Powering Up Conservation:

A Guide to Considering Solar Development in Conservation Easements for Colorado's Land Trust Community

A report by:

COLORADO OPEN LANDS

Acknowledgments

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Introduction

Land trusts primarily utilize conservation easements as a tool to work with private landowners to protect land resources, including water rights in the west, that generate public benefit. Conservation easements and energy development have often been viewed as incompatible, because of the impacts of energy development on land and water resources. However, in the perpetual lifespan of a conservation easement, we must consider scope and scale of uses, including energy development. We have seen the footprint of facilities to extract oil and gas shrink over time as technologies have changed and have adapted our conservation approaches accordingly. This guide attempts to provide a lens through which our own organization (Colorado Open Lands (COL)) and other Colorado land trusts can consider and evaluate the compatibility (or lack thereof) of renewable energy development, specifically solar development, with conservation easements.

Under Governor Jared Polis, the State of Colorado is currently working to transition to 100% clean electricity generation by 2040[1]. As of 2023, solar energy accounted for just under 10% of the states energy generation. This magnitude of energy production, enough to power 855,000 homes, requires approximately 20,138 acres of land area[2]. Therefore, as the state looks to drastically change its energy portfolio, we must recognize that significant new development will result in significant land use impact. The Nature Conservancy of Colorado completed an analysis that determined that this build-out represents approximately a 5x increase in the acreage covered by solar panels, a 3x increase in wind turbines, plus associated storage and transmission infrastructure[3].

Any land use change of this magnitude will impact the work of a land trust. An increase in activity in the energy generation sector and leasing opportunities will likely result in interest and inquiries from landowners who may also be exploring conservation easements and possibly from landowners of conserved properties. Land trusts may also choose to engage in conversations about assessing or balancing energy development compatibility with local priorities for conservation and economic development. Lastly, land trusts may want to engage in shaping where and how energy development is done. While renewable energy can take multiple forms, Colorado Open Lands (COL) has focused this guide specifically on solar energy development, as there is significant research and development investment occurring in the state with the possibility of influencing our organization's priority landscapes. Solar energy is also the fastest growing energy source in the U.S. and is projected to make up over 80% of new generating capacity in 2024, according to the U.S. Energy Information Administration[4].

The goals of this guide are to:

- Lay a foundation for understanding the scope and scale of solar development options and emerging technologies.
- Describe land trust considerations for new conservation projects with solar potential, as well as impacts of solar development on land and importantly, on water rights in Colorado.
- Develop a framework for land trust decision-making and utilize a case study of one of our own priority landscapes to identify opportunities and challenges.
- Identify relevant resources and partnerships.

The authors of this guide are not solar experts. Land trusts often have to make decisions by assessing outside sources and engaging subject experts. The purpose of the guide to create a foundation of knowledge and resources for COL and other Colorado land trusts, and using our expertise in land and water conservation, to build a framework for evaluating compatibility of different types of solar development with conservation easement projects or for guiding solar siting within communities across the state.

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1 "Roadmap to 100% Renewable Energy by 2040 and Bold Climate Action". (https://drive.google.com/file/d/1K_anGQ-pEf-edqhjz5b6D3LJIsfFV3mI3/view)

2 SEIA 2024

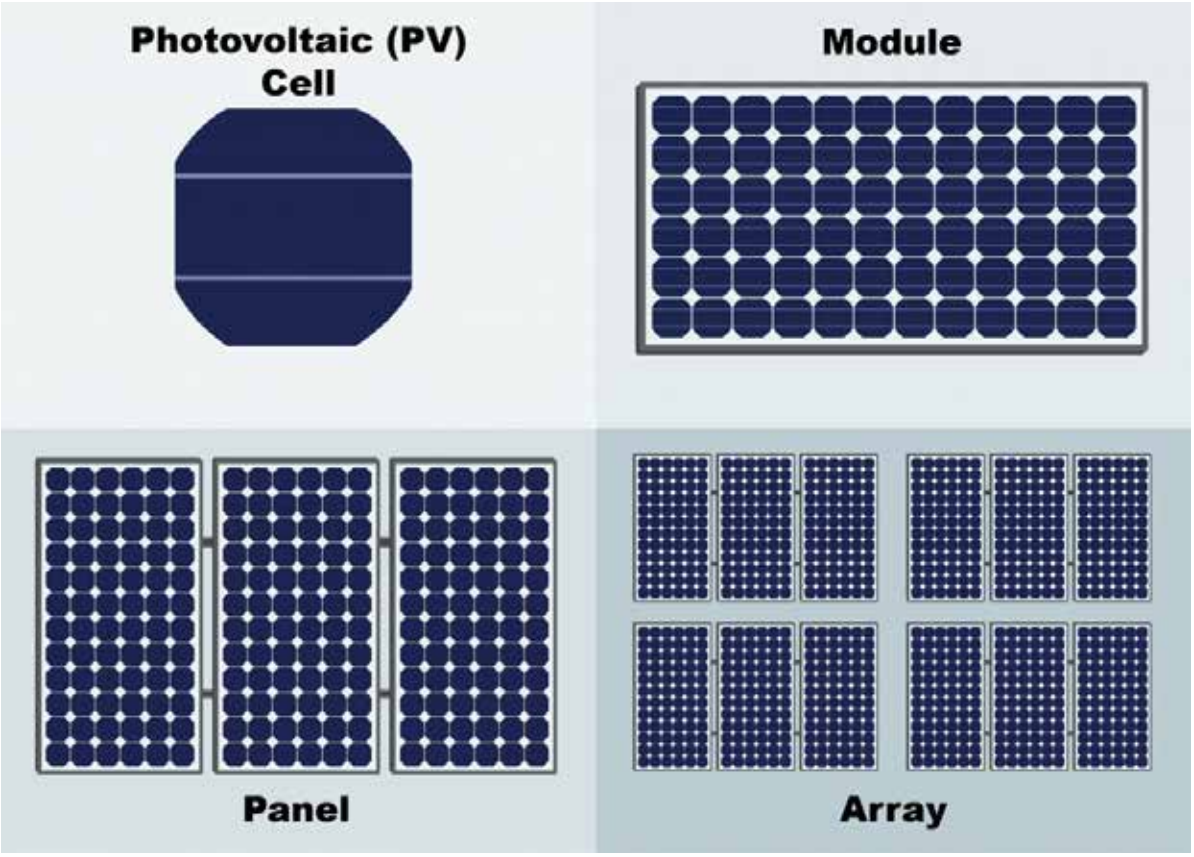
3 Chris Menges, Mountain and Prairie Podcast 6/25/2024

4 https://www.eia.gov/todayinenergy/detail.php?id=61424#:~:text=February%2015%2C%202024-,Solar%20and%20battery%20storage%20to%20make%20up%2081%25%20of%20new,electric%2Dgenerating%20capacity%20in%202024&text=Developers%20and%20power%20plant%20owners,Prelimi.

What do we mean when we talk about solar development?

As with any potential land use, it is challenging to generalize impacts when the scope and scale of the activity can vary greatly. Solar development is one such activity, which can range from small-scale rooftop installations to vast sites that cover thousands of acres. New technologies and approaches to solar energy development are changing what solar development may look like, together with its impacts.

In this section, we introduce some basics about solar energy, including terminology about the technology, as well as language that speaks to scale and type of solar development. When we talk about solar development, we are talking about an array consisting of multiple solar panels, of which a photovoltaic cell is the smallest component. Just how many solar panels are in an array leads us to a discussion of scale.



Graphic source: University of Central Florida: https://energyresearch.ucf.edu/consumer/solar-technologies/solar-electricity-basics/cells-modules-panels-and-arrays/

Scale – How big?

In the renewable energy roadmap released by the State of Colorado, there is a recognition of the need and possibility for solar energy generation at multiple scales. In addition to utility-scale solar, the report specifically advocates for the expansion of community access to solar gardens and allowing energy customers to install onsite solar and storage to meet their own energy needs. Understanding the language of solar development is important to understanding what is being proposed in order to evaluate impacts to land and water rights.

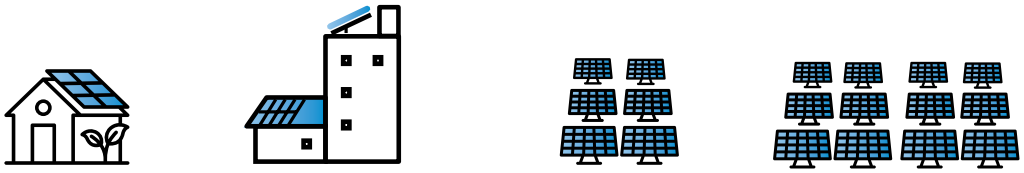
The scale of energy production is often related to the intended user, but it is first helpful to understand, generally, how much land is needed to produce a megawatt of energy.

Energy Produced Relative to Land Footprint*

Megawatts (MW) Generated	Homes Powered (approx.)	Acres of Land Needed
1	200	3.5-16.5 (mean=10)
100	20,000	70-330 (mean=200)
1,000	200,000	7,000-33,000 (mean=20,000)

**This table is based on "What's in a Megawatt", SEIA. seia.org/initiatives/whats-megawatt.*

The scale of solar that may serve a property (house, farm or ranch operation) is known as "in front of the meter (FTM)" because it does not flow from a utility, but excess energy may flow to a utility through net metering. FTM systems are typically small in scale, including rooftop or small-scale arrays on residences or panels on agricultural structures that support those agricultural energy needs. The scale of solar for community, commercial or utility is known as "behind the meter (BTM)" and they feed directly into the power grid. These are typically larger in scale and require associated storage or delivery infrastructure.



SCALE	RESIDENTIAL	COMMERCIAL	COMMUNITY	UTILITY
TYPICAL LAND AREA	On building OR up to 1 acre	On building OR up to 5 acres	5–75 acres	75–10,000 acres
TYPE OF ARRAY	Roof mounted OR Small Ground Mount	Roof mounted OR Small Ground Mount	Ground Mounted	Ground Mounted
TYPICAL SYSTEM SIZE	5 kW–25 kW	10 kW–1 MW	250 kW–10 MW	10 MW–1 GW+
OWNERSHIP & FINANCIAL MODEL	Direct OR Third Party	Direct OR Third Party	Third Party w/ Land Lease & PPAs	Third Party w/ Land Lease & PPAs
TYPICAL APPLICATION	Behind the meter	Behind the meter	Front of the meter	Front of the meter

Table provided by American Farmland Trust

Even when we think of "in front of the meter" solar development projects, the proposed scale can vary dramatically. For Colorado, it may be helpful to think of scale in the context of rural areas and in terms of acreage used, in addition to the end-use customer. In researching solar systems for proposed local land use guidance, the Colorado Agrivoltaic Learning Center originally proposed that any system that encompasses 10 acres or less of surface area be considered small, 10-35 acres of surface area be considered medium, and any system using more than 35 acres or are power tower systems concentrating solar power systems be considered large[5]. Colorado's community solar rules allow agrivoltaics projects up to 10 megawatts (which could range from 50-100 acres). While a land trust framework might be more subjectively tied to the acreage relative to the total acreage of a specific property, it is helpful to understand how the industry might consider scale or how it may appear in local land use regulations.

5 CALC "Solar Development Model Land Use Code: A Guide for Local Colorado Governments"

What kind - Single or dual purpose?

In Colorado, a vast majority (~80%) of ground mounted utility-scale solar arrays are managed for the sole purpose of generating the most energy per unit area. These arrays, considered "single use," help reduce fossil-fuel-related emissions but require a land area footprint approximately 20 times greater than a fossil fuel power plant. Land use change associated with solar development has been shown to have detrimental impacts in the natural and agricultural ecosystems in which they are so often placed. However, there are emerging dual-purpose systems, such as agrivoltaics and ecovoltaics (see inset for definitions) where design and management take multiple priorities into account. The advent of dual use approaches to solar development, which pair solar arrays with another land use, or which prioritizes biodiversity, may help alleviate land use tension by allowing other activities to take place beneath the array.

Defining Dual Use Systms

Agrivoltaics:

A definition for "agrivoltaics" has been put forward by the American Farmland Trust, which defines an agrivoltaic system as a ground-mounted photovoltaic solar energy system that:

- Has been intentionally planned and designed with agricultural producers and/or experts, and
- Is constructed, installed, and operated to achieve integrated and simultaneous production of both solar energy and marketable agricultural products by an agricultural producer:
- On land beneath and/or between rows of solar panels
- As soon as agronomically feasible and optimal for the agricultural producer after the commercial solar operation date, and continuing until decommissioning.
- Agricultural products and activities include:
    - o Crop production,
    - o Grazing, or
    - o Animal husbandry.

Exclusion—agrivoltaic systems do not include pollinator habitat as the sole dual use. Apiaries are also excluded, unless the solar array has been designed and installed to enable the agricultural producer the flexibility to change what they produce, raise, or grow at any point throughout the life of the project.

According to the National Renewable Energy Laboratory, agrivoltaics sites in the U.S. have doubled in acreage in just the years from 2020 to 2024, from 27,000 acres (producing 4.5 GW of solar energy) to 60,000 acres (producing 10 GW of solar energy). Currently there are nearly 600 agrivoltaics sites operating in the United States with grazing, crop production, native and pollinator habitat, greenhouses, and sites that combine these activities.

In 2024, Colorado Open Lands was one of four partners who conducted significant outreach to understand awareness of and attitudes toward agrivoltaics in Colorado. American Farmland Trust (AFT), in partnership with Colorado Open Lands, Agrisolar Consulting, and Colorado State University Extension, engaged more than 300 producers in a survey and approximately 180 producers, community members, and solar developers participated in roundtables on agrivoltaics. to understand perceptions and barriers to participation and to inform recommendations for future agrivoltaics research, policy, and educational resources needed to accelerate adoption. Survey results indicated strong concern for impacts of solar development on agricultural land and land and water resources. The results also showed that only about a third of producer respondents had a solid understanding of agrivoltaics while another third had never heard the term; however, more than 60% would be willing to engage in agrivoltaics activities, particullary if they could generate additional income without losing farm productivity.

Ecovoltaics:

Ecovoltaics is an emerging term coined by researchers Alan Knapp and Matt Sturchio at Colorado State University[6] meant to capture solar energy systems that co-prioritize ecosystem services and energy production and apply ecological principles through the planning, design, and management of the array.

In a recent study published by PNAS[7] (Proceedings of the National Academy of Sciences), researchers explored identified opportunities where the strategic placement of ecovoltaic solar could facilitate enhancement of ecosystem services like water quality, pollination services, and wildlife habitat in crop-dominated ecosystems (the study focused on cropland currently planted in corn for ethanol production). They found that strategic locations of solar arrays, combined with perennial vegetation, could filter excess nutrients and provide heterogeneity, increasing wildlife habitat.

Matt Sturchio, CSU Researcher (and contributor to this guide) measures photosynthesis of vegetation beneath solar panels.

Duration – What is the Life Cycle of a Solar Development Project?

Solar development is typically proposed by a private company, which must conduct siting feasibility and secure access to a viable amount of land. The company must also interest a utility company in purchasing the proposed power, must meet any regulatory requirements, and must often secure local permits. This process of planning to project implementation may take years[8], which is important for landowners and land trusts to understand. A solar company may enter into a lease with a landowner that will never be exercised or may take several years to come to fruition. Once in operation, the current life-span of most solar arrays is 25-35 years[9]. Solar arrays may be decommissioned while still producing power because their efficiency is decreasing.

6 Sturchio, M.A., Knapp, A.K. Ecovoltaic principles for a more sustainable, ecologically informed solar energy future. Nat Ecol Evol 7, 1746–1749 (2023). https://doi.org/10.1038/s41559-023-02174-x

7 Ecologically informed solar enables a sustainable energy transition in US croplands. Matthew A. Sturchio, Adam Gallaher, and Steven M. Grodsky. Edited by Nancy Grimm, Arizona State University, Tempe, AZ; received January 27, 2025; accepted March 19, 2025. https://orcid.org/0000-0001-5067-3770

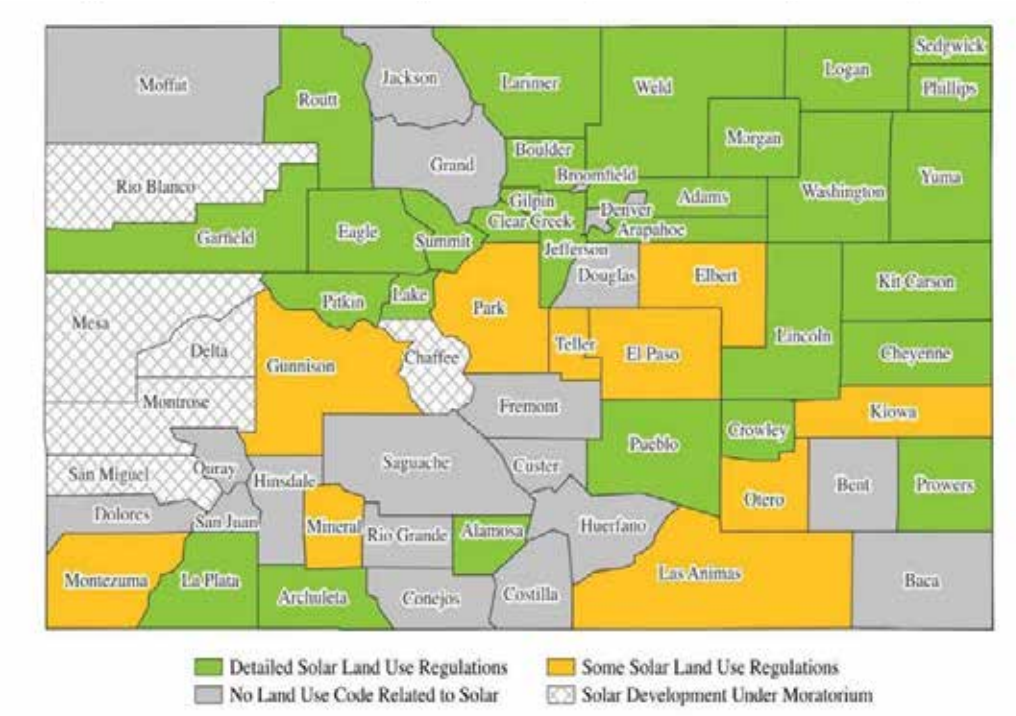
8 AFT solar guide for landowners (used above)

9 https://www.energy.gov/eere/solar/end-life-management-solar-photovoltaics

It is also important to understand the rules that already do, or can apply, to solar development. In Colorado, the local government entity with controlling land use authority has permitting authority over solar energy systems. As of 2023, 39 of Colorado's 64 counties had documented solar land-use regulation[10], while six had moratoriums in place for renewable energy. According to a recent study by the National Renewable Energy Lab, the most common permitting requirements regulate fencing and visual impacts, closely followed by required plans and financial assurance for decommissioning after the system's useful life. Importantly, several counties have specific restrictions regarding solar or general development on irrigated land. In addition to solar-specific regulations, many counties also have "1041" authority (referencing the bill title 74-1041) that could apply to solar energy developments, if there is a nexus to resources of statewide significance[11]. This authority, often referred to as "1041 powers" allow local governments to identify, designate, and regulate areas and activities of state interest through a local permitting process, wherein they may require applicants to identify and offset environmental or economic impacts. This authority must be specifically passed by a local government.

Colorado Counties with Solar Energy Land Use Regulations in Place

This graphic captures a brief snapshot in time; specifically, COL is aware that Montrose County has now updated its code to allow for agri-voltaics as a rural land use.[11]



In addition to local land use regulation, the activities of Colorado's power providers are regulated at the national level by the Federal Energy Regulatory Commission (FERC) and at the state level by the Colorado Public Utilities Commission (PUC). Both local land use authorities and the PUC can ask Colorado Parks and Wildlife for support in order to "avoid,

10 Jackson, Allison, Kate Doubleday, Brittany Staie, Allison Perna, Mariel Sabraw, Liz Voss, Apolonia Alvarez, Byron Kominek, and Jordan Macknick. 2024. County Land-Use Regulations for Solar Energy Development in Colorado. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-88556. https://www.nrel.gov/docs/fy24osti/88556.pdf.

11 https://dlg.colorado.gov/1041-regulations-in-colorado

minimize and mitigate potential impacts to wildlife and their habitats[12]." Colorado Parks and Wildlife can make recommendations but has no regulatory authority over siting solar energy projects.

While this guide does not delve into transmission, we will touch here on one significant effort to add transmission capacity for renewable energy in Colorado right now and the interaction between transmission and siting. Typically only governmental entities have the power of eminent domain; however, energy provider Xcel, also has also been granted this authority under Colorado law. Xcel has been working to implement a project known as "Colorado's Power Pathway" which is a $1.7 billion investment to connect Colorado's eastern plains (seen as a source for renewable energy projects) with the Denver metro area (area of demand) and is sized to accommodate up to 5,000 megawatts of new renewable energy generation. According to Xcel, the system will span twelve counties, primarily in eastern Colorado, and include approximately 550 miles of new double-circuit transmission line (in five segments) together with four new substations and equipment additions or expansion of four existing substations. Colorado's Power Pathway required approval from the Colorado Public Utilities Commission which was granted in the summer of 2022. The written approval provides Xcel Energy the authority and direction to move forward with the Project[13].

However, before it can begin construction on the Project, Xcel must also receive permits from the counties impacted by the transmission corridor, including Special Use Permits, Conditional Use Permits and House Bill 1041 Areas and Activities of State Interest Permits (1041). Not all communities across the corridor are excited about the changes it could bring. In a 2022 article[14], Morgan County commissioner Jon Becker said, "Coal has been a great partner in this county. Solar and wind are nice, but by no means do they pay the taxes or create the employment of a coal-fired power plant. Xcel says that operations may be similar, but until we see it, we are cautious." Some landowners and residents have expressed concerns about the changes to the landscape that large-scale renewable energy projects may bring. Seven of the twelve counties (including Morgan) have now granted Xcel the necessary permits to move forward and construction is underway. While transmission typically follows energy production, Xcel bet that energy production would follow its investment and The Nature Conservancy reports that the largest solar facilities and first utility-scale battery storage components in the state are expected to be located in Colorado's Eastern Plains within the next year[15].

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12 https://casetext.com/regulation/colorado-administrative-code/department-700-department-of-regulatory-agencies/division-723-public-utilities-commission/rule-4-ccr-723-3-rules-regulating-electric-utilities/renewable-energy-standard/section-4-ccr-723-3-3668

13 https://www.coloradospowerpathway.com

14 https://coloradosun.com/2022/06/19/eastern-plains-renewable-energy-xcel-power-pathway/

15 https://www.nature.org/en-us/about-us/where-we-work/united-states/colorado/stories-in-colorado/colorado-renewable-energy/

Conservation Easements, Solar Development, and State and Federal Law

While state law is what governs the creation and enforcement of conservation easements, federal legislation and code, particularly Internal Revenue Code, has an outsized impact on land trust decisions in Colorado. This is because Colorado's uniquely generous conservation easement state tax credit utilizes the Internal Revenue Code as a standard for qualification; consequently, landowners donating all or a portion of their appraised conservation easement value, both the federal charitable deduction and Colorado's valuable state tax credit program are tied to the interpretations of the Internal Revenue Service.

Conservation Easement Law in Colorado

Conservation easements are instruments that are contrary to common law, and as such, have been created as enforceable perpetual agreements on a state-by-state basis. Colorado's conservation easement enabling statute defines a conservation easement as:

"Conservation easement in gross", for the purposes of this article, means a right in the owner of the easement to prohibit or require a limitation upon or an obligation to perform acts on or with respect to a land or water area, airspace above the land or water, or water rights beneficially used upon that land or water area, owned by the grantor appropriate to the *retaining or maintaining of such land, water, airspace, or water rights, including improvements, predominantly in a natural, scenic, or open condition, or for wildlife habitat, or for agricultural, horticultural, wetlands, recreational, forest, or other use or condition consistent with the protection of open land, environmental quality or life-sustaining ecological diversity,* or appropriate to the conservation and preservation of buildings, sites, or structures having historical, architectural, or cultural interest or value[16].

Further, Colorado's enabling statute goes on to state:
All interests not transferred and conveyed by the instrument creating the easement shall remain in the grantor of the easement, *including the right to engage in all uses of the lands or water or water rights affected by the easement that are not inconsistent with the easement or prohibited by the easement or by law*[17].

The combination of a broad list of acceptable purposes for which a conservation easement can be created, together with the affirmative statement of retained rights, except where prohibited by, or inconsistent with, the conservation easement, would suggest that there could be circumstances in which solar energy development could be permissible, depending on the purposes for which the conservation easement was created, the restrictions set forth in the conservation easement, and the scale and type of solar development.

Conservation Incentives and Solar

However, most private land conservation would not occur without incentives, whether tax-related or programs designed to compensate landowners for their foregone value in their real property interest as a result of their choice to perpetually restrict their land and sometimes water rights.

When it comes to new conservation easement implementation, the vast majority of landowners who grant a conservation easement to a land trust or government entity are interested in direct compensation, tax benefits for donation of value, or a combination thereof. Consequently, it is critical to understand whether conservation easement incentives prohibit or allow solar development or have ambiguity that may carry risk.

16 CO Code § 38-30.5-102
17 CO Code § 38-30.5-105

Federal Tax Deductions and Solar

The rules regarding the deductibility of conservation easement donations stem from statute, federal regulation, and interpretation and is guided by judicial opinions. Congress first clarified the eligibility of the donation of a conservation easement in the Tax Reform Act of 1976 and has extended and enhanced the benefits of donations of perpetual conservation easements through legislation over time. Conservation easements were written into the Internal Revenue Code in 1980 in Section 170(h) and their associated Treasury Regulations Section 1.170A-14. The definitions and standards contained in the Code and Treasury Regs have had significant impacts on the shape of conservation easements throughout the country, and in Colorado[18].

Internal Revenue Code 170(h[19]) defines deductibility of a conservation easement across multiple factors including: eligible conservation easement holders (e.g. land trusts), perpetuity, purposes for which an easement can be created, how a conservation easement deduction must be valued and more. In order to be deductible, a donation of a conservation easement must be exclusively for a conservation purpose, where the term "conservation purpose" can mean any of the following:

- the preservation of land areas for outdoor recreation by, or the education of, the general public;
- the protection of a relatively natural habitat of fish, wildlife, or plants, or similar ecosystem;
- the preservation of an historically important land area or a certified historic structure; or
- the preservation of open space (including farmland and forest land) where such preservation is for the scenic enjoyment of the general public, or pursuant to a clearly delineated Federal, State, or local governmental conservation policy; and will yield a significant public benefit.

18 Anson Asbury, The Federal Lawyer
https://www.fedbar.org/wp-content/uploads/2016/03/Easement-pdf-2.pdf
19 Internal Revenue Code §170(h) and Treasury Regulation §1.170A-14

It is worth stating the obvious point that there is no conservation purpose that speaks to renewable energy production. Consequently, if solar development is to be included, another conservation purpose must be used, with an allowance and justification for solar or renewable development.

A conservation easement that allows for solar development ***might*** still qualify for an income tax deduction if it can be determined (with supporting documentation by third-party experts) that the following requirements have been met:

1. Compatibility with Conservation Purpose: If solar installations are permitted, the overall conservation purpose of the easement should not be compromised, and the primary focus of the easement (unless or until the federal tax deduction language is altered) must always be conservation of the protected resource in alignment with the easement's purpose.

2. Restrictions on Location and Scale and/or Requirements for Design: The easement should include specific terms that outline the conditions under which solar projects are allowed, or may be permitted in the future. These terms may address the location, size, and design of solar structures to minimize their impact on the protected area.

3. Neutral or Positive Impact on the Conservation Values: A critical consideration is what kind of impact proposed solar installation would have on the specific conservation values of the property to be protected (which may include both land and water resources). We will explore the potential impacts of solar development on conservation values later in this guide.

4. Solar May Not be an Inconsistent use: Regulation 1.170A-14(e) outlines the rules regarding what constitutes exclusivity for conservation purposes, including that "a deduction will not be allowed if the contribution would accomplish one of the enumerated conservation purposes but would permit destruction of other significant conservation interests." The regulation notes that inconsistent uses may be permitted where those uses are necessary for the protection of the property (for example, a property may be identified as a priority for conservation because of its archaeological value (educational and historic conservation values) but it may also be high scenic - archaeological digs may impact the scenic value, but may be necessary for the educational purpose of the easement); this is an ambiguous section, open to interpretation.

When considering how the IRS might interpret allowance for solar development within a conservation easement, it is important to understand that there has been significant IRS scrutiny of conservation easements. There have been a number of bad actors who have intentionally sought to utilize conservation easements for tax shelter purposes, rather than in alignment with their true intent. As such, conservation easement deductions have been in the top 10 issues litigated by the IRS[20], with a huge volume of associated tax court cases and years-long appeals. Therefore, the meaning of seemingly straightforward categories of conservation purpose and important concepts in 170(h), such as incompatible use, continue to be defined by the ongoing interpretation of the Internal Revenue Service and by the judiciary. As a further example, the IRS seems to have brought the idea of inconsistent use to bear in cases where it is questioning whether the terms of the deed protect the conservation purposes; in other cases, where the concern may be related to valuation, it is limited consideration of conservation purposes to those specified in the deed. Consequently, there must be a consideration of risk.

Tax court cases can be helpful, in that they outline the position of the IRS and the court of applicable jurisdiction. To date, the only federal tax law cases involving (or even mentioning) conservation easements and solar are those where the taxpayer claimed that the appraised value of the conservation easement was based on a highest and best use for a solar installation (and the conservation easements prohibited solar installation)[21]; in these cases, the reference to solar was only regarding the validity of the appraisal, not solar as a permitted use within the conservation easement. As of the drafting of this guide, the authors have not found any known case law that involves the deductibility of a conservation easement allowing solar development.

20 Charitable Contributions of Conservation Easements Adam Looney (Brookings Institution): https://www.irs.gov/pub/irs-soi/17resconlooney.pdf

21 Jackson Crossroads LLC et al. v. Commissioner

Colorado's Conservation Easement Tax Credit and Solar

While Colorado's conservation enabling statute does not directly mirror the conservation purposes spelled out in 170(h); our state's conservation easement tax credit legislation does directly link to the Internal Revenue Code. Since 2000, in the state of Colorado, the donation of a conservation easement that meets the requirements of 170(h) may also qualify for the issuance of state tax credits. Specifically, the statute states: "The credit shall only be allowed for a donation that is eligible to qualify as a qualified conservation contribution pursuant to section 170 (h) of the internal revenue code, as amended, and any federal regulations promulgated in connection with such section[22]."

Colorado is among only a handful of states that allow the easement donor the option of using the credit against their own state tax liability or transferring the credit to a third party. Colorado's tax credit law spells out administration of the tax credit program and safeguards for its oversight, including the requirement for certification of conservation easement holders. In 2024, Colorado modified its conservation tax credit statute, including adding in a provision specific to wind and solar energy:

FOR ANY CONSERVATION EASEMENT GRANTED ON OR AFTER JANUARY 1, 2025, THE CONSERVATION EASEMENT MAY INCLUDE A PROVISION PROVIDING THAT IF TECHNOLOGICAL OR LEGAL CHANGES ALLOW AN EXPANDED USE OF WIND AND SOLAR POWER GENERATION, TRANSMISSION, AND STORAGE TO BE COMPATIBLE WITH THE PROTECTION OF CONSERVATION VALUES CONSIDERED AS A WHOLE AND PURSUANT TO SECTION 170(h) OF THE INTERNAL REVENUE CODE AND ANY FEDERAL REGULATIONS PROMULGATED IN CONNECTION WITH SUCH SECTION, THEN THE HOLDER OF THE CONSERVATION EASEMENT MAY, IN ITS SOLE DISCRETION, APPROVE EXPANDED WIND AND SOLAR POWER GENERATION, TRANSMISSION, OR STORAGE THAT IS COMPATIBLE WITH AND DOES NOT DIMINISH OR IMPAIR CONSERVATION VALUES.

This language does not create a blanket approval of solar development but does create a pathway for a landowner working with an entity certified by the state of Colorado to claim a Colorado conservation easement tax credit, if that certified holder approves that solar development (and/or related infrastructure) because it believes it is compatible with the conservation purposes of 170(h). This seems to read that determination of compatibility (for purposes of a state tax credit only) is in the hands of the certified easement holder, not the IRS.

Funding for the Purchase of Conservation Easements and Solar

Many traditional conservation easement funding programs, such as the Agricultural Conservation Easement Program (ACEP), will allow for energy development within building envelopes or on approved structures, but would not currently allow for larger- scale energy development. For example, the most recent Minimum Deed Terms developed by the Natural Resources Conservation allow for the "sale of excess power generated in the operation of renewable energy structures and associated equipment or other energy structures that Grantee approves in writing as being consistent with the Purpose" of the easement; this seems to suggest that incidental power generation above the needs of the property is permitted, but not an energy project primarily designed to supply power off property.

Another funder of land conservation in Colorado is Great Outdoors Colorado (GOCO)[23]. Their template conservation easement terms include the following:

22 CRS 39-22-522

23 Great Outdoors Colorado. www.goco.org

(4) Alternative Energy.

(i) Wind, solar, and hydroelectric generation facilities that are primarily for the generation of energy for use on the Property in conjunction with those activities permitted by this Deed (collectively "Alternative Energy Generation Facilities") may be constructed in accordance with this **Section 4.g(4)**. Notwithstanding the foregoing, no approval of Grantee shall be required if the Alternative Energy Generation Facilities permitted by this **Section 4.g(4)** are located within a Building Envelope [**revise if no Building Envelopes**] or if the facilities are installed in conjunction with the operation of an agricultural improvement as described in **Section 4.d(_)** above. Any other Alternative Energy Generation Facilities may only be constructed with the prior written approval of Grantee in Grantee's sole discretion. Without limiting Grantee's right to withhold such approval in its sole discretion, factors that Grantee may consider in determining whether to grant such approval shall include but not be limited to (a) whether the installation and siting would substantially diminish or impair the Conservation Values, (b) the physical impact of the proposed facility on the Conservation Values, (c) the feasibility of less impactful alternatives, and (d) such other factors as Grantee may determine are relevant to the decision. The construction of Alternative Energy Generation Facilities that are not for use primarily in conjunction with those activities permitted by this Deed are prohibited anywhere on the Property. Nothing in this **Section 4.g(4)** shall be construed as permitting the construction or establishment of a wind farm or commercial solar energy production facility.

(ii) Any energy generated by Alternative Energy Generation Facilities constructed in accordance with this **Section 4.g(4)** that is incidentally in excess of Grantor's consumption may be sold, conveyed, or credited to a provider of retail electric service to the extent permitted by Colorado law.

