adopted and implemented regenerative agriculture practices supporting continuous living cover and nutrient cycling. To include no-till planting, cover crops, perennial cropping and managed grazing. At present, around 70% of solid livestock manure is composted and land applied, and 100 acres of land are exclusive to perennial pasture. Esser possesses exceptional organizational and planning skills. As the lead in this project, Esser will bring a recognized ability to problem-solve, be adaptive, organize and bring this challenge to fruition. Esser and her MARS management team possess considerable experience with public relations, program growth and development, and strategic planning.

As the lead competitor in this project, Esser has pulled together a diverse team of subject matter experts including veterinarians, managed rotational grazing specialists, grazing plans and infrastructure experts, professionals in the field of agronomy, crop production, and soil science; current livestock agrivoltaics researchers; extension specialists; educators, and production agriculturists/farmers.

Team Members

Nancy Esser is the Superintendent at the University of Wisconsin Marshfield Agricultural Research Station. Nancy will serve as **Lead Competitor**. She will lead meetings, identify subcommittee groups, and is responsible for all project communications, keeping the project on a strict timeline. Esser has more than 23 years' experience working in agricultural research, ruminant nutrition, and program management with the University of Wisconsin. She is a board member and/or advisor to numerous ag related groups and institutions and has experience overseeing, planning, developing, and managing station budgets.

Michael Peters, serves as Director of the University of Wisconsin Agricultural Research Stations, where he oversees staffing and budget at each station while ensuring all research and compliance goals are met.

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Arin Crooks is the Superintendent of the UW Lancaster Research Station.

Greg Cisewski serves as Dean of the School of Agricultural Sciences, Utilities and Transportation at Northcentral Technical College, Wausau, WI.

Jason Cavadini is the University of Wisconsin Extension Grazing Specialist for the state of Wisconsin.

Josh Arnold, JD, MBA, works for the University of Wisconsin- Madison Facilities Planning and Management as a Project Program Manager in the Office of Sustainability.

Ashley Blackburn is the Agronomist and Assistant Superintendent at the University of Wisconsin Marshfield Agricultural Research Station.

Bradley Heins is a Professor of Dairy Production at the University of Minnesota West Central Research and Outreach Center in Morris, Minnesota and Extension Specialist, Dairy Management with the University of Minnesota Extension.

Will Fulwider is Regional Crops Educator for Dane and Dodge County Extension as part of the University of Wisconsin Extension.

Patty Laskowski Morren is the Executive Director of GrassWorks, Inc. Patty is owner/operator of Dancing Cow Farm, in Hillsboro, WI.

Holly Hovanec, DVM is a large animal veterinarian with UW Research Animal Resource and Compliance (RARC), at UW-Madison.

Michael Maroney, DVM has a 20+ year role as a senior Program Veterinarian with UW Research Animal Resource and Compliance (RARC), at UW-Madison.

Teri Raatz, is an instructor of the Agribusiness program at Mid-State Technical College (MSTC), in Marshfield, WI.

Adam Wehling serves as the Dean of Agriculture, Energy, Construction & Transportation at Chippewa Valley Technical College (CVTC) in Eau Claire, WI. Adam is Owner/Operator of Cedar Bee Farm LLC, Mondovi, WI.

Paul Daigle is Owner and Manager of Water and Land Solutions, LLC, providing consultation, guidance, leadership and experience to farmers and to the non-profit Dairy Grazing Alliance (DGA).

Carthik Thoniparambil is a Solar PV Engineer with the solar developer, Ecojiva, LLC.

Clement Vijayakumar is the Director of Engineering at Ecojiva, LLC.

Will Cordes is the Livestock Supervisor at the UW Marshfield Agricultural Research Station.

Project Overview: The proposed PV will be installed in pasture 2, paddock 1, in the north third sub-paddock. Of the 5 pastures at MARS, pasture 2 was selected for this project given its proximity to the electric meter and dairy cattle buildings. Erecting an AV system in paddock 1 as part of this feasibility project will not interfere with the contiguous paddocks in Pasture 2, paddocks 2 – 7.

