**Headline:** Agrivoltaics: The Farm-to-Solar Trend That Can Help Accelerate the Renewable Energy Transition

**Teaser:** Using the same land for the production of both agriculture and solar energy is a win-win for the climate and farmers.

By Tina Casey

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**Credit Line:** *This article was produced by* [*Earth | Food | Life*](https://independentmediainstitute.org/earth-food-life/)*, a project of the Independent Media Institute.*

**Tags:** Climate Change, Environment, Food, Community, Economy, Activism, Animal Rights, Science, Tech, Labor, Indigenous Resistance, Media, Politics, GOP/Right Wing, Biden, Opinion, North America/United States of America, Europe/Spain

**[Article Body:]**

Access to solar power is increasing in rural parts of the U.S., partly with the support of farmers who lease out their land for [utility-scale solar arrays](https://cropwatch.unl.edu/bioenergy/utility-scale-solar). This farm-to-solar trend known as “agrivoltaics”—[defined](https://www.energy.gov/articles/doe-announces-8-million-integrate-solar-energy-production-farming) by the U.S. Department of Energy (DOE) as “the co-location of agricultural production and solar energy generation on the same land”—is intertwined with [regenerative farming](https://nfu.org/2020/10/12/the-indigenous-origins-of-regenerative-agriculture/), a trend that has centuries-old roots within Indigenous cultures. This mindful cooperation between farming and energy poses a threat to the status quo fueling climate change and is facing a [surge of opposition](https://www.reuters.com/world/us/us-solar-expansion-stalled-by-rural-land-use-protests-2022-04-07/), but the emerging field of agrivoltaics could help neutralize the critics and [break down barriers to solar development](https://link.springer.com/article/10.1007/s44173-022-00007-x).

**The Importance of Rural Solar**

[Leasing out land](https://www.energy.gov/eere/solar/farmers-guide-going-solar) for a utility-scale solar array can provide farmers with an [important source of steady revenue](https://pv-magazine-usa.com/2020/02/20/solar-development-on-farms-can-save-farmers-and-farmland/). The income can be a lifeline for individual farmers, and for entire industries. Solar leasing, for example, is credited with helping to sustain [the cranberry industry](https://pv-magazine-usa.com/2020/02/20/solar-development-on-farms-can-save-farmers-and-farmland/) in Massachusetts.

“[R]ural communities have a significant opportunity to strengthen and diversify their local economies by embracing and actively engaging in the ongoing renewable energy transition,” wrote Katie Siegner, Kevin Brehm, and Mark Dyson, authors of a 2021 [report](https://rmi.org/insight/seeds-of-opportunity/) published by Rocky Mountain Institute, a nonpartisan nonprofit organization working to accelerate the clean energy transition.

“By 2030, renewable energy capacity in the United States will at least double, and potentially grow by a factor of seven or higher if new policies are enacted to capitalize on continuing cost declines in wind and solar,” they wrote. “As a result, rural communities—which host 99 percent of onshore wind and a growing share of utility-scale solar projects—stand to receive a sizable boost to their local economies. In fact, annual revenues from wind and solar projects could exceed $60 billion… by 2030—on par with expected revenues from the top three U.S. agricultural commodities: corn, soy, and beef production.”

Bringing more solar energy to rural communities is a priority for the Biden administration with a focus on [improving solar access](https://www.nrel.gov/state-local-tribal/lmi-solar.html) for underserved low- and middle-income communities. Among other provisions, [Biden’s 2024 budget proposal](https://www.whitehouse.gov/briefing-room/statements-releases/2023/03/09/fact-sheet-president-bidens-budget-lowers-energy-costs-combats-the-climate-crisis-and-advances-environmental-justice/) specifies $30 million in grants and $1 billion in loan guarantees for solar, other clean energy systems, and energy efficiency improvements for farmers and small businesses in rural communities, along with $15 million toward the creation of a new Rural Clean Energy Initiative tasked with helping electricity providers meet clean energy goals.

Helping rural businesses reduce their dependence on fossil fuels is another priority for many federal policymakers. In the U.S., the funding sources include the U.S. Department of Agriculture’s (USDA) [Rural Energy for America Program](https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans) (REAP), which was [created](https://www.rd.usda.gov/newsroom/news-release/usda-announces-reap-funding) through the 2008 Farm Bill to support energy efficiency upgrades as well as solar and other renewables on farms, including utility-scale projects.