(iii) In the event of technological changes or legal changes that make "expanded" Alternative Energy Generation Facilities more compatible with I.R.C. Section 170(h) or any applicable successor law, Grantee in its sole discretion may approve expanded Alternative Energy Generation Facilities that would not substantially diminish or impair the Conservation Values. Prior to approving any expanded Alternative Energy Generation Facilities, Grantee shall submit an Alternative Energy Development Plan to the Board for its review. If the Board deems that the facilities proposed in the Alternative Energy Development Plan are inconsistent with the Board's Grant or the Purpose, or that the Alternative Energy Development Plan does not contain sufficient information, Grantee shall not permit any expanded Alternative Energy Generation Facilities on the Property. For the purposes of this **Section 4.g(4)(iii)**, the term "expanded" shall mean the development of Alternative Energy Generation Facilities to an extent that is greater than the level permitted by **Sections 4.g(4)(i) and 4.g(4)(ii)**.

This language suggests a general acceptance of energy generation that is for use on the property to be conserved, including agricultural improvements on the property, but also includes the opportunity for proposal and review of facilities that are beyond the scale of serving the property, provided that they do not "substantially diminish or impair the Conservation Values." This begs the good (and complex) question of how to consider the impacts of solar development to the conservation values. It also speaks to the complexity of navigating the philosophies and requirements of different incentive programs, particularly when trying to match multiple funding sources.

Conservation Values and Solar Development

We have previously outlined the purposes identified in 170(h) for which a conservation easement can be exclusively granted. Many land trusts in Colorado (including Colorado Open Lands) use the language of "conservation values" to describe these purposes, which support benefits that are valued by the public. In this section, we consider the potential impacts of solar development on different conservation values (habitat, scenic views, agriculture, and clearly delineated government policies). We will leave aside historic preservation, as this is a less-common primary conservation value in Colorado conservation easements. The authors acknowledge that the compatibility of solar development with recreation and education will be very subjective, but that there may be more compatibility depending on the type of recreation or education envisioned.

We have discussed the wide range of what solar development can mean on the ground in terms of scale (behind the meter or in front of the meter) and whether it is single purpose or dual purpose. For this section, we will first consider the potential impacts of an "in front of the meter" single purpose solar array whose purpose is to supply energy to the grid, as this is the most common type of solar development currently found in the state. We use the label "traditional" to describe this type of solar development.

Image source: https://crea.coop/2019/03/27/sangre-de-cristo-electric-association-solar-project-begins-operations/

Impacts of Traditional Solar Development on Wildlife and Relatively Natural Habitat

The impacts of the type of common solar development we are focusing on include impacts to wildlife habitat quality and connectivity. As with other widespread land use changes, ecosystems and resulting habitats can be lost, degraded, or fragmented, adding to the myriad stresses faced by wildlife today.

The construction of large-scale single purpose solar installations often requires clearing land, which can destroy existing

habitat and displace wildlife, fragmenting their habitat and making it difficult for animals to move between essential resources such as food, water, and breeding grounds. Fragmentation impacts can be particularly severe for bird populations, disrupting migration routes and making it harder for birds to find food, water, and nesting sites. Big game species are also especially susceptible to damaging impacts of fragmented habitat.

The construction and maintenance of solar infrastructure can disrupt wildlife breeding, foraging, and migration patterns. For example, fencing around solar facilities can create barriers that restrict animal movement, especially for large species like deer and elk. In addition, pollution from the presence of solar panels and infrastructure can disturb wildlife, especially during sensitive periods like breeding or calving. Birds and other animals may collide with solar panels, especially during migration or in low-light conditions. While it has been theorized that panels may create a "lake effect" attracting birds that mistake them for solar panels, there is no conclusive evidence to date that supports this theory.[24] A review of the impacts of solar development on bird species seems to highlight that designing with wildlife in mind has a significant impact, and can have a neutral or positive impact on number and species richness, if carefully planned and executed.[25]

Impacts of Traditional Solar Development on Scenic Conservation Values

Solar farms can negatively impact the visual appeal of a landscape and distract from scenic vistas. The rows of solar panels can disrupt the natural beauty of these areas. The associated infrastructure, such as power lines and access roads, can also contribute to visual clutter and negatively impact the scenic quality. A review of the impacts of solar development on bird species seems to highlight that designing with wildlife in mind has a significant impact, and can have a neutral or positive impact on number and species richness, if carefully planned and executed[26].

Unfortunately, some of the technologies that exist to make solar arrays more compatible with other conservation values – such as elevated panels for an agrivoltaic array – can increase the visibility of the array and degrade this conservation value even further. At times, it may be possible to draft a conservation easement to emphasize or rank the other conservation values ahead of scenic open space. As such, land trusts must consider the visibility of the proposed specific siting of any permitted solar infrastructure from public vantage points.

Impacts of Traditional Solar Development on Agriculture

Traditional solar development can compete with agriculture use for land, reducing the availability of land for crop production and livestock grazing. Converting agricultural land to solar projects can decrease agricultural output, leading to economic losses for farmers and ranchers. For example, if a 20-acre parcel of productive hay ground is converted into a solar farm, the immediate impact is the loss of that specific agricultural use. This can reduce hay production, affecting livestock feed supplies and potentially impacting livelihoods. Agricultural production is diverse in both type and scale across Colorado and the impacts should be evaluated in context. Solar energy installations can have further implications on irrigated agriculture, discussed below in impacts of solar on water rights.

Beyond land availability, traditional solar development may impact soil health and land productivity over the lifespan of the project. Solar arrays, come with construction of infrastructure, ongoing use, and maintenance, and these activities on the land have impacts to consider. Issues such as soil disturbance and soil compaction during construction, maintenance and decommissioning can cause near-permanent damage.

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24 Literature review on impacts to avian species from solar energy collection and suggested mitigations --Chuck Hathcock, EPC-ES. https://www.energy.gov/sites/prod/files/2019/03/f61/Hathcock%202018.pdf

25 Solar farm management influences breeding bird responses in an arable-dominated landscape
Joshua P. Copping a,b, Catherine E. Waite b,c, Andrew Balmfordb,c, Richard B. Bradburya,b,c, Rob H. Fielda,b,Isobel Morrisd and Tom Finch. https://doi.org/10.1080/00063657.2025.2450392

26 Solar farm management influences breeding bird responses in an arable-dominated landscape. Joshua P. Copping, Catherine E. Waite, Andrew Balmford, Richard B. Bradbury, Rob H. FieldaI sobel Morris, and Tom Finch. https://doi.org/10.1080/00063657.2025.2450392

Impacts of Traditional Solar Development on Water Rights

In arid Colorado, conservation values are often dependent on water, so the impacts of solar on any water rights associated with a property should be considered when evaluating impacts to conservation values. For irrigated agriculture, some systems may be more intuitively compatible, such as drip irrigation; however, it is possible to utilize flood or sprinkler irrigation on land covered by a solar array, if contemplated at the time of the lease (or regulatory permitting) and the infrastructure is designed accordingly (for example, power electronics pads are elevated).

Traditional solar development on irrigated land will normally lead to the cessation of historical irrigation and potential abandonment of those water rights, especially considering the lifespan of a solar development relative to the decennial abandonment list produced by the Colorado Division of Water Resources. In Colorado, "abandonment of a water right" means the judicial termination of a water right in whole or in part as a result of the intent of the owner to discontinue permanently the use of all or part of the water[27]. A ten-year period of non-use creates a rebuttable presumption of abandonment[28]. There are, however, several ways to avoid abandonment, including through the enrollment of water rights in a conservation program or through the temporary lease or legal change of use. Please see Appendix 2 for Considerations for Water Rights Holders Contemplating a Solar Lease.

In considering impacts of a proposed solar development on conservation values, it is important to consider whether the proposed actions to continue use of the water or to use the water in a different way or different place, may negatively impact the conservation values. For example, a change from flood irrigation to drip irrigation may allow for the continued use of the water for agricultural production, but may destroy wetlands supported by flood irrigation. Alternatively, new models of dual-purpose solar development, as described below, may enhance conservation values, if carefully designed. An additional consideration is viability of the agricultural operation, including the potential energy savings that may be realized by serving farm energy needs with on-site solar systems.

Considering new models of dual-purpose solar development

Agrivoltaic and Ecovoltaic systems offer new approaches to solar development that intentionally seek to create compatibility, rather than conflict of land use. Agrivoltaic systems integrate solar arrays into the agricultural system. The most common and simplest integration has been grazing sheep under panels. Unlike cattle, sheep do not require mounting panels higher off the ground and provide vegetation control under panels.

However, there are emerging models which seek not to just incorporate livestock into a planned solar array, but rather to develop the solar array to suit the needs of the agricultural operation. There is a growing body of research from an increasing number of on-the-ground dual-use, agrivoltaic and ecovoltaic facilities in different regions of Colorado. Increasingly, experience and research indicate that co-locating solar arrays on working agricultural lands may have benefits to the agricultural productivity of a site.

Some examples of how arrays can contribute to agricultural productivity include providing shade for livestock, an important consideration for animal health and welfare in hot, exposed landscapes.[29] Panels can also contribute to increases in soil moisture, with resulting benefits, when condensation develops on panels and falls to the ground, as well as funneling rainfall off panels and concentrating moisture into rows along the edges of panels. The design of a site to manage for agricultural productivity and/or for ecological benefits, such as vegetative diversity or filtration of agricultural runoff, can have significant benefits.

27 CRS § 37-92-103(2)

28 CRS § 37-92-402(11)

29 Edwards-Callaway LN, Cramer MC, Cadaret CN, Bigler EJ, Engle TE, Wagner JJ, Clark DL. Impacts of shade on cattle well-being in the beef supply chain. J Anim Sci. 2021 Feb 1;99(2):skaa375. doi: 10.1093/jas/skaa375. PMID: 33211852; PMCID: PMC7853297.

Keeping agricultural lands in production, retaining soil moisture and maintaining vegetative land cover, especially when considering movements across areas of the West to fallow lands in the efforts to conserve water resources, is also important for reducing blowing dirt and dust. Dust on snow is an increasing issue across the West that only perpetuates changes to hydrologic cycles, timing of runoff and downstream implications for the hydrology of our river basins.

Where might solar development enhance conservation values?

Jack's Solar Garden is located in Boulder County. Historically used to grow alfalfa, now seven acres of the 24-acre farm serve as the largest commercial agrivoltaics research site in the U.S. On the seven-acre site, there are 3,276 panels which general 1.2-MW, supplying approximately 300 homes. The primarily grower utilizing the land under the panels is Sprout City Farms, which grows a variety of crops from salad greens to herbs to root vegetables. The farm is irrigated using a drip-system.

Researchers from the National Renewable Energy Laboratory (NREL), Colorado State University (CSU), and the University of Arizona (UA) have and are studying the microclimates created by its solar panels and how they impact vegetation growth. Landowner, Byron Komenick, also founded the Colorado Agrivoltaic Learning Center (CALC), which provides on-site educational opportunities for community groups to learn more about agrivoltaics.

Takeaways from research to date at Jack's Solar Garden:
Meg Caley, co-founder and director of Sprout City Farms has noted that in addition to positive crop performance, her farm laborers are happier to work under the shade of the panels.

Photo by Joanna Kulesza, The Nature Conservancy.

Changing Technologies

We recognize that technology is constantly changing. At the ancient site of Pompeii, one of the most visited tourist attractions in Italy, an experimental solar panel has been designed to mimic the look of terra cotta roof tiles, hiding energy production in plain sight. Another innovation is coming out of the Minnesota Department of Transportation which recognized that their need for thousands of miles of snow fences across the state provided an opportunity for use of that surface area to provide solar production[30]. The authors are aware of one agricultural operation in Eastern Colorado that is piloting this technology. Arguably, the addition of solar panels has an identical impact to the existing snow fence and thus a neutral impact on scenic, habitat, and agricultural values. Given that land trusts are in the business of drafting perpetual documents, it may be important to consider drafting for impacts to conservation values rather than for or against specific categories of use, as changes to technology will drastically change solar projects as we think of them today.

30 https://mntransportationresearch.org/2021/12/03/using-noise-barriers-and-snow-fencing-to-capture-solar-energy/

Innovative new solar panel technology on roofs at ancient Pompeii.
Image source: POCITYF https://techxplore.com/news/2022-12-disguising-solar-panels-ancient-roman.html

Snow fences with mounted solar in Minnesota.
Image source: https://mntransportationresearch.org/2021/12/03/using-noise-barriers-and-snow-fencing-to-capture-solar-energy/

What's a Land Trust to Do?

Organizational Considerations for Land Trusts

In considering solar energy, there are different ways in which a land trust may want (or be required) to be involved. These can be specific, in reaction to proposals for solar development on new or existing conservation easements, or overarching, such us crafting organizational policy around solar citing in their service area or drafting solar development provisions in a template deed. This section establishes core questions for land trusts to consider as they determine how their land trust might approach solar. A land trust may want to consider the following questions in determining their approach to solar (whether overarching or for a specific project):

- How does this align with our mission and current strategic plan?
- What kind of capacity do we have, or want to develop, to engage on this issue?
- What are best practices? (see Land Trust Alliance guidance below)

In this section, we begin with the specific, more reactionary position a land trust may find itself in where a landowner is interested in solar on a potential conservation easement or existing conserved property and then the authors will explore approaches to deed drafting and finally broader approaches, such as organizational policy.

Land Trust Alliance Guidance on Renewable Energy on Conservation Easements

In considering how to respond to a solar proposal, it is helpful for a land trust to be aware of guidance issued by the Land Trust Alliance. Many land trusts, including COL, are accredited through the Land Trust Alliance, a national organization which issues standards and practices for conservation easement acquisition and stewardship. In its Practical Pointer publication on renewable energy and conservation easements[31] (see Appendix 1), the Land Trust Alliance stresses that conservation purposes must be the driver for decisions. This publication considers the question "When, and under what conditions, can a land trust allow renewable energy development in a conservation easement?" LTA states that for existing easements, this answer must be determined by the language of the recorded document (the authors discuss this in greater depth below). For new projects, LTA recommends the following:

> When drafting conservation easements, land trusts may address renewable energy by permitting it directly under certain conditions, such as through a specific reserved right, or generally within standard easement clauses regarding potentially permitted uses. Consider including sole discretion language to enable the easement holder to control the scale, scope and siting of the development to ensure that the conservation values are protected. Tie the exercise of sole discretion to the protection of conservation purposes.

The Land Trust Alliance reminds land trusts that evaluating renewable energy projects is a very site-specific question that can only be answered after careful analysis of the conservation values of a given property and in the full context of an individual project. If the solar project conflicts with conservation goals, the land trust may need to decline the project (if a new conservation easement) or decline to allow the project to move forward (if an existing conservation easement).

31 "Siting Renewables on Conservation Easements: What Land Trusts Need to Know" Land Trust Alliance, posted 2019 and updated March 6, 2023
https://landtrustalliance.org/resources/learn/explore/siting-renewables-on-conservation-easements-what-land-trusts-need-to-know?queryID=3ab8bf2f466084faa47b75af40a7c12a

Evaluating A Solar Development Project: What does a land trust need to know and assess?

A land trust should approach the issue of solar development on conservation easements with caution. It is crucial to evaluate whether the proposed development aligns with the conservation values the land trust wants to protect for a new project or is already obligated to protect within an existing conservation easement. The land trust should determine whether it possesses the necessary expertise to evaluate potential impacts on conservation values or whether it needs to engage partners or paid consultants with subject matter expertise. In any case, a land trust and landowner must have good, open lines of communication with the land trust asking about renewable energy interest or contact from third-parties with exploration or leasing opportunities (just as Colorado land trusts do in relation to traditional energy development such as oil and gas). This type of question may be put into a landowner application for potential projects or a monitoring checklist for existing conservation easements.

A land trust typically faces two key decision-making moments with regard to specific solar projects:

- Before accepting a conservation easement: If solar development already exists or a lease/option agreement is in place, the land trust must determine whether to proceed with the easement. Another scenario, explored further later, is prior to accepting a conservation easement when a landowner may wish to allow for the future possibility of solar development, but without any proposal in place.
- After accepting a conservation easement: If a solar development proposal arises, the land trust must assess whether it is permitted by the terms of the deed, and if so, whether it is consistent with the easement's conservation values.

In order to evaluate a solar development, it is important for a land trust to fully understand the project's siting, scope, and scale. Important questions to ask about the existing or proposed development include:

1. Where is/will the project be located?
2. What is the purpose of the solar energy development project? Is the energy for an on-site accessory use, such as for ranch operations and improvements (Behind the Meter)? Or is the principal purpose to generate revenue by supplying electricity into the transmission grid for use off-site of where the system is located (In Front of the Meter)?
3. What is the scale of the existing/proposed development? What is proposed footprint of the solar development and what are needs for roads or other infrastructure that may extend outside of that footprint?
4. What is the proposed design? Is it single use or dual use?
5. If the property is associated with water rights, how will (or are) those water rights be utilized?

In addition to the siting and design of the solar arrays, land trusts must also consider the location, size, surface, and use of associated access roads, fencing, pads, chemical cleaning facilities, transmission line connections, and other infrastructure. All potential impacts should be assessed to avoid or minimize harm.

If there is an existing or proposed lease, the land trust should carefully review the lease to understand the solar development, maintenance and the obligations regarding decommissioning and revegetation and how these might impact conservation values.

A land trust must then apply this information against the conservation values of the new or existing conservation and determine whether the project is compatible or not, or whether it could be made compatible. A landowner and land trust may want to understand the motivation and capacity of the project proponent to adjust the project to make it compatible (and their track record) prior to expending resources as to how it could be compatible with the conservation easement.

In addition to the assessment of the proposed solar development on conservation values of the site, a land trust needs to assess potential organizational implications.

<u>For new conservation projects:</u>

- Evaluating a solar development proposal may necessitate additional staff time and capacity – is the land trust willing to spend the necessary capacity for this project?
- The land trust must consider whether it can steward the conservation easement. Specifically, whether it can effectively

monitor and enforce the terms of the conservation easement in the context of solar development.

For new **and** existing conservation easements:

- The land trust should assess whether there are public perception issues and determine its comfort level and approach to concerns. To moderate potential negative public perception, the land trust may wish to engage with communities impacted by the proposed solar development, both during the development phase and post-implementation and explore whether there are safeguards that can be created within the deed (for new easements) or within the lease to mitigate concerns. Land use for renewable siting remains controversial and land trusts should anticipate potential public opposition and develop a communications strategy with this in mind.
- The land trust should evaluate the compatibility of the solar energy development with its mission and conservation objectives (or against it organizational policy on renewables, if it has one).

Proposed Solar Development on an Existing Conservation Easement

An existing conservation easement offers limited flexibility. It is imperative for the land trust to determine whether the easement could permit solar development (either explicitly, or through a discretionary clause) and if there are any associated restrictions or limitations. Land trusts may evolve their conservation easement language over time, resulting in varying levels of permissibility for solar energy development on different properties. Therefore, each solar energy development proposal on a conserved property must be assessed individually, with careful consideration of the specific terms and conditions of the conservation easement. Regardless of specific language, a bar for any existing conservation easement is that the conservation purposes for which the easement was created must be protected in perpetuity.

In instances where a conservation easement prohibits a proposed solar development, landowners may seek to amend the easement to accommodate the project. This scenario may become more common as renewable energy expands and landowner payments increase. However, land trusts must carefully consider the implications of such amendments. Similar to the process of drafting a new conservation easement or exercising a reserved right, the evaluation of an amendment must rigorously assess the potential impact of the proposed solar development on the conservation values of the property. However, in addition to this assessment, a non-profit land trust must evaluate whether modifying the conservation easement would result in any impermissible private benefit. Providing impermissible private benefit could compromise the land trust's nonprofit status[32]. Any amendment must also be reported to the IRS and may increase the scrutiny on that transaction. Amending an existing conservation easement to allow for an entirely new land use may also result in significant public scrutiny, which the land trust may want to consider and plan for.

Proposed Solar Development on a New Conservation Easement

Solar projects may come to the land trust in different stages of development which can present unique challenges and opportunities. A spectrum of scenarios exists, ranging from fully operational solar projects to landowners contemplating a solar development lease offer. The certainty of a project and its build out may be directly proportional to the level of land trust capacity needed to evaluate the compatibility of the solar development with the conservation values and organizational considerations.

Scenario 1: Existing solar development

When a landowner expresses interest in a conservation easement on land with an existing solar development, the land trust will have certainty regarding build out and impacts. A land trust will be able to evaluate real impacts to conservation values and understand existing community perceptions and weigh these relative to conservation priority of the project for the land trust. While existing solar developments provide certainty regarding the build out, they restrict opportunities for input on site selection and design.

32 Private Inurement and Impermissible Private Benefit Prohibitions. Land Trust Alliance (posted 2018 and updated July 17, 2024) https://landtrustalliance.org/resources/learn/explore/private-inurement-and-impermissible-private-benefit#content

Scenario 2: Existing lease or option agreement

In a scenario where there is a lease or an option agreement in place, there may be less certainty on the build out, but there may be more opportunities to develop a project that would minimize impacts to the conservation values. Review of the lease or option and understanding as to whether there is any ability to negotiate is key. However, land trusts should approach these conversations with care and consideration because divergent opinions on what level of development is appropriate could strain the relationship between the land trust and the landowner. Unlike mineral rights, which can be severed from the land, solar development is entirely voluntary and may offer substantial financial incentives, potentially exacerbating tensions between landowners and conservation organizations.

Scenario 3: Landowner interest (no option or lease)

A third scenario is one in which the landowner has merely expressed interest in pursuing a solar energy project but has not made any plans or commitments. This scenario has challenges and opportunities as well. On the one hand, if a land trust has the opportunity to engage in a solar development plan upfront, they can discuss siting and scaling options that could optimize the interests of the landowner while minimizing impacts to the conservation values and putting the landowner in a place of clarity if an opportunity for leasing arises. On the other hand, without a comprehensive plan, a land trust may not have the confidence that what is being permitted in the conservation easement is practical or even possible. For example, if a land trust and landowner agree to a development envelope that would be suitable (after completing a thorough

analysis of the potential impacts to the conservation values), without a feasibility study or comprehensive plan, they may not actually know if the site is big enough or in a suitable location. All of these are factors which influence whether a solar energy project is feasible, practical and economical. The authors discuss these challenges further in the template easement drafting section.

It is important to recognize that Scenarios 2 and 3 could take considerable staff time and may require expertise outside of the land trust staff, which can be considered within the context of landowner interest, solar developer willingness, conservation priority, and organizational considerations.

Exclusion of Solar Development from the Conservation Easement Boundary

If considering a new conservation easement, another option may be to exclude the land that is or will be occupied by the solar development from the conservation easement. Excluding a portion of the property for solar energy development presents both advantages and disadvantages for the land trust and landowner.

One advantage is that the landowner retains the right to develop the excluded area, providing flexibility for future needs or opportunities. Retaining flexibility for potential future development can mitigate disputes when landowner proposals are incompatible with the conservation goals of the easement. In addition, solar development on the excluded land can generate income for the landowner, which may be beneficial for property management or other expenses. Additionally, excluding solar development from the conservation easement may increase the certainty that the conservation easement qualifies for a federal tax deduction (provided that the exclusion does not create a donut hole within the easement boundary).

From the land trust perspective, excluding solar development from the conservation easement may mitigate negative public perceptions regarding inconsistent land uses. Furthermore, the land trust would have no responsibility for monitoring and enforcing the easement on the excluded area, reducing staff time and expenses.

When contemplating a conservation easement with a solar development exclusion, land trusts should assess the potential indirect impacts of the development on the conservation values of the easement. While excluding the solar development area from the easement may seem like a straightforward solution, it's important to consider whether there are aspects of a project that may have indirect impacts on the conserved property. While it may seem obvious that a land trust cannot have influence over adjacent lands that are not under easement, the intentional exclusion for a known use by the same landowner can introduce conflict if that use begins to impact the land that is under conservation easement. A land trust loses the ability to influence design or encourage dual use, which may be more consistent with the conservation values of the overall property.

The scale and location of the solar development are critical factors when considering an exclusion. Excluding areas with limited conservation value can mitigate negative impacts. However, land trusts should exercise caution when excluding areas surrounded by protected land, as this may exacerbate spillover effects. In addition, excluding a specific acreage from the conservation easement is not a straightforward solution to ensure that development remains confined to the designated area. Unless the solar development plan is fully delineated in advance, there is a risk of unforeseen challenges, such as undesirable locations, economic constraints, or the need for additional infrastructure that may traverse the protected property.

Approaches to Drafting Conservation Easements to allow for Solar Development

As discussed above, there are pros and cons to excluding or including different land uses, such as solar development within the boundary of a conservation easement; land trusts may differ in their philosophical approach to exclusion. When it comes to inclusion, land trusts may address renewable energy in their drafting of conservation easements by 1) explicitly permitting it under certain conditions as a reserved right, 2) using standard easement language regarding potential future permitted uses, or 3) a combination thereof. The choice of approach could depend on a number of factors, such as whether a specific solar project is being considered during the drafting process, whether a property is located near existing trans-

mission infrastructure, or whether a land trust is comfortable maintaining flexibility for future proposals as conditions and technologies change.

If a land trust is considering a specific solar project during the drafting process, one approach could be to draft language specifically tailored to that proposal. These terms may address the location, size, and design of solar structures and associated infrastructure (roads, transmission lines, etc.) to minimize their impact on the protected area.

However, the land trust may want to consider the lifespan of a solar development and the potential downside of creating project-specific language within a perpetual deed, which could lead to situations where future technologies provide better options which were not contemplated during drafting. Another option is to develop language for renewable energy, with the condition that any specific proposal must be approved by the land trust, with the land trust as a party to any lease or option (though not a financial beneficiary). In this case, a land trust will need to be prepared to respond to proposals in the future and may want to consider whether it would be helpful to develop organizational guidelines for solar siting that could guide requirements for leases or management plan, as discussed in the next section.

One provision which is considered low risk and is incorporated by many land trusts, is to allow for renewable energy for the primary purpose of serving permitted improvements (such as a house or agricultural structure). A land trust may explicitly allow for this type of Behind-the-Meter solar development and may specify whether this is permitted only within a building envelope and whether there are height or impervious surface limitations. A land trust may then also have a provision which could offer future flexibility for solar development beyond this, subject to approval. While consultation with experts may be critical to gain insight and input, it is essential that a land trust has sole discretion, as it is the obligation of the land trust to defend the conservation values of the conservation easement in perpetuity.

Organizational Policies and Guidelines

A land trust may choose to adopt an organizational policy around solar development, which may be distinct to its service area or resource of focus, or it may mirror policies created and adopted by organizations with whom its mission aligns.

For example, at a national scale, American Farmland Trust (AFT) has developed "Smart Solar principles" which it believes can help shape solar development as it plays out across the country. These principles include: prioritization of new solar on buildings and land unsuitable for agriculture, and protecting agricultural viability if land is used for solar, including developing agrivoltaics as a tool that genuinely supports and enhances agriculture. AFT advocates for incorporation of these principles into land use planning and has also invested considerable capacity into agrivoltaics, creating resources for landowners contemplating or negotiating leases, and creating technical assistance to support decision makers and landowners. AFT's resources, as well as those developed by other groups, such as The Nature Conservancy, are listed in the section below on partners and resources.

Within Colorado, as a different example and approach, the Colorado State Land Board (SLB), which owns, stewards, and leases four million acres of land, has developed a board policy on renewable energy leasing. The stated objective of the policy is "To promote renewable energy development on state trust lands in a manner that generates market-based revenue, is compatible with other current and future uses, and minimizes impacts to natural values and agricultural lands." While the mandate of the State Land Board to generate revenue for Colorado public schools is very different than the mission of a land trust, its objective to strive for compatibility and minimize impacts may offer some insights, particularly for Colorado land trusts looking to develop further guidelines for considering solar development (for example, the SLB will not consider utility-scale leasing on land leased for irrigated or dryland crop production and will only consider if it is located within five miles of an electrical substation, switchyard, or transmission line with capacity greater than 200 kilovolts). (see Appendix 3 for the full policy).

A land trust may invest in its own guidelines for solar siting and management, which could be updated over time, particularly as new technologies emerge. These could be internal documents used by the land trust to make a decision about a proposal and could guide requirements for siting, infrastructure, operations and reclamation within a lease and/or approval document for the landowner. A land trust may also consider requiring additional stewardship funding for landowners

who wish to reserve the right for future solar development or already have a lease or project in place. Such guidelines may include components such as:

1. Limitation on single purpose solar installations to designated areas like building envelopes (existing or permitted in the future); or on permitted structures. Building envelopes will have been selected in advance and delineated in the easement document.
2. Requirement for consultation with external experts for proposals for dual purpose solar, with review and approval of land trust; for agrivoltaics systems that involve irrigation, a requirement for specific planning with regard to water right use, or actions that will be taken to prevent abandonment, if water use is reduced.
3. Identification whether existing roads may be used and/or whether new roads will be permitted. If new roads are allowed, specify their location in advance or describe the conditions under which new roads will be permitted.
4. Determination if existing transmission lines are sufficient, and/or whether new transmission lines will be permitted. If so, define their permitted locations, height and scale. Consider whether they can be above ground or must be underground.
5. Define and limit any other improvements or infrastructure associated with the solar installation (e.g. battery storage systems, fencing, etc.).
6. Use of visual screening or setbacks.
7. Address the restoration of the site after decommissioning and removal of panels and infrastructure.

Depending on the service area and protection focus of the land trust, it may be more or less difficult to develop organizational guidelines. A land trust must also consider its capacity to monitor for and enforce these guidelines, if included as part of an approval, just as a land trust would need to monitor and enforce against any management plan referenced as part of a deed or approval. The authors have developed a case study below to illustrate the complexities of context and conservation purpose as they relate to how a land trust may consider solar development.

Considering Solar in the San Luis Valley: A Case Study on a Priority Landscape for Conservation

Colorado Open Lands is a statewide land trust that holds over 700 conservation easements across the state. COL has focused its conservation efforts primarily in priority areas, recognizing the importance of landscape scale perspective and effort informed by and implemented through meaningful local engagement. COL's priorities for protection differ based on local context – resources, opportunities, and needs.

For example, in Northwest Colorado, COL's work has centered on conserving larger, intact, sage brush dominated ranchlands that provide critical habitat for Sage-grouse and elk and support a thriving livestock industry. In this landscape, it is challenging to envision a scenario in which a traditional solar development could be compatible with protection goals for habitat, as this habitat can be dramatically impacted by disturbance, such as installation of solar infrastructure. However, it is possible that innovative technologies, such as the replacement of traditional snow fences along highways with solar panel lined snow fences could be compatible, if there is no change in impact.

In many other areas of the state, COL works to protect irrigated agricultural land, recognizing the multitude of ecological and economic benefits it provides to communities. However, as our climate changes and water supplies are stressed, there is a recognition that historic agricultural use will be more challenging. In Colorado's San Luis Valley, irrigators and water managers have recognized that the underground aquifers on which the economy of this six county-area depends, have been in significant decline and have been working to try to reduce water use to bring these aquifers back to a more sustainable level. The San Luis Valley is a priority conservation landscape for Colorado Open Lands, where we have worked to protect approximately 120,000 acres of land. This context of community-led efforts to forge a water-smart future for the San Luis Valley, while recognizing the need to build economic reliance through new avenues, provides a unique place in which to explore how solar development might align with community goals and conservation efforts.

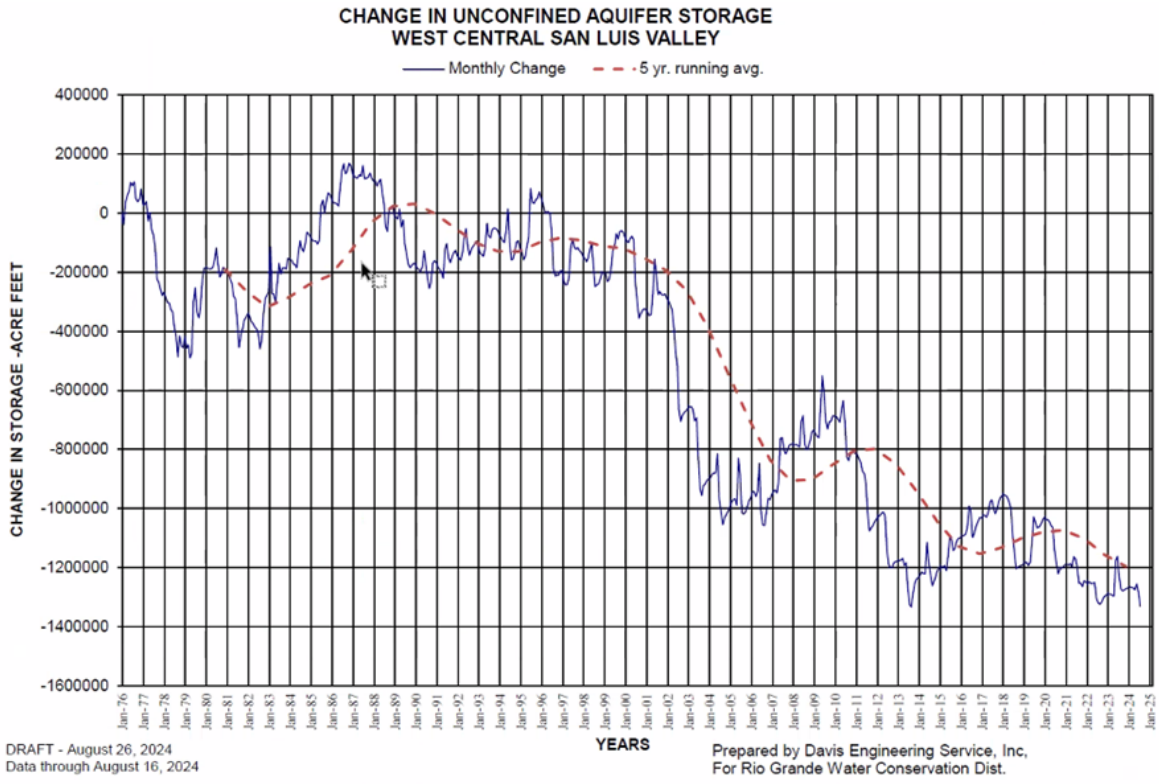
A Changing Agricultural Landscape and Economy

The San Luis Valley (SLV) is a large, high altitude desert basin near the headwaters of the Rio Grande in southcentral Colorado. With a land area of about 8,000 square miles, it is sparsely populated with only 46,000 residents[33] across six counties. Surrounded by mountain ranges whose highest peaks reach 14,000 ft, the valley floor is high and largely flat, receiving very little precipitation. From the western flanking range, the San Juan Mountains, the Rio Grande makes its way through the SLV, joined by tributary rivers along the way. Historically, it was these rivers that provided the draw for European settlers to begin farming in the San Luis Valley. As the population began to grow from the early 1900s on, people began to tap the groundwater resources from the valley's confined and unconfined aquifers. Phases of prolific well drilling occurred, and today there are over 20,000 wells across the valley, with over 4,500 decreed for irrigation[34]. Approximately half a million acres of irrigated farmland cover the valley floor, supported by a mixture of surface water and groundwater. Agriculture is the primary economic industry of the San Luis Valley.

