THE WORLD CONFERENCE
AgriVoltaics2024
June 11-13 Denver, CO, USA

AgriVoltaics 2024
Student Design Competition

COMPETITION BRIEF

Background

Agrivoltaics is the combination of agriculture and solar photovoltaic technologies on the same land in novel configurations. These systems actively prioritize food production (crops and/or livestock), ecosystem services, farm viability, local community values, and land use efficiency alongside energy generation to increase the sustainability and shared value of solar development. Lessons learned from early research and development of agrivoltaics underscores how inclusive and holistic system design is a key component of success, as design impacts farm operation compatibility, crop suitability, power production, site environmental conditions, and social acceptance.

The AgriVoltaics 2024 Student Design Competition aims to inspire students to think creatively and holistically about energy integration across rural and urban landscapes. The purpose of this competition is to provide students an opportunity to develop innovate agrivoltaic design concepts that address community sustainability challenges across the food-energy-water nexus. To that end, we are orienting the evaluation of projects around the 5 C's of Agrivoltaic Success – Climate, Configuration, Crops and Cultivation, Compatibility, Collaboration – to ensure a full range of technical, social, and ecological factors are integrated into agrivoltaic projects. The final aim of this competition is to design a novel compelling agrivoltaic solution for common use cases globally, building off real sites based in Colorado, USA.

Students are encouraged to leverage findings from recent scientific research in a range of fields, including but not limited to agricultural sciences, ecology, sociology, human behavior, and urban design theory. Student participants have the opportunity to apply established research theories in their designs, which should be grounded in evidence-based approaches while also pushing the boundaries of what is possible in agrivoltaic systems. This includes providing measurable data and best practices to demonstrate tangible environmental, social, and economic benefits.

Competition Objectives

Innovative Integration: Proposals should create designs that thoughtfully integrate PV facilities into agricultural landscapes while co-optimizing agricultural productivity, energy generation, and engagement.

Food Energy Water Nexus: Proposals should address all aspects of the food energy water nexus, particularly in optimizing agricultural and energy outputs while minimizing the impacts of freshwater usage in the context of Colorado's climate.

Scalability and Adaptability: Relative to each location's scale, designs should be adaptable to different geographies with similar climatic conditions.

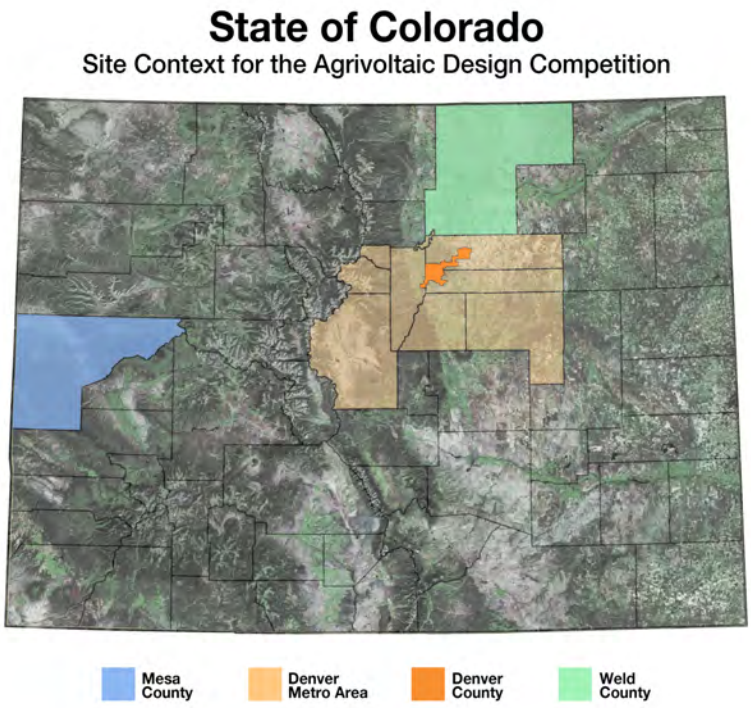
Social Dimensions and Community Engagement: Proposals should include novel approaches to engage local communities and stakeholders in the context of food and energy generation on the same land area, including long-term food security considerations.

Site Context

As agrivoltaic solutions can look different based on different agricultural contexts, this competition is considering three distinct agricultural applications that are representative of conditions for which novel agrivoltaic solutions are needed across the globe. This includes large-scale cattle grazing and commodity crop farming; fruit production, orchards, and viticulture; and urban systems that could include smaller farms and/or rooftop systems. To provide a consistent set of boundary conditions related to climate and scale, specific locations within the state of Colorado have been selected as host sites for the competition categories.