**Opposition to Rural Solar**

Despite this investment from the U.S. government and interest from farmers, rural energy projects are not always welcomed by all parties—and have faced civic opposition hurdles that are not new. Local residents have long joined with environmental organizations to rally against mountaintop coal mining, natural gas fracking, and oil pipelines. Local residents and organizations can also oppose rural solar projects on environmental grounds. [Razing a forest](https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2021/04/30/locals-worry-wind-and-solar-will-gobble-up-forests-and-farms) to install a solar array would be one such example.

However, in the absence of any significant environmental impacts, solar projects can still face opposition based on disinformation about climate change. In April 2022, [Reuters drew attention](https://www.reuters.com/world/us/us-solar-expansion-stalled-by-rural-land-use-protests-2022-04-07/) to a recent sharp increase in the number of Facebook groups dedicated to blocking rural solar.

“Reuters identified 45 groups or pages on Facebook dedicated to opposing large solar projects, with names such as ‘No Solar in Our Backyards!’ and ‘Stop Solar Farms.’ Only nine existed prior to 2020, and nearly half were created in 2021. The groups together boast nearly 20,000 members,” [wrote](https://www.reuters.com/world/us/us-solar-expansion-stalled-by-rural-land-use-protests-2022-04-07/) Reuters reporter Nichola Groom.

Groom observed that these Facebook groups have become powerful engines of opposition that reflect local concerns about aesthetics and tree removal, among other topics. However, she also noted that these groups are [larded with false claims](https://www.reuters.com/world/us/us-solar-expansion-stalled-by-rural-land-use-protests-2022-04-07/) about climate change, including claims that climate change is a hoax, and that solar panels can leach cadmium, a carcinogen, into the environment.

Groom’s findings suggest the influence—whether coincidental or directed—of organizations connected to the promotion of disinformation on solar energy and climate change. The Heartland Institute, for example, has raised [questions about cadmium safety](https://heartland.org/opinion/solar-industry-catching-heat-over-toxic-metal/), and the [Texas Public Policy Foundation](https://www.nytimes.com/2022/12/04/climate/texas-public-policy-foundation-climate-change.html) has maintained that “[[n]o sound scientific evidence](https://www.texaspolicy.com/legelocalgovclimate/)” supports the potential for catastrophic climate change.

In addition, a [reporting team](https://www.npr.org/2023/02/18/1154867064/solar-power-misinformation-activists-rural-america) composed of Michael Copley of National Public Radio and Miranda Green from Floodlight has been following the activities of Susan Ralston, [described](https://www.npr.org/2023/03/16/1164050912/activists-spread-misleading-information-to-fight-solar) as a “longtime conservative operative” who is “stoking opposition to solar projects by spreading misinformation.”

According to a March 2023 [interview](https://www.npr.org/2023/03/16/1164050912/activists-spread-misleading-information-to-fight-solar) with Copley on NPR’s All Things Considered about his and Green’s February 2023 [report](https://www.npr.org/2023/02/18/1154867064/solar-power-misinformation-activists-rural-america), Ralston worked her connections in conservative circles to set up and run the group [Citizens for Responsible Solar](https://www.citizensforresponsiblesolar.org/) in 2019. The group’s treasurer, for example, has worked for Marco Rubio and J.D. Vance, and its official paperwork is handled by a firm that has represented “[at least two dozen conservative groups](https://www.npr.org/2023/03/16/1164050912/activists-spread-misleading-information-to-fight-solar).” That includes some groups connected to Leonard Leo of the Federalist Society (though Copley and Green [emphasized](https://www.npr.org/2023/02/18/1154867064/solar-power-misinformation-activists-rural-america) they have not found a direct link between Ralston’s group and the others).

Copley and Green also noted that a consulting firm owned by Ralston received $300,000 from the foundation of Republican donor and coal shareholder Paul Singer that coincided with the launch of Citizens for Responsible Solar (though they did not find a direct link between that money and startup funding for Citizens for Responsible Solar).

**The Appeal of Farm-Located Solar**

Despite the opposition, farmland attracts solar developers because it is sunny, relatively flat, and free of trees and other obstructions that raise the cost of site preparation. Access to existing roads and transmission lines is another advantage.

To the extent that farmland is already commercialized, industrialized, and lacking in biodiversity, farm-located solar arrays are also shielded from the environmental issues that arise when a solar project replaces a forest or other natural habitat.