A severe drought in 2002 brought conversations about water management to a head in the SLV. As the figure below shows, a decline in the SLV's unconfined aquifer has persisted since the late 1980s. Significant gains and recoveries must be made in the coming years to meet requirements set by the Colorado Division of Water Resources to recover the aquifers or risk regulatory shut-downs of thousands of wells. As Cleave Simpson, State Senator, and General Manager of the Rio Grande Water Conservation District (and COL Board Member), said at a forum in the SLV in November 2023, "If the next 20 years look like last 20, with the status quo, there will probably be 100,000 acres without an adequate water supply." One hundred thousand acres is 156 square miles, or about half the size of New York City. The scale of land that could potentially be forced out of irrigation is huge. Water scarcity means that agriculture as it is now practiced in the SLV must change. A variety of payment incentive programs have been used in the valley to pay landowners to retire or reduce their groundwater use.

33 2020 U.S. Census

34 https://www.slvdrg.org/wp-content/uploads/2017/04/F.-Water-Resources.pdf



Groundwater-focused conservation easements

Colorado Open Lands recognizes the importance of agriculture for food and fiber production, heritage, and for the habitat it provides. In the San Luis Valley, agricultural irrigation create a rich network of wetland and riparian habitat and the agricultural fields themselves provide upland forage for migratory birds, like the Greater Sandhill Cranes, as well as important wintering ground for mule deer and pronghorn. The shutdown of wells by the State would be catastrophic not only for farming and ranching families but would also drastically alter the Valley's ecology and the incredible wildlife habitat it supports. COL and the local land trust, Rio Grande Headwaters Land Trust, began to explore whether the conservation easement tool could be applied to the area's most precious natural resource: groundwater. Irrigators, local water managers, and the state agency tasked with administering water rights all weighed in on the concept development. These conversations led COL to pioneer the use of the easement to incentivize farmers and ranchers to keep water in the ground by using the conservation easement to reduce historic groundwater pumping. The State recognizes this groundwater conservation easement as a nonuse of the water right that cannot be claimed or pumped by another irrigator, but that must remain in the aquifer.

Solar as An Option for Economic Resilience

As the San Luis Valley grapples with a future that can no longer support the level of agriculture it has in the past, good and hard questions arise: how does a region successfully transition away from this thoughtfully and incrementally, and still maintain a tax base, viable income streams for residents, and also not leave the land abandoned in such a way that a dust and weed bowl results?

From a climatic point of view, the SLV has some of the best solar development potential in the State of Colorado with its abundance of clear, sunny days. The National Renewable Energy Laboratory (NREL) has estimated that the insolation in the SLV (the amount of thermal radiation from the Sun received on an area of land) is the highest in the state. US Bureau of Land Management (BLM) has twice completed a solar programmatic Environmental Impact Statement processes and three of four sites identified in the state are located in the San Luis Valley.

Despite its significant production potential, the SLV has seen only four traditional utility-scale solar projects (82-225 acres in area) developed over the years. This is in part due to community concerns raised around one proposed project, such that the county of jurisdiction denied the project proponents a 1041 permit. In larger part, it is due to constraints on transmission corridors out of the San Luis Valley. While questions remain as to the economic viability of major solar projects to replace reduced agricultural production, it is helpful to contemplate how larger-scale solar development could align with conservation goals, should current barriers change over time and also to think about how different scales of solar might align with, or even advance, conservation objectives.

More broadly, as an organization, this context of community need and opportunity creates a compelling space for COL to consider our approach to engaging in solar development.

Exploring conservation compatibility

Where could solar development, at a variety of scales, fit into the San Luis Valley in the future, and how could it possibly support a healthy land transition away from reliance on irrigated agriculture? In 2023, COL organized a conversation with leaders in agriculture and water together with solar researchers and the rural electric cooperative to discuss the role solar could play in supporting agriculture and the required land transition. There was interest in smaller scales and more innovative solar design ideas that could support energy needs internal to the San Luis Valley. In considering possible options, it is important to consider the abundance of already disturbed agricultural land that could become fallowed in the next several years, the need for the community to maintain economic well-being, and the community need for more electrical power independence and resilience.

Ideas of interest to the community centered on on-site solar on existing residences and agricultural structures (such as large hay barns, and utility shops) wherein the power generated could be used to support pumps for irrigation systems, to charge electric farm equipment and to support larger packing facilities. For center-pivot irrigated systems, there could be compatibility with utilizing non-irrigated corners of fields for solar arrays. There was a project that attempted this design and brought together major utility, Xcel Energy, with local groups including the SLV Resource Conservation and Development Council and the Monte Vista Coop, as well as agricultural producers in an attempt to generate the power needed for irrigation of the pivots. Unfortunately, while the idea centered on reducing costs for irrigators, this was not the result at least in part due to nuances in the Xcel contracts, and these projects were abandoned and left a sour taste around this model.

Siting with Wildlife in Mind

Bird Migration Corridors
The San Luis Valley is part of a critically important migration flyway for a diversity of bird species, including the Greater Sandhill Crane and many species of waterfowl. A complex of significant habitat across riparian areas and extensive wetlands, spread as a mosaic across the valley floor (also occurring predominantly on private lands) is critical to the continued support of these avian species in their use of the valley.

Additionally, grain fields serve as a vital resource for the Great Sandhill Cranes who migrate through the valley twice annually. Feeding on the waste grain in barley fields is a critical component of their use of the valley as a stopover site in their migration. Being mindful of migration corridors, and siting relative to wet areas and grain fields will be an essential part of smart solar siting in the valley.

Big Game Corridors
Possible impacts to big game corridors and winter range are another important consideration for solar development in the San Luis Valley. Many of the lower elevation and flatter agricultural fields on the valley floor are mapped as overall and winter range for big game species including mule deer, elk, and pronghorn. Understanding migration routes, and important areas utilized by these animals, especially during winter, will be an important part of making informed choices as to where appropriate solar siting should occur on the valley floor.

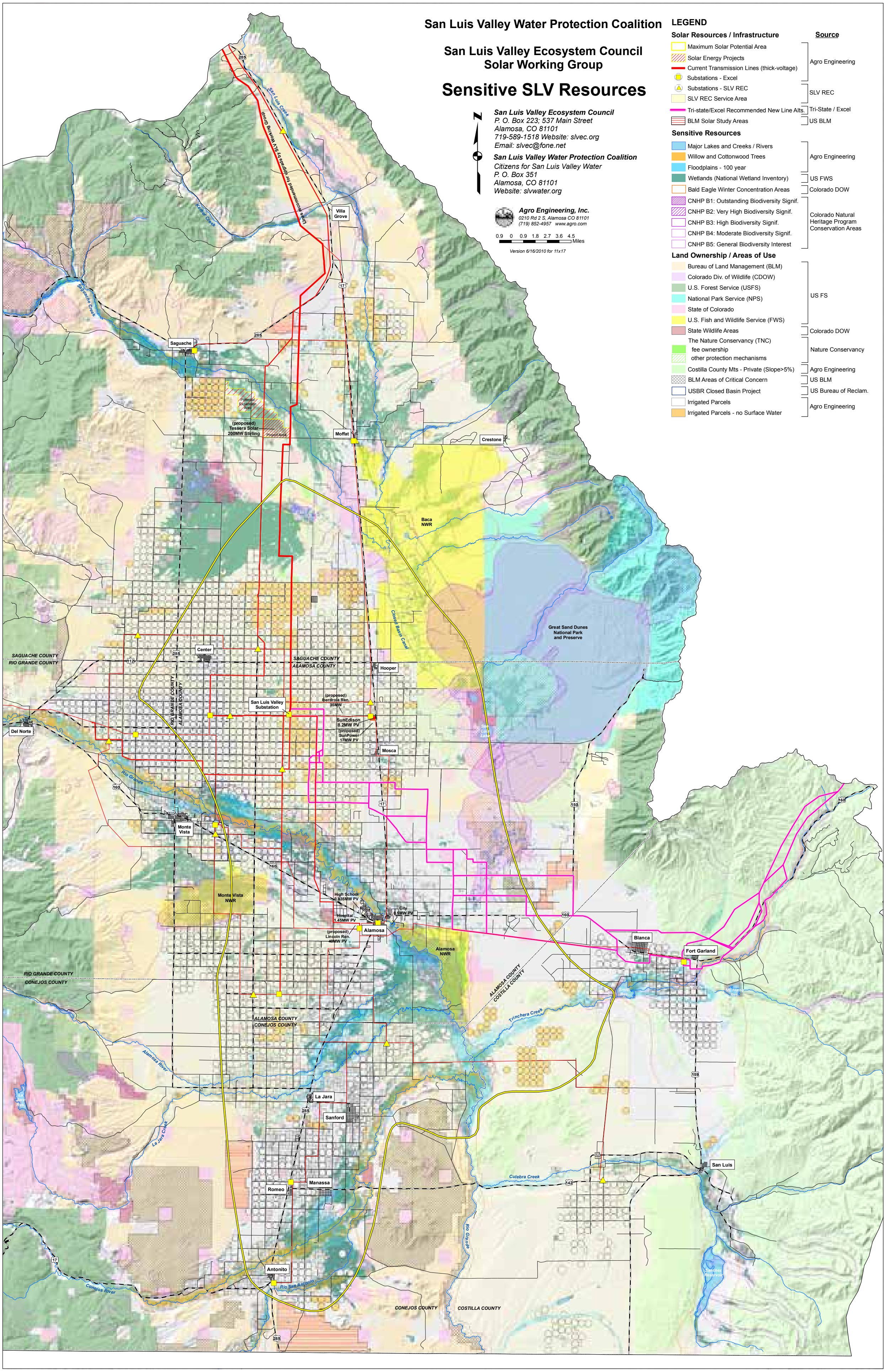
One role for land trusts may be to support the compilation of good data, including on existing conservation easements and new conservation priorities. The San Luis Valley Ecosystem Council (SLVEC) has taken a leadership role within the San Luis Valley by compiling information on public and privately protected lands, sensitive habitat, and existing solar resources. An excellent map prepared by the SLVEC, below, shows the sensitive land and water resources of the San Luis Valley and can be used as a helpful tool in land use planning and solar energy development discussions. One extension of this data may be that lands coming out of irrigation could benefit from ecovoltaic-supported land transition.

A very different idea around solar in the San Luis Valley could focus on those lands transitioning out of irrigated agricultural use and the design of a dual purpose ecovoltaics system to support the establishment of permanent vegetation. In land restoration, practitioners often strive to create heterogeneity (structural or environmental variance) to facilitate the successful establishment of diverse seedlings. Under solar arrays, environmental heterogeneity is created through passive alteration in patterns of rainfall and sunlight, there is great potential for biodiverse plant communities that in turn provide a suite of ecosystem services[35]. Colorado State University ecovoltaics researcher, Matthew Sturchio believes,

> "There are opportunities to utilize solar panels as habitat builders in old agricultural lands that no longer have access to water. The combination of amplified rainfall events at the edges of solar panels and reduced evapotranspiration, could help to maintain the functionality of otherwise abandoned fallow farmland. Solar arrays also act to slow down windspeeds, so the combination of this and greater vegetation cover could also reduce the amount of soils that are lost to the wind.'

If we consider a groundwater conservation easement, where the primary conservation purpose is to support aquifer recovery, we can justify alignment with dual purpose solar development. Colorado Open Lands has written our groundwater conservation easement template as a deed that we feel meets the qualifying conservation purpose of open space as defined 170(h). More specifically, groundwater conservation easements are clearly delineated in local governmental policy and produce a significant public benefit as codified in the Rio Grande Basin Implementation Plan under the Colorado Water Plan. The public benefit of a groundwater conservation easement occurs under the surface of the property in stored water in the aquifer. However, groundwater conservation easements (at least as contemplated and utilized in Colorado), also include protection of the surface of the land. Transition from irrigated cropland to grassland or shrubland is a challenging one in an arid environment and establishment of quality habitat may take decades. If an ecovoltaics system can be designed to enhance or increase the speed of ground cover establishment, therefore improving habitat, it would seem to be squarely compatible with a groundwater conservation easement.

35 In Nature, Ecology and Evolution. "Ecovoltaic principles for a more sustainable, ecologically informed solar energy future" by Matthew A. Sturchio and Alan K. Knapp


San Luis Valley Water Protection Coalition
San Luis Valley Ecosystem Council
Solar Working Group
Sensitive SLV Resources
San Luis Valley Ecosystem Council
P. O. Box 223; 537 Main Street
Alamosa, CO 81101
719-589-1518 Website: slvec.org
Email: slvec@fone.net
San Luis Valley Water Protection Coalition
Citizens for San Luis Valley Water
P. O. Box 351
Alamosa, CO 81101
Website: slvwater.org
Agro Engineering, Inc.
0210 Rd 2 S, Alamosa CO 81101
(719) 852-4957 www.agro.com
0.9 0 0.9 1.8 2.7 3.6 4.5 Miles
Version 6/16/2010 for 11x17
LEGEND
Solar Resources / Infrastructure
Source
Maximum Solar Potential Area
Solar Energy Projects
Current Transmission Lines (thick-voltage)
Substations - Excel
Agro Engineering
Substations - SLV REC
SLV REC Service Area
SLV REC
Tri-state/Excel Recommended New Line Alts.
Tri-State / Excel
BLM Solar Study Areas
US BLM
Sensitive Resources
Major Lakes and Creeks / Rivers
Willow and Cottonwood Trees
Floodplains - 100 year
Agro Engineering
Wetlands (National Wetland Inventory)
US FWS
Bald Eagle Winter Concentration Areas
Colorado DOW
CNHP B1: Outstanding Biodiversity Signif.
CNHP B2: Very High Biodiversity Signif.
CNHP B3: High Biodiversity Signif.
CNHP B4: Moderate Biodiversity Signif.
CNHP B5: General Biodiversity Interest
Colorado Natural Heritage Program Conservation Areas
Land Ownership / Areas of Use
Bureau of Land Management (BLM)
Colorado Div. of Wildlife (CDOW)
U.S. Forest Service (USFS)
National Park Service (NPS)
State of Colorado
U.S. Fish and Wildlife Service (FWS)
US FS
State Wildlife Areas
Colorado DOW
The Nature Conservancy (TNC)
fee ownership
other protection mechanisms
Nature Conservancy
Costilla County Mts - Private (Slope>5%)
Agro Engineering
BLM Areas of Critical Concern
US BLM
USBR Closed Basin Project
US Bureau of Reclam.
Irrigated Parcels
Irrigated Parcels - no Surface Water
Agro Engineering
Saguache
Villa Grove
Moffat
Crestone
(proposed) Tessera Solar 200MW Stirling
Baca NWR
Great Sand Dunes National Park and Preserve
Closed Basin Canal
Center
Hooper
SAGUACHE COUNTY
RIO GRANDE COUNTY
ALAMOSA COUNTY
San Luis Valley Substation
Del Norte
Mosca
Monte Vista
Monte Vista NWR
Alamosa
Alamosa NWR
Blanca
Fort Garland
RIO GRANDE COUNTY
CONEJOS COUNTY
ALAMOSA COUNTY
COSTILLA COUNTY
Rio Grande
Trinchera Creek
Alamosa River
La Jara
Sanford
La Jara Creek
San Luis
Culebra Creek
Manassa
Romeo
Antonito
Conejos River
COSTILLA COUNTY
CONEJOS COUNTY
San Luis Creek
Saguache Creek

Finding Resources and Partners

Solar technology will continue to change and land trusts will benefit from good resources and connecting with knowledgeable partners. When considering a specific project, the authors highly recommend reaching out to Colorado Parks and Wildlife and/or the Natural Resources Conservation Service to support consideration of impacts and best practices. In Colorado, we are fortunate to be home to the National Renewable Energy Laboratory (NREL) which houses some of the nation's experts on emerging solar research, including dual use systems as well as the Colorado Agrivoltaics Learning Center.

The amount of data available on different best practices can be overwhelming and should be taken in context of the type of land and water resources (and conservation values) as well as the scale and type of solar development. The authors have included a comprehensive bibliography with excellent resources, but here are a distilled list of extra helpful partners and resources.

Colorado Parks and Wildlife's Energy Development and Land Use page:
https://cpw.state.co.us/energy-development-and-land-use

Focus: renewable energy impacts on wildlife habitat

Key Resource: Colorado Parks and Wildlife Best Management Practices for Solar Energy Development, which outlines CPW's approach of "avoid, minimize and mitigate" and has examples for different key species (see Appendix 4 for CPW's guide, last updated 5/27/21)

Key Takeaways:

- Siting:
  - Avoid high priority wildlife habitat (see TNC's mapping resource below) and prioritize siting on previously disturbed areas or areas adjacent to existing infrastructure
  - Understand how wildlife use the proposed site; CPW recommends that surveys be conducted to determine the site use and temporal and spatial distribution for wildlife that are potentially impacted by the development
  - For single use systems, minimize overall footprint and use existing roads when possible
  - Maintain riparian access and connectivity; avoid playas and wetlands
  - Buffers may be needed for certain species
- Design considerations are largely species-dependent and may include both the array and associated infrastructure, such as security fencing, lighting, or evaporation ponds
- Constructions and operations protocol; timing matters for certain species, so avoiding noise and disturbance during certain periods, such as breeding or nesting, may be critical
- Decommissioning: as with construction, plans should contemplate timing around disturbance and revegetation to support appropriate habitat (or ideally, retention of original habitat in the first place)

Consult, consult, consult!

CPW regional energy liaisons and land use staff are a diverse group of wildlife professionals located throughout the state. This group works with energy companies and developers, and federal, state and local government agencies to manage the impacts of development on wildlife.

Contact information for Energy Liaisons and Land Use Coordinators for each region can be found at: https://cpw.state.co.us/energy-development-and-land-use

Site Renewables Right developed by The Nature Conservancy:
https://www.nature.org/en-us/what-we-do/our-priorities/tackle-climate-change/climate-change-stories/site-wind-right/

Focus: renewable energy siting

Key Resource: interactive online map which essentially highlights areas with great potential for solar that are unlikely to result in wildlife conflict of critical species; this tool could support conservation organizations saying yes to solar development (if it can be made compatible with other conservation purposes)

InSPIRE project (funded by the US Department of Energy and managed by the National Renewable Energy Lab):
https://openei.org/wiki/InSPIRE/Guidebook

Focus: native vegetation, pollinator habitat, agrivoltaics

Key Resource: Low-Impact Solar Development Strategies Guidebook; the guide includes best practices and establishes solid arguments for cost-savings to developers, based on real data and testimonials from industry.

Key takeaway: grading (land leveling) matters

- fixed arrays (as opposed to single axis tracking systems) allow for more variability in topography, reducing the need for grading and allowing installation that works with native vegetation
- keeping native vegetation also reduces the challenges of re-seeding that can occur after re-vegetation (including challenges of irrigation here in the arid west); however, if revegetation is conducted, consulting with local professionals to establish an appropriate native seed mix is critical
- in an agrivoltaics system, keeping native vegetation is essential for pasture, and minimizing grading (which can strip rich top soil) is key for soil health and productivity; different crops will perform better than others; equipment needs matter for spacing and array height matters for different types of livestock (PSA: goats may chew wires)

Solar site preparation and construction developed around existing vegetation, Photo by Jordan Macknick, InSPIRE project principal

AgriSolar Clearinghouse developed by the National Center for Appropriate Technologies:
https://www.agrisolarclearinghouse.org/agrisolar-information/

Focus: agrivoltaics

Key Resources: one stop shop for information on planning, leasing, and solar design with specific information on different agricultural systems and potential compatibility with solar (including irrigation and harvest) as well as farm efficiency considerations to offset on-farm energy needs

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Colorado Agrivoltaic Learning Center (nonprofit research and outreach arm of Jack's Solar Garden):
https://www.coagrivoltaic.org/

Focus: agrivoltaics

Key Resources: opportunity to tour and learn about an agrivoltaics system in action; CALC also hosts regular workshops and webinars to share out on-site research findings, but also to connect landowners, solar developers, and other stakeholders with subject matter experts; great video library

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American Farmland Trust's Farmland Information Center Smart Solar page:
https://farmlandinfo.org/solar-siting/

Focus: providing resources for landowners and decision makers on single use systems as well as agrivoltaics

Key Resource: Key Resource: AFT has produced specific materials for Colorado which can be found here:
https://farmlandinfo.org/publications/perspectives-on-agrivoltaics-in-colorado/

These include:

- Farmer and Rancher Perspectives on Agrivoltaics in Colorado
- Funding Opportunities for Agrivoltaics in Colorado for Producers, Landowners, and Service Providers
- Addressing Barriers to Producer Adoption of Agrivoltaics

Land trusts may be in a unique position to help think through a proposal most holistically, bringing together expertise on wildlife, agriculture, and viewshed, grounded in an understanding of community concerns and opportunities.

Conclusion

While Colorado's conservation easement tax credit legislation has opened the door for qualification of solar energy projects on conserved land, the burden of proof remains at the project-specific level. Renewable energy is absent from the federal code governing deductions for qualified conservation easements and there are no tax court cases that provide direction on the issue. Entities that provide funding for conservation easements have mixed approaches to their requirements or allowances for current and future solar projects. In the absence of policy that clarifies standards under which solar energy development can align with conservation easements, investigation and support for a decision remain critical. Landowners and land trusts will need to assess risk and if a project emerges, thoroughly vet design, implementation, and decommissioning plans that are specific to the property and its conservation values.

When it comes to energy development in Colorado, nonrenewable energy sources have a more extensive regulatory framework that is coupled with state resources to evaluate and monitor standards (Colorado Energy & Carbon Management Commission and Division of Reclamation, Mining and Safety). As discussed in this guide, counties are developing land use codes that can accommodate new dual use systems; however, ensuring that the implementation aligns over time may depend on the willingness of the parties to enforce lease terms and conservation easement terms. Land trusts may currently lack the capacity to evaluate and enforce individual projects, making partner resources all the more critical. American Farmland Trust believes that agrivoltaics holds promise for Colorado agriculture, with potential to support both economic diversification and climate resilience; however, they note that significant investment in policy, research and accessible technical assistance will be critical.

Perpetual conservation easements challenge land trusts to think about land and water resources through a very long-term lens, drafting documents now that must be durable, balancing protection with flexibility in the absence of a crystal ball. Since the advent of conservation easements and the adoption of enabling statutes that define the purposes for which they can be created and enforced, holders of conservation easements and partners have found creative applications of conservation easements that fit changing public needs around valuable resources. As we strive to make informed decisions, we must strive to continue to educate ourselves, while recognizing limits on our capacity and within the law that governs and incentivizes conservation easements.

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2. Considerations for Water Rights Holders Contemplating a Solar Lease

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7. American Farmland Trust Funding Opportunities for Agrivoltaics in Colorado

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Appendix 1:

Land Trust Alliance Practical Pointer:

Siting Renewables on Conservation Easements: What Land Trusts Need to Know

Note: Pratical Pointers are updated from time to time. Check the LTA Resource page for the most up to date version. The version included in this document was updated March 6, 2023.

https://landtrustalliance.org/resources/learn/ways-to-learn/practical-pointers

Land Trust Alliance
Together, conserving the places you love

Practical Pointer

Siting Renewables on Conservation Easements: What Land Trusts Need to Know

As the transition to a clean energy system accelerates and renewable energy development pressures increase, land trusts are facing, with far greater frequency, questions regarding renewable energy and conservation easements. *When, and under what conditions, can a land trust allow renewable energy development in a conservation easement?* The answers are different for existing conservation easements without a specific clause permitting renewable energy structures and in yet to be signed and recorded conservation easements. For existing easements, the language of the easement itself dictates whether siting renewables is permissible or not. Many easements prohibit structures outright and so renewable siting is not an option. Also consider whether the proposed use is consistent with any restrictions on commercial use. Amendments to existing conservation easements to permit structures and improvements outside of building areas may be contrary to conservation purposes and may be too high risk to undertake. Please use the 2017 edition of the *Amendment Report* to assess any such requests for existing conservation easements.

For new conservation easements before signing and recording, land trusts may consider *renewable energy development when it is consistent with the conservation purposes and does not harm conservation values.* A land trust should address this issue through clear easement language when it elects to allow this activity.

Assessing whether renewable energy is an appropriate activity is a site-specific question that can only be answered after careful analysis of the conservation values of a given property and in the full context of an individual project. As with any easement issue, research and apply best practices and guidelines, specifically, *Land Trust Standards and Practices*.

Renewable Energy and Conservation Easements: Key Considerations

1. **Conservation values**. First and foremost, the land trust should determine if renewable energy development is consistent with the conservation purposes of the conservation easement. Depending on what conservation values a land trust seeks to protect, different levels of compatibility will likely exist. For example, if the goal is the protection of endangered songbird habitat, there are likely limited (or no) opportunities to allow renewable energy development while also protecting this habitat. On the other hand, if the goal is farmland conservation, some limited flexibility may exist to site renewable energy development and all the associated infrastructure while still achieving conservation objectives.
2. **Siting, scope and scale**. Understanding the siting, scope and scale of the proposed development will help a land trust evaluate its impact on the property's conservation values. Important questions to ask include:

- Where will the project be located?
- What is the purpose of the energy development? Is the energy for an on-site accessory use, such as for farm operations and improvements? Or is the principal purpose to generate revenue by supplying electricity into the transmission grid for use off-site of where the system is located?
- What is the size of the development? For personal use (which generally implies smaller scale of 1-20 kW or less for one residence) or for broader consumption (mid to larger scale or utility scale which is generally considered 1 MW or more)?
- What is the associated infrastructure and impacts of lines, pipes, roads, pads, water and so forth?

3. **Funding restrictions.** Easements that are partially or completely funded by grants from private foundations or government agencies may be restricted or limited in what the easement can allow. Some state and local officials see energy leases as "double-dipping" and do not support state or local agricultural and open space funding programs that allow renewable energy development on protected or to-be-protected properties. Land trusts need to fully understand the views of funding partners and the potential funding limitations prior to drafting an easement.
4. **Energy lease terms**. Does the landowner have an existing energy lease on the property? If so, the land trust may need to engage with the energy developer to understand the terms of the lease. While evaluating title encumbrances is critical to any conservation easement transaction, it is especially important with respect to energy leases because understanding and assessing lease terms can be difficult and time consuming. Key issues may include:
   - *Release of parcels*. Under what conditions, if any, can parcels of land (particularly those identified as possessing important conservation values) be released from the lease? What, if any, is the willingness of energy companies to amend existing leases to ensure the protection of the property's conservation values?
   - *IRS deductibility.* The lease terms may impact IRS deductibility, so a land trust and appropriate legal counsel need to review the lease in the context of the regulations. See below for further information.
   - *Project costs.* What are the potential costs and who are the responsible parties for the project expenses (such as transportation, infrastructure and maintenance costs)?
   - *Liability*. Are there any additional liability issues associated with any title encumbrance or existing lease?
5. **IRS deductibility.** A land trust needs to understand how easement provisions on renewable energy may impact the potential federal deductibility of an easement donation. There are two different regulatory prohibitions of inconsistent uses. The first disallows deductions where the conservation purpose is the protection of open space and the terms of the easement permit a degree of intrusion or future development that would interfere with the essential scenic quality of the land or with the governmental conservation policy that is being furthered by the donation. (Treas. Reg. §1.170A-14(d)(4)(v)). The second prohibition is more general and prohibits the retention of inconsistent uses and is applicable to conservation easements regardless of the category of conservation purpose under which they qualify (Treas. Reg.§1.170A-14(e)(2)). It is difficult to know what this means for renewable energy development. For example, how many wind turbines might be acceptable under the regulations? The answer is unclear. In some cases, it may be necessary for the landowner to forgo a tax deduction or forego energy siting. The IRS has begun to disallow deductions where *any inconsistent use* regardless of scale is present or allowed. Another option is to leave land areas that

may be subject to potentially inconsistent uses out of the deductible easement with the excluded areas fully restricted including a prohibition on division by a non-deductible easement. This is a risk to the deductible easement if the excluded areas are interior to the conserved land. A third option is to clearly articulate how the siting of renewables is necessary for the protection of the conservation interests pursuant to Treas. Reg.§1.170A-14(e)(3). Third party expert reports will reduce the risk that the IRS disallows the deduction. A mere assertion by the owner or land trust has been insufficient in other cases.

6. **Landowner goals.** Land trusts will need to listen carefully to landowners and prepare language that reflects the shared views, if any, of the land trust and the landowner on renewable energy, recognizing that some landowners may want to reserve the right in order to maintain flexibility while others may want to explicitly prohibit such activity.
7. **Renewable energy credits.** If there are renewable energy credits or tax credits for renewable energy development, who owns them if they are sold in the future or traded into an energy grid? Explicitly address any energy, ecosystem service, carbon or similar credits in the conservation easement deed. Please review the Practical Pointers on Carbon Offsets.

Easement Drafting Considerations

If a land trust has evaluated and documented that the siting of renewables is consistent with the conservation purposes for the subject property, it must contemplate easement protections. When drafting conservation easements, land trusts may address renewable energy by permitting it directly under certain conditions, such as through a specific reserved right, or generally within standard easement clauses regarding potentially permitted uses. Consider including sole discretion language to enable the easement holder to control the scale, scope and siting of the development to ensure that the conservation values are protected. Tie the exercise of sole discretion to the protection of conservation purposes.

Consider these drafting tips for addressing renewable energy in conservation easements:

1. Limit location of renewable energy development to existing or reserved building sites or special use zones without conservation values. Require that all necessary infrastructure and improvements also be located in the special use zones.
2. Consider protecting scenic values by requiring a natural buffer to provide screening of the renewable energy structures.
3. Limit energy development to on-site use. Avoid utility scale projects which generally require more infrastructure, such as transmission lines, roads, grading and chemicals. Consider siting renewables on locations where it is possible to use existing transmission infrastructure as it minimizes pressures for transmission lines elsewhere on conservation lands.
4. Harmonize the easement's limitations on improvements, structures and impervious surfaces with provisions concerning renewable siting. If the easement prohibits all structures and improvements, siting of renewables will be prohibited from the outset.
5. Include provisions governing construction, operation, decommissioning and restoration of renewable energy installation sites guided by best practices satisfactory to the land trust and consistent with conservation purposes.
6. Use similar language to that permitted by the IRS for the extraction of subsurface minerals (oil and gas development). The regulations provide that when subsurface mining activity is (a) limited, (b)

localized and (c) "not irremediably destructive of significant conservation interests," it is permitted (see Treas. Reg. §1.170A-14(g)(4)(I)).

7. Research the best management practices for renewable siting for guidance with the goal of identifying only reputable standard setters with a preference for those with conservation missions. Consider, for example, Great Plains Institute Best Practices: Photovoltaic Stormwater Management Research and Testing, American Farmland Trust's Smart Solar Principles, U.S. Fish and Wildlife Services Land-Based Wind Siting Guidelines, The Nature Conservancy's mapping tool Site Renewables Right and Scenic Hudson's Solar Siting Guide and replicable Solar Mapping Tool.
8. Assess the impact on tax deductibility. In the before and after analysis of an appraisal conducted for the purposes of obtaining a federal tax deduction for a charitable donation of a conservation easement, the calculation of the after value once the conservation easement is in place must account for the value of any retained right to site renewable energy. Such retained right could decrease the value of the easement and in turn reduce the taxpayer's deduction.
9. Remind the landowner to research property tax treatment of renewable energy in the state and municipality. The siting of renewables could eliminate a property tax exemption or current use tax benefit or could be trigger a distinct property tax exemption for renewable siting. The repercussions of being subject to property tax as opposed to qualifying for an exemption are severe. In a recent Rhode Island case, the court rejected the taxpayer's argument that a solar energy development was subject to beneficial property tax treatment and concluded that the assessed value of the ten-acre property rose from $7,500 per acre to $40,000 per acre following the solar development. *Polseno Properties Mgmt., LLC v. Keeble,* No. 2021-299-Appeal 2023 WL 2125824 (RI Feb. 21, 2023).
10. Consult with stewardship staff and confirm that associated monitoring requirements are feasible.
11. Ensure that you have an increased stewardship and legal reserves fund for the additional work and risk associated with these uses and structures.

Related resources:

- *Amending Conservation Easements: Evolving Practices and Legal Principles*, second edition, Land Trust Alliance, 2017.
- *Clean Energy, Green Communities: A Guide to Siting Renewable Energy in the Hudson Valley,* Scenic Hudson, 2018.
- *Conservation Easement Drafting: Pointers for Balancing Risk*, Land Trust Alliance, last revised April 18, 2019.
- *Conservation in a Changing Climate: Renewable Energy Siting,* Land Trust Alliance, 2019.
- *Land Trust Standards and Practices*, Land Trust Alliance, 2017.
- Model Grant of Conservation Easement and Declaration of Covenants, 7th edition, Pennsylvania Land Trust Association, 2019.
- *Pointers for Balancing Risk on Conservation Easement Permitted Structures Following the Full Tax Court Decision in* Pine Mountain Preserve v. Commissioner, Land Trust Alliance, last revised April 3, 2019.
- *Private Inurement and Impermissible Private Benefit Prohibitions*, Land Trust Alliance, 2017.
- *Reshaping the Energy Future: Renewable Energy and Land Trusts*, Land Trust Alliance, 2019.

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Appendix

The Land Trust Alliance provides these examples for informational purposes only. Drafters are strongly advised to work with knowledgeable local legal counsel to custom tailor this language for consistency with the easement as a whole and compliance with state and federal law and that the Alliance is not engaged in rendering legal, accounting, tax or other professional counsel.

EXAMPLE 1

Discretionary Approval

No rights-of-way, easements of ingress or egress, driveways, roads, utility lines, leases, other easements or other use restrictions shall be constructed, developed, granted or maintained into, on, over, under or across the Protected Property [1]without the prior written permission of Grantee, which may be denied, conditioned or approved in Grantee's sole discretion, except as otherwise specifically permitted under this Grant and as appear of record prior to the date of this Grant.

EXAMPLE 2

Owner's Reserved Rights. The Owner reserves the following rights:

Electric Power Generation. Subject to the process and approvals set forth herein, the right to construct, maintain, repair, improve, and remove facilities used for generation and transmission of electrical power, including but not limited to geothermal, windmills, solar arrays and other renewable energy sources, but not expand or relocate said improvements or structures; provided however, that Grantor first obtains the prior written permission of Grantee, which may be denied, conditioned or approved in Grantee's sole discretion. Placement of electrical generation improvements shall be within the Homestead *only* and shall have minimal visual impact from outside the property boundaries, as determined by the Grantee in its sole discretion. Such improvements shall be limited to those for which the sole purpose is to supply energy to the buildings on the Property. Additional electrical generation improvements are permitted with approval by [Land Trust], in its sole discretion based on its sole discretion evaluation of the protection of the purposes of this Conservation Easement. All new transmission lines shall be placed underground. No more than 0.25-acre shall be cleared for electric power generation improvements in the aggregate. No improvements shall be relocated or expanded.

