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	Educating Colorado Communities on Agrivoltaics	
Grant Request Amount		**$100,411.20**
Primary Category		$100,411.20
Agricultural Projects		
Total Applicant Match		**$34,086.00**
Applicant Cash Match		$30,086.00
Applicant In-Kind Match		$4,000.00
Total Other Sources of Funding		**$0.00**
Total Project Cost		**$134,497.20**

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
Phone: 970-344-8066
Email: byron@coagrivoltaic.org

Organization Contact - Alternate: Liz Voss
Position/Title: Operations Coordinator
Phone: 720-320-5620
Email: liz@coagrivoltaic.org

Grant Management Contact: Byron Kominek
Position/Title: Executive Director
Phone: 970-344-8066
Email: byron@coagrivoltaic.org

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	This project affects stakeholders in 32 of Colorado's 64 counties, which have multiple associated water sources in all seven water basins and multiple water districts. The application portal will not allow the selection of 32 counties.
Basins	Arkansas; Colorado; Gunnison; Metro; Yampa/White/Green; Rio Grande; South Platte; Southwest; Nort...
Counties	Weld; Morgan; Adams; Boulder
Districts	6-Boulder Creek; 3-Cache La Poudre River; 7-Clear Creek; 5-St. Vrain Creek; 1-South Platte: Greeley to Balzac; 4-Big Thompson River; 2-South Platte: Denver Gage to Greeley; 64-South Platte: Balzac to Stateline; 8-South Pla...

Water Project Overview

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

Description

The Colorado Agrivoltaic Learning Center (CALC) proposes the project Educating Colorado Communities on Agrivoltaics to help Colorado mitigate and adapt to the effects of climate change, including future water scarcity. Agrivoltaics is a dual land use measure incorporating solar arrays over agricultural activities using shade and moisture redistribution off the panels to keep water in the ground longer. The funding requested from the Colorado Water Conservation Board will help CALC engage community stakeholders and organizations in at least 32 Colorado counties. Our education team will present the benefits of the microclimates created by solar

panels that can benefit agriculture by reducing water usage and keeping vegetation and livestock cooler in the summer heat. This project will facilitate the usage of solar array land that will use less water to produce agricultural products while reducing the drying up of agricultural lands underneath solar panels.

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)
Area of Restored or Preserved Habitat (acres)
Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)
Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning
700 Number of Coloradans Impacted by Engagement Activity
Other

As education is a long-term strategy, long-term outcomes for this project will be seen with the number of solar arrays developed across Colorado over the coming years that are built and operated in a way that facilitates varied agricultural and water-conservation activities.

Water Project Justification

Created in 2020, The Colorado Agrivoltaic Learning Center (CALC) is an education-first nonprofit based at Jack's Solar Garden in Longmont, Colorado. Its mission is to showcase clean energy generation coupled with local food production—agrivoltaics—to educate and inspire our community to take action to improve land stewardship within solar arrays. CALC teaches our youth via Colorado school districts about solar energy and agriculture and systems thinking through the lens of agrivoltaics systems. We show them a more sustainable future and the many career opportunities related to agrivoltaics. We provide public and private tours to individuals, community groups, and businesses to showcase the possibilities of agrivoltaics as an innovative solution to our growing energy, food, water, and land use challenges. We also offer agrivoltaic workshops to give participants an in-depth understanding of agrivoltaics.

Further, CALC educates land use regulatory agencies about how solar arrays can be installed so that farmland is not lost. We believe that society can still preserve the land within solar arrays and provide agricultural jobs to land stewards. We believe that by providing fact- and data-based education grounded in real-world experience from Jack's Solar Garden, we can promote the adoption of agrivoltaics as a climate-resilient solution for Colorado's energy, water, and food security needs.

The American West is facing its worst drought in over a millennium, threatening agriculture. Farmers must rethink water usage or risk losing productivity, while solar developers are eyeing agricultural land to build solar arrays. Typical solar installations degrade land, taking it out of agricultural production. Solar panels last over 25 years, with 30 million acres needed in the American West by 2050 for net zero goals, per a report by The Nature Conservancy. Thoughtful solar development can provide biodiverse habitats, support farmers, and offer land access, avoiding land degradation and food supply loss while simultaneously producing clean energy.