Paddocks 2 – 7 will be available as needed for future research. If this proposal is successful in Phase 1, the PV and AV advisory committee members will decide if an Option 2 layout of panels (extended to paddocks 2, 3, and 4) is desired.

To successfully graze heifers in an intensive rotational grazing system, the size of animal placed on pasture, the daily forage requirement per animal, quantity of forage available on the pasture (varies by spring, summer and fall), and area of the pasture must be carefully considered. The overall goal is to define the combination of land, time and number of animals to ensure the sustained, long-term productivity of the pasture. The optimum number of animals on the pasture makes efficient use of the forage without waste but still leaves enough forage to allow plant recovery. To fully test the goal of this prize, large animals will be used. MARS proposes to graze pregnant heifers, ranging from 1000 to 1400 lbs. under the panels of the PV system. This location is equally compatible for lactating dairy cattle at MARS due to the existing pasture lanes and fencing infrastructure and proximity to the milking parlor.

MARS' length of grazing season goal will be a minimum of 180 days (6 months) of grazing. This will be accomplished by frequent animal rotation, leaving a percentage of residual forage behind, and allowing a resting period of 30 – 40 days following grazing. To achieve the goal, the carrying capacity or stocking density must be accurately calculated. Carrying capacity or stocking density is the number of animals a parcel of land can support by providing them pasture forage, and retaining and recycling the nutrients they leave behind. When done correctly, the results are healthy animals, healthy pastures and a healthy ecosystem.

The rest time allows plants to regrow above ground but also expand their root structure below ground. The work below ground is important since it contributes to increasing soil microbe life and improving soil structure for water infiltration and retention. In addition, rest should allow for enough time for the internal parasite life cycle to end before animals return to the paddock.

MARS pastures consist predominantly of meadow fescue and clovers, the main species grown on the farm. Cattle in pasture 2 will move sequentially from one sub-paddock to another, spending an average of two to three days in each sub-paddock, depending on forage growth to ensure fresh pasture is constantly available. Determining the number of heifers a pasture can sustain is crucial to healthy pastures and cattle. As a rule of thumb, 4% of body weight is used as intake. It's more accurately 2.5-3.0%, but an additional 1% is accounted for trampling of forage on pasture. Historically, grass/forage stand density for most of the MARS' pastures is approximately 300 lbs. of dry matter (DM) per inch of grass. We intentionally leave a residue of 4 inches of grass behind to protect regrowth. To determine number of heifers MARS will plan to use on pasture 2, let's look at this example. If sward height is measured at 12 inches in the stand, 8 inches are available to graze. Using this example, the forage available for grazing is 8 inches x 300 lbs./per inch of grass equaling 2400 lbs. of DM available per acre. At 4% of 1000 lbs. per animal, that results in a potential maximum of 56 head/acre/day. However, paddocks in Pasture 1 measure approximately two-thirds of an acre. The number of animals we can fittingly put on pasture would be .66 ac x 2400 lbs. of DM per acre equals 1584 lbs. of DM per acre. The number of heifers between 1000 and 1400 lbs. eligible for grazing would be (using this example) 28 – 40. Pasture growth varies throughout the season as a result of weather, precipitation, and heat meaning the number of cattle eligible to

safely graze on paddocks will vary. Given this nuance, heifers will be added to and subtracted from pasture, based on pasture DM availability.

Pastures will be measured with a pasture stick, once a week to ensure forage mass is available to sustain animals. All grazed animals will be under daily evaluation and visual observation, as required by the University of Wisconsin Institutional Animal and Care Use Committee (ACUC), to observe for presence of health abnormalities or injury. Observations are made to monitor for presence of scouring, pinkeye, bloat, and acceptable body condition score. In addition, access to clean water and supplemental vitamins and minerals are supplied and daily reported.

The perimeter of the pastures is four-strand, smooth wire, high tensile, electric fence. Energy to the fence is provided by AC power energizer with solar back-up. Individual paddocks are subdivided using single strand polywire and movable fence posts. Water is piped to each pasture to a mobile stock tank equipped with an automatic float. Heifers will be supplemented a vitamin and mineral package. If pastures slow or discontinue growth and forage production cannot sustain the animals grazing dry matter intake requirements, animals will be brought into the MARS barn facilities and provided a grass haylage diet available from the farm feed reserves while conditions allow for grazing to resume.