Sixty days prior to the commencement of construction of or site preparation for any new, replacement or additional electrical generation or transmission improvement, the Owner shall submit to the [Land Trust] in writing for [Land Trust]'s review a proposed preliminary site plan that

[1] Capitalized text throughout these example clauses indicates a term that is defined in the larger template from which the example text is extracted. Should a land trust use any of these example clauses, be mindful of what terms require further definition or alternatively, should be replaced with other already defined terms in a land trust's easement template.

shall depict the proposed electrical generation or transmission improvement, including the layout of the site, a sketch of all improvements proposed to be constructed, details of the design and location of access roads and, if pertinent, plans for the cutting or trimming of trees and other vegetation around and between any of said improvements and access roads, and best management practices for the construction, operation and decommissioning of the proposed development. Following submission of complete information, which shall include a site map showing all of the items required in the previous sentence, the [Land Trust] shall have a period of 60 days within which to review the proposal and provide written approval or disapproval or further requests for information pursuant to Paragraphs 10 (Requests for Permission), 11 (Discretionary Consent) and 31 (Notices). Construction and site preparation may not begin prior to the issuance of said written approval. At the expiration of said 60-day period, if the land trust has not issued a determination, then the request for approval is automatically denied.

EXAMPLE 3

Definitions:

"Renewable Energy" is energy that is generated from resources that are naturally replenished at a rate that is greater than or substantially similar to the rate of depletion of the resource, if any, by such energy generation and does not contribute Greenhouse Gases to the atmosphere. Examples include energy generated from sunlight, wind, rain, tides, waves, running water and geothermal heat, and production of energy from anaerobic digesters used to convert organic agricultural wastes into biogases.

"Renewable Energy Infrastructure" is any structure or improvement associated with the generation, storage, use and delivery of Renewable Energy, including but not limited to, solar panels, wind turbines, geothermal piping, associated utilities or battery storage facilities, and fencing or such other structures or improvements as may be developed in the future to harness Renewable Energy provided that all such structures and improvements including without limitation fences are consistent with the Conservation Purposes.

Permitted Uses within the Renewable Energy Overlay

With advance written approval of Grantee, which may be denied, conditioned or approved in Grantee's sole discretion, Renewable Energy production and associated Renewable Energy Infrastructure for the purpose of generating energy for the agricultural and residential needs of the Property only is permitted within the _____-acre Renewable Energy Overlay Area (as defined by Exhibit B). Renewable Energy Infrastructure shall cover no more than a maximum of ___ acres of said Overlay area and shall be situated to minimize the amount of land that is utilized by said infrastructure all of which is subject to the prior review of Grantee , which may be denied, conditioned or approved in Grantee's sole discretion and which approval is required to be obtained by Grantor prior to undertaking any Renewable Energy Infrastructure construction, building, placement, site work, ground disturbance, vegetation removal, topography change and any and all other initiation of any preparation for such Renewable Energy Infrastructure as well as disassembly and removal and the site fully restored.

[*Size and location of Renewable Energy Overlay to be determined through in-house analysis of pertinent factors and relative size of conserved property. The preference is for the Overlay to be located in*

proximity to the Farmstead Complex in order to limit impacts on the remainder of the Property and located off of Prime Soils and Soils of Statewide Significance. If this is a federally deductible easement, this work should be documented by a third-party expert in a full siting report and included in the baseline documentation regarding lack of inconsistent use of the conserved land in order to reduce the risk of disallowance of the donation by the IRS. Please also review all funder requirements for additional documentation required.]

In seeking Grantee approval, Grantor is required to and shall submit plans to Grantee for the construction, maintenance, placement, site work, ground disturbance, vegetation removal, topography change and any and all other initiation of any preparation for such Renewable Energy Infrastructure and disassembly and removal and the site fully restored of Renewable Energy Infrastructure at least 90 days prior to submitting applications for necessary permits, and must demonstrate that the siting and use of said Renewable Energy Infrastructure will not adversely impact the Property's Conservation Values or the Purpose(s) of the Conservation Easement. As part of its review, Grantee may require Grantor to take steps to mitigate potential impacts to Conservation Values (including but not limited to best management practices for stormwater and erosion control, planting screening trees, or pollinator friendly plantings and any other activity or mitigation including project redesign without limitation on conditions that Grantee may impose in its sole discretion). Grantor is required to post a bond naming Grantee, its successors and assigns as Obligee and payee thereunder, in an amount deemed by Grantee sufficient to cover the future disassembly and removal of Renewable Energy Infrastructure from the Property and to furnish information regarding such bond to Grantee prior to commencement. Until the Renewable Energy Infrastructure is disassembled and fully removed and the site fully restored, Grantor shall maintain a bond acceptable to Grantee at all times and shall renew same prior to expiration of its term without allowing any lapse in coverage.

Following the initial installation of any approved Alternate Power Equipment, any later proposed expansion in any manner or respect shall require the Grantee's advance approval following the same process set forth herein.

For the purposes of this Conservation Easement, "Alternate Power Equipment" is any installation or improvement designed to make energy available for collection or conversion from direct sunlight, wind, running water, organically derived fuels, including but not limited to, wood and agricultural sources, waste heat and geothermal sources that can be used without depleting its source, such as, for example without limitation, solar, wind, geothermal and movement of water (hydroelectric and tidal).

Example 4

Renewable Energy/Ancillary Improvements. Without permission from the Land Trust, other improvements, including but not limited to, facilities for the generation and transmission of electrical power, such as windmills and/or [detached] solar arrays may be built within the Building Envelope. Generation of any electrical power shall be principally for use on the Property. Ancillary improvements constructed within the Building Envelope count toward the impervious surfaces limitation as set forth herein. Construction of telecommunications towers is prohibited. All energy production plans, construction and distribution contracts and other agreements must be made expressly subordinate to this Easement and to the rights of Land Trust in this Easement to protect the Conservation Values in perpetuity.

[*Limit to particular types of improvements, if appropriate. Consider whether to identify the location of these improvements even within the Building Envelope, if large or visible to the public or likely to impact wildlife, to minimize impact on conservation values. Depending on the circumstances, specify height, footprint and other limitations on the improvements and consider including a Land Trust approval requirement or a pre-construction notice requirement. Consider whether to permit telecommunications towers that are built as part of the other structures.*]

Example 5

Ancillary Improvements. Other improvements, including but not limited to, facilities for the generation and transmission of electrical power, such as a windmill and/or methane digesters may be built on the Property only for the use on the Property and only with the approval of the Land Trust, as provided herein.

[*Identify the location of these improvements, if possible, to minimize impact on conservation values. Depending on the circumstances, specify height, footprint and other limitations. Consider whether the limit to use strictly on the Property is appropriate or should be extended to adjacent properties under common ownership or another extension.*]

Example 6

Alternative Energy/Communications Structures and Improvements. Structures and improvements necessary to undertake alternative energy activities, such as wind, solar, methane, and other similar energy generation activities, as well as communications facilities, such as cell towers or 911 communications towers, are permitted as further described below, so long as they are compatible with the Purposes of this Easement, subordinate to the _____[conservation]_____ use of the Property and located in a manner that minimizes the impact to ___[primary conservation attributes, prime or statewide important soils, scenic, riparian, habitat, etc.].

(a) Building Envelope: Within the Building Envelope, Owner may construct structures and improvements limited to flat rooftop panels [and _____] without permission of Land Trust. Other structures and improvements require prior Land Trust approval as set out herein.

[*Structures that can be concealed inside or immediately adjacent to existing structures, such as a communications tower that can be inside a silo, may also be permitted without Land Trust approval.*]

(b) _____Area: Subject to the impervious surface coverage limitations set forth herein and the requirement that they affect no more than _ percent of the __ Area, such structures and improvements may be built in the ____ Area with the prior approval of Land Trust as set forth herein. Land Trust may condition approval upon the posting of a bond providing _____.

[*The size, nature and duration of the bond would depend on the structure. A bond may be appropriate for the construction period but less necessary thereafter. Consider also the need for any ongoing insurance obligation for Owner, for example, to address land restoration after a devastating storm. The size and character of the structure dictate the importance of a bond or ongoing insurance obligation.*]

(c) Location: Before selecting the location of any site for these structures and improvements, Owner shall give Land Trust an opportunity to participate in an onsite meeting to review proposed locations and any required roads by giving notice as provided herein. Owner shall comply with the State Department of [Agriculture and Markets or Environment as appropriate] guidelines for mitigation for impacts caused by construction and operation of such structures.

[*This subparagraph is usually fine if the structure and road are confined to the Building Envelope. If not, or if the envelope is large, then selection of the location should be subject to Land Trust approval. If the Granting Owner has plans to build in the immediate future, then the plans should be defined more specifically in the Easement.*]

(d) Easement Governs: All plans, construction and distribution contracts and other agreements shall be made expressly subordinate to this Easement and to the rights of Land Trust to protect the Conservation Values in perpetuity.

Example 7

Renewable Energy Generation. Construction, use, maintenance, repair and replacement of one turbine for the generation of wind energy may be permitted upon receipt of Land Trust's prior written approval (which may be granted, conditioned, or withheld in its sole discretion). When considering whether to issue such approval, Land Trust shall weigh and evaluate, among other relevant factors, the overall aesthetic impacts of the proposed turbine in the context of the surrounding landscape, the environmental impacts, the scope of its anticipated energy benefits, and upon Land Trust's request, Owner shall be required to provide Land Trust with written documentation addressing these and other matters deemed relevant by Land Trust.

[*Depending on the circumstances, include height, footprint and other limitations and consider whether to limit the location to a portion of the Property.*]

Example 8

Wind, Solar and Hydropower Energy. To the extent permitted by, and in accordance with, all then-applicable federal, state and local laws, regulations and requirements, Owner may place or construct facilities for development and utilization of wind, solar and hydropower energy resources for [residential agricultural/] use principally on the Property; provided, however, that there shall be no more than _____ structures

[*The opening clause is often used but is essentially redundant as the Owner must comply with law in any event.*]

[that may be located within the "Energy Zone" depicted on Exhibit __.]

[that may be located anywhere on the Property except in the _____.]

[that may not be located in any location where visible from _____ Road.]

[that may be no more than _____ feet in height.]

Installation of wind, hydropower and solar energy structures shall be with prior Land Trust permission as provided herein, and Land Trust shall take into consideration the impact on scenic and ecological Conservation Values and the Conservation Purposes. All plans, construction and distribution contracts and other agreements shall be made expressly subordinate to this Easement and to the rights of Land Trust to protect the Conservation Values in perpetuity. Owner and the Land Trust hereby agree this paragraph is a reasonable restriction under [applicable law].

[*Omit one or more of wind, solar and hydropower as appropriate. Consider the risks and benefits of*

relying in part on "then applicable" laws when their content is unknown when drafting the Easement. Impose any necessary restrictions or limitations in the Easement without assuming laws in the future will do so. The reference to use "principally on the Property" arises from the fact that connection to the electric grid means that excess electricity at any point will flow off the Property while insufficient electricity will be drawn from the grid. The requirement that the facilities be designed to produce electricity for use principally on the Property imposes a limit on size and scope of the facilities.]

Example 9

Community Commercial Wind Generation. The _____ [*insert general location, e.g., "ridge line at the northeast corner" or more specific designation, identify on map exhibit*] _____ on the Property may have a sufficient wind resource to be suitable for the generation of electric power. Owner and Land Trust may elect to explore wind energy production collaboratively employing ___ [one / up to ___ / no more than _____] wind turbines in partnership with _____ community with the objective of providing energy to that community and not principally for economic gain. Any such wind energy project, including the scale, location and all other conditions, shall require the prior written approval of both Owner and Land Trust, and either party may in its sole discretion withhold or condition said approval.

[*Provide for allocation of any economic benefit. Consider any limits on the size or footprint of the turbines.*]

Example 10

Possible Future Commercial Energy Production. As of the date of this Easement, Grantor and Land Trust mutually agree that current technology for commercial wind and solar energy generation, using tall and visually intrusive wind turbines and large arrays of solar panels, is incompatible with protection of the Conservation Values, and therefore, commercial alternative energy production using such technology is prohibited. If alternative energy production technology changes in the future so that alternative energy production on a commercial scale is compatible with protection of the Conservation Values and Conservation Purposes, Grantor may seek Land Trust's approval of an alternative energy production plan in accordance with _____ and taking into consideration the impact on scenic and ecological Conservation Values and Purposes. All plans, construction, distribution contracts and other agreements shall be made expressly subordinate to this Easement and to the rights of Land Trust to protect the Conservation Values in perpetuity.

[*Set out the limitations and conditions to suit the land and circumstances.*]

Appendix 2:

Considerations for Water Rights Holders Contemplating a Solar Lease

Appendix 2: Considerations for Water Rights Holders Contemplating a Solar Lease

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If you are considering a solar lease, the best place to locate a solar array is on marginal farmlands without irrigation. If this is not an option, the landowner should weigh the alternatives of what to do with any water rights that are decreed for and historically used for irrigation on the same land as the potential solar array.

Most Coloradoans have heard the maxim "use it or lose it," which refers to abandonment of a water right for non-use. Fortunately, if the project is in an area with either surface or groundwater irrigation rights, the landowner has multiple temporary and permanent options available that can either preserve the water right for future use on the farm or can provide additional income by permanently changing the water for use at a new location or for new type of use. The question of what to do with the water right – change, lease or donate all or a portion – should be addressed prior to contracting for construction of the solar project.

Landowners with water rights

All water in Colorado belongs to the public. Anyone may, however, obtain the right to use water by appropriating a specific amount of water and placing it to beneficial use, such as irrigation. Water courts recognize appropriations by entering decrees that specify the point and quantity of diversion, and the type and place of use of surface and ground water. The State Engineer may alternately authorize groundwater use by issuing a permit. Although water rights are rights of use, they are also real property in Colorado and may be transferred independently of land for different use than the original appropriation by obtaining a change decree from water court or amending a permit from the State Engineer.

Where to begin?

Do you own water rights historically used on the land proposed for energy development?

- Surface diversion rights from stream or river adjudicated by water court? or

a. Shares in an incorporated mutual and reservoir ditch company?

b. Membership in an acequia?

- Groundwater rights adjudicated by water court and/or permitted by State Engineer?
- Storage rights adjudicate by water court? or

c. Shares in an incorporated mutual ditch and reservoir company

- Do you obtain water under contract with a conservancy or conservation district? from an irrigation district?
- Do you know the historical use of your water rights?

a. Was it used fully or partially within its decreed/permitted area of use?

b. Do you have records of use?

i. For how many years?

c. Is your diversion location the same as decreed or permitted?

i. If not, do you know how far it is from the decreed or permitted location?

- Have you used your water since the last census (2020)?

a. How often and to what extent?

- Do you desire/intend to use part or all of your water rights in conjunction with the solar array?
- If you will not use your water rights while in a solar contract, do you want to retain/protect the use of your water rights in the future?
- If your water is associated with an unincorporated joint ditch company, incorporated mutual ditch and reservoir company, acequia, or irrigation district, do you need their approval to change the use of your water right, either temporarily or permanently?
- Is there anything you need to do to make sure any of your water rights are eligible for lease or other types or locations of use before installing solar arrays?

Avoiding abandonment of your water right for non-use

In Colorado, "abandonment of a water right" means the judicial termination of a water right in whole or in part as a result of the intent of the owner to discontinue permanently the use of all or part of the water. CRS § 37-92-103(2). A ten-year period of non-use creates a rebuttable presumption of abandonment. CRS § 37-92-402(11). There are, however, several ways to avoid abandonment via lease, sale, donation or legal change of use:

a. **Participation in governmental conservation program**. Any period of nonuse of any portion of a water right shall be tolled, CRS § 37-92-103(2), and no intent to discontinue permanent use shall be found for the duration that;

i. The land on which the water right has been historically applied is enrolled in a **federal land conservation program**; CRS § 37-92-103(2)(a) or

ii. The owner patriciates in:

1. A **water conservation program** approved by a state agency, a water conservation district, or a water conservancy district, or established through formal action or by a municipality or its municipal water supplier; CRS § 37-92-103(2)(b)(I) and (II)

2. An approved **land fallowing** program as provided by law in order to conserve water; CRS § 37-92-103(2)(b)(III) or

iii. A **water banking** program as provided by law. CRS §§ 37-92-103(2)(v)(IV) and 37-80.5-101 et seq.

b. **Contracting with the Colorado Water Conservation Board (CWCB) for instream flow**

i. The State Engineer can approve expedited loans of water to the CWCB for previously decreed instream flows during times of declared drought. CRS § 37-83-105. Loans are protected against abandonment and reduced consumptive use during the use of the loan. A water right owner may loan water no more than 120 days in a calendar year, no more than three years in a ten-year period, and may not renew a loan if ever exercised.

1. Any contract or agreement with the to use all or a part of a water right to preserve or improve the natural environment to a reasonable degree requires the CWCB to adjudicate the new use in water court.

c. **Temporary transfer for another place or type of use**

i. **Substitute Water Supply Plans (SWSP).** The state engineer may approve a SWSP allowing water rights owners to use water for not-yet-decreed purposes (types and places of use), as long as they provide the stream with a substitute water supply. CRS § 37-92-308.

1. The state engineer may approve SWSPs in four circumstances: (1) during water court proceedings; (2) without a water court proceeding if the plan is for a limited (five-year) duration; (3) during emergency health and welfare situations; and (4) for a third-party's use of water available as a result of their action to address a storage restriction, e.g., dam safety issue.

2. The state engineer may only approve an SWSP for one year (ninety-one days for a health or welfare emergency).For SWSPs associated with pending water court applications, annual renewals can be obtained for two more years. To obtain approval for a fourth and fifth year an applicant must demonstrate to the state engineer that the delay in obtaining a water court decree is justifiable and that not being able to continue operating under an SWSP until a decree is entered will cause undue hardship to the applicant. Upon a showing of good cause, the water judge can allow additional annual SWSP approvals beyond five years while an application is pending in water court.

3. For SWSPs not associated with a pending water court application, annual renewals may be obtained by refiling the application. Renewals are limited to a total of five years.

ii. **Interruptible Water Supply Agreements (IWSA).** IWSAs are intended for use in circumstances under which administrative approvals can maximize the beneficial use of Colorado water resources without the need for an adjudication and without injury to vested water rights or decreed conditional water rights. CRS § 37-92-309. They are intended to enable water users to transfer the HCU of an absolute water right for application to another type or place of use on a temporary basis, without permanently changing the water right.

1. An IWSA is basically a loan between water users that allows the borrower to exercise an option to use the loaned water in accordance with the agreement while the owner of the water right stops using the water.79 The amount of water available to loan is the HCU.80
2. The state engineer may approve IWSAs for up to ten years, but the option may only be exercised in three of those ten years. IWSAs may apparently be renewed for two additional ten-year terms, although there is some confusion in the statute as to whether a renewal can occur if the IWSA has been exercised during the original term.

iii. **Temporary Ag to Ag loans.** Colorado allows for one temporary loan of all or a portion of a water right decreed solely for agricultural irrigation to the owner of a similarly decreed water right on the same stream system. CRS § 37-83-105(1)(a). Loans are limited to 180 days during any one calendar year, and limited to one-time.

iv. **Fallowing-leasing pilot program**. Colorado authorizes irrigators to enter into agreements for municipal, environmental, industrial, and recreational uses of their water, in which irrigators forego irrigating parcels of land and lease the water temporarily. CRS § 37-60-115(8).

1. Pilot projects may not involve the fallowing of land more than three in ten years, or the fallowing of more than 30 percent of a farm for more than ten consecutive years.
2. The CWCB may approve (following the State Engineer's recommendations) up to fifteen pilot projects lasting up to ten years each, with two additional ten-years possible. The Pilot Program is limited to fifteen pilot projects, with no more than five in any major river basin (Arkansas, Colorado, Rio Grande and South Platte). Pilot projects cannot involve the transfer of water across the Continental Divide, or out of the Rio Grande basin.
3. The purpose of the pilot program was to develop and implement non-permanent leasing of agricultural water rights for different uses, hoping to stem permanent agricultural dry up. The program has successfully met its purpose. Now, fallowing-leasing usually uses simpler SWSPs or IWSAs.

v. **Agricultural Water Protection Water Right Act**. The Agricultural Water Protection Water Right Act (the "AWPWRA") provides a mechanism for water users to quantify the Historic Consumptive Use of a senior irrigation right and to enter into annual leases of up to 50 percent of the identified consumptive uses. These rights are limited to the South Platte and Arkansas River Water Divisions, although no one has taken advantage of the statute. CRS §§ 37-92-305(19) and 37-92-308(12).

d. **Permanent change of water right for your use at a different location or purpose**

i. A Colorado water right is a right to use beneficially a specified amount of water from the available supply of surface water or tributary groundwater that can be captured, possessed, and controlled in priority under a decree, to the exclusion of all others not then in priority under a decreed water right. *Santa Fe Trail Ranches v*. Simpson, 990 P.2d 46 (Colo. 1999).

ii. The appropriator may transfer the water right to another place or type of use but a transfer must be accomplished (1) "by proper court decree," (2) only for "the extent of use contemplated at the time of appropriation" and (3) "strictly limited to the extent of former actual usage." *Green v. Chaffee Ditch Co*., 371 P.2d 775 (Colo. 1962).

iii. Changing a water right requires application and approval of the water court. The applicant has the burden of demonstrating that the change will not injure other water rights, i.e., result in an expansion of use or decrease historical return flows to the stream system that others relied upon. Anyone may oppose an application in water court, and change cases are often protracted, expensive, and it's not just a cliché that the owner leaves water court with less water than they entered in order to settle with objectors.

1. Changing a water right requires an engineering analysis of historical consumptive use (HCU), i.e., the amount of water consumed by the beneficial use. That use would typically be the amount of water consumed by irrigating crops over a reasonable period of time – usually 20 or more years. Only historical use for decreed purposes and places of use count towards transferrable HCU.

2. Anyone changing the type or place of use must maintain historical return flow patterns to protect other users from injury. For example, crops may consume 40 to 85% of the water applied (depending on irrigation method); the unconsumed water then returns to the stream over some period of time, which return flow must be maintained after a change.

3. Limiting the use of a changed water right by its HCU avoids enlargement of the right and maintaining the historical return flow prevents injury to other water rights.

iv. Many ditches are "Catlinized," i.e., require approval of the ditch company for any change of use outside the ditch system in order to protect other ditch users from injury from reduced flow of carriage water in the ditch to deliver water. (The name comes from the Catlin Ditch, the first ditch to secure water court approval of such a requirement). Approval may be difficult to obtain so start discussions as soon as possible.

v. While the same process applies to changes of conditional water rights, decreed rights not yet put to use, it is more difficult because most river basins are over-appropriated, i.e., there are more decreed rights than wet water available so proposed changes are. intensely scrutinized. The "contemplated draft" (expected beneficial consumptive use) of a conditional water right is basis and measure of the right in lieu of an HCU analysis.

Options if you won't need all of your water right in the future

Although alternate energy development on your land will probably require taking some land out of irrigation, it may not require discontinuing irrigation in total. If not, you could permanently change the use of formerly used irrigation water for use in a different location, say another farm you own, or another use, a fish farm for example. The water court process described immediately above can be used to change a portion of a water right, or one or more water rights out of a portfolio of water rights.

Additional information concerning avoiding abandonment of your water right can be found below.

Governmental conservation programs	Federal: CRS § 37-92-103(2)(a) State & local: CRS § 37-92-103(2)(b)(I) & (II)
Land fallowing-leasing	CRS § 37-92-103(2)(b)(III); CRS § 37-60-115(8) & https://cwcb.colorado.gov/fallowing-leasing-pilot-projects
Water banking	CRS §§ 37-92-103(2)(v)(IV) & 37-80.5-101 *et seq*
Colorado Water Conservation Board (CWCB) instream flow leases	CRS § 37-83-105 & https://cwcb.colorado.gov/instream-flow-water-acquisitions
Substitute Water Supply Plans (SWSP)	CRS § 37-92-308 & https://dwr.colorado.gov/public-information/policies-and-guidelines, *see* Policy 2003-08-12
Interruptible Water Supply Agreements (IWSA)	CRS § 37-92-309
Temporary ag-to-ag loans	CRS § 37-83-105(1)(a)
Agricultural Water Protection Water Right Act	CRS §§ 37-92-305(19) & 37-92-308(12); *see also* https://cwcb.colorado.gov/agricultural-water-protection-right
Change of water right	CRS § 37-92-102(5) & CRS § 37-92-302

Contacts for assistance with finding a new use for your water to avoid abandonment

- Principal private non-profit water conservation organizations:
  - Colorado Open Lands: https://coloradoopenlands.org/
  - Colorado Water Trust: https://coloradowatertrust.org/
  - Colorado Trout Unlimited: https://coloradotu.org/
  - The Nature Conservancy in Colorado: https://www.nature.org/en-us/about-us/where-we-work/united-states/colorado/

- State and regional governmental conservation agencies:
  Colorado Water Conservation Board: https://cwcb.colorado.gov/
  Colorado water conservation districts:
    - Colorado River Water Conservation District: https://www.coloradoriverdistrict.org/
    - Republican River Water Conservation District: https://republicanriver.com/
    - Rio Grande Water Conservation District: https://www.rgwcd.org/
    - Southwestern Water Conservation District:https://swwcd.org/

  Principal Colorado water conservancy districts active with water conservation:
    - Conejos Water Conservancy District: https://www.conejoswcd.org/
    - Lower Arkansas River Water Conservancy District: https://www.lowerark.com/
    - Northern Colorado Water Conservancy District: https://www.northernwater.org/
    - San Luis Valley Water Conservancy District: https://slvwcd.org/
    - Upper Arkansas Water Conservancy District: https://www.uawcd.com/
    - Upper Gunnison Water Conservancy District: https://ugrwcd.org/
    - Upper Yampa Water Conservancy District: https://upperyampawater.com/

  Colorado Division of Water Resources (water administrative agency)

Appendix 3:

Colorado State Land Board Renewable Energy Leasing Policy

Appendix 4:

Colorado State Land Board Renewable Energy Leasing Policy

STATE OF COLORADO
State Board of Land Commissioners

RENEWABLE ENERGY LEASING POLICY — Policy No. 300-003

Original Issue: March 2014	Last Reviewed/Revised: July 2021	Page 1 of 4

OBJECTIVE

To promote renewable energy development on state trust lands in a manner that generates market based revenue, is compatible with other current and future uses, and minimizes impacts to natural values and agricultural lands.

AUTHORITY

The Constitution of the State of Colorado, Article IX, Section 10 requires the Colorado State Board of Land Commissioners (State Land Board) to prudently manage the assets it holds in trust in order to produce reasonable and consistent income over time while protecting and enhancing the long term value and productivity of these assets through the application of sound stewardship.

C.R.S. § 36-1-147.5 requires the State Land Board to assess its assets, and identify and promote those properties deemed appropriate for renewable energy development, working with federal and state agencies as necessary to realize economic value for the School Trust.

State Land Board Strategic Plan (June 2019)

Strategic Goal 1: Financial Trusteeship

Protect and enhance the long-term economic value of the whole trust.

Strategic Objective 1Fa: Increase renewable energy leasing on state trust land in order to contribute to the state's goal of moving the electric grid to 100% renewable sources by 2040.

Strategic Goal 2: Real Property Stewardship

Protect and enhance the long-term economic value of the trust's physical assets.

Strategic Objective 2A: Apply high standards of care on all state trust land to ensure long-term health and productivity of natural values.

ACCOUNTABILITY

Director, Real Estate Section Manager, and Renewable Energy Program Manager

SCOPE

I. Application Review

A. Wind and Solar Planning Leases

Planning leases allow the lessee to conduct research on a potential future renewable energy production site and do not allow production facility development.

1. New Planning lease applications are reviewed by the Program Manager, Line of Business Managers, Stewardship Trust Manager, and the appropriate District Manager to identify any potential conflicts with other uses and to determine whether the proposed use is in the best interest of the associated Trust.
2. Prior to approval of a Planning lease, Staff makes all reasonable efforts to review the proposal with any lessee holding a State Land Board agriculture lease on the affected property.
   a) Staff solicits comments from the agriculture lessee on how it may be impacted.
   b) Staff considers comments when making recommendations to the Board.

B. Utility Scale Solar Lease Location Considerations
   1. Utility scale solar production facilities are larger than 320 acres in size.
   2. Utility scale solar facilities are not permitted on state trust land leased for dryland or irrigated crop production or on land designated into the Stewardship Trust.
   3. Staff directs developers of proposed utility scale solar facilities to state trust land that:
      a) Has adequate solar resources to support the proposed project based on data published by the National Renewable Energy Laboratory (NREL).
      b) Is located within five miles of an electrical substation, switchyard, or transmission line with capacity greater than 200 kilovolts.
      c) Has average annual forage production of less than 1,250 pounds per acre based on data published by the National Resource Conservation Service (NRCS).

C. Wind and Solar Production Leases

   Prior to construction of facilities allowed by a new Production lease the Board requires all applicants to contact local government entities with jurisdiction and secure all required permitting.

D. Compatibility
   1. Staff reviews proposed projects for compatibility with all other existing leases and future potential uses for the property.
   2. The Stewardship Trust Manager and/or Conservation Services Manager completes an assessment of compatibility with natural values.
   3. The Renewable Energy Program Manager and/or District Manager confirms legal and/or practical access.
   4. Staff consults with other (non-agriculture) lessees on the property when Staff determines it is appropriate.

II. Management Practices

A. Production leases include site development, construction, operation, and management requirements based on best management practices for specific renewable energy technologies.

B. If Staff identifies issues of potential resource concern, Staff will consult with the most appropriate agency resources and/or outside advisors (e.g. Colorado Parks and Wildlife) to determine an appropriate course of action.

C. Staff inspects the premises of all leases at appropriate regular intervals during the term of the lease to determine lease compliance.

III. Lease Terms

The following lease terms are reviewed and modified as appropriate by the Board no less frequently than every three years.

A. Length of Term
   1. Planning Leases
      a) Solar Gardens: Up to two (2) years with Staff's ability to approve a one (1) year extension.

b) Utility Scale Solar and Wind: Up to three (3) years with Staff's ability to approve a one (1) year extension.

c) Planning leases do not create an obligation or guarantee the Board will grant a Production lease.

2. Production Leases

a) The Board shall consider all lease term lengths in excess of the Power Purchase Agreement on a case-by-case basis.

B. Exclusivity of Use

Staff shall have the authority to approve leases that are exclusive or non-exclusive to other renewable energy lessees.

C. Minimum Pricing

1. Planning Leases

a) The minimum annual rental for the first year is $2,000 per site.

b) The minimum annual rental price shall never be less than $10 per acre.

c) For parcels in the single or in the aggregate, larger than 200 acres, Staff may increase the annual rental rate if market data supports a higher rate.

d) Multi-year leases will include a provision for an increased rate for each year after the first year.

2. Production Leases

a) Minimum annual rental rates will be based on lease rates achieved by other landowners participating in the same project and/or based on the market in which the project is located.

b) The minimum rate for one-time bonus payments is $1,500 per MW installed.

c) The minimum standard rates for lease assignments

i. Solar Garden: $1,000/acre

ii. Utility Scale Solar: $500/acre

iii. Wind: $500/acre

3. Staff periodically reviews information regarding lease rates obtained by other government agencies and private landowners and determines whether the rates for leases on state trust land will be adjusted.

D. Performance Bond

1. Any work conducted on the property during the term of any Planning or Production lease will require the lessee to obtain a performance bond as specified in the lease.

2. Staff approves final site reclamation prior to the release of bonds.

E. Insurance

Lessee shall comply with the insurance requirements mandated by the State Office of Risk Management.

IV. Lease Management

A. Staff may approve Planning leases, for wind generation projects, solar generation projects smaller than 320 acres in size, utility scale solar generation projects that meet all of the criteria described in paragraph I.B.3, related exploration permits, amendments, assignments, renewing leases and extensions.

B. If a co-located State Land Board agriculture lessee objects to a planning lease, the Planning lease is presented to the Board for decision.

C. The Board approves all new Production leases, Production lease renewals, and Production lease extensions.

V. Policy Review

This policy is reviewed and modified as appropriate by the Board no less frequently than every three years.

STATE BOARD OF LAND COMMISSIONERS

Christine Scalan, President

Date

Appendix 4:

Colorado Parks and Wildlife Best Management Practices for Solar Energy Development

Appendix 3:

Colorado Parks and Wildlife Best Management Practices for Solar Energy Development

COLORADO
Parks and Wildlife
Department of Natural Resources

Colorado Parks and Wildlife Best Management Practices for Solar Energy Development

Colorado Parks and Wildlife has a statutory responsibility to manage all wildlife species in Colorado. As such, we encourage protection for Colorado's wildlife species and habitats through responsible energy development and land use planning. Protection of core wildlife areas, quality fisheries and habitat, big game production and winter range, and other sensitive wildlife habitats are of highest importance. CPW is not a decision-maker with regard to energy development permitting. Instead, CPW provides recommendations to local, state, and federal regulatory agencies on ways to *avoid, minimize, and mitigate* impacts from development and land use changes, with the goal of providing for the long-term conservation of wildlife and wildlife habitats across the State of Colorado.

Impacts to wildlife will result from all forms of development. However, projects that are large in scale, expand development into remote or previously undisturbed areas, displace wildlife from crucial habitat, or cause a significant loss of habitat are of greater concern. Due to the large land requirements and the projected rate of development, utility-scale solar has the potential to significantly impact wildlife populations in Colorado. CPW encourages a scientific approach to siting decisions and careful consideration of the impacts to habitat necessary to sustain Colorado's wildlife populations. The recommendations in this document are intended to promote responsible development of large scale solar projects, upholding Colorado's responsibility to wildlife while supporting the renewable energy and climate change goals and standards set forth by the State of Colorado.

1. **Assessment of Potential Adverse Effects.** *The development of utility-scale solar energy facilities results in large-scale land use and potentially significant impacts to habitat and wildlife. The impacts to wildlife are influenced by the project size, location, and type of solar technology installed.* CPW takes a site-specific approach to assessing impacts of large-scale solar project development and presumes that habitat within the project footprint will become inaccessible to most wildlife and a functional loss within the larger landscape. In collecting information for a new solar project CPW recommends that the proponent conduct pre and post-development surveys that assess and measure wildlife utilization of the site in order to evaluate how the lost habitat may impact wildlife species.

2. **Alignment and Compliance with Colorado Public Utilities Commission (CPUC) Rule 3668-Environmental Impacts.** New renewable energy projects are required to follow CPUC Rule 3668 and conduct pre-development wildlife surveys, use these surveys to avoid, minimize and mitigate potential impacts to wildlife and their habitats, and work with CPW in the design of their project.

3. Avoiding/Minimizing Impacts. *In selecting sites for construction, focus on options that avoid high priority wildlife habitats over the use of mitigation strategies*. Impacts to wildlife will be lessened when solar development occurs on lands that have been previously disturbed and at locations within and adjacent to developed areas. Areas that exhibit high levels of wildlife use within the project area would benefit greatly by not placing facility infrastructure, including transmission lines, adjacent to or over such areas. Locally, micro-siting of infrastructure may be effective in minimizing losses to habitat and wildlife. If all measures for avoiding impacts are taken and prove insufficient to adequately protect wildlife and their habitat, then CPW recommends appropriate minimization and mitigation strategies be identified and implemented in consultation with CPW.

