COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Water Plan

Water Project Summary

Name of Applicant	Colorado Agrivoltaic Learning Center
Name of Water Project	Solar Array Lands Supporting Agribusinesses (SALSA)
Grant Request Amount	**$342,000.00**
Primary Category	$342,000.00
Agricultural Projects	
Total Applicant Match	**$349,170.60**
Applicant Cash Match	$339,170.60
Applicant In-Kind Match	$10,000.00
Total Other Sources of Funding	**$0.00**
Total Project Cost	**$691,170.60**

Applicant & Grantee Information

Name of Grantee: Colorado Agrivoltaic Learning Center
Mailing Address: 8102 N 95th Street Longmont CO 80504

Organization Contact: Byron Kominek
Position/Title: Executive Director
Email: byron@coagrivoltaic.org
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Organization Contact - Alternate: Liz Voss
Position/Title: Operations Coordinator
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Grant Management Contact: Byron Kominek
Position/Title: Executive Director
Email: byron@coagrivoltaic.org
Phone: 970-344-8066

Description of Grantee/Applicant

No description provided

Type of Eligible Entity

- ☐ Public (Government)
- ☐ Public (District)
- ☐ Public (Municipality)
- ☐ Ditch Company
- ☐ Private Incorporated
- ☐ Private Individual, Partnership, or Sole Proprietor
- ■ Non-governmental Organization
- ☐ Covered Entity
- ☐

☐ Other

Category of Water Project

■ Agricultural Projects
Developing communications materials that specifically work with and educate the agricultural community on headwater restoration, identifying the state of the science of this type of work to assist agricultural users among others.

☐ Conservation & Land Use Planning
Activities and projects that implement long-term strategies for conservation, land use, and drought planning.

☐ Engagement & Innovation Activities
Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website.

☐ Watershed Restoration & Recreation
Projects that promote watershed health, environmental health, and recreation.

☐ Water Storage & Supply
Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap.

Location of Water Project

Latitude	40.122552
Longitude	-105.130321
Lat Long Flag	Other: Coordinates based on other boundaries or locations
Water Source	South Platte River
Basins	South Platte
Counties	Boulder; Weld; Denver; Adams; Arapahoe; Morgan
Districts	2-South Platte: Denver Gage to Greeley; 1-South Platte: Greeley to Balzac; 8-South Platte Cheesman to Denver Gage

Water Project Overview

Major Water Use Type	Agricultural
Type of Water Project	Construction / Implementation
Scheduled Start Date - Design	11/1/2024
Scheduled Start Date - Construction	

Description

The Colorado Agrivoltaic Learning Center (CALC) proposes the Solar Array Lands Supporting Agribusinesses (SALSA) project to showcase how agrivoltaics can help farmers and ranchers adapt to climate change and water scarcity. The funding requested from the Colorado Water Conservation Board will enable CALC to leverage existing relationships with solar companies operating solar arrays along the Front Range of Colorado to pair them with Latinx and immigrant community members interested in starting agribusinesses within the arrays. SALSA will subcontract these agribusinesses for a 12-month performance with sufficient funds to showcase the potential of agrivoltaics. As SALSA participants, these new agribusiness owners will receive training in agrivoltaics and water conservation techniques, milestone-based payments to decrease the financial risks associated with starting a new agribusiness, community networking, and further support from CALC to facilitate their success. SALSA’s dual land-use strategy and incorporation of marginalized community members into agrivoltaics will offer numerous examples of how agrivoltaics can conserve water, create local agribusiness opportunities, and maximize land utilization.

Measurable Results	
	New Storage Created (acre-feet)
	New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive
	Existing Storage Preserved or Enhanced (acre-feet)
	New Storage Created (acre-feet)
	Length of Stream Restored or Protected (linear feet)
	Length of Pipe, Canal Built or Improved (linear feet)
	Efficiency Savings (dollars/year)
	Efficiency Savings (acre-feet/year)
5	Area of Restored or Preserved Habitat (acres)
	Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)
30	Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning
610	Number of Coloradans Impacted by Engagement Activity

Other

SALSA will facilitate land access for ten marginalized and under-resourced community members and support them in startup agricultural businesses under solar arrays that showcase agrivoltaics as a water-saving farming method and dual land use strategy.