Nevertheless, opponents of farm-located solar have argued that utility-scale solar arrays are [not an appropriate use of farmland](https://www.sciencedirect.com/science/article/abs/pii/S2214629622001013?via%3Dihub). This argument has also been advanced by Citizens for Responsible Solar, which has declared that “[[i]ndustrial-scale solar](https://www.citizensforresponsiblesolar.org/culpeper-history-opposition) is not agriculture; it is a power plant.” Other groups of opponents have adopted the “industrial solar” messaging directly, as with the Facebook group [Stop Industrial Solar Plants in Shelby County Indiana](https://www.facebook.com/groups/681624026030898/) (a splinter group of [Citizens Against Industrialized Solar Plants in Southwestern Shelby County](https://www.facebook.com/Citizens-Against-Industrialized-Solar-Plants-in-Southwestern-Shelby-County-118732933253853/)). Others don’t use “industrial” in their front-facing messages, but they link to other groups that do. The Facebook group [Stop Solar Farms](https://www.facebook.com/groups/stopsolarfarms/), for example, has reposted content from [Citizens for Responsible Solar](https://www.facebook.com/groups/stopsolarfarms/posts/726967761404661/) against “industrial-scale solar.”

In response, solar stakeholders raise the point that solar development can help preserve and improve farmland in the long run. A new solar array enables a farmer to realize income from a solar lease while enabling the soil below the solar panels to “rest” for the lifespan of the project, typically about 25 years.

Soil rest can help [break the breeding cycle of pests](https://blog.freshharvestga.com/why-soil-needs-as-much-rest-as-we-do/). A resting period can also enable soils heavily treated with agricultural chemicals to revert to a natural state, enabling the potential for a [transition to regenerative farming](https://www.naturesafe.com/knowlegde-center/blog/transitioning-to-regenerative-agriculture#:~:text=To%20make%20the%20soil%20healthy,practices%20that%20improve%20soil%20health.). Additionally, soil rest is consistent with the goals of the USDA’s [Conservation Reserve Program](https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/), which pays farmers for taking sensitive land out of production and planting species that restore environmental health.

An Indiana farmer cited by [the Indiana Business Journal](https://www.ibj.com/articles/solar-farm-boom-hits-hoosier-backlash) in 2020 observed that farms are places of work and that farmers should be the ones making decisions about their land “based on science and best practices,” regardless of the desire for bucolic surroundings expressed by solar opponents.

**Agrivoltaics 101**

Solar arrays can also be interplanted with clover and other species that support pollinator populations on farmland. The emerging field of agrivoltaics builds on that dual-use capability to create a new paradigm that could help accelerate solar development on farms.

The term “agrivoltaics” refers to solar panels that are raised higher off the ground, and far enough apart, to permit agricultural activity within the array. That provides for uses beyond establishing pollinator habitats. “Solar grazing,” for example, is emerging as a [preferred practice](https://www.climatehubs.usda.gov/hubs/northeast/topic/agrivoltaics-coming-soon-farm-near-you) for livestock farms.

Agrivoltaic arrays can resemble conventional solar arrays. Researchers have also been investigating vertical panels and other [alternative designs](https://www.nrel.gov/news/program/2022/growing-plants-power-and-partnerships.html).

The case for agrivoltaics has been bolstered by a [growing body of evidence](https://openei.org/wiki/InSPIRE) that demonstrates symbiosis within the array. Plants that grow under and around the panels contribute to a cooler environment for the solar panels, helping to improve their solar conversion efficiency. In turn, shade from the panels helps to conserve water and prevent soil loss, while [improving crop yields](https://www.nrel.gov/news/program/2019/benefits-of-agrivoltaics-across-the-food-energy-water-nexus.html).

Solar arrays may also help some crops continue to thrive as global temperatures rise. A pilot project in Spain, for example, is aimed at demonstrating the [microclimate benefits](https://cleantechnica.com/2022/10/06/solar-panels-create-micro-climate-to-save-vineyards-in-spain/) of solar panels in vineyards.

**Agrivoltaics, Regenerative Agriculture, and Big Ag**

The water and soil elements of agrivoltaics overlap with another trend: the regenerative agriculture movement.

[Regenerative agriculture](https://rodaleinstitute.org/why-organic/organic-basics/regenerative-organic-agriculture/) refers to farming practices that prioritize improving soil health, building up the soil, and conserving water, along with a holistic focus on human and animal welfare. While the term regenerative agriculture is attributed to Robert Rodale, son of the pioneering agriculturalist J.I. Rodale, it has been [practiced](https://nfu.org/2020/10/12/the-indigenous-origins-of-regenerative-agriculture/) for centuries by Indigenous peoples.

Regenerative farming has lingered on the fringes of the agriculture industry for decades. With the growing climate crisis, the [carbon-sequestering benefits of soil conservation](https://observatory.wiki/A_Climate_Change_Solution_No_One%E2%80%99s_Talking_About:_Better_Land_Use) have come into sharper focus, along with the potential for bottom-line benefits related to carbon credit policies.