4. Habitat Loss and Fragmentation. *Habitat loss and fragmentation are significant concerns regarding solar development.* Minimizing the project footprint can help reduce the impacts to wildlife. CPW recommends that the developer consolidate facilities and roads to the extent possible to minimize the amount of land that is disturbed and fragmented. Perimeter fencing of the facility is of particular concern in addition to the extensive infrastructure of solar projects as a whole. Early consultation with CPW is recommended to identify high priority habitat that could be impacted by a project. CPW maintains a list of species-specific high priority habitats (HPH) in Colorado along with recommendations for management actions that may be implemented to avoid, minimize, and mitigate impacts to wildlife during land use development. CPW's recommendations were developed internally by a team of subject matter experts, are reviewed regularly, and are publicly available on CPW's website. High priority habitats include those that support state species of concern and Species of Greatest Conservation Need (SGCN) identified in Colorado's State Wildlife Action Plan and habitats that support wildlife during critical life stages. Because riparian areas are important habitats for a variety of wildlife and provide important wildlife movement corridors, a layout that maintains riparian access and connectivity for wildlife is preferred. Riparian areas within the proposed project area may be of particular concern given the limited availability of this habitat in some areas and the proportionally high use by many different species. Similarly, playas provide important habitat for waterfowl and other bird species, reptiles, bats, and amphibians. Placement of infrastructure within or near playas could impact wildlife habitat, increase avian collision risk, and alter playa hydrology. CPW recommends that projects with impacts to large playas and high priority playa clusters follow the Best Management Practices as put forth by Playa Lakes Joint Venture. If site development equates to a significant loss of habitat for any wildlife and/or a barrier to wildlife movement across the landscape, CPW may recommend project-specific compensatory mitigation. CPW recommends that any compensatory mitigation, including projects funded with monetary compensation, occur in the same geographical area as the impacts. A comprehensive statewide standard compensatory mitigation program would help address the significant habitat impacts resulting from anticipated future solar development throughout the state.

5. Study Protocols and Monitoring. *Consult with CPW for review and comment on wildlife and habitat survey protocol before the protocol is finalized.* CPW recommends that surveys be conducted to determine the site use and temporal and spatial distribution for wildlife that are potentially impacted by the development. The minimum recommended length of study for both pre and post-construction surveys for utility-scale solar projects is one year. It is recommended that pre-construction and construction/post-construction monitoring be conducted using similar methods, so that valid comparisons can be made. CPW requests the opportunity to comment on baseline or impact surveys, as well as amendments made to infrastructure/facility placement, county permit requirements, or recommendations. CPW encourages developers to be proactive in bringing plans for additional phases or developments to our attention prior to establishing infrastructure placement and routing. Proactive, cooperative efforts will identify concerns early in the project so that they may be appropriately addressed prior to final planning and construction. CPW requests the developer/operator provide pre-construction and post-construction reports with all forms of raw data collected at onset, during, and post construction surveys to CPW's Regional Energy Liaison in a timely manner.

6. Wildlife Protection. The development of new solar energy project sites could impact wildlife diversity and regionally unique habitat types. CPW recommends that sensitive wildlife species and high priority habitat features be identified and buffered when considering infrastructure placement and operation, especially during critical nesting periods. We suggest continued contact with CPW representatives throughout the planning process to determine specific sensitive areas for each of these species.

The species listed below are suggested as examples only. Please consult with CPW regional staff for site-specific impacts and recommendations.

o **Big Game Species.** *It is recommended that developers work with CPW to identify high priority habitat for ungulate species within the proposed project area.* CPW recommends avoiding development in big game winter range, parturition areas, and migration pathways or pinch points. Loss of habitat elsewhere within the range of big game species should be evaluated for impacts, including implications for wildlife management.

o **Raptors.** *Identify raptor nests within the project area and implement an appropriate buffer from solar infrastructure and transmission lines. During nesting periods, observe timing stipulations for construction activities located near nests.* Raptor species included in CPW's high priority habitat list include bald and golden eagles, Ferruginous hawks, prairie and peregrine falcons, goshawks, and Mexican spotted owls. Raptors are likely to use any trees or larger rock escarpments for nesting or perching. Prairie dog towns located in the project area provide excellent foraging habitat for numerous resident and migratory raptors as well as shelter and nesting habitat for burrowing owls. By affording these areas a buffer when considering infrastructure placement, impacts to raptor species can be greatly reduced. Species-specific recommendations are available in CPW's Recommended Buffer Zones and Seasonal Restrictions for Colorado Raptors (attached).

o **Migratory Birds.** *Consultation with the US Fish & Wildlife Service (USFWS) is recommended to ensure compliance with the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act.* The best way to avoid impacts on the nesting efforts of migratory birds is to focus construction activities outside of the breeding season. For the majority of species that breeding season would be within the time frame April 1 to August 31. If construction must occur during the breeding season, CPW recommends surveys for active nests be conducted prior to ground disturbance. All migratory birds are protected under the MBTA and removal or disturbance of any active migratory bird nest requires consultation with USFWS prior to disturbance.

o **Grouse species (Gunnison sage-grouse, Greater sage-grouse, Columbian sharp-tailed grouse, Plains sharp-tailed grouse, Greater prairie-chicken, Lesser prairie-chicken).** *Consult with CPW to site infrastructure, including transmission lines, away from breeding and production areas.* Grouse species are known to avoid areas of man-made disturbance, including tall structures, such as transmission towers and buildings. Roads contribute traffic noise and the possibility of collision. Such infrastructure could be a factor in the abandonment of leks, failure of nests, and reduced brood-rearing success, and thus, appropriate setbacks are recommended. Consult with CPW for species-specific recommendations for buffers from leks, buffers from brood rearing habitat, and any associated timing stipulations. ***Gunnison sage-grouse:*** *The Gunnison sage-grouse is listed as a threatened species by the USFWS. The USFWS has produced a map of Critical Habitat for the species. In some situations (where the landowner has a federal nexus) the landowner (and perhaps the operator) may need to consult with the USFWS.*

o **Mountain plover and long billed curlew.** *Identify habitat and plover/curlew nests within the project area, and plan construction activity outside of critical nesting periods, April 1st through August 15 where these species are found.* Mountain plovers can nest in short-grass prairie, dryland cultivated farms, and prairie dog towns. Long billed curlews can nest in short grass prairie. *Mountain Plover and Long Billed Curlew are Colorado species of special concern.*

o **Burrowing owls.** *All prairie dog towns within and adjacent to the proposed project should be located prior to construction. If any prairie dog colonies are located within the project area and development in prairie dog towns will occur between February 1 and October 31, CPW recommends surveys to determine the presence/absence of burrowing owls.* If nesting burrowing owls are present, CPW recommends no permitted or authorized surface disturbing activities within 660 feet of a burrowing owl nest during the nesting season (March 15 - August 31) and buffers of 0.25 mile for large industrial disturbances. If burrowing owls merely occupy the site, it is recommended that earthmoving and other disturbance activities be delayed until late fall after they have migrated. *Burrowing Owls are protected under the MBTA and are a State Threatened Species.*

o **Bats**. *Acoustic monitoring of bats is recommended for areas with habitat for bats, near water bodies, and near where bats roost.* Acoustic monitoring is recommended for spring and fall seasons. It is recommended that all survey data collected be accessible and provided to CPW.

o **Kit fox:** *Identify and avoid maternal kit fox den sites.* CPW recommends surveys of suitable kit fox habitat for active dens prior to surface disturbance. If dens are present, we recommend the operator avoid surface disturbance within 0.25 mile of den sites while young are den dependent (approximate dates: Feb 1 to May 1). Any disturbance or destruction of dens while young are dependent would be detrimental to the species.

- **Reptiles and amphibians.** *Identify high priority reptile and amphibian habitat, including escarpments, ephemeral ponds, and wetlands, and avoid during construction and when siting infrastructure*. With an increase in roads and traffic, reptiles and amphibians could be negatively impacted within the project area. CPW recommends the "construction and operational considerations" portion of this document be considered to minimize impacts to these species.

7. Construction and Operational Considerations. During construction and operations, CPW recommends limiting vehicle speeds to 25 mph on project roads. CPW also recommends that the construction plan minimize the amount of exposed or open trenches. If spans of trenching will be open for extended periods of time CPW recommends the installation of trench plugs, earthen ramps, or other means as necessary to ensure that open trenches do not trap wildlife or impair wildlife movements. During operations, CPW may have site-specific suggestions on limits for on-site visit frequency and timing by service personnel, especially during critical nesting periods, to minimize impacts to wildlife. In consultation with CPW, projects should include training for construction and operations personnel on wildlife laws and enforcement. We also recommend providing education on wildlife issues, such as where species might be found, and at what time of day. During the operational phase, CPW recommends the operator provide staff training in documenting wildlife mortalities and notifying local wildlife officials in a timely manner.

8. Weed Management. *Weed control measures should be conducted in compliance with the Colorado Noxious Weed Act, C.R.S. §35-5.5-115 and the current rules pertaining to the administration and enforcement of the Colorado Noxious Weed Act.* CPW recommends the developer actively eradicate noxious weeds, and develop and implement a noxious weed and re-vegetation management plan where there will be disturbance due to construction or maintenance activities. Care should also be taken to avoid the spread of noxious weeds, and all construction equipment should be cleaned prior to leaving the site. CPW would appreciate the opportunity to review the project's Noxious Weed Management Plan prior to the start of construction.

9. Security Fencing and Lighting. *The CPW publication "Fencing with Wildlife in Mind" is available for your consideration and review when designing fencing for a project.* CPW is aware that the solar project may include security fencing. The typical specifications for security fencing make this fence type exclusionary for most wildlife. In these cases CPW requests that the project design adhere to the recommendations for exclusionary fencing that are safe for wildlife. If wildlife exclusion fencing is installed, CPW requests that efforts be taken to avoid entrapping wildlife within the facility during construction of the fence and that the solar facility be checked regularly or structures installed to allow animals to escape, in the unlikely event that a deer or other wildlife becomes trapped in the facility. CPW recommends any non-security fencing on the project site be wildlife friendly. CPW also recommends that any security lighting be designed to minimize light pollution and take into consideration lighting initiatives that aim to reduce impacts to wildlife.

10. Transmission Line Development. *CPW recommends new transmission lines be co-located with existing transmission lines or infrastructure corridors whenever possible to minimize additional impacts on wildlife and reduce habitat fragmentation.* Of high concern regarding electrical transmission lines is the potential for collisions and raptor electrocution. The Edison Electric Institute and the Avian Power Line Interaction Committee, in cooperation with the USFWS, have developed Best Management Practices to minimize impacts to avian species. CPW recommends that both the *"Suggested Practices for Avian Protection on Power Lines, the State of the Art in 2006"* and the *"Reducing Avian Collisions with Power Lines: The State of the Art in 2012"* documents be consulted for proper design considerations to minimize raptor electrocution. These documents can be ordered at the Edison Electric Institute website (www.eei.org) or can be downloaded at the Avian Power Line Interaction Committee website (www.aplic.org). This recommendation is applicable to all segments included in the project.

11. Avian Fatality Risk. *Proximity of the project site to rivers, reservoirs, migratory stop-over habitat, and habitat for wintering roosts for bald eagles may be a factor in the overall risk to birds.* Waterfowl and other avian species that utilize the area during migration may be at risk of collision with solar panels. There are also technology-specific factors associated with avian fatality risk at solar facilities and the final site plans could influence the potential risk for birds at the location. Any industrial surface water or evaporation ponds associated with the site could increase the risk to wildlife on the installation either due to toxicity issues or by acting as an attractant. CPW recommends a site design that prevents wildlife access to any artificial water sources associated with the project that could be a risk to wildlife. In locations with high avian migration and use and where there is a potential risk to avian species, CPW recommends development of a post-construction monitoring program in accordance with the USGS 2016 report Mortality Monitoring Design for Utility-Scale Solar Power Facilities. Design adjustments or additional features to mitigate collision or other fatality risks may be requested if fatalities related to on-site concerns are identified during monitoring.

12. Reclamation and Decommissioning. *Reclaim areas disturbed by construction and develop long-term decommissioning and reclamation plans in the event that it is decided to decommission any infrastructure of the facility.* CPW prefers that native vegetation be retained on site during the operational lifespan of the project, both as habitat for wildlife and to ensure successful reclamation of the project area. Proper reclamation, from a wildlife perspective, involves not only stabilizing the soil and establishing ground cover, but fostering plant communities with a diversity of species and plant types -grasses, woody plants, and broadleaf forbs- which will fully serve the nutritional and hiding cover needs of wildlife. Areas should be reclaimed with seed for native vegetation appropriate for the site, as recommended by CPW and the local Natural Resources Conservation Service office. CPW recommends that decommissioning plans include (but not be limited to) timing of decommissioning individual or project wide infrastructure and plans to reclaim areas back to pre-construction conditions.

Appendix 5: Colorado Open Lands' Template Language applied in the context of solar development

Utility Improvements. Existing energy generation or transmission infrastructure and other utility improvements, including but not limited to: (i) natural gas distribution pipelines, electric power poles, transformers, and lines; (ii) telephone and communications towers, poles, and lines; (iii) septic systems; (iv) domestic water storage and delivery systems; and (v) energy generation and storage systems including, but not limited to, wind, solar, geothermal, or hydroelectric ("Utility Improvements"), may be repaired or replaced with an improvement of similar size and type at their current locations on the Property without further approval from Grantee. Existing Utility Improvements may be enlarged and new Utility Improvements may be constructed on the Property, subject to the restrictions below.

> ***Within the Building Envelope(s).*** Grantor may enlarge or construct Utility Improvements within the Building Envelope without further approval of Grantee, provided that no Utility Improvements exceed thirty-five (35) feet in Height.
>
> ***Outside of the Building Envelope(s).*** Grantor shall not enlarge or construct Utility Improvements outside of the Building Envelope(s) without approval of Grantee, pursuant to Section 23 (Grantee's Approval) of this Deed. Any permitted Utility Improvement shall be no more than thirty-five (35) feet in Height.
>
> ***Additional Requirements.*** Following the repair, replacement, enlargement or construction of any Utility Improvements, Grantor shall promptly restore any disturbed area to a condition consistent with the Purpose. Any easement, right of way or other interest granted to a third party or otherwise reserved, to be used for Utility Improvements is subject to Section 8.9 (Easements, Rights of Way or Other Interests) of this Deed.
>
> ***Generation of Excess Energy.*** Any energy generated on the Property in accordance with this Section 6.2.5 (Utility Improvements) that incidentally is in excess of Grantor's consumption may be sold, conveyed, or credited to a provider of retail electric service to the extent permitted by Colorado law.

In addition to this utility section, referenced sections such as easements and approval, also apply, as would other sections that may not be referenced, but may still apply to a particular proposal, such as roads or impervious surface limitations.

Appendix 6:

American Farmland Trust Colorado Agrivoltaics Farmer Survey Findings and Initial Recommendations

COLORADO AGRIVOLTAICS SURVEY REPORT

FARMER SURVEY FINDINGS & INITIAL RECOMMENDATIONS

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September 20, 2024

AGRISOLAR CONSULTING
Prepared for: AMERICAN FARMLAND TRUST

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Executive Summary

The "Colorado Agrivoltaics Outreach and Engagement Project," led by the American Farmland Trust (AFT) in collaboration with Agrisolar Consulting, Colorado Open Lands, and Colorado State University Extension, was designed to advance understanding of Colorado agricultural sector interests and concerns with agrivoltaics. The project's central effort was to deploy a survey that targeted 6,000 producers across the state. The survey received approximately 300 responses, which provided valuable, novel information on producer attitudes and awareness regarding agrivoltaics. Key takeaways from the survey data include significant concerns among Colorado producers about the negative impacts of climate change on farming and a strong preference for siting solar projects on less productive or underutilized farmland. The importance of continued farming activity and land restoration after solar projects was also emphasized. Further, the survey findings suggest that providing financial incentives and improving the environmental benefits of projects can increase adoption and support for agrivoltaics. These results underscore the need for targeted education, technical assistance, and supportive policies to promote agrivoltaics as a viable solution for integrating renewable energy with agricultural practices in Colorado. By addressing the concerns and promoting the motivations of the agricultural community highlighted by this survey, Colorado can better advance its renewable energy goals while maintaining agricultural viability and sustainability through agrivoltaic solutions.

Objectives of this report:

1. **Elevate Farmer Perspectives**: Gather and analyze farmer perspectives regarding the implementation and impact of agrivoltaic systems.
2. **Identify Barriers and Opportunities**: Identify the key barriers to and opportunities for the adoption of agrivoltaic systems, providing a comprehensive understanding of the landscape.
3. **Assess Demographic Differences**: Examine the perceptions and attitudes towards agrivoltaic systems across different demographic groups to tailor strategies effectively.
4. **Interpret Survey Results:** Analyze survey data to identify trends and patterns in stakeholder responses.
5. **Conduct Impact Assessment**: Based on survey results, assess the potential environmental, economic, and social impacts of agrivoltaic systems. Determine the perceived benefits and drawbacks of agrivoltaic systems from the perspective of different stakeholder groups.

6. **Develop Recommendations for the Future:** Based on survey findings and stakeholder feedback, identify gaps in current knowledge and propose areas for future research, engagement, and policies that support agricultural producers.

Keywords: Agrivoltaics, Photovoltaics, Solar, Agriculture, Renewable Energy, Sustainability, Land-Use, Colorado, Farmland Conservation, Farm Viability, Agriculture, Energy, Climate Resistance, Survey, Farmer Attitudes, Producer Awareness

Recommendations for Promoting Agrivoltaic Systems in Colorado

Prepared for the Colorado Department of Agriculture

1. **Educational Outreach:** Partner with Colorado State University Extension and other trusted organizations to facilitate peer-to-peer learning and novel demonstrations through workshops, training courses, and informational materials that explain the benefits, costs, installation considerations, long-term land lease agreement options, and life cycle analysis of agrivoltaic systems.

2. **Technical Assistance:** Establish a technical assistance program to support producers by leading feasibility studies, site assessments, and project planning services for agrivoltaic installations.

3. **Incentives:** Introduce targeted tax incentives, grants, and low-interest loan programs to reduce the initial investment by developers required for agrivoltaic systems, which would make projects more accessible to a wider range of farmers and landowners. Provide additional funding or incentives for agrivoltaic projects that incorporate multiple co-benefits, such as water conservation, crop production, habitat creation, diversification, or community benefit agreements.

4. **Partnerships:** Create inter-agency and cross-sectoral partnerships to foster collaboration between state government agencies, academic research institutions, agricultural producers, electric utilities, and solar developers. This could include public-private partnerships and joint funding opportunities for shared research and demonstration projects across Colorado's diverse geographies, and across community and utility-scale projects.

5. **Regulation:** Work with local governments to create clear zoning regulations and land-use policies that enable agrivoltaic projects, ensuring that ground-mounted solar is an acceptable agricultural land use if projects meet agrivoltaic objectives.

6. **Sustained Stakeholder Engagement:** Manage regular communication channels and discussion forums through surveys, focus groups, and advisory committees to gather input from farmers, landowners, and other stakeholders and to co-develop state research and development priorities. This engagement can be used to proactively adjust policies and programs as needed.

7. **Accessibility to Information:** Develop a long-term outreach and engagement toolkit that is composed of several resources for the agricultural community, and can be used by CDA, CSU Extension, and other organizations. As part of the engagement toolkit, an online resource portal can provide access to peer-to-peer learning opportunities, research findings, technical guides, research & demonstration plots, funding opportunities, and best practices in Colorado for agrivoltaics.

8. **Just Transitions, Equity, and Inclusion**: Ensure that research and partnerships actively focus on promoting diversity, equity, and inclusion to enhance broad participation and ensure the benefits of agrivoltaic systems are accessible to all communities.

Project Impact / Overview

Over the next three decades, the transition from a fossil-fuel-dependent electric power sector to a distributed and decarbonized energy network will be driven by market dynamics and ambitious state and federal policies. Solar and other forms of renewable energy are more cost-competitive than ever before; coupled with policies aimed at addressing climate change that require substantial increases in renewable energy, primarily solar, the United States is projected to experience a large-scale deployment of solar in the near future. A U.S. Department of Energy's Solar Futures study projects that solar energy could rise from 4% to 45% of the nation's total energy production by 2050 (DOE, 2021). In Colorado, the Greenhouse Gas Pollution Reduction Road Map aims for a 90% reduction in greenhouse gas emissions from 2005 levels, necessitating significant

increases in solar photovoltaic (PV) capacity, bolstered by funding and tax incentives from the Inflation Reduction Act.

Achieving these energy goals could require nearly 7.4 million acres by 2040 and over 10 million acres by 2050, with approximately 90% of this development projected to occur in rural communities (DOE, 2021). According to modeling by the American Farmland Trust's *Farms Under Threat* report, 83% of new solar installations by 2040 could be sited on agricultural lands, with almost half on highly productive land for food and crops (AFT, 2023). In Colorado, ongoing urban and peri-urban development pressures could lead to the loss or conversion of 417,500 acres of farmland and ranchland by 2040 (AFT, 2023). This displacement could negatively impact agricultural productivity, farm viability, and food security while increasing adverse environmental and rural development impacts. Solar development in rural areas can reshape landscapes and economies, potentially generating public backlash and slowing decarbonization efforts.

Agricultural producers in Colorado face challenges such as drought and water supply issues, which could result in more fallowed land. Multi-benefit land repurposing projects, including Smart Solar and agrivoltaics, are key to enhancing agricultural resilience to climate change. This project aimed to engage and support Colorado's agricultural producers by promoting agrivoltaics as a strategy for renewable energy deployment, while also ensuring farm viability and protecting productive agricultural lands.

The project involved extensive outreach and engagement with Colorado farmers and ranchers to understand their awareness, attitudes, interests, and concerns in agrivoltaics. This report assesses perceptions of benefits, costs, and obstacles to adoption, providing valuable insights for future research, system design, education, training, technical assistance, and policy support. By addressing knowledge gaps and technical concerns, and fostering collaboration between producers and developers, the project identifies barriers to agrivoltaics adoption in Colorado.

Engaging in community conversations, smart planning, and project design is critical for scaling up agrivoltaics in Colorado. The outcomes from this project are intended to inform policies, programs, and resources to support agrivoltaics, as well as to guide future incentives, funding, and technical assistance for farmers.

Ultimately, this project aims to help Colorado achieve its renewable energy goals by facilitating the responsible co-utilization of agricultural lands for solar energy production.

The insights derived provide valuable directives to inform effective policies and programs, and this initial effort serves as a platform for continued agrivoltaics engagement with the agricultural community. Most importantly, this project has elevated the voices of Colorado agricultural producers in the broader conversation about solar energy and agrivoltaics.

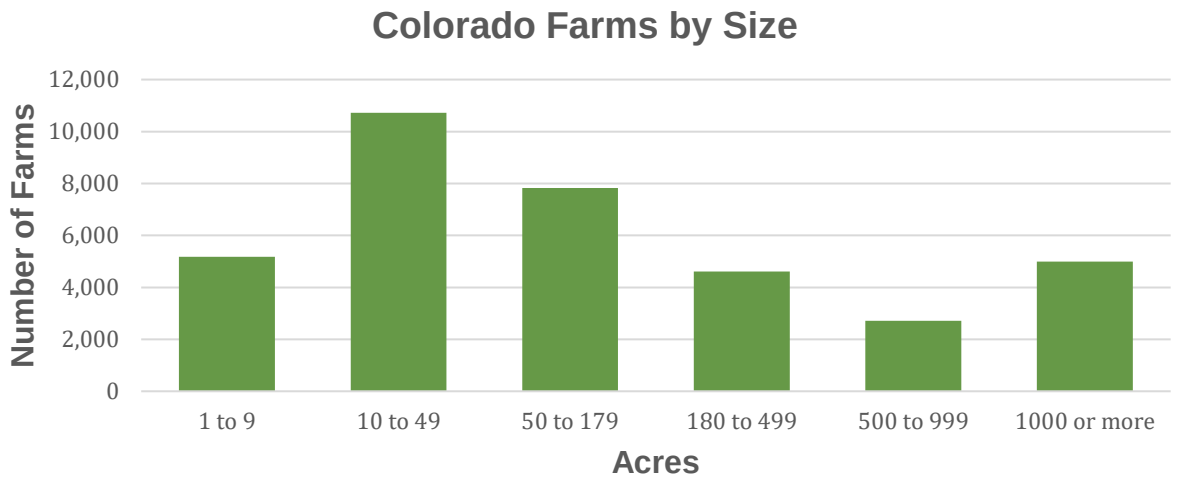
Agriculture in Colorado

Colorado's agricultural sector is a vital part of the state's economy and culture, providing a diverse range of products, including livestock, crops, and specialty farming. However, the industry faces significant challenges such as climate change, water scarcity, and economic pressures.

Colorado has 36,056 farms encompassing 30,213,899 acres of agricultural land. The average size of a farm is 838 acres, while the median size is 75 acres. The estimated market value of land and buildings averages $2,011,854 per farm and $2,401 per acre. Additionally, the estimated market value of all machinery and equipment totals $4,938,560,000, with an average value of $136,973 per farm.

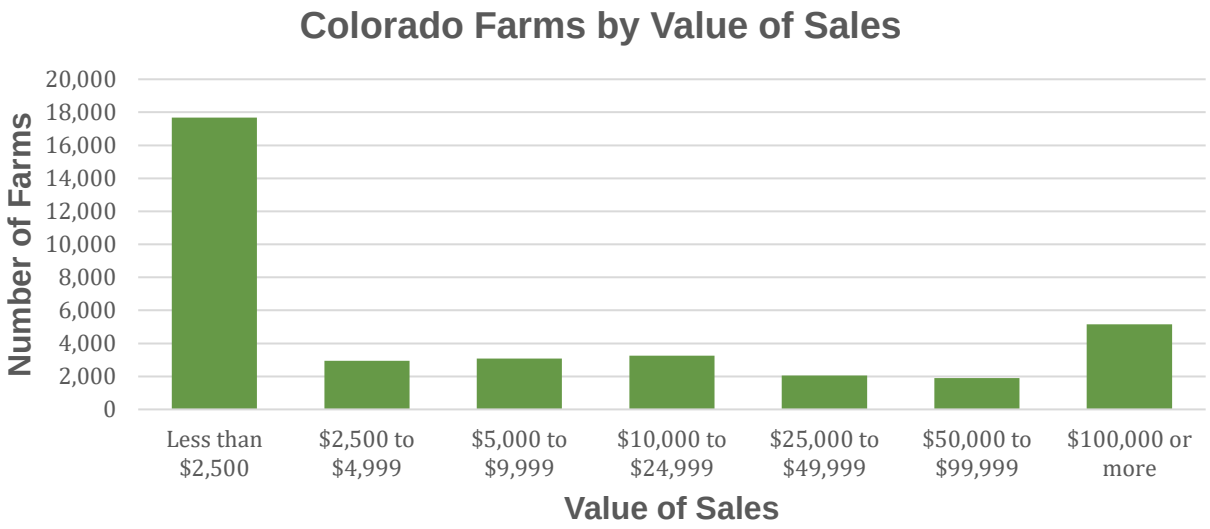
Colorado Farms by Size

The majority of farms in Colorado fall within 10 to 49 acres, comprising nearly 30% of all farms. Farms sized between 50 to 179 acres also represent a significant portion, accounting for about 21.70%. Smaller farms (1 to 9 acres) make up approximately 14.37%, while the largest farms (1,000 acres or more) represent 13.86% of the total. Farms in the 180 to 499 acres range constitute about 12.81%, and those in the 500 to 999 acres range are the least common, making up 7.53%.



Colorado Farms by Sales Value

In terms of sales value, 49.06% of farms have sales less than $2,500, 8.16% have sales between $2,500 to $4,999, 8.54% have sales between $5,000 to $9,999, 9.01% have sales between $10,000 to $24,999, 5.71% have sales between $25,000 to $49,999, 5.25% have sales between $50,000 to $99,999, and 14.28% have sales of $100,000 or more.



Data From: (2022 Census by State - Colorado | 2022 Census of Agriculture | USDA/NASS)

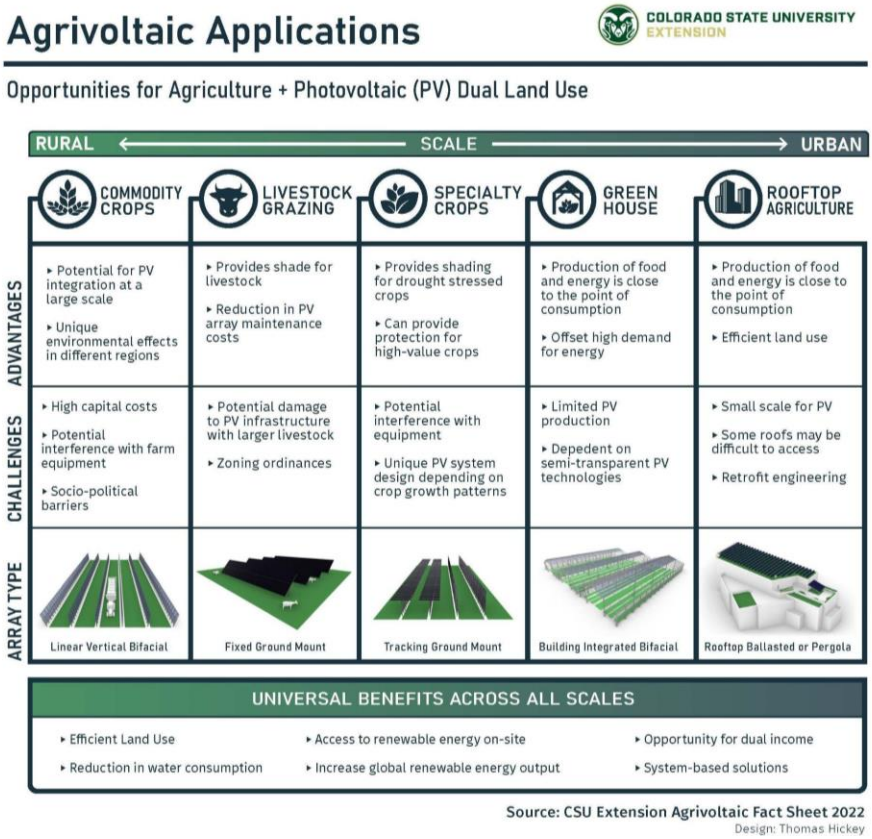
Agrivoltaics in Colorado

Agrivoltaics has the potential to significantly contribute to the sustainability and resilience of Colorado's agricultural and energy sectors. The integration of solar panels with agricultural activities, such as crop production, livestock grazing, and apiary management, provides multiple benefits. These include creating microclimates that protect crops, reduce water evaporation, and support biodiversity through habitat creation.

Agrivoltaics Overview

Agrivoltaics is the practice of co-locating solar energy installations and agriculture, with crops or grazing land beneath or between rows of photovoltaic panels (CDA, 2023). The hallmark characteristic of agrivoltaics is thus the sharing of sunlight between the two energy conversion systems: photovoltaics and photosynthesis. Agricultural activities include practices that satisfy human food, fiber, and fuel needs as well as activities that

enhance environmental quality and the natural resource base upon which the agricultural economy depends (adapted from the U.S. Department of Agriculture (USDA)) (U.S. Department of Agriculture, 2007). To date, agrivoltaics in the United States has included crop production, livestock grazing, apiary management, and other activities that intentionally involve the provision of ecosystem services (e.g., habitat creation, support for beneficial pollinating and predatory insects, native vegetation restoration, or cover cropping for soil health benefits and carbon sequestration). It is important to note that not all PV installations on farms can be considered agrivoltaics. An essential component of an agrivoltaics system is that the solar and agricultural activities have an influence on each other. Therefore, installing rooftop PV on a barn, where there is no direct impact of the PV system on the vegetation, soil, or livestock, would not be considered an agrivoltaic project. Similarly, conventional ground-mounted solar infrastructure adjacent to agricultural land with no direct vegetation, soil, or livestock integration would not be considered an agrivoltaic project. Moreover, simply using electricity from a solar installation to power farm-related activities is not considered agrivoltaics. However, there can still be value in on-farm production and usage of solar energy outside of agrivoltaics. Solar Power Europe has proposed to specifically designate the term agrisolar as a broader umbrella term that can encompass agrivoltaics as well as non-agrivoltaic solar energy on agricultural properties.



Colorado has emerged as a pioneering state in the development and implementation of agrivoltaics, leveraging its legislative and financial commitments to advance research within the field. Under the leadership of Senator Sonya Jaquez Lewis, the bill's prime sponsor, Colorado became the first state to establish agrivoltaics in statute and allocate state funding to support these projects. This legislative framework demonstrates the state's commitment to combining agricultural productivity with renewable energy generation, positioning Colorado as a leader in this field.

Governor Jared Polis, in his State of the Union address, has articulated an ambitious vision for Colorado's energy future, aiming for 100% of the state's electricity to be sourced from renewable energy by 2040. This vision is detailed in policy documents such as the "Roadmap to 100% Renewable Energy by 2040 and Bold Climate Action" (May 2019) and the "Greenhouse Gas Pollution Reduction Roadmap" (January 2021). Xcel Energy, a major utility provider in Colorado, has also set a target to achieve 100% carbon-free electricity before 2050. These frameworks set the stage for significant advancements in renewable energy infrastructure, with agrivoltaics playing a key role.

Several notable agrivoltaic projects across various scales illustrate Colorado's leadership in this field, including Jack's Solar Garden, CSU ARDEC South, and Denver Botanical Gardens - Chatfield, with several more demonstration-scale projects in the pipeline. One proposed upcoming project - the Garnet Mesa Solar Project, will have an 80-megawatt capacity and plans to integrate 1,000 local sheep. This project is sixty times larger than Jack's Solar Garden demonstrating the scalability and potential impact of recent policy initiatives. Projects like this enable the examination of large-scale agrivoltaic applications and the analysis of their economic, environmental, and social impacts.

The commitment to renewable energy extends past state initiatives, with 14 counties and towns in Colorado, including Denver, Pueblo, Boulder, Fort Collins, Summit County, Frisco, Aspen, Glenwood Springs, Breckenridge, Longmont, Lafayette, Nederland, and Golden, setting their own 100% renewable energy goals as of 2019. This municipal commitment highlights the grassroots support for renewable energy and fosters a collaborative research environment where local governments, academic institutions, and private enterprises can work together to address common challenges and share best practices.

The state's diverse geographic and climatic conditions offer unique research opportunities. Colorado's varied topography, ranging from high plains to mountainous regions, allows for the study of agrivoltaic systems in different environmental contexts. Research can focus on optimizing agrivoltaic designs for specific climatic conditions, evaluating the resilience of agrivoltaic systems to extreme weather events, and assessing the long-term sustainability of these systems in diverse agricultural landscapes.