CALC promotes climate resilience and resource efficiency by encouraging the solar industry to change its

designs and adopt land stewardship operations that support agricultural activities in their solar arrays (agrivoltaics). Since 2020, CALC has reached over 10,000 people through on-site tours and workshops, online educational videos and webinars, and off-site discussions about agrivoltaics in conferences and policy meetings. CALC leads the way in advocating for climate resiliency within solar developments, demonstrating a path forward, and inspiring society to take action.

CALC proposes the Educating Colorado Communities on Agrivoltaics Project, an agricultural outreach and education project that connects with Colorado stakeholders and community members in their hometowns to discuss the dual usage of land within solar arrays. The benefits of agrivoltaics will be discussed with stakeholders to give them an appreciation for the impacts of shade from the solar panels on soil moisture retention and how solar panels redistribute precipitation, soaking soils more deeply at their edges. CALC will also offer an on-farm workshop at Jack's Solar Garden, where water use efficiencies, agricultural integration, and conservation potential of agrivoltaics are showcased to drive home how agrivoltaics can support our water-limited state. Agrivoltaics in Colorado essentially means less water needed for vegetation growth and livestock stability due to the shade provided by solar panels. Such integration of solar with farmland keeps our agricultural lands from drying up while producing the electricity our society needs.

The project will focus on the dual land use and water conservation aspects of agrivoltaics, engaging water districts, community stakeholders, agencies, and organizations in 32 Colorado counties. CALC will educate them about the potential of agrivoltaics to reduce water usage in farming and ranching operations, especially on farmland facing a reduction in or loss of irrigation resources. CALC will encourage the spread of agrivoltaics by helping stakeholders understand the science behind, design, and integration of agriculture into agrivoltaic systems. We hope this results in more agrivoltaic projects on irrigated farmland, contributing to Colorado's clean energy goals while minimizing traditional permanent buy-and-dry of irrigated acreage (South Platte Basin Roundtable Implementation Plan, January 2022, pages 30-31) by enabling agrivoltaics on lands that would otherwise be dried up and underutilized in traditional solar arrays.

Agrivoltaics enhances farming adaptability to climate change and long-term sustainability. Solar panels provide shade that reduces soil and crop temperatures, water evaporation, and plant heat stress. Such a microclimate helps maintain crop yields during heatwaves, which are becoming more frequent due to climate change. This is crucial as climate change leads to unpredictable rainfall, prolonged droughts, and longer stretches of 90+°F. Agrivoltaics aligns with Colorado's Water Plan in its focus on resilient planning for water security in the face of climate change and declining water sources. As a dual land use strategy incorporating energy and agriculture on the same site, agrivoltaics benefits more than one sector, providing society with improved land use efficiencies.

From increasing solar panel efficiency to conserving water to increasing crop yield, the findings from CALC's research partners at Jack's Solar Garden provide critical insights that enable the proliferation of dual-use renewable energy projects across the United States. Research from a project site in Arizona indicates that solar panels with crops growing underneath stayed cooler by 16°F and produced 2% more electricity than those without crops. Shade from solar panels can also create cooler, more humid microclimates for vegetation. Researchers are working to better understand how these microclimates impact Jack's Solar Garden vegetation. Colorado State University's research at Jack's Solar Garden has shown that with a single-axis solar array, rainfall is concentrated along the edges of the panels, emulating large rainfall events and increasing forage production at the edges. The clean energy produced by the solar panels outweighs the 6%-7% reduction in overall forage productivity within the solar array. Such findings help make a case for the climate resilience and economic viability of agrivoltaics as policymakers, farmers, and communities weigh the costs and benefits of turning farmland into solar arrays.

The Statewide Water Education Action Plan For Colorado 2020-2025 (SWEAP) aims to "significantly improve the

level of public awareness and engagement regarding water issues statewide by 2025, as determined by water awareness surveys, and engage Coloradans statewide on at least five key water challenges" (page 6, Statewide Water Education Action Plan). As an educational initiative promoting awareness and knowledge of the dual land use and water use efficiencies of agrivoltaics, the Educating Colorado Communities on Agrivoltaics Project is aligned with this mission through its goal, objectives, and outcomes:

Goal: Educating Colorado Communities on Agrivoltaics aims to meet Colorado stakeholders and community members in their hometowns to discuss the dual usage of land within solar arrays to benefit agriculture and water conservation.