Proposals must select one location and design one site within the boundaries of that location while matching the scale and agricultural application for their submission.

Location	Agricultural Application	Max Land Area
Weld County, CO, USA	Cattle Grazing / Commodity Crop Farming	200 hectares (500 Acres)
Mesa County, CO, USA	Fruit Production / Orchard / Viticulture	8 hectares (20 Acres)
Denver County, CO, USA	Urban Farm / Rooftop Farm / Small Farm	2 hectares (5 Acres)



Weld County // Eastern Plains

Weld County, Colorado has firmly established itself as a leading agricultural region both within the state and across the United States. It's recognized as the leading (economic) agricultural producing county east of the Rocky Mountains and ranks within the top 10 in the United States. The county's agricultural landscape is vast, covering over one million hectares (2.5 million acres), with about 75% of this area dedicated to farming and livestock raising. This includes more than 3,000 farms actively contributing to the county's agricultural output.

Weld County is particularly known for being Colorado's leading producer of beef cattle, grain, sugar beets, and dairy. The dairy industry, in particular, has seen significant growth, with the number of milk cows doubling between 2010 and 2021. This growth in the dairy sector has also brought challenges, especially in terms of water usage which is a critical resource in the region's semi-arid environment.

Mesa County // Western Slope

Mesa County is located within Colorado’s Western Slope, a region of the state that lies west of the continental divide. The agricultural sector in Mesa County is facing modern challenges, particularly influenced by the region's unique climate and water resources. The Western Slope's agriculture heavily relies on irrigation from rivers and streams, with over 90% of water diversions in the area managed for crops like fruits, vegetables, hay,

and alfalfa. This variety is supported by the Colorado River, which provides essential irrigation water. However, the region faces significant challenges due to declining river flows and overconsumption downstream on the Colorado River Basin. This highlights the importance of water resource management in the region, as agriculture is the largest user of water from the Colorado River and its tributaries.

Climate change poses another challenge, particularly for fruit orchards. The orchards in this area, situated at high altitudes, require special care and are subject to unpredictable and volatile weather conditions, including the likelihood of unseasonal frost. Despite the challenges, the unique climate of the Western Slope contributes to the distinct flavor and quality of the fruit produced in the region, Overall, the agriculture sector in Mesa County is adapting to changing environmental conditions and water resource challenges, while continuing to produce high-quality agricultural products.

Denver County // Front Range Urban Corridor

Denver is situated on the western edge of the High Plains, adjacent to the eastern side of the Rocky Mountains' Front Range. Known as the "Mile High City," Denver's official elevation is precisely one mile above sea level (5280 feet or 1609 meters). The greater Denver Metropolitan Area, encompassing 10 counties, had a 2020 census population of 2,963,821, ranking as the 19th most populous in the United States. Sitting at the epicenter of the Denver Metro Area is Denver County. Denver County's population has grown from ~551,000 in 2004, to ~713,000 in 2022 - an increase of nearly 30% over that time span. It is the most populous city in a 900 km (560 Mile) radius and holds the position of the second-most populous city in the Mountain West region.

As the Denver Metropolitan area continues to grow in population, the associated stresses of urbanization grow with it. Developing over natural habitats, open space, and agricultural lands; inflated land values, food insecurities, and a strain on the limited water supply have all become a reality in Denver County. In an effort to combat the loss of open space, in 2018, Denver passed the Green Building Ordinance to encourage building developers to consider green spaces within the city by enhancing water and stormwater management, and promoting the utilization of solar energy sources. Overall, Denver is adapting to the influx of population as its happening - new solutions that maximize land use will be necessary to maintain sustainable growth in the Mile High City.

Rules & Requirements

- **Eligibility** – The Competition is intended for currently enrolled undergraduate and graduate students in any country.
  - Students K-12 may participate, but they will be subject to different review process and will NOT be eligible for University Student Awards.
- Only one design submission is allowed per person or team.
- Maximum 4 students per team – no restriction on group composition (field of study, year of study, etc).
- All deliverables to be submitted in the English language.
- All Competition winners should be present at the AgriVoltaics 2024 Conference to receive their award, or provide a 3-minute pre-recorded video to acknowledge their award.
  - Finalists will be notified in advance to prepare.
- All individuals or teams need a Faculty Point of Contact.
- No indirect costs allowed for institutions.
- All submissions will be managed through the HeroX Platform.
- *All participants must indicate their intent to submit a project by "Following the Competition" via HeroX Platform by **March 29, 2024**.*

- *Registration Deadline: March 29th, 2024 at 5pm EST*
- *Submission Deadline: **May 10th, 2024 at 5pm EST***

Grading & Guidelines

Grading Criteria

Competition Judges will use the following scoring rubric. Submissions that receive the highest scores (maximum 100) will be considered as finalists to receive an award.