These 5 things have been identified as key pillars for successful agrivoltaic project implementation by the National Renewable Energy Laboratory (NREL):
NREL's framework, the 5 C's for agrivoltaic success, can be used as a reference to understand the necessary components for successful projects (Macknick et al., 2022). C5: Collaboration, and C4: Compatibility include collaborations through stakeholder engagement and agreements; and compatibility of not only technology but also compatibility of stakeholder needs and interests. Collaboration and Compatibility set the foundation for C3: Crops, C2: Configuration, and C1: Climate, and must be prioritized in the earliest stages of project origination.

"The 5 Cs":

- Climate, Soil, and Environmental Conditions (C1): The ambient conditions and factors of the specific location that are beyond the control of the solar owners, solar operators, agrivoltaic practitioners, and researchers.
- Configurations, Solar Technologies, and Designs (C2): The choice of solar technology, the site layout, and other infrastructure that can affect light availability and solar generation.
- Crop Selection and Cultivation Methods, Seed and Vegetation Designs, and Management Approaches (C3): The methods, vegetation, and agricultural approaches used for agrivoltaic activities and research.
- Compatibility and Flexibility (C4): The compatibility of the solar technology design and configuration with the competing needs of the solar owners, solar operators, agricultural practitioners, and researchers.
- Collaboration and Partnerships (C5): Understandings and agreements made across stakeholders and sectors to support agrivoltaic installations and research, including community engagement, permitting, and legal agreements.

Survey Materials, Methods & Limitations

Survey Design

In December 2023, AFT convened an Advisory Committee with representation from the Colorado Department of Agriculture, AgriSolar Consulting, Colorado Open Lands, and Colorado Agrivoltaic Learning Center, that collaborated on the design and distribution of a state-wide survey of producer perspectives on agrivoltaics.

The survey instrument was co-designed by project partners and the Advisory Committee to identify potential opportunities and challenges, from an agricultural perspective, associated with integrating solar energy and farming practices (agrivoltaics) in Colorado. The target population included farmers, ranchers, and farmland or ranchland owners within the state. The survey instrument was developed based on prior work by AFT and AgriSolar Consulting in the state of Connecticut, focusing on agricultural producers' opinions about solar development on agricultural land, experiences with solar projects, perspectives on agrivoltaics, and general demographic information (Pascaris et al., 2023).

The main survey objectives were to:

- Identify producers' perceived interests and benefits of agrivoltaics.
- Assess factors of concern and reasons for opposition towards agrivoltaics.
- Determine what type of information and resources producers are interested in related to agrivoltaics

The survey was divided into five unique sections that included:

1. Introduction / Qualifier.
2. Solar on Agricultural Lands & Agrivoltaics.
3. Solar on "Your" Agricultural Land.
4. Information about Solar & Agriculture.
5. Demographics.

The survey included 33 questions of varying length and type, with a total expected user completion time between 15-20 minutes.

Survey Distribution

The survey was distributed with the assistance of the project Advisory Committee to ensure wide coverage across the entire state of Colorado. Additional partners for survey distribution included statewide agricultural organizations like Rocky Mountain Farmers Union, Colorado Fruit and Vegetable Growers Association, Colorado Livestock Association, land trusts such as Colorado Community Land Trust and AFT, the Colorado Land Board, Colorado Agrivoltaic Learning Center, and the CSU Extension network. The initial outreach began in January 2024, targeting approximately 6,000 producers to achieve the desired response rate of at least 200 completed surveys. The targeted response rate was informed by previous experience with similar surveys. As an incentive, all respondents who chose to provide information were entered into a drawing to win one of five $100 Visa gift cards.

Data Collection

The survey was administered online using Qualtrics Software (Qualtrics, Provo, UT), an online survey tool that was used to build and distribute the survey, collect responses, and perform the initial analysis of response data. The survey was launched on January 23rd, 2024, and was closed to new responses on May 10th, 2024. Once the survey instrument was launched, it was promoted through agricultural networks and project partners, at outreach events across the state, through CSU Extension, and the State of Colorado Land Board. A total of 312 survey responses were obtained.

Data Analysis

While the survey was live, preliminary results were analyzed by AgriSolar Consulting to inform upcoming outreach and engagement activities while guiding ongoing survey distribution strategy.

At the conclusion of the survey, AgriSolar Consulting utilized R Studio (RStudio, Boston, MA) and Qualtrics Software (Qualtrics, Provo, UT) for the final survey data analysis, which streamlined the handling and processing of the dataset. Data manipulation and visualization were conducted to uncover patterns and trends. Data analysis includes descriptive metrics from all five sections of the survey to summarize attitudes and awareness levels, preferences, and demographic factors influencing opinions on agrivoltaics.

Survey Limitations

The survey conducted as part of this research faced limitations that must be acknowledged for proper interpretation of the findings. Primarily, the survey was constrained by the timeframe of the grant cycle, which restricted the duration available for data collection. The survey was launched on January 23, 2024, and was closed on May 10, 2024. The latter half of the survey period falls in line with the planting season for certain crops in Colorado, thereby reducing the survey's priority for respondents.

The online survey's accessibility was another noteworthy limitation. The survey was exclusively administered digitally in English, creating barriers for non-English speakers and those with limited internet access or digital literacy, particularly older farmers. The geographic scope was also limited, potentially failing to encompass all regions equally and thus affecting the diversity of responses. This geographic constraint, coupled with the small sample size, raises concerns about the representativeness of the findings for all producers in Colorado.

The survey design itself presented several biases. Most questions did not require mandatory responses, leading to variations in the total number of valid responses. The length and complexity of the survey likely contributed to survey fatigue, possibly causing participants to either hastily complete or abandon the survey altogether. The technical language used could have been inaccessible to some, potentially deterring individuals without an advanced educational background from participating meaningfully.

Finally, the lack of trust in the survey's purpose among participants may have compromised the validity of the responses, as indicated in the open-ended comments provided by respondents.

Despite these survey instrument and distribution limitations, the resulting data has undergone rigorous analysis and the findings derived have been interpreted through the lens of the listed limitations. The producer perspectives captured by this survey are not intended to be statistically generalizable to all producers in Colorado but are intended to be logically representative of producers with similar characteristics, which is insightful for many stakeholders and satisfies the research purpose. The survey and its findings remain a valid contribution to ongoing agrivoltaic research and development in Colorado.

Survey Ethics & Data Confidentiality

Participation in the survey was voluntary, with informed consent obtained from all respondents shared at the beginning of the survey. Confidentiality was maintained by anonymizing responses and securely storing data in the Qualtrics database. All reported results have been de-identified to protect the privacy of survey participants.

Survey Response Metrics

- 225 complete responses + 87 partial responses, totaling 312 survey responses.

Survey Results & Discussion

Overview of Concerns and Barriers

- Environmental Concerns - One of the foremost concerns among respondents is the potential negative impact of solar projects on land conservation and farm productivity. A substantial 61% of respondents expressed being very concerned about the impacts on land conservation, while 57% shared similar levels of concern regarding farm productivity and the visual landscape. These concerns are rooted in the fear that the installation of solar panels might disrupt the ecological balance, leading to soil degradation and loss of biodiversity. Farmers are particularly weary of the initial land disturbance during construction and the long-term ecological footprint of these projects.

- Information Barriers - The survey identified a need for more accessible and clear information about agrivoltaic systems, and solar energy development in general. Specifically:
    - Information about land lease agreements, risk, liability, insurance, asset ownership, and scalability.
    - Guidance on relevant local, state, and federal regulations or incentives.
    - Knowledge exchange and access related to technical assistance and ongoing project management.
    - Information addressing concerns about the durability and maintenance of solar panels, particularly in harsh weather conditions.

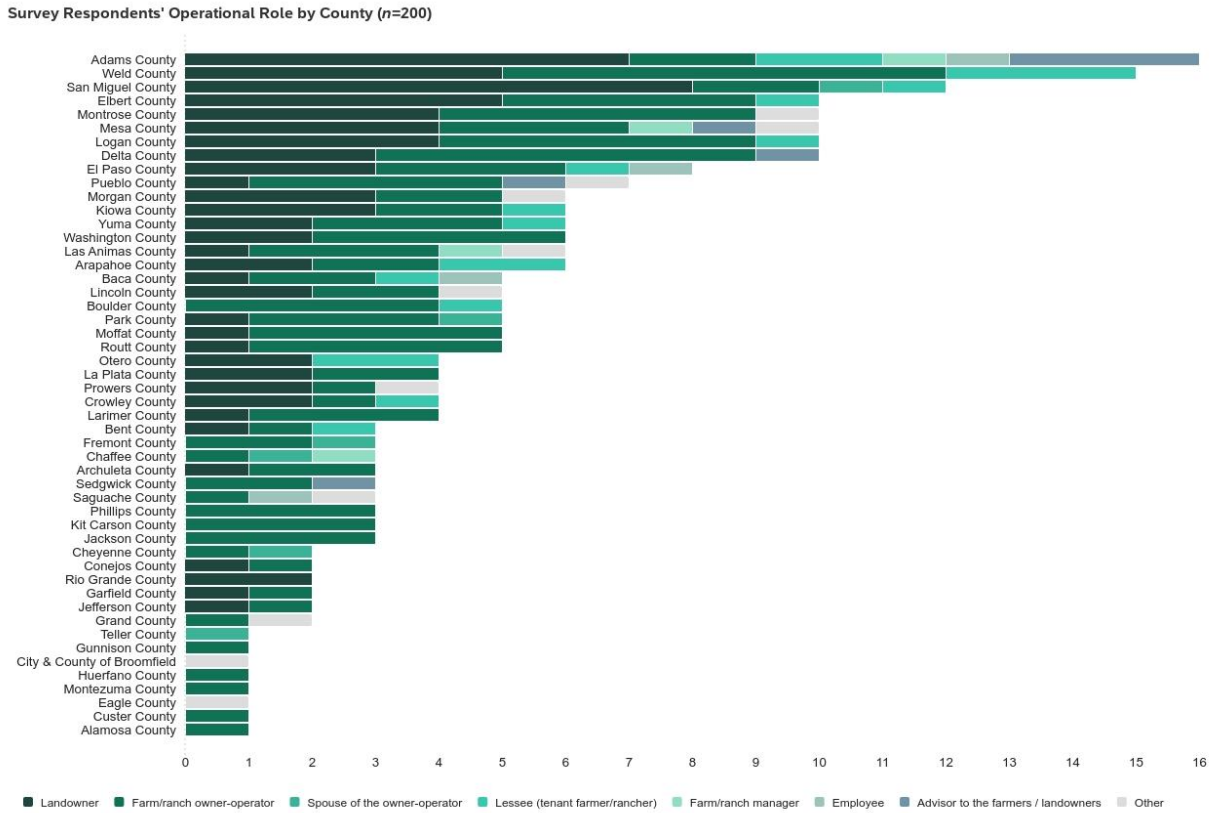
Overview of Opportunities

- Most producers are willing, or possibly willing to engage with most agrivoltaic activities (48%-65%).
- Integrating agricultural benefits and additional revenue streams into solar development projects to gain greater support from the agricultural community. Support for solar increases if specific steps within solar/agrivoltaic development are taken. Ensuring that the land is returned to a state with equal or improved agricultural viability at the end of the project life significantly boosts support (57%), while guaranteeing the solar developer maintains access to the land for continued agricultural production (55%), designing solar project for dual use (54%), and generating additional revenue for the landowner (52%) also increase support.

- Economic Opportunities - 61% of survey respondents indicated that the opportunity to provide supplementary income would influence their motivation to lease land for solar development, while 39% indicated that the ability for solar to support their operation would influence their motivation to lease land.
- Solar adoption is perceived as a strategy to boost long-term farm viability.

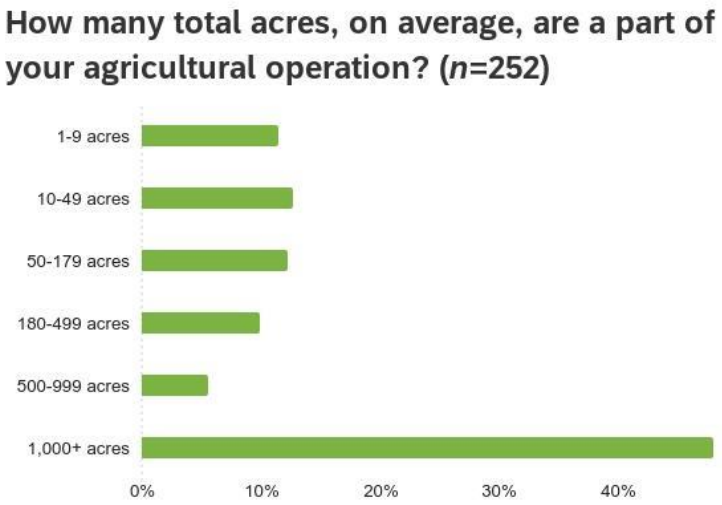
Survey Response Demographics

Respondent County / Location



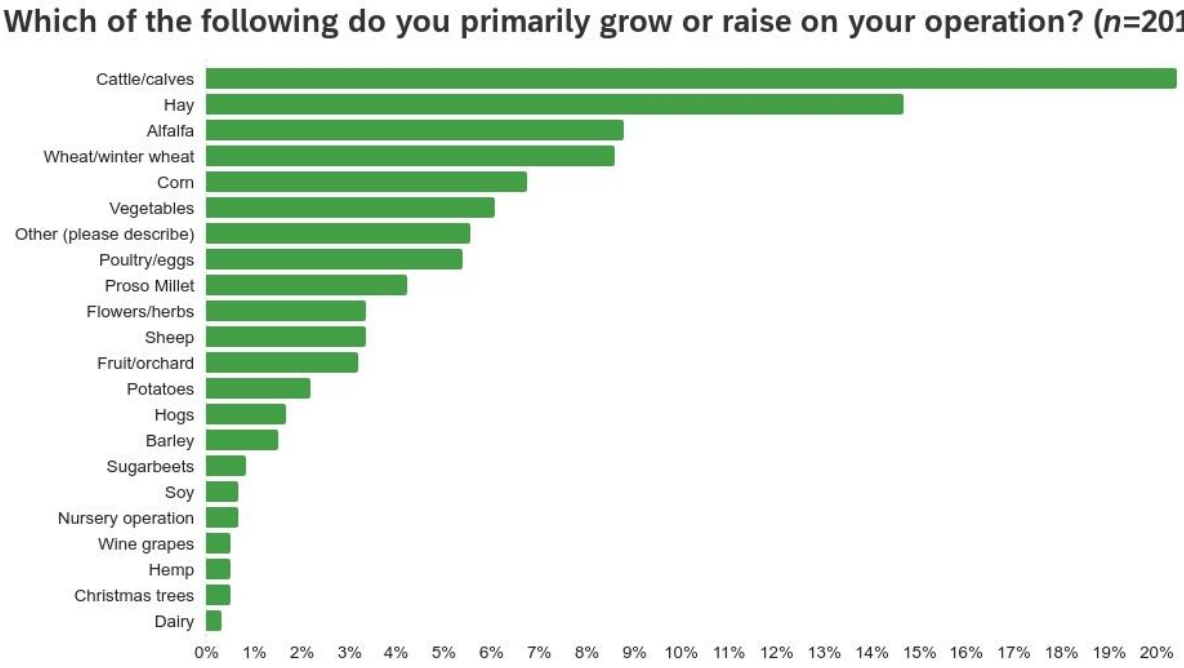
This graph illustrates the distribution of locations (counties), paired with agricultural operation roles among 200 survey respondents, specifying the counties where their farms are situated. Adams County is the most common location, with about 8% of respondents representing this location. In total, 50 out of Colorado's 64 counties were represented in the survey.

How many total acres, on average, are a part of your agricultural operation?



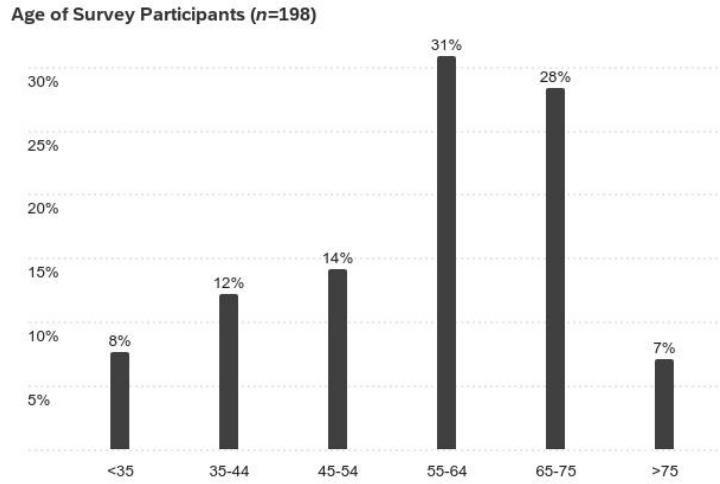
This graph shows the distribution of farm sizes among 252 respondents, measured by the total acres of their agricultural operations. The majority, over 40%, manage farms larger than 1,000 acres. Smaller operations of 1-9 acres, 10-49 acres, and 50-179 acres each represent roughly 10% to 15% of respondents. Mid-sized farms of 180-499 acres account for about 15%, while farms between 500-999 acres are the least common, making up just under 10%. This distribution highlights that large-scale farming operations dominate the sample, while smaller and mid-sized farms are less prevalent.

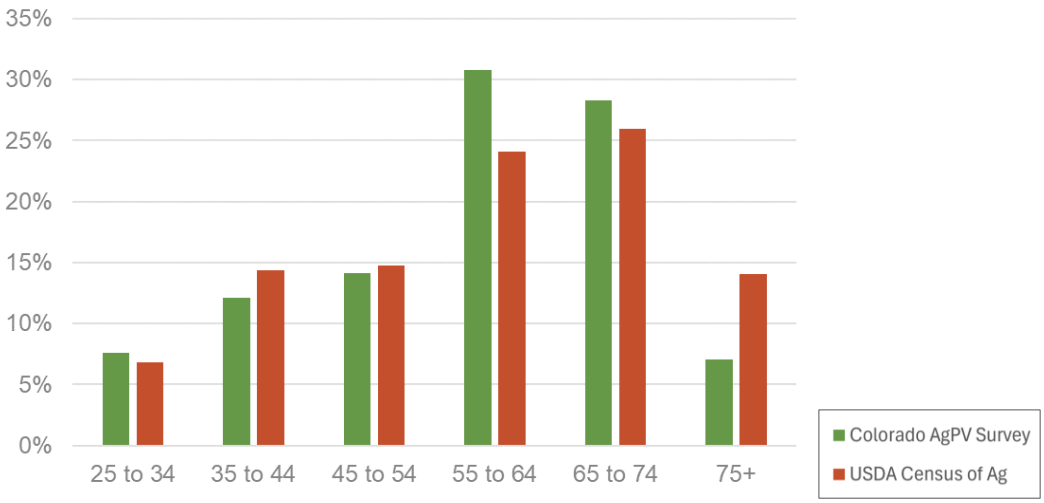
Type of Agricultural Operation



This graph depicts the primary agricultural products grown or raised by 201 respondents on their operations. The most common products are cattle/calves (20%) and hay (15%). Alfalfa and wheat/winter wheat each account for about 9%, while corn is cultivated by 7% of respondents. Vegetables are grown by 6%, and other unspecified products by 6%. Poultry/eggs and proso millet are each reported by 4.5%-6%. A variety of other products, including flowers/herbs, sheep, fruit/orchards, potatoes, hogs, barley, sugar beets, soy, nursery operations, wine grapes, hemp, Christmas trees, and dairy, are each reported by smaller percentages, ranging from 4% down to near 0%.

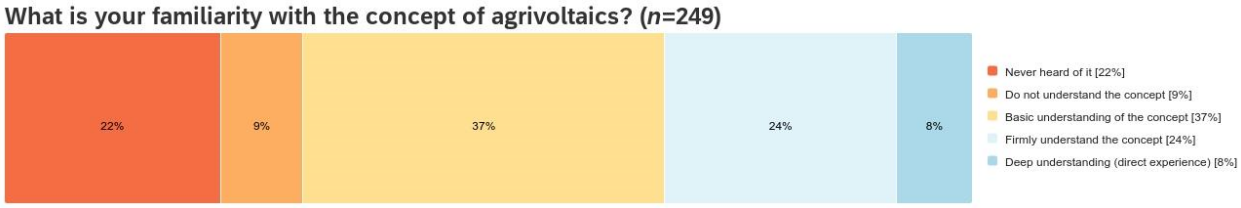
Age of Respondents





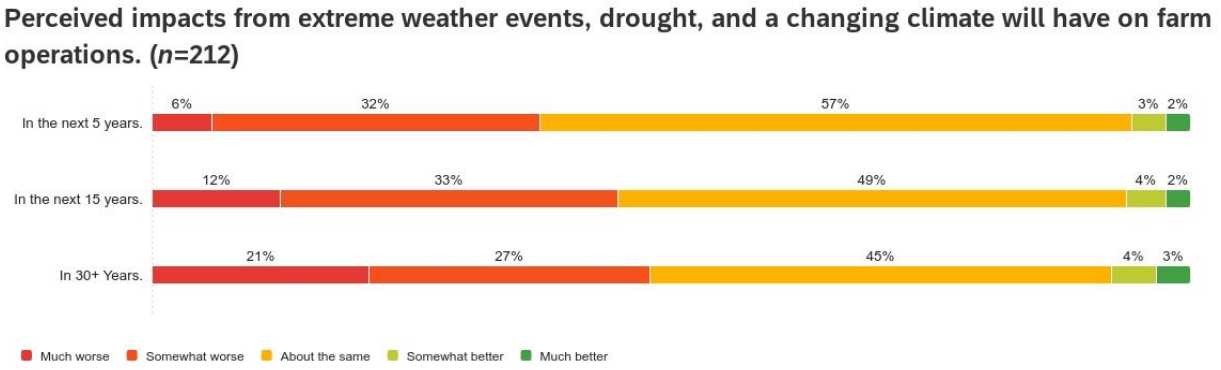
The survey's demographic data reveals insight into the respondent profiles. The above graph indicates that the majority of respondents are seasoned farmers, most of whom are aged over 50. A comparison of the ages of survey respondents against USDA Agricultural Census data suggests that the producers sampled in Colorado are generally representative of national age averages, besides that older producer (75+) are underrepresented and middle-aged producers (55-64) are overrepresented in the Colorado survey.

Understanding of Agrivoltaics Prior to Survey



The survey measured farmers' familiarity with the concept of agrivoltaics. The findings indicate that 22% of respondents have never heard of agrivoltaics, 9% do not understand the concept, 37% have a basic understanding, 24% firmly understand, and 8% possess a deep understanding with direct experience. This finding demonstrates that agrivoltaics is not well-known or widely practiced among the farming population in Colorado. To improve this, more education, research, supportive policies, and collaboration between agriculture and energy sectors are needed to make agrivoltaics more commonplace and effectively communicated.

Perceived impacts from extreme weather events, drought, and a changing climate will have on farm operations.

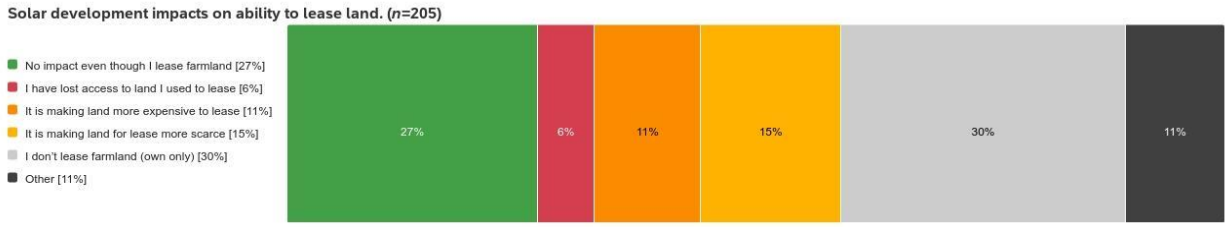


This graph illustrates perceptions of how extreme weather, drought, and climate change will impact farm operations among 212 respondents over three timeframes: the next 5 years, 15 years, and 30+ years. In the next 5 years, 6% expect much worse impacts, 32% somewhat worse, 57% about the same, and small percentages anticipate slight improvements. In the next 15 years, the anticipation of negative impacts increases slightly, with 12% expecting much worse and 33% somewhat worse conditions, while 49% foresee conditions remaining the same. Looking 30 years ahead, the expectation of negative impacts grows significantly, with 21% predicting much worse and 27% somewhat worse conditions, while 45% think conditions will remain unchanged. This trend indicates increasing concern over time about the adverse effects of climate change on farming, suggesting the need for long-term planning and adaptation strategies in the agricultural sector. In all three timelines, 3% or fewer respondents stated that they believe weather will have a positive impact on farm operations.

The data clearly shows an increasing concern about the negative impacts of climate change on farming over the next several decades. By integrating solar energy production with agricultural activities, agrivoltaics can help stabilize farm operations, protect crops from extreme weather, improve water use efficiency, and contribute to climate mitigation efforts.

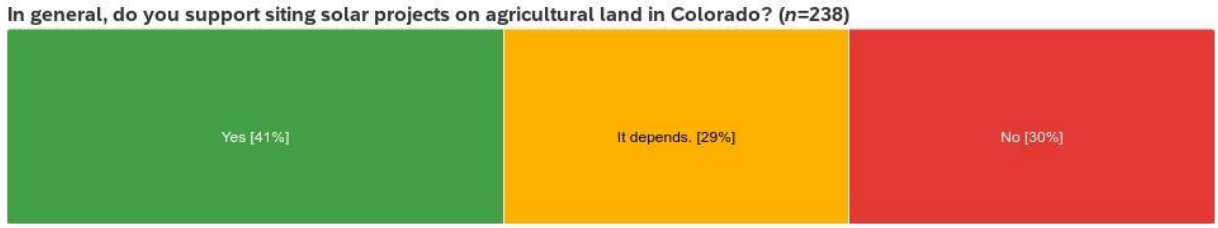
Solar on Agricultural Land & Agrivoltaics

Solar development impacts on the ability to lease land.



This graph illustrates the perceived impacts of solar development on the ability to lease farmland, based on responses from 205 participants. The data is categorized into six distinct impacts: no impact even though I lease farmland (27%), I have lost access to the land I used to lease (6%), it is making land more expensive to lease (11%), it is making land for lease scarcer (15%), I don't lease farmland (own only) (30%), other (11%).

General Support for Solar on Agricultural Lands



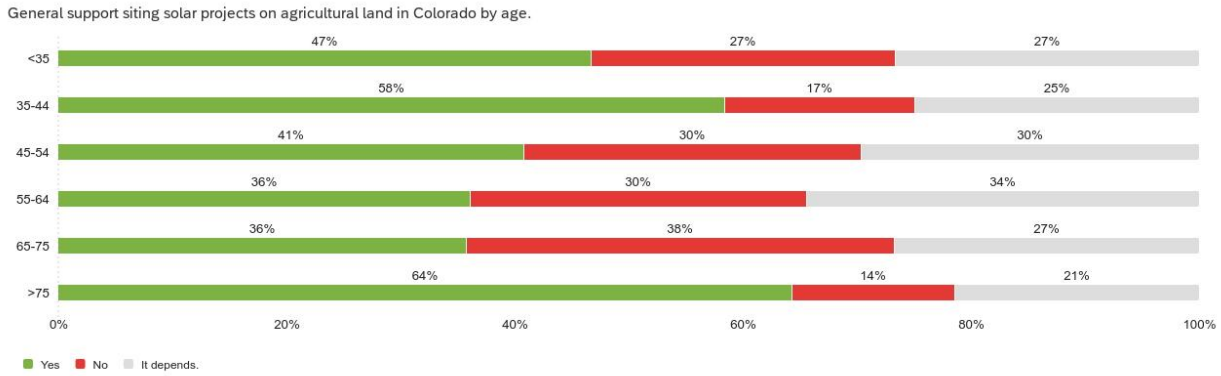
Out of 238 respondents, 41% support siting solar projects on agricultural land, while 30% oppose it, and 29% believe it depends on specific circumstances. Here are some elaborations on their answers:

"I believe that those in agriculture who want a solar project on their land should have the opportunity to investigate and accept or refuse that opportunity. I am most concerned that the initial disturbance of the land during construction might not be mitigated to the owner's satisfaction and that there would be little if any, legal remedy. Electric companies are notorious for this."

"I am 100% in support of small-scale solar, such as rooftop panels and discreet setups for personal use by landowners. However, I am nearly equally opposed to large-scale solar projects that industrialize the natural landscape Colorado is renowned for and disrupt its fragile ecosystems."

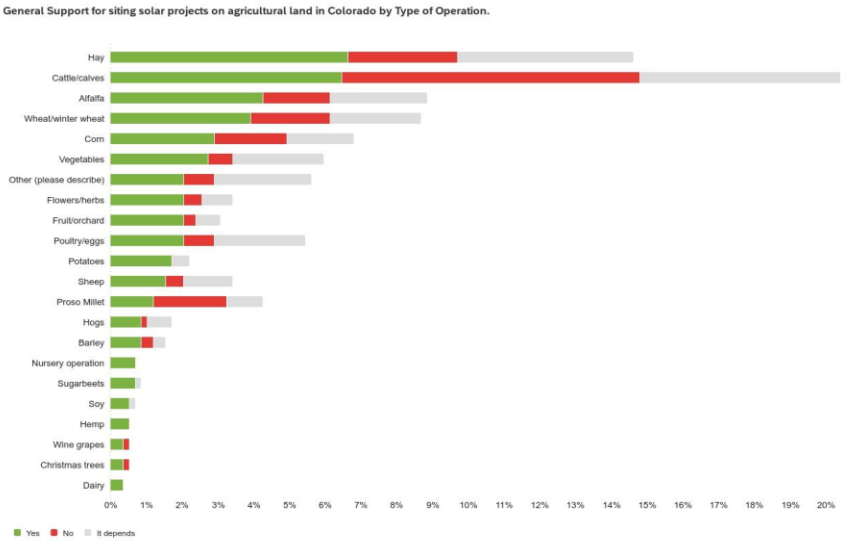
"I do not support solar projects on most large, rural plots of agricultural land. However, in the case of land that is located within, near, or adjacent to a municipality and that is not degrading contiguous wildlife habitat and productive range, I believe it is a beneficial land use."

General Support of Solar by Age



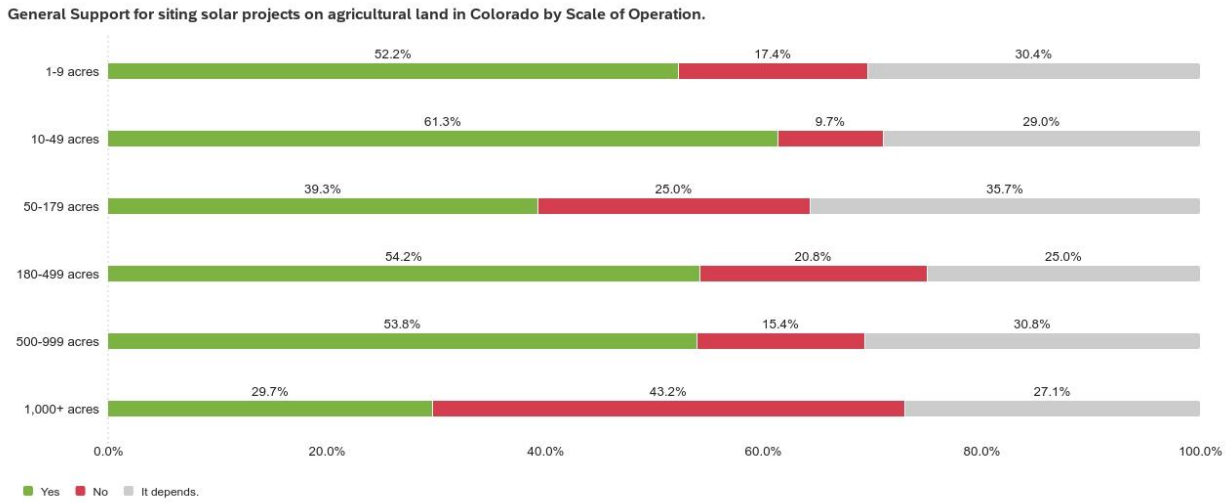
This graph illustrates the general support for siting solar projects on agricultural land in Colorado, categorized by age groups. Nearly half of the respondents under 35 support solar projects on agricultural land, while the remaining half is split evenly between opposition and conditional support. Ages 35-44 show the highest level of support among the younger cohorts, with a significant 58% in favor. Support is consistent at 36% for 55-64 and 65-75 year olds. However, the 65-75 age group has the highest level of opposition of all the age groups. Those over 75 are most supportive of siting solar on agricultural land with 64% indicating “yes”. Of the opposing stances within the 75+ group, one respondent elaborated: “It is too long a term to contract for use of my land, based on my age.”

General Support of Solar by Farm Operation Type



General support for solar by farm operation type, shown as a percentage of total responses.

General Support of Solar by Farm Size



This graph illustrates general support for siting solar projects on agricultural land in Colorado, segmented by the scale of agricultural operations, as indicated by acreage. The data is divided into six categories: 1-9 acres, 10-49 acres, 50-179 acres, 180-499 acres, 500-999 acres, and 1,000+ acres.

1-9 Acres:
Support: 52.2%
Opposition: 17.4%
Depends: 30.4%

Farmers with small-scale operations (1-9 acres) show moderate support for solar projects, with over half in favor, 17% opposed, and nearly a third stating that their support depends on various factors.

10-49 Acres:
Support: 61.3%
Opposition: 9.7%
Depends: 29%
This group demonstrates the highest level of support among all categories, with a significant majority (61%) in favor of siting solar projects, 10% opposed, and 29% contingent on certain conditions.

50-179 Acres:
Support: 39.3%
Opposition: 25%
Depends: 35.7%
Support decreases in this mid-range category, with 39% in favor, 25% opposed, and a larger portion (36%) expressing conditional support.

