HARVESTING THE SUN: ADVANCING ON-FARM SOLAR DEPLOYMENT

PLATFORM RECOMMENDATIONS AT-A-GLANCE

- Promote a Least-Conflict Process for On-Farm Solar Siting
- Set Up a California Clearinghouse for On-Farm Renewable Energy Generation
- Ramp Up the State's Role in Accelerating Agrivoltaics Deployment

A CLIMATE PLATFORM FOR CALIFORNIA AGRICULTURE

This is one in a series of CalCAN policy briefs that describe approaches to moving California agriculture boldly and quickly toward a carbon-neutral and climate-resilient future. Together, they make up *A Climate Platform for California Agriculture.*

Access the full report at: calclimateag.org/ca-agriculture-climate-platform

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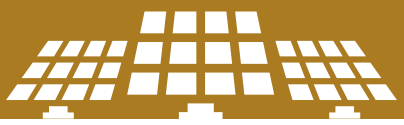

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INTRODUCTION

Here we examine opportunities for scaling up on-farm distributed solar energy projects (either traditional solar panels or agrivoltaics co-located with crop and livestock production). We also take stock of the development pressures created by utility-scale solar and explore guardrails needed to limit negative impacts on food production and farm profitability.

Farmers and ranchers who install solar arrays can save money by offsetting their energy costs while also contributing to a clean energy future. Many in California do, producing more renewable energy than their counterparts in any other state in the country. The U.S. Department of Agriculture (USDA) Census of Agriculture shows that the number of Californian farms with solar installations almost tripled between the 2012 and 2017 census. In 2017, almost 14,000 farms in California made up 15 percent of the country's on-farm solar projects.[70] While the results of the 2022 census are not yet available, it seems likely that this upward trend has continued and, given the investments the Biden Administration is making in renewable energy, could accelerate dramatically in the coming years.

While there are many advantages to small-scale distributed solar on agricultural land, it should be noted that utility-scale solar deployment, if not sited carefully, can present a threat to the conservation of farmland needed to produce food. Farmland and rangeland is attractive to solar developers because it tends to be flat, with good exposure to sun, and relatively cheap to develop. A recent study by the U.S. Department of Energy[71] found that achieving a carbon-free energy supply by 2050 will require the deployment of solar on 10 million acres of land across the country. A report by the Public Policy Institute of California[72] found the following:

83%

of new solar generation built by 2040 would likely be sited on agricultural acreage

[70] USDA National Agricultural Statistics Service. *2017 Census of agriculture.*

[71] Office of Energy Efficiency & Renewable Energy. *Solar futures study.* U.S. Department of Energy.

[72] Public Policy Institute of California. (2022). *Solar energy and groundwater in the San Joaquin Valley.*

As of 2019, there were about 20 gigawatts (GW) of installed solar capacity (including utility-scale and distributed generation) throughout the state, with about 3 GW of that located in the San Joaquin Valley—in both cases, roughly half of this capacity was installed in the last five years. Capacity is expected to increase rapidly in the coming decades, and eventually exceed 70 GW if California reaches its 2045 renewable energy goals (California Energy Commission 2021), with potential for 100 GW or more, depending on the extent of electrification in the rest of the economy.

Concerned about how this would impact farmland and food production, the American Farmland Trust (AFT) produced an analysis estimating that 83 percent of new solar generation built by 2040 would likely be sited on agricultural acreage.[73] They sum up the concern as follows: "This growth will create opportunities, but it also threatens farmland. America needs both—renewable energy and productive, resilient farms and ranches."

Projected build-out of solar energy resources to achieve SB 100 goals

Senate Bill 100 (De León, 2018) sets a 2045 goal of powering all retail and state agency electricity sold in California with renewable and zero-carbon resources.

We interviewed thought leaders about on-farm solar development, seeking their input on how to achieve an appropriate balance between the three goals that AFT identifies in its "Smart Solar"[74] framework: (1) accelerating solar energy development, (2) strengthening farm viability, and (3) safeguarding land well-suited for farming and ranching. We offer recommendations for accelerating farm-scale distributed solar and agrivoltaics projects as well as guardrails for utility-scale projects.

FINDINGS

Solar Development Pressure Could Accelerate the Loss of Valuable Farmland

As noted in the section *Protecting Farmland Using Integrated Land Use Planning*, for many years California has been losing farmland to various types of development at a rate of approximately 50,000 acres per year. With the average age of farmers continuing to rise, those looking to retire may be tempted to sell to solar developers who can outbid other farmers trying to rent or buy land.

This is of particular concern for young farmers, as Holly Rippon-Butler, land campaign director for the National Young Farmers Coalition, pointed out in a recent media story:[75] "Land access is the No. 1 challenge [beginning farmers] are facing, and this challenge is even greater for farmers of color. Are we really understanding what we trade off when we put solar panels on farmland?" Others point out that losing farmland has an impact on rural economies and jobs. Farmworkers are already vulnerable when land is taken out of production due to flooding, wildfires, or fallowing caused by drought or restrictions on groundwater use due to Sustainable Groundwater Management Act (SGMA) regulation. Displacement due to utility-scale solar development creates a permanent loss of farmworker jobs.