Animals assigned to a active ACUC approved experiments are not be eligible for the PV project. It is desired to use large heifers, confirmed pregnant as they fit the scope of this project, evaluating large animals and co-location within an AV system. Confirmed pregnant heifers are low maintenance animals to care for on pasture. They will not need to come off pasture for breeding and will not need to undergo routine pregnancy checks. Prior to going out on pasture, it is standard operating procedure that all heifers are vaccinated for pink eye and administered a pour-on fly control product. In addition, an insecticide infused ear tag will be attached to the herd identification tag to control face flies. Animal weights will be obtained prior to being placed on pasture and again during mid-grazing season. As heifers grazing season ends, individual weights on heifers will be taken upon removal from pasture.

It is assumed the solar mounts will intrigue dairy heifers, given their curious nature. We theorize heifers may use the posts to scratch their bodies on. We plan to record simple observational data on heifers when in contact with the solar panel mounting system. Information such as resting time, standing time, time interacting with the mounting system, grazing time, and ratio of heifers exposed to shade. Comparisons can be made in full sun, part sun, and days with no visible sun.

Previous research on lactating dairy cattle agrivoltaics was published in 2019 by researchers at the University of Minnesota West Central Research and Outreach Center in Morris, Minnesota. Twenty-four cows were randomly assigned to 2 treatment groups, shade or no shade. Replicated treatment groups of cows were offered shade from a 30-kW photovoltaic system. Researchers found PVs incorporated into pasture dairy systems may reduce the intensity of heat stress in dairy cows and increase well-being of cows and the efficiency of land use. Based on this study, future research may include effects of climate change on heat stress in grazing dairy cows and impacts from heat abatement systems on pasture. Research has not been conducted on pastures fully shaded by

agrivoltaics and occupied by large ruminants leaving many unanswered questions regarding the health and behavior impacts to cattle on pasture.

System Design: Ecojiva, LLC is a solar developer with over 50 years of experience in the electrical utility industry specializing in designing and engineering solar energy systems that fuel and interact with the grid. Ecojiva, LLC located in Bloomfield Hills, Michigan is the solar developer partnering with UW MARS in this project.

Definitions

- Agrivoltaics: The simultaneous use of land for solar energy production and agriculture, specifically cattle grazing in this project.
- Pre-development Phase: Initial project phase involving feasibility studies, site selection, and preliminary design.
- Fixed-Tilt System: A type of solar array installation where panels are fixed at a specific angle and do not track the sun's movement.

Abbreviations

- PV: Photovoltaic
- DAS: Data Acquisition System
- MWh: Megawatt-hour
- kW-dc: Kilowatt Direct Current

In collaboration with UW MARS, this research-driven initiative evaluates the environmental, economic, and operational impacts of co-locating solar PV infrastructure with livestock. The project aims to assess how this integration influences land management, cattle well-being, and system performance.

The project site is located at 208356 Drake Ave, Stratford, WI 54484. The land is owned by UW MARS, and Ecojiva, LLC will coordinate with UW MARS to confirm land use permissions and site control documentation.

This effort also establishes a replicable model for future agrivoltaics projects, emphasizing data collection and analysis to refine best practices. By providing a structured approach to monitoring and evaluation, the initiative contributes to broader adoption of sustainable energy solutions in agricultural landscapes, offering a scalable framework for similar developments.

Preliminary System Design: The project is currently in the pre-development phase, focusing on site selection, initial feasibility studies, and preliminary design assessments to ensure the viability of integrating solar PV with cattle grazing. The size of the system the cattle will be interacting with is 250.56 kWDC, consisting of 464 modules, each rated at 540 watts.