Objective 1: Make in-person outreach visits to 32 Colorado counties to engage water districts, community organizations, local solar companies, agricultural organizations, and county agency staff about the utilization of land within solar arrays and the water-saving potential of the shade they provide. Main topics will include the science of agrivoltaics, alternative solar siting regulations, safety considerations, and best practices to enable optimal installation of agrivoltaic systems.

Outcome: CALC will engage 700 stakeholders in agrivoltaics educational visits over the course of the grant period.

Objective 2: Conduct an educational workshop at Jack's Solar Garden in Boulder County to showcase to stakeholders how agrivoltaics can help agriculture and address water conservation issues.

Outcome: Approximately 30 participants will attend this workshop. They will leave with improved awareness and understanding of agrivoltaics as a water-conserving and dual land-use solution to dwindling agricultural water sources they can share with their communities.

The SWEAP Strategic Framework (pp. 12-16, SWEAP) is designed to work toward the final overall impact of engaging Coloradans in well-informed community discourse and decision-making regarding balanced water solutions" and empowering them "to take thoughtful action regarding critical water challenges facing the state and their communities" (page 12, SWEAP). The Educating Colorado Communities on Agrivoltaics Project is poised to do this by implementing a focused educational outreach and engagement strategy within water districts, community organizations, local solar companies, agricultural organizations, and county agency staff. The project will engage them in presentations and discussions about using land within solar arrays and the water-saving potential of the shade they provide.

The Educating Colorado Communities on Agrivoltaics Project will conduct outreach through group gatherings and in-office visits to water districts and county organizations involved in land preservation, agricultural advocacy, solar/clean energy deployment, and water conservation. CALC will educate these stakeholders about agrivoltaics as a dual land-use and water conservation strategy to protect irrigated farmlands from solar array design and installation practices that compromise soil health and agricultural productivity. CALC will share expertise gained through the solar array design and installation process at Jack's Solar Garden, partially funded by a previous grant from the Colorado Water Conservation Board, as well as insight into county regulations affecting the approval of agrivoltaic systems. By helping communities that enable agrivoltaic projects on irrigated farmlands, the Educating Colorado Communities on Agrivoltaics Project will facilitate greater awareness and understanding of agrivoltaics as an economically viable, water-conserving, and climate-resilient farming method on their land.

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, in collaboration with research partners and JSG, has demonstrated how rural economies can benefit from the incorporation of solar arrays on their land while maintaining and enhancing Colorado's agricultural productivity within solar arrays. 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 forage successfully within an agrivoltaic system. Growing operations have demonstrated water conservation for crop growth under solar arrays, which will assist in meeting Colorado Water Plan and 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 during the hottest months, unlike neighboring traditional farms, where they must be irrigated daily.

Solar panels redistribute moisture to the edges of their panels, mimicking large rain events and enabling deeper soil moisture retention (Sturchio et al., 2023). Solar panels also provide shade to 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 like Colorado because they can help lower irrigation requirements.

A recent study at JSG found that semiarid C3 grasses growing beneath our agrivoltaic system only had a net primary productivity reduction of 6%–7% with no irrigation over the past three years (Kannenberg et al., 2023). Permitting that allows for the dry-up of the land but continued agricultural production, such as grazing and hay production, would allow this coupling of solar with agriculture on such lands. These results indicate that agrivoltaic systems can serve as a scalable way to expand solar energy production while maintaining ecosystem function in managed grasslands, especially in climates where water is scarce compared to sunlight.

The Educating Colorado Communities on Agrivoltaics Project will take the knowledge gained from the farming operations, research, and water-saving successes enabled by the 2019 grant from the CWCB at Jack's Solar Graden to stakeholders across Colorado. The project will share what we have learned about agrivoltaic system design, function, and operations with water districts, agricultural, solar development, and land use entities. In this way, the project aims to increase the understanding of best practices in agrivoltaics as a water-conserving and climate-resilient practice in irrigated farmland in our state.

Taxpayer Bill of Rights

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