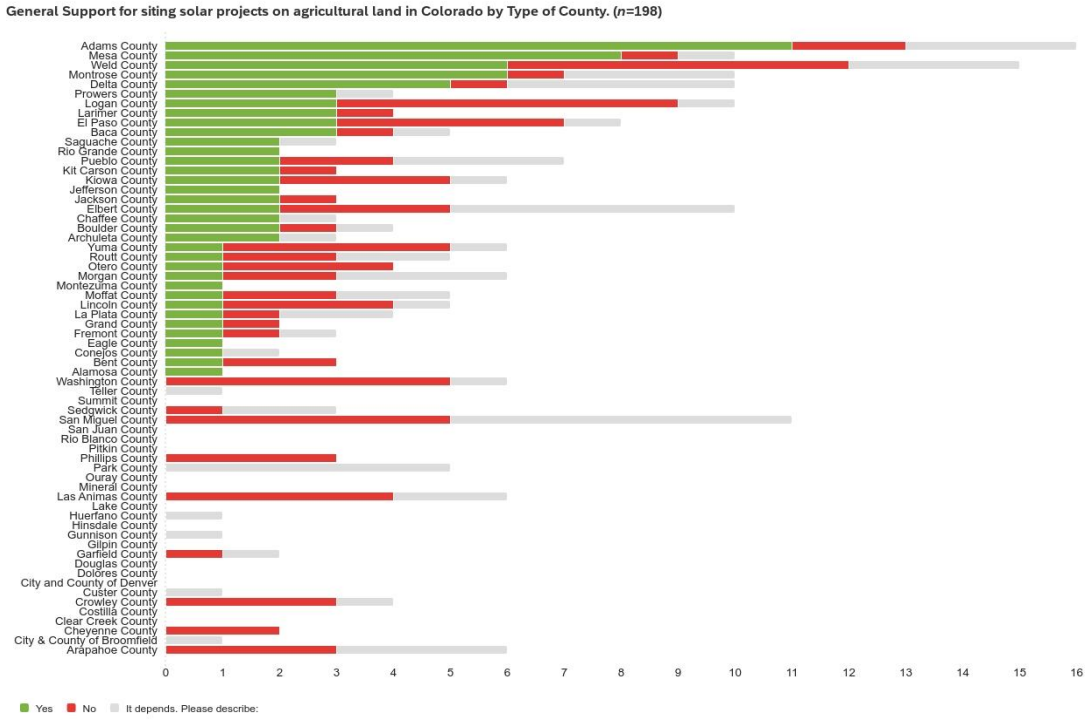
180-499 Acres:
Support: 54.2%
Opposition: 20.8%
Depends: 25%
Support rises again with 54% of farmers in this category favoring solar projects, 21% opposing, and a quarter indicating their decision depends on specific circumstances.

500-999 Acres:
Support: 53.8%
Opposition: 15.4%
Depends: 30.8%
Similar to the previous category, 54% support the projects, but with a lower opposition rate (15%) and a substantial portion (31%) depending on various factors.

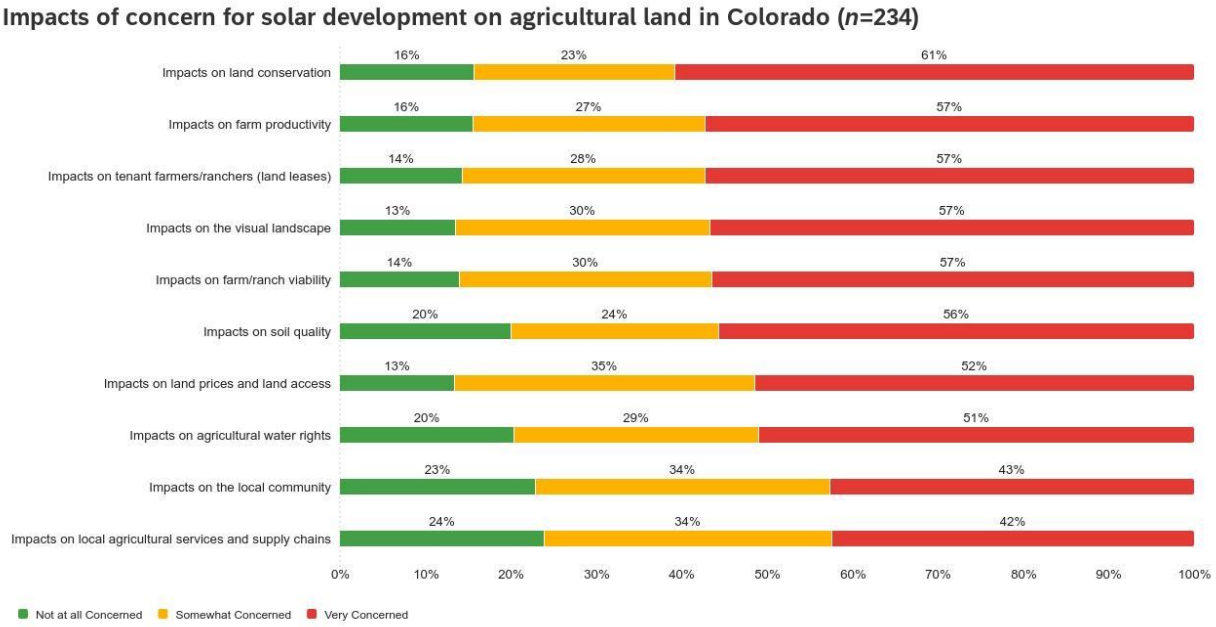
1,000+ Acres:
Support: 29.7%
Opposition: 43.2%
Depends: 27.1%
Large-scale operations (1,000+ acres) show reduced support, with 30% in favor, the highest opposition rate (43%) among all categories, and 27% expressing conditional support.

Overall, support for siting solar projects on agricultural land varies by the scale of the operation. Smaller and medium-scale farms (1-9 acres and 10-49 acres) generally show more support, whereas large-scale operations (1,000+ acres) exhibit higher opposition. Conditional support remains significant across all categories, indicating that many farmers' decisions are influenced by specific factors such as project design, compensation, and potential impacts on their land and operations.

General Support by County

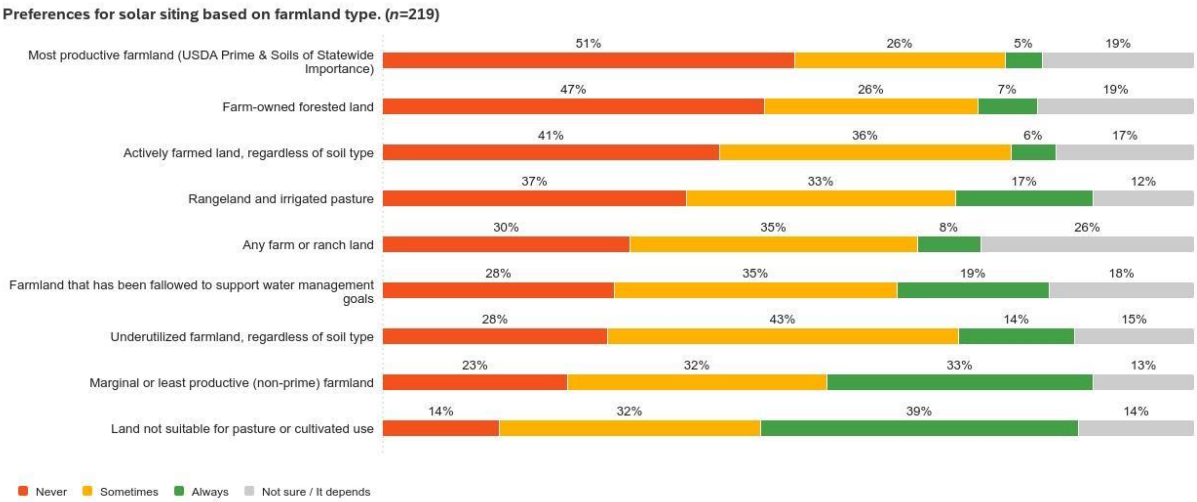


Level of Concern



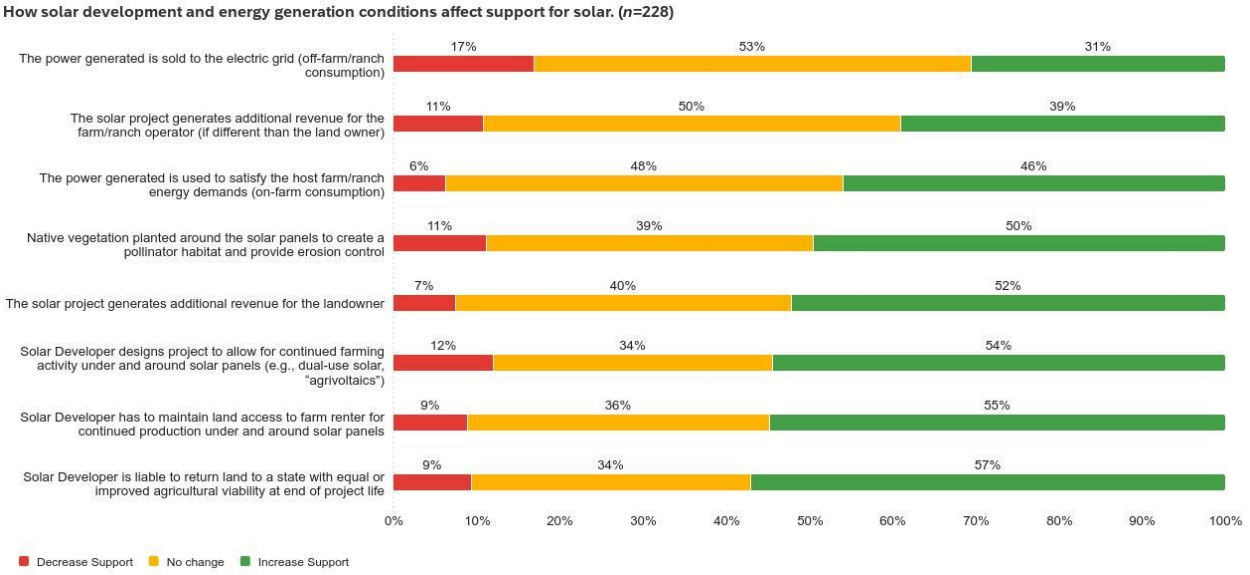
This graph shows that out of 234 respondents, many are worried about the effects of solar projects on agricultural land in Colorado. Most are very concerned about impacts on land conservation (61%), farm productivity (57%), tenant farmers/ranchers/leases (57%), the visual landscape (57%), farm and ranch viability (57%), soil quality (56%), land prices and access (52%), and impact on agricultural water rights (51%). The remaining two options, impacts on the local community and local agricultural services and supply chains are of less concern at 43% and 42% respectively.

Opinions about solar development on specific land types



The data reveals a strong preference for siting solar projects on less productive or underutilized farmland rather than on highly productive or actively farmed land. Respondents show the highest support for using marginal or least productive land (39% always in favor) and land not suitable for pasture or cultivation (33% always in favor), indicating a strategic choice to minimize the impact on prime agricultural areas. There is significant opposition to placing solar projects on the most productive farmland (51% never in favor) and farm-owned forested land (47% never in favor), reflecting concerns about preserving these natural resources.

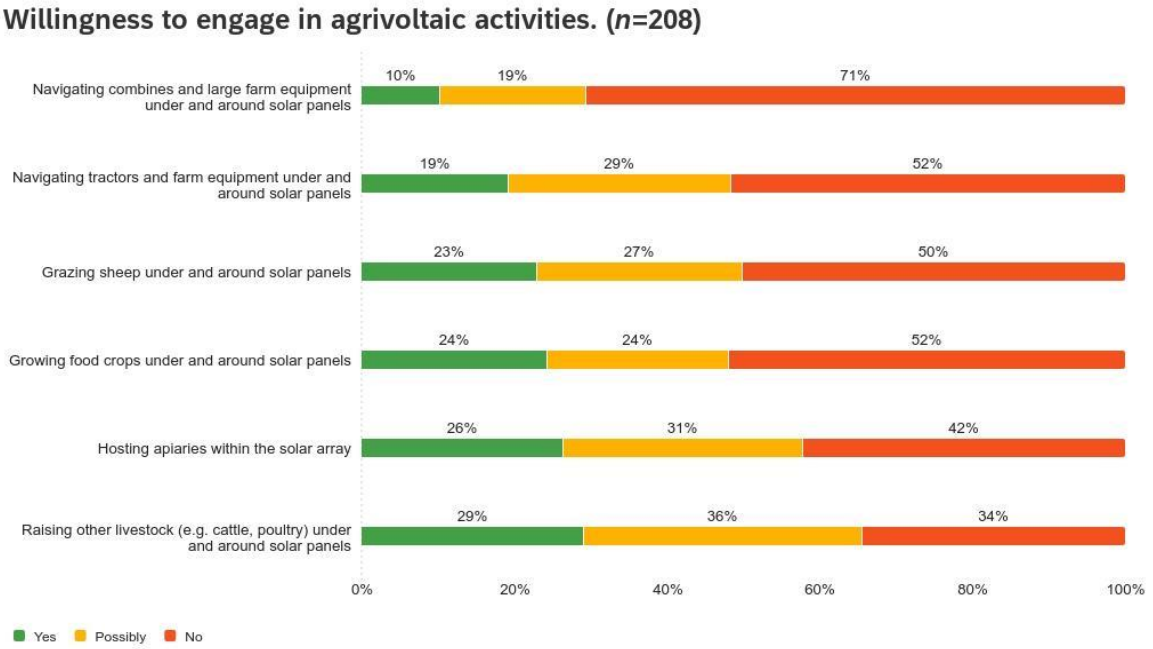
Factors that affect support for solar



When considering factors that affect support for solar development on farmland, long-term agricultural viability, continued land access, array design for agrivoltaic activities, and revenue generation for the landowner all increase support.

Solar on Your Agricultural Land

Willingness to engage in agrivoltaic activities



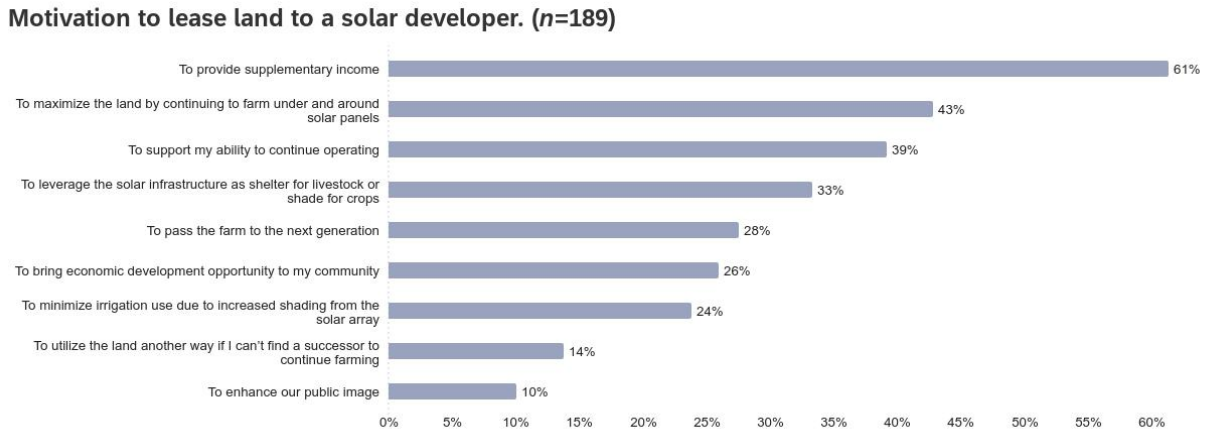
In an assessment of willingness to engage in agrivoltaic activities, trends in responses varied based on the type of agricultural activity and the necessity to involve equipment in the operation. Producers are least likely to engage in agrivoltaic operations that involve combines and large equipment (71%=No) but are most likely to engage in other agricultural activities like raising livestock (65% = Yes or Possibly), or hosting apiaries within the solar array (57% Yes or Possibly). Producers are split on willingness to engage in other activities such as navigating tractors (48% =Yes of Possibly), grazing sheep (50%=Yes or Possibly), or growing food crops (48% Yes or Probably); where the latter two have been implemented regularly across Colorado and other states.

Select producer quotes in response to this question: *"Which of the following considerations would apply to hosting a solar project on your land to generate electricity for off-farm/ranch consumption? (Please check all that apply)"*

- "Vertically mounted solar panels could provide cross fencing for intensive rotational grazing on all qualities of land."
- "I'm mostly interested in doing my own on-farm energy production, storage, and consumption."
- "I use solar for power for irrigation on my land."
- "I would need more info on the actual impacts on the land, the ability to farm around the panels, and actual income from solar farming"

- "We currently have a large amount of solar panels on the property. They came with the property when we purchased it. The amount of energy they produce is not even worth the damage to the environment from the materials collected to make the panels and they are toxic waste when they get to the end of their life cycle."
- "I utilize some small solar tools and love them. Electric fence solar chargers and solar to keep water troughs thawed. Beyond that, large-scale solar is too cost-inefficient and has severe environmental consequences to ecosystems. Recycling is also environmentally damaging and we are reliant on China for the supply of solar goods. Mining of rare earth minerals has a huge carbon footprint. We need a mix of energy, coal, natural gas, hydro, nuclear, hydrogen, solar, and wind. No single source of energy should be preferably subsidized and should stand on its own."
- "An outside solar developer would have to assure the local community that the power generated by the project will be utilized locally, and that a portion of the revenue stream supports the LOCAL economy. I think the days of exploitative energy (i.e. natural gas fields, oil drilling, etc.), which have left local communities high and dry, are over. We should not set up a similar structure with solar and other renewable energy projects."

Motivation to lease land to a solar developer.



Analysis of the motivations for leasing lands to solar developers also reveals an interplay of economic drivers paired with long-term farm viability considerations. The opportunity for solar to provide supplementary income is the top motivation to lease land for solar development, while maximizing the land use, and supporting the ability to continue the current operation are secondary motivators. However, fears noted by the respondents include land degradation, long-term financial viability, and ecological impacts of solar installations. This indicates that while economic benefits are persuasive, they should be coupled with assurances of environmental stewardship and long-term farm viability.

One respondent explained this sentiment: "Most every farm/ranch has less desirable farmland that may be a good fit for solar. Proper planning processes should be done, which includes

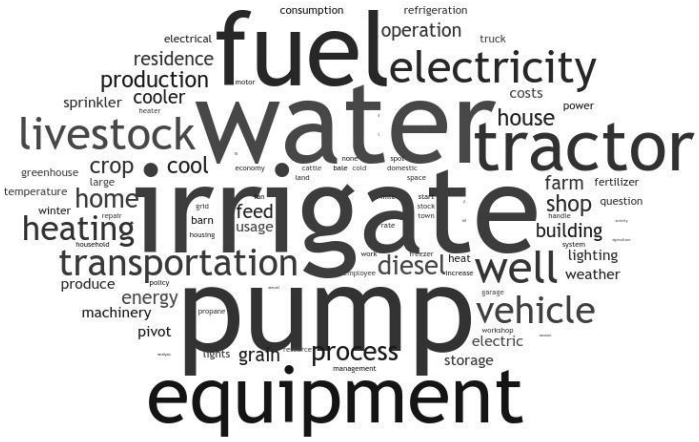
working with knowledgeable stakeholders, such as local Conservation Districts, Extension specialists, and others that will properly guide landowners and solar companies, to find the best alternatives or NO options found at each operation."

Further, findings indicate producers are unsure about the upfront costs and the reliability of the long-term benefits (financial, environmental) of agrivoltaics over time. Respondents expressed a need for clear and accessible information about the financial logistics, and legal agreements when considering agrivoltaic projects.

- "If I could run the same amount of cattle on a SMALL portion of my land, if there were proven benefits of shade for grass and animals, and use that energy for my ranch it might be a consideration."
- "None. Solar and Wind projects are littered with hype and promises. They pose real issues for landowners and local communities when they reach end-of-life."
- "We will never ever ever lease our land to solar. It damages the land and creates too much radiant heat which damages the natural microclimates."
- “Conservation easement”
- "It is too long a term to contract for use of my land, based on my age"
- "Reputation and experience of developer"

On-farm energy Consumption

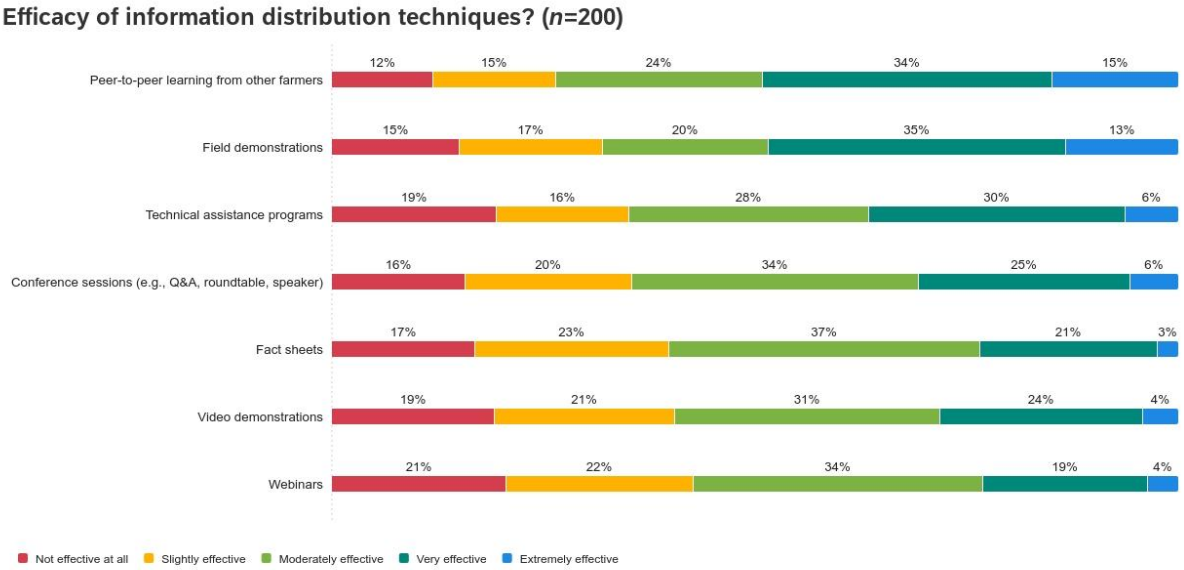
Top 3 drivers of on-farm energy consumption. (*n*=146)



In a qualitative analysis of the on-farm energy consumption, the word cloud visualizes trends in free responses. Irrigation, water, pump, fuel, and equipment were the top responses indicating that there is an opportunity to increase energy efficiencies and introduce renewable energy production to offset consumption in these key areas.

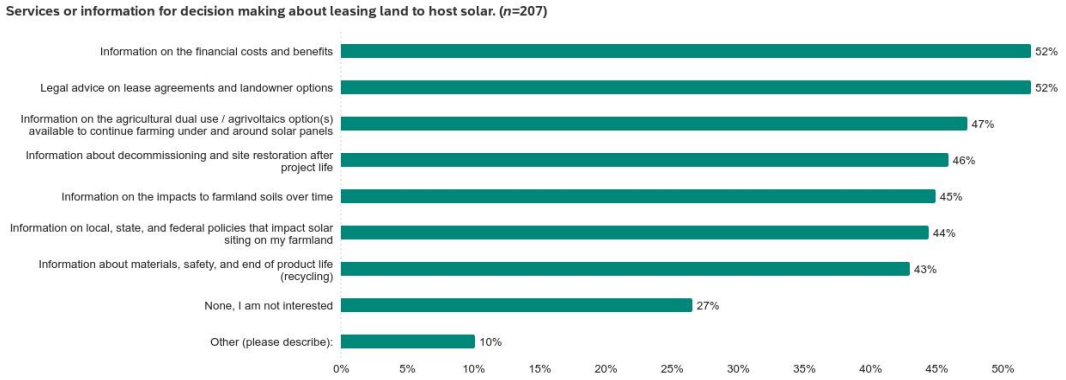
Information About Agrivoltaics

Information & Outreach Techniques



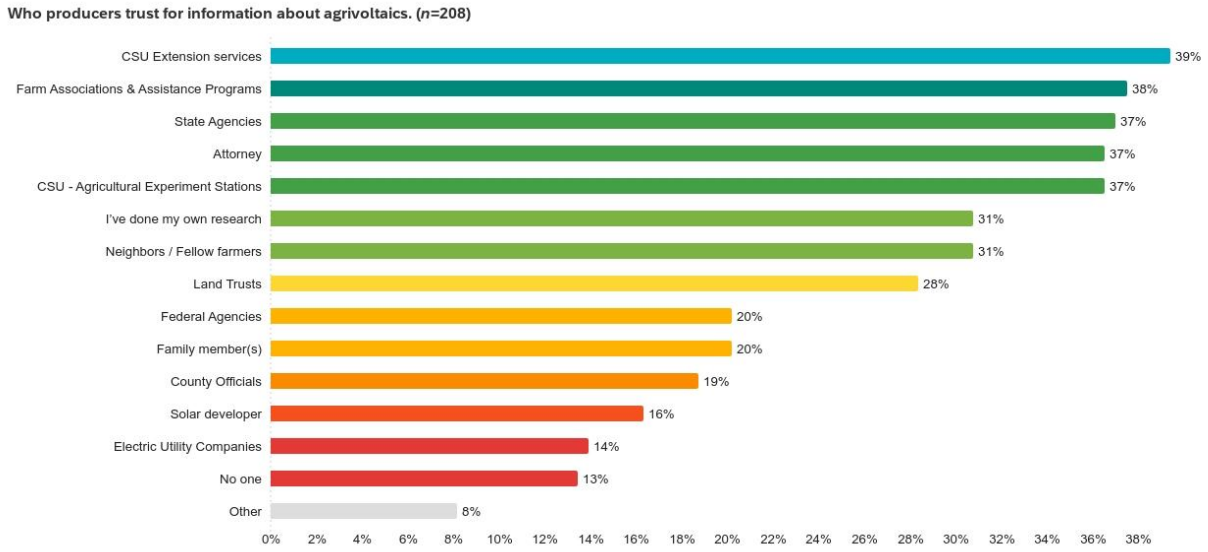
Effective and accessible information is critical to the adoption and implementation of agrivoltaic systems. These findings demonstrate that farmers prefer learning through field demonstrations, and peer-to-peer learning, and also find conference sessions and fact sheets to be effective means of information distribution. These preferences should guide the development of targeted information distribution strategies that address the diverse needs and concerns of the agricultural community.

Information and services for decision-making



Producers indicate that information about financial costs and benefits (52%) along with legal advice related to lease agreements and ownership (52%) are the most important when making decisions about leasing land for solar development.

Who do farmers trust for information?



This graph highlights a strong preference for traditional and established sources of agricultural information, such as extension services, farm associations, state agencies, and university-affiliated research stations. CSU extension services are the most trusted, with 82 out of 208 respondents relying on them. Similarly, farm associations, state agencies, attorneys, and CSU agricultural experimental stations each reflected confidence from 76-78 respondents. Utility companies such as Xcel are the least trusted sources.

The following quotes indicate “other” trusted sources of information:

- "Funding opportunities"
- "What happens when solar company go broke and moves on"

- "Oil and gas companies promised full remediation and restoration, but found ways to break those contracts. Information and education about how solar development contacts will be any different from past energy development schemes is needed."
- "I am interested in site-specific planning and design that would immediately offset the farmer's energy needs"
- "Information on research and development that reduces the land use impact (which is unfortunately over 75 times that of an oil pad currently)"
- "What the ecological impact is when panels have reached maximum use age and the biodegradable time, if any"

Overall, a significant portion of respondents had limited prior knowledge of agrivoltaics, with 22% never having heard of the concept and only 8% possessing a deep understanding, there is mixed support for solar projects on agricultural lands, with 41% in favor, 30% opposed, and 29% conditional on specific circumstances. Effective information distribution strategies are critical next steps, so producers may make informed decisions about agrivoltaics that they are confident in. Further, the survey findings emphasize that ensuring that information is accessible and tailored to different farm sizes and types is essential for broader adoption. To advance the appropriate deployment of agrivoltaics, the report recommends partnering with Colorado State University Extension and other educational institutions to create and deliver workshops, training courses, and informational materials. Establishing a dedicated technical assistance team within the Colorado Department of Agriculture to lead feasibility studies, site assessments, and project planning services is also advised.

Conclusion

The “Colorado Agrivoltaics Outreach and Engagement Project” survey, which garnered 312 responses from producers across Colorado, presents a foundation for future research, policy, and development by contributing preliminary insights concerning producer perspectives on agrivoltaics. With a robust and diverse agricultural sector that is challenged by drought, the state of Colorado is uniquely positioned to benefit from the ecological and economic advantages of agrivoltaics. The findings from this survey offer novel and actionable insights for the Colorado Department of Agriculture and other key stakeholders in the state to advance the deployment of agrivoltaics in a manner that reflects the interests, needs, and concerns of the agricultural community.

Quotes from the survey:

In general, do you support siting solar projects on agricultural land in CO? It depends:

- "The areas possibly suitable are typically very, very remote.. who is going to be RESPONSIBLE for clean up? The bond posted today will not even come close in the future.. Don't fool yourself" Financial concerns and responsibility- who will take care of the solar on the farm
- "I do not support solar projects on most large, rural plots of agricultural land. However, in the case of land that is located within, near, or adjacent to a municipality and that is not degrading contiguous wildlife habitat and productive range. I believe it is a beneficial land use."
- "If it is up to the private property owner yes. Never by govt force."
- "I believe that those in agriculture who want a solar project on their land should have the opportunity to investigate and accept or refuse that opportunity. I am most concerned that the initial disturbance of the land during construction might not be mitigated to the owner's satisfaction and that there would be little if any legal remedy. Electric companies are notorious for this."
- "San Miguel County serious issue w BLM section of generational leased land. Big water issue amongst others"
- "I am 100% in support of small-scale solar, such as rooftop panels and discreet setups for personal use by landowners. And I am nearly equally as opposed to large-scale solar projects that industrialize the natural landscape Colorado is known for and disrupt the fragile ecosystems"
- "Dryland pasture is a fragile environment that is wholly dependent on natural moisture to produce enough grass for cattle to graze. any disturbance of the land could take years to recover."

Please indicate whether you think solar developers should be allowed to site solar projects to generate electricity for off-farm/ranch consumption (utility-scale solar) on the following agricultural land categories throughout Colorado.

- "I had to choose "it depends" for all questions because you didn't draw any distinction on size. There's a difference between a land owner putting up solar panels for personal use and selling any excess at peak times back to the grid, and a major industrial application of panels covering hundreds of acres. I would even dare say there are suitable, barren locations in the state for the latter... It's just not near communities, wildlife habitats, tourist destinations, and scenic routes."

- "Put them in town"
- "Colorado can't afford to lose any more farm, ranch, and habit. There is plenty of surface area that can be utilized in cities that have 0 production or habitat value." parking lots
- "This is oil, gas, and minerals all over again. Colorado gets hit with sexy win-win ideas for farmers to sell off or lease land for natural resource extraction. The quick buck makes it worse. While solar is at least not a fossil fuel, the infrastructure will age and leave us wondering why we ever allowed this in a few decades. Our farmland here is absolutely hammered by oil and gas wells, and now an increasing amount of solar farms. Both make the farmer money today, but kill the farm tomorrow. I don't want to see my community overrun by another boom-bust idea that our kids will regret we dove into."
- "The scope of solar projects in rural areas is not acknowledged by politicians, local governments, adjacent landowners, nor the project land lessee. Rural Colorado cannot deal with the scope of construction traffic, construction workers, and maintenance workers after the project is completed. Nor is the land capable of recovery from the construction disturbance and maintenance traffic."
- "Most every farm/ranch has less desirable farmland that may be a good fit for solar. Proper planning processes should be done, which includes working with knowledgeable stakeholders, such as local Conservation Districts, Extension specialists, and others that will properly guide landowners and solar companies, to find the best alternatives or NO options found at each operations."
- "Usable land can be enhanced with careful and planned use. Just putting solar on farmland, whether or not it is usable, being used, or unusable in order to provide a product to non-farming areas must be approached with much consideration of "don't put that in my backyard" except it would be in their backyard."
- "I think adding in solar panels into any system will have negative consequences to the ecology, but may benefit society"
- "In general, if the addition of a solar development will maintain or increase the productivity of the ground it is sited upon, or potentially make use of underutilized or fallow ground, all without negative impact on wildlife/broader ecology, I support it."

<u>Climate</u>

- "With the influx of people into the state of Colorado...we are seeing people leave the cities and move into our small quiet towns bringing all their city problems with them. Agricultural land is being lost to growth!"
- "What does this question have to do with agrivoltaics? We have dealt with and adapted to weather events, drought, monsoons, blizzards, etc., along with a growing population

and continue to be viable, provide food for others, live in harmony with wildlife, and keep the prairie grasslands open and beautiful. Agriculture has become a scapegoat for global warming enthusiasts."
- "Extreme weather events (including drought) and climate changes (temperature fluctuations) come and go. Urban growth and the "Green Energy" mandates with their associated projects and infrastructures are a greater impact on the future operations of rural Colorado agriculture."
- "A good manager continually adapts to both weather and climate."

Which of the following considerations would apply to hosting a solar project on your land to generate electricity for off-farm/ranch consumption? (Please check all that apply) Other:
- "Vertically mounted solar panels could provide cross fencing for intensive rotational grazing on all qualities of land."
- "I'm mostly interested in doing my own on-farm energy production, storage, and consumption."
- "I use solar for power for irrigation on my land."
- "I would need more info on the actual impacts on the land, ability to farm around the panels, and actual income from solar farming"
- "We currently have a large amount of solar panels on the property. They came with the property when we purchased it. The amount of energy they produce is not even worth the damage to the environment from the materials collected to make the panels and they are toxic waste when they get to the end of their life cycle."
- "I utilize some small solar tools and love them. Electric fence solar chargers and solar to keep water troughs thawed. Beyond that, large-scale solar is too cost-inefficient and has severe environmental consequences to ecosystems. Recycling is also environmentally damaging and we are reliant on China for the supply of solar goods. Mining of rare earth minerals has a huge carbon footprint. We need a mix of energy, coal, and natural gas, hydro, nuclear, hydrogen, solar, and wind. No single source of energy should be preferably subsidized and should stand on its own."
- "An outside solar developer would have to assure the local community that the power generated by the project will be utilized locally and that a portion of the revenue stream supports the LOCAL economy. I think the days of exploitative energy (i.e. natural gas fields, oil drilling, etc.), which have left local communities high and dry, are over. We should not set up a similar structure with solar and other renewable energy projects."

Motivation for leasing land to a solar developer:

- "If I could run the same amount of cattle on a SMALL portion of my land, if there were proven benefits of shade for grass and animal, and use that energy for my ranch it might be a consideration."
- "None. Solar and Wind projects are littered with hype and promises. They pose real issues for landowners and local communities when they reach end-of-life."
- "We will never ever ever lease our land to solar. It damages the land and creates too much radiant heat which damages the natural microclimates."
- conservation easement
- "It is too long a term to contract for use of my land, based on my age"

Information/services that would help you make a decision to host solar on your farm in the future:
- "Funding opportunities"
- "What happens when solar company go broke and moves on"
- "Oil and gas companies promised full remediation and restoration, but found ways to break those contracts. Information and education about how solar development contacts will be any different from past energy development schemes is needed."
- "I am interested in site-specific planning and design that would immediately offset the farmers energy needs"
- "Information on research and development that reduces the land use impact (which is unfortunately over 75 times that of an oil pad currently)"
- "What the ecological impact is when panels have reached maximum use age and the biodegradable time, if any"

Plans for operation over the next 5 years:
- "We are hoping to add solar grazing to offset reducing our livestock production in order to reduce labor costs. So it's kind of a combo of diversifying and reducing."
- "If we can successfully build an agrivoltaic project with Xcel paying a reasonable amount for RECs we'll continue the farming operation. Otherwise, we'll sell out."
- "Depends if my land gets a solar lease or not."