Appropriate Siting of Large Solar Is the Key

AFT has developed guiding principles to help shape solar development and protect our most productive agricultural land.[76] They state that solar siting should be prioritized on buildings, contaminated land, and on land not suited for agriculture. Irrigation canals present an interesting opportunity, and recent research on solar installations over irrigation canals found that they reduce evaporation, enhance photovoltaic performance due to the cooler microclimate next to the canal, and mitigate aquatic weed growth, all of which helps to

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[72] Public Policy Institute of California. (2022). *Solar energy and groundwater in the San Joaquin Valley.*

[73] American Farmland Trust. *Farms under threat 2040.*

[74] American Farmland Trust. *Smart solar on farmland and rangeland.*

[75] Marshall-Chalmers, A. (2023, April 12). The rush for solar farms could make it harder for young farmers to access land. *Civil Eats.*

offset the additional cost of the cable-support structures required to span the canals.[77] The Turlock Irrigation District expects to complete California's first such project in 2024.

A second principle AFT puts forward is that policies and practices should protect soil health if solar is developed on farmland or ranchland, especially during construction and decommissioning, to enable the land to be farmed again after the typical 30-year lifespan of solar installations. Third, they aim to expand development of agrivoltaic projects—or the generation of solar energy and farm products on the same piece of land throughout the lifetime of the project. Finally, they state that farmers and underserved communities should benefit from solar energy development and that it is important that the siting and design of solar projects be determined based on "inclusive stakeholder engagement to ensure projects strengthen farm viability and reflect farmer interests, including underserved producers that face barriers to accessing land and other resources."

Farm-Scale Solar Development Can Benefit Farmers and the Environment

Farms and ranches have many opportunities to install solar to meet their energy demands. Agricultural operations have many cost-effective solar siting opportunities, including houses, barns, equipment or packing sheds, on pumps for stock water and irrigation (both of which can be funded by California's SWEEP program), ground-mounted arrays that provide shade or can be located in under-utilized areas, and in some cases over ponds or compost windrows. Farmers can benefit from the Net Energy Metering Aggregation program[78] which makes it easier and cheaper to connect renewable energy projects to the grid and enables one solar installation to serve the aggregated load of multiple meters.

As electric cars, trucks, and tractors, like this one at Pie Ranch in Pescadero, become more available and affordable, farmers may find it profitable to convert to electric fleets and power employee vehicles.

One solar consultant we interviewed envisions integrating electric farm vehicles and charging stations into on-farm solar infrastructure. As electric cars, trucks, and tractors become more available and affordable and diesel fuel gets more expensive, it may prove profitable for farmers to convert to electric fleets and provide power for employee vehicles. Power purchase agreements negotiated with solar installers can remove some barriers for farmers to financing and accessing rebates. As battery storage (and eventually microgrid technology) becomes more affordable, farms and ranches are good candidates for these technologies to buffer them against power outages that can endanger livestock health and lead to food spoilage.

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[76] American Farmland Trust. *Smart solar.*

[77] McKuin, B., et al. (2021). Energy and water co-benefits from covering canals with solar panels. *Nature Sustainability*, *4*, 609–617.

[78] California's incumbent utilities offer net energy metering aggregation following passage of a 2014 bill that CalCAN sponsored (SB 594, Wolk). More information from PG&E can be found here.

Interest in Agrivoltaics Is Growing

There is a groundswell of interest and research in agrivoltaics technology that generates solar energy in a way that is compatible with crop or livestock production.[79] One approach is to graze animals beneath solar arrays where they control weeds and grasses, thereby eliminating the need to mow. Another approach is to mount specially designed solar panels over crops that allow the red wavelengths of the light spectrum that plants need to grow to penetrate through while filtering out the blue wavelengths that are most effective for generating energy.[80]

The shade provided by solar panels can be beneficial for the people who grow our food, for cool season crops such as brassicas and lettuces, and potentially even for heat-tolerant species as climate change leads to more extreme heat days. The shade also reduces the amount of water that evaporates from soils and plants, and in turn plant evapotranspiration cools the panels and improves their efficiency.[81] One researcher told us that water use efficiency is an important criterion for evaluating the impact of agrivoltaics on crop yield, particularly in water-scarce areas of the state. Frost protection may also be a benefit in some crops and seasons. More research is needed to better understand the optimal conditions for scaling up this technology, as well as pilot projects in partnership with farmers willing to experiment with it.

RECOMMENDATIONS

Promote a Least-Conflict Process for On-Farm Solar Siting

In 2016, then-Governor Jerry Brown's Office of Planning and Research (OPR) took part in a project called Solar and the San Joaquin Valley Identification of Least-Conflict Lands Project.[82] The diverse stakeholders involved set out, in a relatively short six-month time frame, to come to mutual agreement on mapping lands that could be suitable for solar development.[83] The assumption was that the process would result in less litigation for projects on sites identified collectively and that it would provide more surety for developers and guide decisions about building new transmission infrastructure. While the experts we interviewed who were involved in the process agree that it successfully mapped optimal sites for solar, questions remain about how well it is informing actual project development.