- Panel Type: Longi Solar LR5-72HBD-540M (540W)
- Total Modules: 464 panels
- Total Area Covered: 23,538.68 ft^2 (2,186.53 m^2)
- Panel Mounting: Fixed-tilt system at 10 ft minimum height at the lowest point

- Row Spacing: 18 ft intrarow spacing
- Annual Energy Production Estimate: 300.5 MWh
- Tilt Angle & Orientation: 30° tilt, South-facing (Azimuth 180°)

Data Collection and Monitoring: The project will gather key performance and environmental data using Ecojiva, LLC's Proprietary DAS. The primary data parameters include:

- Solar Irradiance: Correlating sunlight exposure with PV output.
- Energy Production: Monitoring AC/DC output and system efficiency.
- Panel Performance: Identifying potential hotspots or shading impacts.
- Environmental Data: Tracking ambient temperature, wind speed, and rainfall.
- System Maintenance: Observing dust accumulation and potential soiling impacts due to cattle movement.

Scalability and Replication Potential: The solar array is designed as a standard ground-mount system, making it easily replicable across other farms with minimal design changes. The only modification required for each site would be adjusting the panel height based on the livestock type and farm conditions. Since the installation process is similar to traditional solar farms, agrivoltaics can be scaled efficiently without additional technological barriers.

Agronomic Plan: In management intensive rotational grazing, multi-paddock system, (MIRG) livestock are regularly and systematically moved to fresh forage to optimize quantity and quality of forage growth, improve manure distribution, and improve soil health. MIRG increases harvest efficiency of vegetation with grazing animals through smaller paddock sizes, while maintaining plant residue with enough energy reserves to recover quickly when adequate soil moisture is available for regrowth. Routine analysis and observations in the paddock will include forage quality and sampling. A rising plate meter or pasture stick can be used to measure and compare forage mass in the paddock, with and without the array. Composition of forage present can be measured using observations and using an assessment of forage population present. Quality of forage can be measured by submitting samples to a certified testing lab. In addition, soil penetration and infiltration will be measured.

Most peer-reviewed publications related to grazing beneath solar panels pertain to small ruminant (i.e. sheep) grazing, but little on recommendations, variety data, impacts, etc. regarding forage and soil under the PV system. Given the solar panels will provide shade for the livestock and thereby are assumed to increase the standing time and impacts to pasture ground under the PV system, soil health factors should be investigated. These factors include but are not limited to soil microbiology, bulk density, soil organic carbon, soil structure, soil moisture, soil fertility, forage species' selection, compaction, water infiltration, aggregate stability, and nutrient concentration in plants. All those factors influence the capacity to function as a living ecosystem.

Other tools or equipment to utilize in collecting valuable information are unmanned aircraft systems (UAS) or drones. The use of drones with different sensors such as RGB, multispectral (MS), hyperspectral, thermal cameras, or Lidar. With the increasing use of these technologies can offer mapping, spatial and temporal resolution information related to the crop, vegetation maps to help

better understand to make better decision making. Plants reflect light at varying levels due to the chlorophyll content in the plant and the biomass. Normalized Difference Vegetation Index (NDVI) utilizing near infrared (NIR) band can indicate leaf coverage and plant health. While thermal cameras emit wavelengths proportional to temperature and the information collected can be used for plant health. However, thermal can be used for mapping not just for plant health but for maturity development and crop damage. Lidar aids in assessing plant height, crop phenology, water flow, and much more. Utilizing these types of sensors in the grazing underneath solar panels and comparing them to MIRG can capture important crop information from crop stress, pest or diseases signs, fertility, erosion and soil loss, sunlight exposure, and water impacts that are needed. The list below contains some of the analysis that would be used by collecting the data from the sensors.

- Leaf Area Index (LAI)
- Normalized Difference Vegetation Index (NDVI)
- Triangular Greenness Index (TGI)
- Above Ground Biomass (AGB)

After data is collected the valuable information will be analyzed for statistical analysis. The dissemination of the information would include field days, publications (published and fact sheets), and videos.