Water Project Justification

The American West is facing its worst drought in over a millennium, threatening agriculture. Colorado's water supplies are affected by temperature and precipitation patterns, and these historical patterns are shifting. The most recent (May 2021) NOAA 30-year forecast reflects warmer temperatures than previous iterations and changing precipitation patterns. This presents complexities and uncertainties for Colorado water supplies and points to a shift toward aridification (Colorado Water Plan, 2023). Farmers, as large water consumers, must rethink their usage or risk their business productivity.

Challenges of farming in Colorado's Front Range, which is experiencing increased temperatures and prolonged droughts due to climate change, include:

~Urbanization, permanent transfer of agricultural water supplies for municipal and industrial use, and encroaching residential and recreational development will decrease irrigated lands and impact the agricultural economy and open space.

~Financial resources are needed to maintain or replace aging irrigation infrastructure.

~The rapid increase in the value of water rights makes it difficult to acquire additional irrigation supplies and increases "buy-and-dry" pressure.

~Decreased water availability in the future due to declining aquifer levels in designated basins and diminished surface supplies from climate change will impair farmers' ability to irrigate their crops fully.

The Colorado Agrivoltaic Learning Center (CALC) promotes climate resilience and resource efficiency by encouraging changes in solar developments to enable novel farming methods through agrivoltaics. CALC is headquartered at Jack's Solar Garden, 8102 N. 95th Street, Longmont, Colorado 80504, USA. CALC conducts on-site tours of Jack's Solar Garden, where 3,276 solar panels create a 1.2 MW community solar garden – powering 300+ homes. Jack's Solar Garden is our country's premier site for agrivoltaics and a national model for governments, solar developers, and farmers. Because of CALC, Jack's Solar Garden is the most visited solar array in the US, with over 4,000 visitors and an off-site reach of more than 6,000 since 2020. CALC leads the way in climate resiliency, demonstrating a path forward to climate reliance in Colorado farming communities and inspiring others to take action to preserve the state's agricultural heritage in a time of uncertainty.

CALC proposes the project Solar Array Lands Supporting Agribusinesses (SALSA) to showcase to society how we can mitigate and adapt to the effects of climate change by promoting and increasing the adoption of agrivoltaics in existing solar arrays in Colorado. SALSA will facilitate agreements between solar companies and underserved populations to enable the formation of novel agribusinesses within solar arrays. SALSA will employ a phased approach to affect systemic change in land access and use in the Western United States to promote climate resiliency in the region.

Agrivoltaics offers a unique value proposition that integrates solar energy production with agricultural practices, which maximizes land use efficiency. This dual-use approach addresses the growing demand for renewable energy while preserving agricultural productivity, making it particularly valuable in regions with limited arable land. Shade from solar panels can create a more favorable microclimate for crops and livestock, reducing heat stress, potentially enhancing yields, and reducing water usage through decreased evaporation.

While farmers grapple with hot temperatures and drought, solar developers are eyeing agricultural land to build solar arrays. Traditional solar installations are not designed for agricultural integration and typically degrade the land during construction. As solar panels last over 25 years, and considering our country needs 30 million acres of solar arrays in the American West by 2050 to be net zero, thoughtful solar development can support farmers, offer land access, avoid land degradation, and preserve soil moisture longer for the benefit of select vegetation.

Agrivoltaics integrates solar development with agricultural productivity, fundamentally changing the traditional paradigms of agriculture and energy production. Agrivoltaics demonstrates the feasibility and benefits of dual land use, drives technological innovation, promotes sustainability, and alters economic and policy landscapes. This disruption fosters a more integrated and resilient approach to land use, energy production, and agricultural practices.

SALSA will:
~Increase access to land for Latinx and immigrant community members to start agribusinesses within solar arrays through outreach and education to connect experienced agricultural practitioners to participating solar companies' existing solar arrays.
~Reduce the financial risk associated with starting up an agribusiness by contracting upwards of ten Latinx and immigrant community entities to trial and showcase the possibilities of diverse agricultural activities within solar arrays.
~Share lessons learned with policymakers, solar developers, water conservation districts, and agricultural organizations through reports and in-person visits to the solar arrays to demonstrate the possibilities of agrivoltaics in their area.