Topics	Key Criteria to Consider	Points
Climate, Soil, and Environment	-General site analysis of existing conditions -Water access and management -Suitability based on soil and climate conditions -Siting considerations, proximity to infrastructure	10
Configuration, Solar Technologies, and Design	-PV system capacity and generation -PV technology (modules and racking) -PV design (including panel height and groundcover ratio) -Project layout within the land area	30
Cultivation Methods, Crop Selection, and Management Approaches	-Vegetation / Crop selection suitability based on Climate and Configuration -Harvesting and site management -Planting / vegetation plans -Markets and distribution in context of local food systems	10
Compatibility and Flexibility	-Farm operation & equipment compatibility -Safety considerations -Adaptability of system design to other agricultural activities -Infrastructure (PV and agricultural) requirements	20
Collaboration and Partnerships	-Consideration of potential social impacts of project design -Community and stakeholder engagement opportunities -Educational opportunities -Identification of relevant types of partners and agreements across different sectors	20
Project Novelty and Impact	-Novelty and uniqueness of approach -Scalability of project design across geographies -Other relevant factors important to adoption of agrivoltaic systems	10
		Total 100

Submission Guidelines

All submissions must be submitted through the HeroX Platform. Student teams must create a HeroX account and then "Solve the Challenge" by completing all sections of the Submission Form.

To be eligible for consideration, all submissions must satisfy the following guidelines:

1. Project Narrative (1,500 words maximum):

- Purpose Statement – Includes overview of project, goals, scope, etc.
- Discussion of the project's key considerations in the context of the "5 C's of Agrivoltaics Success" – How is a full range of technical, social, and ecological factors integrated into the project?
- Optional "Other Justification" – Describe any other relevant analysis or factors worth consideration.

2. Site Design (PDF 8 pages (maximum), 11"x17", or, A3 size paper)

- Site Analysis Diagrams
- Master Plan
- For larger sites, detailed callout plans are acceptable
- 2 Perspective Renders
- 2 Section Diagrams
- Project Metrics & Diagrams
- Describe agricultural production, PV generation, ecological factors, water consumption, etc.

3. OPTIONAL

- Develop a poster (36" x 48" / 91cm x 122cm) for display at the AgriVoltaics 2024 Conference that showcases your project.
- **All participants who develop a poster will receive free admission to the conference!**

Timeline

- **Registration Deadline:** March 29th, 2024 at 5pm EST
- **Submission Deadline:** May 10th, 2024 at 5pm EST
- **Judging Period:** May 13th – May 31st, 2024
    - ***Winners will be notified prior to public announcement***
- **Awards Ceremony:** June 13th, 2024 at the 2024 AgriVoltaic World Conference in Denver, Colorado

University Student Awards

- There will be one winning team per site (Denver, Mesa, Weld Counties).
- It is anticipated the first-place awards will be $2,000 USD provided by industry sponsors (sponsor TBD).
- All Competition winners should be present at the 2024 AgriVoltaics World Conference to receive their award, or provide a 3-minute pre-recorded video to acknowledge their award
- Finalists will be notified in advance to prepare.

Competition Judging Committee

- **Dr. Stefano Amaducci** // Università Cattolica del Sacro Cuore, Department of Sustainable Crop Production, Italy
- **Dr. Stephan Schindele** // Head of Product Management Agri-PV at BayWa r.e., Germany
- **Dr. Jody Beck** // University of Colorado Denver, College of Architecture and Planning, Landscape Architecture Department, USA
- **Jane Choi** // Colorado State University, Department of Horticulture & Landscape Architecture, USA
- **Makoto Tajima** // Director of the Institute for Sustainable Energy Policies (ISEP), Japan
- **Julia Park** // Namaste Solar, O&M Portfolio Manager, USA
- **Jordan Macknick** // NREL, Lead Energy-Water-Land Analyst, USA

Inquiries

If you have questions, visit the FAQ (Frequently Asked Questions) Tab on the HeroX Website. If you cannot find the answer, ask on the Forum Tab.

If you want to participate or receive updates on the prize, please subscribe by using the "follow this competition" feature on the HeroX platform

For any outstanding questions, message us directly at thomas.hickey@nrel.gov.

Information Disclaimer

This document was last updated January 16th, 2024.
For the most up to date information about the competition visit the AgriVoltaics 2024 Student Design Competition HeroX Website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