Current Initiatives: UW-Madison launched an initiative focused on environmental sustainability by lowering emissions and adding the use of renewable energy. The initiative includes plans to procure 100% renewable electricity on the UW-Madison campus by 2030 and achieve net zero emissions by 2048 to lower UW–Madison's carbon footprint. The initiative, *Net-Zero Emissions by 2048,* coincides with the university's 200th anniversary while also aligning with recommendations from the Intergovernmental Panel on Climate Change as well as the City of Madison's 2050 goal and the Wisconsin Clean Energy Plan. UW–Madison has also set an interim target of 100% renewable electricity by 2030–an ambitious yet critical step on the path to net-zero emissions.

The infrastructure changes required to achieve Net Zero will be a major undertaking. Success will depend on actions by UW–Madison and the university's partners. UW–Madison is seeking to understand opportunities for action, as well as continuing to expand their renewable energy portfolio and locate opportunities for collaboration. One example of the *Net Zero Emissions by 2048* is to reduce indirect carbon emissions from electricity produced off-campus, purchased for use of the university. Campus solar projects have been the starting point for this initiative. The Gordon Dining & Event Center features a solar array on the roof projected to produce 42,800 kWh of electricity a year. The UW Arboretum Visitor Center completed lighting upgrades and a solar project with an online dashboard to track clean electricity production. The university is completing a study of campus rooftops for potential solar installation; partnering with utilities on solar projects such as the O'Brien Solar Fields; and developing renewable energy at outlying lands such as a solar and agricultural research project at the Kegonsa Research Campus (https://sustainability.wisc.edu/strategic-initiatives/renewable-energy/kegonsa-research-campus/). The MARS LASSO project is a natural fit with the *Net-Zero Emissions by 2048* initiative.

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We are confident in the support for and success of this project as it has backing from members of the UW Office of Sustainability.

Outreach: "I shall never be content until the beneficent influence of the University reaches every family of the state." Those were the words coined by University of Wisconsin President Charles Van Hise in 1905. His vision was simple yet serves to this day as one of the longest and deepest traditions guiding UW-Madison; The Wisconsin Idea. The Wisconsin Idea signifies a principle that education should influence people's lives beyond the boundaries of the classroom; centering people, viewing campus and its outlying lands as a living learning lab that benefits students and researchers, and working cooperatively with the private sector, our neighbors, and local communities to honor the contributions of our alumni and inspire the leaders of tomorrow.

With the Wisconsin Idea as a framework for outreach and education, MARS will capitalize on an established outreach program reaching 800 – 1000 visitors annually, at the research farm. Visitors and visitors' purpose is vast and include people of all ages and backgrounds, from Wisconsin and around the world. MARS boasts many K-12 school-based partnerships where students utilize the MARS station for tours and classes. More formal arrangements include Youth Apprenticeships, Technical Credit courses, job shadows, youth safety, Earth Day activities, college prep programs, and agricultural literacy events. Post-secondary education training courses occur with technical colleges and 4-year universities. Learning Is ForEver (LIFE) is an example of MARS' collaboration with adult learners facilitated through a Universities of Wisconsin System 4-year university, encouraging lifelong learning. Two-thirds of the visitors and visiting groups visit MARS research farm in these capacities.

MARS engages with professional partners from around the state. Agricultural industry representatives, farm and civic organizations, watershed groups, visit MARS to take part in trainings, research tours, field walks, presentations, farmer workshops and meetings, and staff development. MARS actively engages in social media (https://www.facebook.com/MarshfieldAgriculturalResearchStation/) and podcasts to disseminate information.

MARS will develop an outreach and education plan educating the public, sharing results and providing practical advice and on-site demonstrations of the array. Multiple members of the advisory committee are situated to support, consult, and participate in outreach. MARS will leverage the support of the Dairy Grazing Alliance, the Eau Pleine Partnership for Integrated Conservation (EPPIC) watershed group, Professional Dairy Producers (PDP), Mid-State Technical College, North Central Technical College, and Chippewa Valley Technical College, GrassWorks, the Marshfield Area Chamber of Commerce and Industry Agribusiness Committee, and internal conduits of outreach including UW-Madison Extension and UW–Madison Badger Talks program (https://badgertalks.wisc.edu/).

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