The partnerships that SALSA will facilitate will empower immigrant and Latinx communities through entrepreneurial agriculture-focused opportunities. CALC intends to follow each agribusiness's progress, documenting water usage compared to state or national averages. The success of this program will have a national impact, as there are at least a million acres of solar arrays across our country, with 10,000 acres in Colorado. These are underutilized lands, and access to them can benefit local communities by producing food with less water.

The 2023 Colorado Water Plan communicates a vision for Robust Agriculture (pp. 192-203) that includes

Thoughtful Storage, Meeting Future Water Needs, Wise Water Use, and Healthy Lands. The plan states on page 192, “Innovations are needed to sustain irrigated agriculture, including strategies to stretch available water supplies, increase resiliency, enhance food production, and maintain profitability.” The SALSA Project is poised to accelerate that innovation through agrivoltaic demonstration projects.

SALSA's goal of increasing the adoption of agrivoltaics on the Front Range will impact the Wise Use and Healthy Land areas indicated in the 2023 Water Plan's vision. Specifically, Partner Action 2.10 on page 203 of the Plan is proposed to “increase focus on promoting soil and water conservation to sustain agricultural production. Pairing soil and water conservation strategies with positive production and economic outcomes is essential for increased adoption.” Action 2.10 calls for agricultural partners to integrate soil health, water conservation, and adaptive practices that increase economic outputs with less water use.

Agrivoltaics integrates several sustainable practices that contribute to soil health, water conservation, adaptive practices, and economic outputs.

1. Soil Health
Shade Provision: The partial shading provided by solar panels reduces the daily average exposure the soil has from direct sunlight, reduces soil temperatures, and decreases the rate of soil moisture evaporation. Reducing the average daily swings in sunlight, temperature, and soil moisture makes it easier for soil microbiology to thrive.
Diverse Biology: The varied microclimates found within solar arrays support different insect populations and vegetation that can support a more diverse soil microbiology.

2. Water Conservation
Reduced Evaporation: The shade solar panels cast on the ground decreases the evaporation rate from the soil, retaining soil moisture longer and reducing the need for irrigation.
Efficient Water Use: Farmers/ranchers can optimize water use by selecting crops and forage more suited to grow under the partial shade of solar panels. Such vegetation will likely have lower water requirements, leading to overall water savings. Livestock within solar arrays benefit from shade and lowered heat stresses leading to less water consumption throughout the day.

3. Adaptive Practices
Climate Resilience: By dampening the extreme swings in temperature and light exposure each day, agrivoltaics can help crops withstand extreme weather conditions like heat waves or droughts. This resilience leads to more reliable harvests, reduced crop failure rates, and less heat exhaustion in animals, meaning less livestock mortality.
Dual Land Use: Integrating solar panels with agriculture allows for dual land use, maximizing productivity. This can lead to increased economic output from energy production and agricultural activities.

4. Economic Outputs with Less Water Use
Cost Savings: Reduced irrigation needs lower water costs and can decrease the need for expensive water infrastructure. The savings can be substantial in areas where water is a significant expense.

Agrivoltaics offers a multifaceted approach to integrating soil health, water conservation, and adaptive practices that can lead to increased climate resilience and use of less water for crop and livestock production.

Due to urbanization, water transfers to municipal and industrial uses, and groundwater sustainability, the amount of irrigated land in the South Platte Basin is anticipated to decrease in the future. Climate change may increase on-farm shortages due to increased irrigation demand and lower irrigation water supply. The strategic vision communicated in the South Platte Basin Roundtable Implementation Plan (BIP) (January 2022) considers the basin's goals, projects, and desired water future and concisely describes the strategies needed to meet future challenges.