Citations

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Appendix 7:

American Farmland Trust Funding Opportunities for Agrivoltaics in Colorado

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

AgriSolar Consulting

Funding Opportunities for Agrivoltaics in Colorado

A GUIDE FOR PRODUCERS, LANDOWNERS, AND SERVICE PROVIDERS

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

American Farmland Trust (AFT) is the largest national organization dedicated to protecting farmland, promoting sound farming practices, and keeping farmers on the land. AFT unites farmers and environmentalists in developing practical solutions that protect farmland and the environment. We work from "kitchen tables to Congress," tailoring solutions that are effective for farmers and communities and can be magnified to have greater impact. Since our founding, AFT has helped to protect more than seven million acres of farmland and led the way for the adoption of conservation practices on millions more. AFT has a national office in Washington, D.C., and a network of offices across America where farmland is under threat.

For more information, visit us at **farmland.org**

AgriSolar Consulting

AgriSolar Consulting was founded to advance sustainable land use, farm viability, and renewable energy through agrivoltaic solutions. Recognizing that global food and energy security require innovative local solutions, AgriSolar Consulting works at the nexus of agriculture and energy to promote synergies that enhance community resilience. To realize practical, integrated climate solutions and progress innovative policies and practices for agrivoltaics in the U.S., AgriSolar Consulting leverages expert experience in social science, energy policy, solar development, horticulture, land use, and 3D modeling. This small, woman-owned, Michigan-based consulting company is devoted to ensuring that the future of renewable energy is shaped by, and benefits, America's agricultural communities.

For more information, visit us at **agrisolarconsulting.com**

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This work is made possible with generous support of the Walton Family Foundation

COVER: Farmers harvesting dry beans at Jack's Solar Garden in Longmont, Colorado.
PHOTO BY WERNER SLOCUM/NREL

Executive Summary

Agricultural lands and producers in Colorado have a key role to support agricultural production, water conservation, and renewable energy development. Colorado is well positioned at the forefront of efforts to integrate solar energy into farming operations with mutual co-benefits for farm income, drought resiliency, and clean energy generation (Gomez-Casanovas, et al 2023). Hosting solar is a major economic opportunity for producers and landowners seeking to diversify their income, but navigating the maze of state and federal funding opportunities for on-farm solar can be a formidable challenge.

WERNER SLOCUM/NREL

To improve access to trusted information and boost service provider capacity in supporting farmland solar adoption, this document summarizes relevant funding and assistance opportunities for Colorado producers and landowners. Producers and landowners can use this document to identify programs relevant to their circumstances. Extension agents and other service providers can use this information to bridge information gaps and support the needs of Colorado's agricultural stakeholders.

Given the diversity of farming and ranching in Colorado, there will be significant variability in the scale, feasibility, ownership models, and funding opportunities available for on-farm solar. The key funding opportunities that Colorado agricultural stakeholders should be aware of are:

1	Federal Investment Tax Credit (ITC)
2	United States Department of Agriculture (USDA) Rural Energy for America Program (REAP)
3	State Personal Property Tax Exemption for Agrivoltaics
4	Colorado Department of Agriculture (CDA) programs:
A	Accelerating Colorado Renewable Energy & Energy Efficiency (ACRE3)
B	Agricultural Energy Renovation Opportunities (AERO)
C	Agrivoltaic Research & Demonstration Grants

Understanding Farmland Solar Models

Solar energy projects vary widely in scale & ownership. This section provides a brief overview of these variations and their relevance to on-farm solar.

Project Scale

The solar industry is generally broken into four segments based on the scale of the system and where the energy is consumed:

1. Residential;
2. Commercial;
3. Community; and
4. Utility.

Residential and commercial solar tend to be smaller-scale and provide energy for on-site consumption—the solar industry refers to these systems as "behind-the-meter" because they are installed on the customer-side of the electric meter. These systems are typically mounted on rooftops but can also be installed as "ground-mounted" systems with metal racking structures attached to the ground.

Most electric utilities and rural electric cooperatives place limits on the size of these systems based on the type of electric rate on the meter (e.g., 10 kW limit for residential service, 25 kW limit for commercial service) or the annual electricity consumption for that meter (e.g., projected electricity generation cannot exceed 120% of annual electricity consumption). To learn more, you can contact your utility or search online for the "net metering" rate for your utility.

Community solar projects in Colorado typically range from 250 kW to 5 MW—or up to 10 MW for agrivoltaics projects—and provide energy that can be purchased by neighbors and local businesses. In terms of land use, a 10 MW project would require approximately 75 acres of land.

Utility solar projects sell power directly to a utility and range from around 10 MW up to hundreds of megawatts. For both community & utility solar, projects are generally built as ground-mounted systems with power sold for off-site consumption.

One emerging type of solar for off-site consumption is agrivoltaics, defined by American Farmland Trust as the intentional integration of solar energy generation and commercial agricultural production on the same piece of land for the life of the solar array. Agrivoltaics provides a unique opportunity for Colorado producers to diversify income, protect crops and livestock from heat stress, and reduce water requirements (Barron-Gafford et al., 2019). The benefits and tradeoffs of agrivoltaics vary regionally, but the growing evidence in semi-arid regions demonstrates that the growing conditions in agrivoltaics systems can reduce soil temperatures and protect crops from extreme weather events, while maintaining agricultural yields and providing economic diversification for producers (Hickey et al., 2024, Uchanski et al., 2023; CSU Extension, 2023).

Project Ownership

AGRISOLAR CLEARINGHOUSE

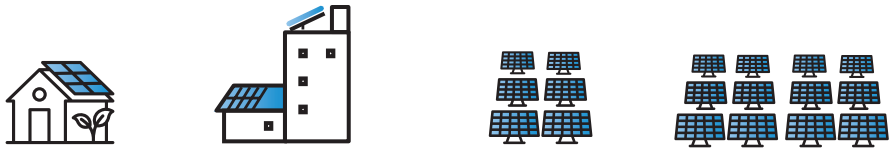
There are two primary ownership models in solar: direct ownership and third-party ownership. Eligibility for incentives and revenue potential from a system depend on who ultimately owns the solar assets.

Under a direct ownership model, the landowner finances and owns the system, and is responsible for claiming any potential tax credits or incentives. Direct ownership is most relevant to smaller-scale systems (residential & commercial). It's possible for landowners to directly own larger systems (community & utility), and this has greater financial upside, but it also entails greater financial risk and is likely cost-prohibitive for most farmers and ranchers. A typical 1 MW community solar array will incur a capital cost exceeding $1.5 million, making this option incredibly expensive for the average producer.

The alternative is third-party ownership, where a solar developer owns the solar assets and sells power from the system directly to customers or a utility. This ownership model mainly applies to larger systems where the developer pays the landowner to lease their land, and the developer is responsible for financing, permitting, construction, and maintenance of the project. However, this can also apply to smaller-scale systems, where the developer finances, builds, and owns the system, and sells the power to the site host (i.e., a residential or commercial customer).

Table 1 organizes key considerations across these various solar models to demonstrate the particularities and distinctions that are relevant for determining the funding opportunity most appropriate for your circumstance.

TABLE 1: OVERVIEW OF POTENTIAL SOLAR MODELS



SCALE	RESIDENTIAL	COMMERCIAL	COMMUNITY	UTILITY
TYPICAL LAND AREA	On building OR up to 1 acre	On building OR up to 5 acres	5–75 acres	75–10,000 acres
TYPE OF ARRAY	Roof mounted OR Small Ground Mount	Roof mounted OR Small Ground Mount	Ground Mounted	Ground Mounted
TYPICAL SYSTEM SIZE	5 kW–25 kW	10 kW–1 MW	250 kW–10 MW	10 MW–1 GW+
OWNERSHIP & FINANCIAL MODEL	Direct OR Third Party	Direct OR Third Party	Third Party w/ Land Lease & PPAs	Third Party w/ Land Lease & PPAs
TYPICAL APPLICATION	Behind the meter	Behind the meter	Front of the meter	Front of the meter

Federal Funding Opportunities for Farmland Solar

AMERICAN FARMLAND TRUST

This section provides a high-level overview of federal funding opportunities relevant for producers and landowners interested in adopting solar. While this document is focused primarily on Colorado, these federal funding opportunities are potentially available to producers located anywhere in the United States. This information is accurate at the time of publication, but program terms and eligibility criteria may change over time.

Investment Tax Credit

Passed in 2022, the Inflation Reduction Act (IRA) extended and expanded the Investment Tax Credit (ITC) to stimulate continued investment in clean energy technologies. Using the ITC, both taxable and non-taxable entities can receive tax credits for a portion of the cost of renewable energy projects, including solar PV and energy storage. Qualifying clean energy projects that meet labor requirements and commence construction from 2025 through 2032 will receive a credit of 30% of the eligible capital investment or "tax basis" of the system.* In addition to the 30% tax credit, projects may be eligible for bonus credits—which can be combined for a single project—based on domestic content and siting criteria, detailed further in Table 2.

TABLE 2. KEY ITC PROVISIONS

BASIS	Eligible upfront cost of the system (typically 80 to 95% of the total system cost). Interconnection costs are considered ITC-eligible for projects less than 5 MW_{AC}
TIMING	Awarded when taxes are filed for the project's first year of operation. In practice, this means that construction financing and/or bridge loans may be necessary to cover upfront costs prior to receipt of the tax credit
AMOUNT	**Projects less than 1MW_{AC}:** 30% tax credit (labor requirements do not apply)
	Projects equal to or greater than 1 MW_{AC}: 6% base tax credit + 24% for meeting prevailing wage and apprenticeship requirements
BONUS CREDITS	**Domestic Content:** +10%
	Energy Community: +10%
	<5 MWAC and Sited in Low-income Community or on Indian Land: +10%
	Qualified Low-Income Residential Building or Economic Benefit Project: +20%

* According to Internal Revenue Service guidance: "phase-out [of the ITC] starts for the later of 2032 or when U.S. greenhouse gas emissions from electricity are 25% of 2022 emissions or lower." Under existing policy, the tax credits will retain 100% of their value in the first year after the beginning of the phase-out, 75% of their value in the second year, 50% of their value in the third year, and 0% thereafter.

OTHER ITC CONSIDERATIONS: TIMING, TRANSFERABILITY, AND ELECTIVE PAY

While the ITC provides sizeable benefits, this incentive structure creates two key problems for producers:

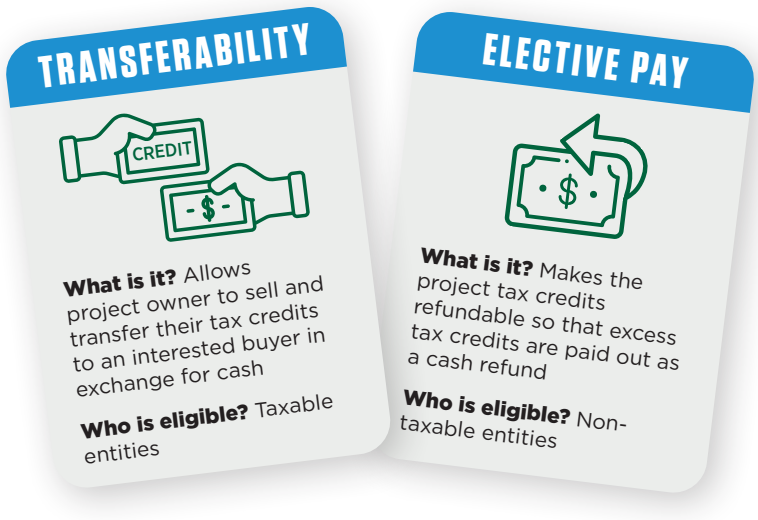
1. Most farmers and ranchers do not have sufficient tax liability to fully monetize the value of the tax credits in the first year of operation. This diminishes the value of the tax credits for farmer-owned projects.

   To put this in context, the capital cost of a 1 MW solar array is approximately $1.5 to $2 million, resulting in an income tax credit of $450,000 to $600,000. It is possible to roll this tax credit forward to future years, but that erodes the value of the tax credit, increases the cost of power, and makes these projects less competitive to potential power purchasers.

2. Tax credits do not provide upfront capital, so farmers will likely need debt financing to cover the initial investment until the tax credits are received. This incurs high transaction costs, imposes financial risks for producers, and may create significant barriers to access, especially for underserved producers and beginning farmers.

To address these issues, the IRA contains provisions for tax credit transferability and elective pay so that both taxable and non-taxable project owners can monetize their tax credits regardless of income tax liability. For taxable entities (e.g., individuals, LLCs), transferability provides the option to transfer the tax credits to a buyer—typically at a discount—in exchange for upfront cash. For non-taxable entities (e.g., non-profits, schools, rural electric cooperatives), elective pay makes the tax credits refundable, so that they get the full value of the tax credits in cash.

FIGURE 1. TRANSFERABILITY AND ELECTIVE PAY INFORMATION



DETERMINING IF THE ITC IS RIGHT FOR YOU

If you or your business are investing in a solar photovoltaic project in the United States, you can almost certainly benefit from the ITC.

RESOURCES

- EPA Summary of Inflation Reduction Act Provisions Related to Renewable Energy (including guidance on Tax Credit Monetization)
- DOE Federal Solar Tax Credits for Businesses
- White House Clean Energy Technical Assistance Guide
- Transferability: Selling Tax Credits by Norton Rose Fulbright
- IRS Prevailing Wage and Apprenticeship Requirements
- Accelerated Depreciation Benefits for Renewable Energy

USDA Renewable Energy for America Program (REAP)

REAP provides grant funding and loan guarantees to agricultural producers and rural small businesses for renewable energy systems, energy efficiency upgrades, and agricultural production and processing equipment. Grants for renewable energy systems range from $2,500 up to $1,000,000 and can fund varying scales of solar, including agrivoltaics. Energy efficiency grants range from $1,500 to $500,000 and can be used for various efficiency upgrades, including solar-powered irrigation pumps.

TIMELINE

REAP applications are currently accepted on a quarterly basis and that is subject to change.

ELIGIBILITY CRITERIA

- Agricultural producers with at least 50% of gross income coming from agricultural operations
- Small businesses located in eligible rural areas that meet one of the following criteria:
  - Private for-profit entity (sole proprietorship, partnership, or corporation)
  - A cooperative (including those qualified under Section 501(c)(12) of IRS Code)
  - An electric utility (including a Tribal or governmental electric utility) that provides service to rural consumers and operates independent of direct government control
  - A Tribal corporation or other Tribal business entity chartered under Section 17 of the Indian Reorganization Act (25 USC 477) or have similar structures and relationships with their Tribal entity without regard to the resources of the Tribal government
  - Must meet the Small Business Administration size standards in accordance with 13 CFR 121
- Agricultural producers and small businesses must have NO outstanding delinquent federal taxes, debt, judgment, or debarment

DETERMINING IF THE REAP PROGRAM IS RIGHT FOR YOU

REAP is most relevant for rural businesses and agricultural producers who want to invest in and own on-site energy improvements. REAP is best suited to serving on-farm energy needs, but REAP grants and loan guarantees can also be utilized to fund larger solar projects that export electricity to the grid for off-farm consumption.

RESOURCES

- REAP Website
- Colorado AERO Program for technical Assistance (see below)
- Colorado State Office—USDA Rural Development
- USDA Rural Business-Cooperative Service—State Energy Coordinators

Summary: Federal-level Opportunities

Taken together, both the ITC and REAP programs may be leveraged to minimize financial barriers to farmland solar adoption. These opportunities can provide significant cost savings across solar model types. Key considerations for accessing these opportunities, especially the ITC, are related to project ownership and upfront investment. There is no clear restriction against accessing both financial opportunities at once and applying them to the same solar project. Table 3 summarizes the key takeaways to help users determine the relevance of the opportunity for them.

TABLE 3. FEDERAL FUNDING OPPORTUNITIES SUMMARY TABLE

FUNDING OPPORTUNITY	ITC	REAP
OVERVIEW	The IRA provides tax credits for renewable energy projects, including solar and energy storage.	Provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements.
FUNDING AMOUNT	No limit	Renewable Energy System Grants: $2,500–$1 million
		Energy Efficiency Grants: $1,500–$500,000
		Loan guarantees on loans up to 75% of total eligible project costs.
		Grants for up to 50% of total eligible project costs.
		Combined grant and loan guarantee funding up to 75% of total eligible project costs.
KEY ELIGIBILITY CRITERIA	Taxable or non-taxable entities, including individuals and businesses	Agricultural producers with at least 50% of gross income coming from agricultural operations.
		Small businesses located in eligible rural areas.
SOURCE	US Department of Energy: Federal Solar Tax Credits for Businesses	REAP Website

AMERICAN FARMLAND TRUST

State Funding Opportunities for Farmland Solar

This section provides a high-level overview of Colorado-specific funding opportunities. Funding programs and criteria are expected to change over time.

Advancing Colorado's Renewable Energy and Energy Efficiency (ACRE3)

OVERVIEW

The ACRE3 program promotes the development and implementation of renewable energy and energy efficiency projects for Colorado's agricultural producers and processors. As Colorado's principal source of state-level support for agricultural energy management, ACRE3 program provides financial and technical assistance and education to help agricultural producers and processors cut energy costs, develop their own energy resources, and create markets for agriculturally derived energy and fuels. ACRE3 provides 50% cost-share of project costs, with a limit of $100,000 per agricultural operation, though this limit can be spread across multiple projects.

ELIGIBILITY

- The applicant's primary occupation is as an agricultural producer in the state of Colorado
- The applicant's operation is based within the state of Colorado
- The applicant's annual energy costs are around $5,000 for stationary equipment (not including fuel costs for vehicles and mobile equipment)
- The applicant can provide proof of good economic performance (measured by Internal Rate of Return, Payback Period, Net Present Value, more)
- The renewable energy project will serve on-farm energy loads (residential applications are not eligible)

TIMELINE

Applications are accepted on a rolling basis. Applicants should expect 6–12 months of assessment and planning (technical report, engineering, and permitting) and 12–24 months for implementation (financing and construction).

DETERMINING IF THE ACRE3 PROGRAM IS RIGHT FOR YOU

Both roof-mounted and ground-mounted solar projects are eligible for ACRE3 support, but the applicant must be an agricultural producer, and the power must serve on-farm energy loads. Reach out to CDA specialists (listed below) to indicate interest in the ACRE3 program and determine if your operation is eligible for the program. Once your operation is determined to be eligible, you will receive a third-party energy audit paid for by CDA, which will then inform which energy efficiency opportunities are most relevant to your operation.

RESOURCES

- ACRE3 Website
- CDA Agricultural Drought and Climate Resilience Office—Energy Programs

WERNER SLOCUM/NREL

Agricultural Energy Renovation Opportunities (AERO) Program

OVERVIEW

Funded by a grant from USDA Rural Development, CDA provides technical assistance to producers interested in USDA REAP grants (details above) for energy efficiency and renewable energy. The AERO Program can help with the following areas:

- Deciding if REAP is right for you
- Free grant assistance to farmers, ranchers, and rural small businesses interested in a REAP award
- Free technical reports and feasibility studies, (required for REAP applications)
- Potential grant assistance for qualified projects
- Project development assistance

CDA will support any project, but the primary focus of the program is on underutilized technologies, projects in Distressed or Disadvantaged Communities (as defined by USDA), and projects requesting $20,000 or less.

TIMELINE

Applications are accepted on a rolling basis. See REAP application timeline above.

ELIGIBILITY CRITERIA

Must be eligible for REAP (see above in Federal section).

DETERMINING IF THE AERO PROGRAM IS RIGHT FOR YOU

If you meet REAP eligibility, the AERO program technical assistance will assist you in completing an application. AERO may be most valuable for you if you are interested in offsetting on-farm energy costs and directly financing your solar system.

RESOURCES

- 2024 CO REAP Journey Map.pdf
- Reach out to cda_aero@state.co.us with a brief description of your project idea.
- Fill out this Pre-Application Survey to the best of your ability.
- For rural small business—please reach out to Laura Getts at TriState Energy: laura.getts@tristategt.org

Colorado SB23-092: Agricultural Producers Use of Agrivoltaics

OVERVIEW

SB23-092 aims to remove financial barriers and create more opportunities for agrivoltaics and floatovoltaics (solar PV installed on top of water bodies) research and demonstration projects in Colorado. SB23-092 provides a personal property tax exemption for projects that meet the definition of agrivoltaics and all other eligibility criteria (described below). SB23-092 also provided $500,000 worth of research and demonstration grant funding for the 2023-2024 legislative session.

TIMELINE

Personal property tax exemption is available between 1/1/2024 and 1/2/2029.

The Research & Demonstration Grant has been allocated for FY25. More state funds may be allocated to the same program in FY26.

ELIGIBILITY CRITERIA

- Both taxable and non-taxable entities (individuals and business) are eligible to apply
- Qualifying agrivoltaics asset owners are eligible for property tax exemption
- Colorado defines agrivoltaics so that agrivoltaics "means one or more solar energy generation facilities directly integrated with agricultural activities, including crop production, grazing, animal husbandry, apiaries, cover cropping to improve soil health or insect habitat benefits or carbon sequestration, or production of agricultural commodities for sale in the retail or wholesale market."
- An eligible agrivoltaics project must also be one that incorporates novel designs, technologies, or configurations that significantly expand the potential for agricultural activities, which may include but is not limited to: elevating panels, using semitransparent panels or alterative tracking algorithms, extending panel row spacing, and/or altering wire management systems.

JOE DELNERO/NREL

DETERMINING IF THE SB23-092 PROGRAM IS RIGHT FOR YOU

This funding opportunity is specific to agrivoltaics projects. If you are not interested in actively cultivating the land within a ground-mounted solar array to produce crops or manage livestock, this program is not relevant for you. If you are interested in agrivoltaics, the property tax exemption will be relevant for the asset owner (direct or 3rd party). Producers may also compete for research and demonstration funding in future grant cycles to explore the potential benefits of agrivoltaics in Colorado.

RESOURCES

- Overview of CO SB23-092
- Colorado Department of Agriculture Agrivoltaics Grants

Summary: State-level Opportunities

The Colorado Department of Agriculture provides various funding and technical assistance programs for farmland solar. The programs described herein complement one another and may be combined depending on the user's needs. While ACRE3 and AERO are relevant for solar projects more broadly, the property tax exemption provided by SB23-092 is only relevant to agrivoltaics projects. Table 4 summarizes the key takeaways to help users determine the relevance of the opportunity for them.

TABLE 4. STATE FUNDING OPPORTUNITIES SUMMARY TABLE

FUNDING OPPORTUNITY	ACRE3	AERO	SB23-092
OVERVIEW	The ACRE3 program promotes the development and implementation of renewable energy and energy efficiency projects	CDA is providing technical assistance to producers interested in USDA REAP grants for energy efficiency and renewable energy.	Provides personal property tax exemption to agrivoltaic projects
			Provides research and demonstration grant funding
FUNDING AMOUNT	Cost Share Program to offset total project costs	Priority for projects requesting less than $20,000	No limit on property tax exemption
			$500,000 grant funding
			$249,000 maximum award per project
KEY ELIGIBILITY CRITERIA	Agricultural producers in the state of Colorado with significant stationary on-farm energy loads.	Must be eligible for REAP	Meet state definition of agrivoltaics
			Meet certain solar design principles
			Placed in production after 1/1/2009
SOURCE	ACRE3 Website	AERO Website	Overview of CO SB23-092

KEY TAKEAWAYS

Accessing Farmland Solar in Colorado

Taken together, these Federal and State funding opportunities and assistance programs provide an enabling framework for farmland solar adoption in Colorado. Depending on their circumstance and the solar model of interest, producers and landowners may combine the various opportunities to achieve low-cost adoption. Service providers, such as Colorado State University Extension, can play a key supporting role in connecting producers and landowners to these opportunities, providing technical assistance, and reducing barriers to adoption.

KEY OPPORTUNITIES INCLUDE

1. Off-set on-farm energy and installation investment costs through the ITC and REAP simultaneously
2. AERO technical assistance from CDA to help producers complete REAP applications and reporting
3. Agrivoltaics asset owners are eligible for personal property tax exemption

NOTABLE BARRIERS OR CHALLENGES INCLUDE

1. The ITC requires sizeable upfront investment, which may be a barrier to access for entities who wish to directly own the PV system but do not have sufficient start-up capital
2. ACRE3 is only relevant for on-farm energy applications (behind-the-meter), which involves direct ownership and self-financing

WERNER SLOCUM/NREL

GLOSSARY

Agrivoltaics: the intentional integration of solar energy generation and commercial agricultural production on the same piece of land for the life of the solar array.

Behind the Meter (BTM): Energy generation and/or storage systems that provide power primarily for on-site energy consumption.

Electric Utility: The companies that own and maintain electrical equipment and are responsible for the physical delivery of electricity to homes or businesses.

Front of the Meter (FTM): Energy production and/or storage systems that provide power for off-site consumption, typically involving large-scale energy generation, transmission, and distribution infrastructure.

Net Metering or **Net Energy Metering (NEM):** Programs that allow customers with behind-the-meter energy generation systems (e.g., rooftop solar) to receive credits on their utility bills for energy they export to the grid.

Photovoltaic (PV) Technology: Materials and devices that convert sunlight into electrical energy.

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Uchanski, M., Hickey, T., Bousselot, J., & Barth, K. L. (2023). Characterization of agrivoltaic crop environment conditions using opaque and Thin-Film Semi-Transparent modules. Energies, 16(7), 3012. https://doi.org/10.3390/en16073012

RESOURCES

Check out **farmland.org/solar** or contact:

Austin Kinzer, Agrivoltaics Senior Technical Specialist,
akinzer@farmland.org, (425) 281-2920

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

American Farmland Trust

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Appendix 8:

American Farmland Trust Addressing Barriers to Producer Adoption of Agrivoltaics

American Farmland Trust
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AgriSolar Consulting

Addressing Barriers to Producer Adoption of Agrivoltaics

RECOMMENDATIONS FOR THE STATE OF COLORADO

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

American Farmland Trust (AFT) is the largest national organization dedicated to protecting farmland, promoting sound farming practices, and keeping farmers on the land. AFT unites farmers and environmentalists in developing practical solutions that protect farmland and the environment. We work from "kitchen tables to Congress," tailoring solutions that are effective for farmers and communities and can be magnified to have greater impact. Since our founding, AFT has helped to protect more than seven million acres of farmland and led the way for the adoption of conservation practices on millions more. AFT has a national office in Washington, D.C., and a network of offices across America where farmland is under threat.

For more information, visit us at **farmland.org**

AgriSolar Consulting

AgriSolar Consulting was founded to advance sustainable land use, farm viability, and renewable energy through agrivoltaic solutions. Recognizing that global food and energy security require innovative local solutions, AgriSolar Consulting works at the nexus of agriculture and energy to promote synergies that enhance community resilience. To realize practical, integrated climate solutions and progress innovative policies and practices for agrivoltaics in the U.S., AgriSolar Consulting leverages expert experience in social science, energy policy, solar development, horticulture, land use, and 3D modeling. This small, woman-owned, Michigan-based consulting company is devoted to ensuring that the future of renewable energy is shaped by, and benefits, America's agricultural communities.

For more information, visit us at **agrisolarconsulting.com**

WALTON FAMILY FOUNDATION

This work is made possible with generous support of the Walton Family Foundation

COVER: Cattle grazing under solar panels at Jack's Solar Garden in Longmont, Colorado.
PHOTO BY JOE DELNERO/NREL

Based on modeling from American Farmland Trust (AFT), Colorado could experience significant additional conversion of the state's most productive agricultural lands by 2040—up to 417,500 acres, equivalent to 1,900 farms, could be lost under a business-as-usual scenario with 53% occurring on Colorado's best farmland.[1] Funding and policy support for Smart Solar,℠ including advancement of agrivoltaics as a tool to enhance agricultural viability and economic resilience for farmers, represents an important priority for Colorado and other states that are on course for accelerated deployment of solar energy generation projects in the coming years.

BRYAN BECHTOLD/NREL

Agrivoltaics holds promise for Colorado's agricultural sector, especially in terms of economic diversification and resilience to climate change. Widespread adoption will require concerted efforts in research, policy, and technical assistance. The Colorado Agrivoltaics Survey, conducted by AFT in partnership with AgriSolar Consulting, Colorado State University, Colorado Open Lands, and Colorado Department of Agriculture's (CDA) Agrivoltaics Research and Demonstration program, aimed to increase understanding about Colorado agricultural stakeholder's perceptions, interests, and concerns with agrivoltaics (co-locating solar panels with agriculture). The survey was distributed to 6,000 agricultural producers across the state in spring of 2024. Insights gathered from approximately 300 diverse respondents provide a novel description of the state-of-knowledge of agrivoltaics among Colorado producers and identifies key barriers and needs related to implementation. Generally, the findings highlighted common environmental concerns among producers accompanied by interests in economic benefits and dual land use.

Informed by AFT's farmer engagement efforts, we recommend a suite of educational resources, technical assistance opportunities, policy tools, and research priorities designed to address producers' concerns and interests in agrivoltaics identified by the Colorado Agrivoltaics Survey. Recommendations are presented in tandem with key survey findings to ensure next steps are stakeholder-driven and to underscore how the Colorado Agrivoltaics Survey is foundational for informing action items for the Colorado agrivoltaics community. These recommendations are intended to help mature the agrivoltaics market in Colorado in a way that reflects agricultural stakeholder interests and concerns.

1 Hunter, M., A. Sorensen, T. Nogeire-McRae, S. Beck,S. Shutts, R. Murphy. 2022. Farms Under Threat 2040: Choosing an Abundant Future. Washington, D.C. https://farmland.org/project/farms-under-threat.

Educational Resources and Technical Assistance

OPPORTUNITY IDENTIFIED There is opportunity to expand Colorado producer awareness of agrivoltaics and support their decision to adopt the practice. 48%–65% of survey respondents are willing to engage with most agrivoltaic activities, yet nearly 70% of respondents have basic or no understanding of the concept. Respondents indicated they prefer learning through field demonstrations, peer-to-peer learning, and also find conference sessions and facts sheets to be effective means of information distribution.

Recommendations

- Launch webinar series that addresses key knowledge gaps identified by survey respondents, specifically financial, legal, and land lease considerations.
- Develop Agrivoltaics Farming Guides and other fact sheets that feature best management practices learned from the Colorado Agrivoltaics Learning Center and other projects in comparable climatic regions.
- Deliver workshops, demonstrations, and training courses to improve producer knowledge and capabilities in agrivoltaics.
- Host farm-to-table events at Denver Botanical Gardens agrivoltaics site and the Colorado Agrivoltaics Learning Center to increase awareness and of agrivoltaics.

OPPORTUNITY IDENTIFIED CSU Extension can play a key role in facilitating the appropriate deployment of agrivoltaics in Colorado. In the farmer survey, respondents indicated they trusted CSU Extension (39%) above other sources for information about agrivoltaics, followed by farm associations and state agencies. Respondents also expressed interest in technical assistance programs to better understand economic and technical opportunities for agrivoltaics.

Recommendations

- Dedicate state funding to enable CSU Extension to act as service providers in agrivoltaics.
- Establish a dedicated technical assistance team, staffed by both CSU Extension and CDA, to provide site assessments, project planning, and feasibility studies to producers interested in agrivoltaics.
- Expand AERO grant writing technical assistance to support applicants seeking property tax exemption through SB23-092.

CONCERN IDENTIFIED Financial and legal uncertainties challenge producer adoption of agrivoltaics. More than 50% of survey respondents indicated that information about financial costs and benefits, as well as legal advice related to lease agreements and ownership, are the most important when making decisions about leasing land for solar development. Survey respondents noted concerns about the reliability of solar developers and how legal contracts might address long-term maintenance, liabilities, and land restoration.

Recommendations

- Develop Solar Leasing Guide specific to Colorado, building on previous work lead by AFT (PNW Solar Leasing Guide).
- Expand AERO technical assistance to include direct services related to navigating land leases and cost-benefit analysis for producers.
- Promote producer engagement with the DOE C2C Expert Match program administered by NREL.

Policy Tools

OPPORTUNITY IDENTIFIED Agrivoltaics may be more financially accessible to producers through market mechanisms. Tax incentives, grants, and low-interest loans were highlighted by survey respondents as potential tools to reduce costs and therefore enable adoption. Survey results indicate that producers would be motivated to lease land for solar, or to try agrivoltaics, if it provided supplementary farm income.

Recommendations

- Strengthen provisions for agrivoltaics as stipulated in SB23-092 (Agricultural Producers Use Of Agrivoltaics), specifically:
  - Extend SB23-092 property tax exemption throughout life of an agrivoltaics project; enable qualified agrivoltaics projects to be assessed as agricultural for purposes of property taxes.
- Develop explicit provisions within ACRE3 that set agrivoltaics system criteria and allow producers to pursue system cost share for qualifying agrivoltaics projects.

OPPORTUNITY IDENTIFIED Survey respondents indicate preferred lands for solar siting, which helps inform solar development strategy and land use policy. There was strong support for placing solar panels on underutilized or marginal lands rather than on highly productive agricultural areas.

Recommendation

- Encourage the state to mandate utility bid preference programs that reward projects that are actively sited on underutilized or marginal lands, or that awards projects that meet agrivoltaics criteria.

CONCERN IDENTIFIED Producers are worried about the effects of solar projects on agricultural land in Colorado. Survey respondents noted impacts on land conservation, farm productivity, and soil quality among their highest concerns with solar development.

Recommendations

- Include provisions within community agreements for returning land back to a state with equal or improved agricultural viability at end of project life.
- Include construction performance standards and land stewardship metrics as part of evaluation criteria in solar RFPs to minimize site disturbance.

WERNER SLOCUM/NREL

Research Opportunities

OPPORTUNITY IDENTIFIED Producers are most interested in learning more about agrivoltaics and solar integration opportunities to continue farming through peer-to-peer learning, and field demonstrations. There is also significant interest in information about financial costs, benefits, and opportunities for their operations.

Recommendations

- Extend CDA SB23-092 to offer a Phase 3 funding for continued research dedicated to understanding agricultural productivity and ecological sustainability of agrivoltaics in the state. Extend the funding cycle to better align funded projects with the growing season to more effectively support or field-based crop trials and related research.
- Facilitate more state-level surveys and targeted engagement activities to identify concerns and interests across stakeholder groups, including community members and solar developers. Leverage findings to inform ongoing research priorities for Colorado.

CONCERN IDENTIFIED There are concerns about solar among producers related to land degradation, long-term financial viability, and ecological impacts. Producers noted concern about the challenges associated with restoring land after the life cycle of solar projects.

Recommendations

- Institute longitudinal research on land restoration methods, successes, and opportunities for improvement.
- Conduct field-based research on agronomic and economic impacts of agrivoltaics, with comparative analyses across Colorado's growing regions.
- Focus field research efforts on areas where natural synergies exist between climate and configuration—for example, where climate may impact high value crops that are already grown in tandem with infrastructural costs.

WERNER SLOCUM/NREL

RESOURCES

Check out **farmland.org/solar** or contact:

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