OPR, the California Department of Food and Agriculture (CDFA), and the California Energy Commission (CEC) should build on the least-conflict approach in the San Joaquin Valley in several ways:

1. Evaluate the impact of the process on solar development projects in the San Joaquin Valley since completion of the project.
2. Develop a best practices guidebook for replicating the least-conflict process in counties, irrigation districts, and community choice aggregation entities. To set the table for a least-conflict approach, CDFA should develop guidelines for siting utility-scale solar projects to avoid negative impacts on agricultural land. Models to look to are those created by the Pennsylvania Department of Agriculture.[84]
3. Create incentives to encourage solar on the agreed-upon sites (e.g., regulatory efficiency, permit consolidation, first in line for grants and loans, etc.).

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[79] In June 2023, S.1778 was introduced in Congress to advance research and demonstration of agrivoltaics.

[80] Camporese, M., & Najm, M. A. (2022). Not all light spectra were created equal: Can we harvest light for optimum food-energy co-generation? *Earth's Future*, *10*(12).

[81] USDA Climate Hubs. *Agrivoltaics: Coming soon to a farm near you?*

[82] UC Berkeley Center for Law, Energy and the Environment. (2016). *A Path Forward: Identifying least-conflict solar PV development in California's San Joaquin Valley.*

[83] A process modeled on the California experience is underway in a region of Washington state to answer this question: "Where can utility-scale solar be developed in the Columbia Plateau region while also ensuring that important natural habitat, productive farmlands and ranchlands, and tribal rights and cultural resources are protected?"

[84] Pennsylvania Department of Agriculture. Farmland considerations for siting grid-scale solar panels.

Set Up a California Clearinghouse for On-Farm Renewable Energy Generation

We recommend that the California Energy Commission launch an agriculture-focused resource center to serve farmers and solar developers. One model is the AgriSolar Clearinghouse created by the National Center for Appropriate Technology.[85] Another is the Bay Area Regional Energy Network (BayREN), a network of nine counties formed to promote water and energy efficiency and funded by utility ratepayer funds through the California Public Utilities Commission.[86] The clearinghouse could offer a range of services such as the following:

- Farmer-focused educational materials and outreach events
- Listings of qualified consultants and advisors that offer free or discounted technical assistance to help farmers navigate their options for on-farm solar
- Directory of solar consultants and technical assistance providers vetted based on certain standards
- Solar project financing resources such as grants, rebates, on-bill financing, and cost-share programs at the state and federal level
- Easily accessible mapping tools that show the available capacity on existing grid infrastructure near their customers

Investor-owned utilities, municipal utility districts, community choice aggregators, and irrigation districts could also take the initiative to set up services like these to accelerate on-farm renewable energy deployment.

Ramp Up the State's Role in Accelerating Agrivoltaics Deployment

There are several actions that various California agencies can take to accelerate the use of agrivoltaics.

CALIFORNIA ENERGY COMMISSION	Invest in more research on agrivoltaics and distributed solar generation on agricultural land, including better quantification of greenhouse gas (GHG) reductions and other co-benefits such as decreased evapotranspiration. The New York Power Authority[87] produced a technical report that is one example of a statewide effort like this.
CALIFORNIA PUBLIC UTILITIES COMMISSION	Promulgate rulemaking to provide regulatory clarity and consistency for agrivoltaics permitting and development and set a target for agrivoltaic deployment.
DEPARTMENT OF CONSERVATION	Develop guidelines pertaining to the development of agrivoltaics projects on land under Williamson Act[88] protection.

[85] See here for more on the AgriSolar Clearinghouse: https://www.agrisolarclearinghouse.org/

[86] See here for information on BayREN: https://www.bayren.org/

[87] New York Power Authority. (2023). Agrivoltaic leading practices technical report.

[88] The Williamson Act Program enables local governments to enter into contracts with private landowners for the purpose of protecting their agricultural use.

In addition, the legislature could look to models in other states and at the federal level for approaches to accelerating agrivoltaics and on-farm solar research and development while protecting working lands. Some examples include the following:

- U.S. Senate: Introduced in June 2023, the Agrivoltaics Research and Demonstration Act of 2023 (S. 1778, Heinrich and Braun) develops a regulatory definition of agrivoltaics and funds a study to identify gaps in agrivoltaics research and examine the risks and benefits, economic scalability, and best options for agricultural land for such systems. It also sets up a network of demonstration sites across the country to focus on increasing farm productivity, profitability, resilience, biodiversity, and economic opportunities in rural communities.
- Colorado (SB 23-092): Sets up a task force and funds agrivoltaics demonstration or research projects.
- Maine (LD 1227): Establishes a pilot to test and study best practices for "dual-use projects" combining solar development on agricultural lands.
- Massachusetts: Developed an Agriculture Solar Tariff to encourage on-farm solar development.

In 2023, the California legislature considered a bill (SB 688, Padilla[89]) that would require the State Energy Resources Conservation and Development Commission to fund research and development in agrivoltaic systems and to work with CDFA to develop funding guidelines and criteria. The bill, which CalCAN supports, will be held over to 2024.

Photo Credit: Agrisolar Clearinghouse

[89] SB 688 text here.