The strategic vision for the South Platte and Metro Basin Roundtables focuses on four elements:

- Meeting the municipal supply gap
- Protecting irrigated agriculture
- Protecting and enhancing watersheds
- Implementing projects

As stated on pages 30-31 of the BIP, the Basin's fifth goal for action is to "Maintain and Improve Irrigated Agriculture" by supporting measures to maintain and, where legally, physically, and economically possible, improve and increase irrigated agriculture in the face of increasing municipal and industrial demand. The SALSA Project is aligned with the first two strategies under this goal:

1. Minimize traditional permanent buy-and-dry of irrigated acreage by implementing other strategies, including implementation of multi-purpose projects, maximizing use of native South Platte River Basin supplies, conservation, reuse, implementation of ATMs, and other innovative water-sharing measures.
2. Develop multi-purpose projects to address agricultural water shortages.

SALSA speaks to the need for additional strategies to reduce the permanent dry-up of irrigated acreage through conservation and implementation of multipurpose projects. Agrivoltaics reduces soil water evaporation due to the partial shade provided by solar panels, thereby maintaining more moisture in the ground for plants to access and reduces thermal stresses on livestock, making their water demand less. This ability to retain more moisture in soils and haul less water for animals helps farmers/ranchers economically and lessens the likelihood of their fields dring up. Agrivoltaics could help make drylands more viable for both crops and livestock.

Typical solar energy installations use single-seed turf grasses or grade lands into barren wastelands, negating any potential water retention, soil stability, carbon sequestration, or wildlife habitats. As solar panels last over 25 years, and 30 million acres are needed in the American West by 2050 for net zero goals, society can change the traditional installation practices to support environmental and agricultural factors. Thoughtful solar development can provide habitats, support farmers, conserve water, and offer access to lands for agribusinesses, thereby avoiding land degradation and food supply loss while producing clean energy. Society just needs more examples, like what SALSA offers, to showcase how we can make these changes.

Related Studies

Through the study of agrivoltaics enabled by previous funding from the CWCB for an irrigation system at Jack's Solar Garden (JSG), CALC has demonstrated how rural economies can benefit from the incorporation of solar arrays on their land while maintaining agricultural productivity within a solar array. By monitoring microclimates created by a solar array built over farmland, JSG has realized and demonstrated water savings and learned how to grow food and grazing crops successfully within an agrivoltaic system. Such water savings supports Colorado's Water Plan and the South Platte Water Basin Implementation Plan goals to maintain and improve irrigated farmlands and promote agricultural resiliency in a warming climate and dwindling natural water source scenarios. For example, tomatoes at JSG can be watered every other or every third day, unlike neighboring traditional farms, where they must be irrigated daily.

Partners at Colorado State University (CSU) studied at JSG how the 6ft long solar panels redistribute moisture to the edges of their panels, turning light rainfalls into larger rain events and enabling deeper soil moisture retention at the panel edges (Sturchio et al., 2023). Solar panels also shade the ground, lowering soil and plant temperatures while reducing evaporation rates from the soil (Barron-Gafford et al., 2019). These benefits are especially important in semiarid climates and higher elevations like Colorado because they can help lower irrigation requirements and dampen the drastic daily temperature swings we experience in the summer months.

A recent CSU study at JSG found that for semiarid C3 grassland growing beneath an agrivoltaic system, the aboveground net primary productivity was reduced by only 6%–7% with no irrigation over three years (Kannenberg et al., 2023). These results indicate that agrivoltaic systems can serve as a scalable way to expand solar energy production while maintaining forage productivity in managed grasslands, especially in climates where water is scarce compared to sunlight. This has important implications for prospective livestock management plans in grasslands under solar panels. Such considerations will help inform County permitting processes when deciding how to allow solar array installations on farm and ranch lands.

The SALSA Project builds on the water-saving successes enabled by the 2019 JSG grant from the CWCB by sharing what we have learned about agrivoltaic system design, function, and operations with marginalized and disadvantaged community members. By contracting these community members to start their own agribusinesses within existing solar arrays, CALC can increase the adoption of agrivoltaics as a water-conserving and climate-resilient practice on irrigated farmland in our region. Further, SALSA will showcase how land access can be provided to underserved populations to support local food production and enhance rural economic and climate resiliency.

Taxpayer Bill of Rights

Colorado Agrivoltaic Learning Center does not anticipate any TABOR issues affecting this application.