In November 2022, the industry-led organization Sustainable Markets Initiative (SMI) announced the launch of [a new regenerative agriculture program](https://www.sustainable-markets.org/news/world-s-leading-food-farming-businesses-launch-action-plan-to-scale-regenerative-farming-warning-speed-of-progress-must-triple-to-tackle-the-impacts-of-climate-change) through its Agribusiness Task Force. The initiative aims to accelerate regenerative practices globally, in concert with carbon markets and other government policies that draw bottom-line benefits from carbon sequestration.

Members of the task force include familiar names like Bayer, Mars, McDonald’s, Mondelez, PepsiCo, and Yara International along with the global french-fry supplier McCain Foods and the global cocoa, coffee, cotton, and rice producer Olam. The data platform HowGood is also a member, along with the microbe-focused soil conservation firm Indigo Agriculture, the employee-owned retailer Waitrose & Partners, and Sustainable Food Trust.

The global agricultural and food processing industries have amassed a terrible record on [human](https://digitalcommons.law.seattleu.edu/cgi/viewcontent.cgi?article=1127&context=faculty), [environmental](https://www.worldbenchmarkingalliance.org/news/big-food-companies-failing-on-climate-and-human-rights/), and [labor rights](https://www.ethicalconsumer.org/food-drink/workers-rights-food-industry). Nevertheless, money talks. As described by the Agribusiness Task Force, the potential for profit is at the heart of the initiative.

“The Task Force calls for common metrics and [market-based financial incentives](https://www.sustainable-markets.org/news/world-s-leading-food-farming-businesses-launch-action-plan-to-scale-regenerative-farming-warning-speed-of-progress-must-triple-to-tackle-the-impacts-of-climate-change/) for environmental outcomes, targeted government policy and an overhaul of food sourcing—all to make regenerative agriculture a ‘no brainer’ business decision for farmers,” the organization stated in a November 2022 press release.

**The Carbon Sequestration Angle**

Whether or not the SMI plan results in a faster uptake of the fully holistic practices articulated by Robert Rodale and practiced by Indigenous farmers remains to be seen. However, in terms of carbon sequestration, the Task Force is in a position to exercise its influence on a global level, and that could have a ripple effect on opportunities for agrivoltaic development.

Lightsource BP, for example, has been promoting its solar business as a form of regenerative agriculture, loosely speaking. The company has drawn attention to similarities between the benefits of farm-located solar arrays and the [soil conservation and biodiversity](https://www.lightsourcebp.com/us/projects/cottontail-solar-farm-project/) goals of the USDA’s [Conservation Reserve Program](https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/), which rewards farmers for taking arable land out of production.

Lightsource BP is also a sponsor of the [American Solar Grazing Association](https://solargrazing.org/) along with Engie, EDF, and other renewable energy stakeholders.

**More Federal Support for Agrivoltaics**

The USDA has been supporting agrivoltaics research and development through its [InSPIRE](https://www.nrel.gov/news/program/2021/future-of-agriculture-combined-with-renewable-energy-finds-success-at-jacks-solar-garden.html) program. In December 2022, the DOE announced [$8 million in funding for six new research projects](https://www.energy.gov/articles/doe-announces-8-million-integrate-solar-energy-production-farming) under its Foundational Agrivoltaic Research for Megawatt Scale (FARMS) program. Though the total is relatively small, it could have a widespread impact in terms of communicating best practices, developing a trained workforce, and overcoming barriers to rural solar.

Five of the projects aim to demonstrate agrivoltaic practices in different regions of the U.S.: a horticulture and beekeeping program atIowa State University; a suite of crop and grazing trials that partners Rutgers University in New Jersey withDelaware State University; a grazing and hay production trial at an existing solar array by Ohio State University; a grazing trial at another solar array by the University of Arizona; and a project at the University of Alaska Fairbanks aimed at adapting agrivoltaics to underserved, high-latitude communities.

The sixth project enlists the Washington, D.C., organization [Solar and Storage Industries Institute](https://www.seia.org/news/solar-industry-launches-nonprofit-alleviate-clean-energy-roadblocks) to partner with utilities as well as agriculture stakeholders to produce guides for overcoming barriers. The organization is a branch of the Solar Energy Industries Association.

The opposition to rural solar is sure to increase in the coming years. However, the trend toward regenerative agriculture and agrivoltaics could provide a counterbalance, by allying solar industry stakeholders with local farmers as well as leading businesses in the global agriculture industry.