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Can Solar Power Help Pollinators?

A new EPRI study examines the feasibility of co-locating solar and pollinator habitat

By Chris Warren

Anyone paying even a little attention to the power industry's transformation in recent years will know that the market for solar energy is big and growing quickly. The drivers of solar's evolution from a niche technology affordable only to those with few alternatives—NASA, to power satellites, for instance—into a mainstream energy source that routinely heads the list of new capacity additions are varied. Among the most important factors are dramatic price declines, performance improvements, favorable policies, and rapidly increasing manufacturing scale.

Taken together, these and other drivers are forecast to lead to a total of 1,600 gigawatts of solar power plants installed in the United States by 2050. Tax credits for solar in the recently passed Inflation Reduction Act of 2022 may accelerate deployment even more. While market growth will lead to the installation of an increased number of solar panels, inverters, and racks—not to mention new grid connections and substations—the size and scale of the market for turning photons into electrons can also be measured in land mass.

In fact, large-scale solar photovoltaic (PV) power plants worldwide are expected to cover over 40,000 square miles by 2030 and 140,000 square miles by 2050—equivalent to the territories of Virginia and New Mexico, respectively. The U.S. could reasonably account for about 10 percent of this land.

AN OPPORTUNITY TO BENEFIT POLLINATORS

Habitat loss, invasive species, pesticides, and climate change have all combined to threaten the ability of important pollinator species to continue to reproduce and be healthy. Pollinator species such as the rusty patched bumble bee are listed as endangered under the federal Endangered Species Act. Currently, the monarch butterfly and four additional bumble bees in the western United States are being reviewed by the U.S. Fish and Wildlife Service for possible protection as threatened or endangered.

Consider that one-third of all the food we eat, including strawberries, chocolate, and coffee, depends on healthy pollinator populations, particularly bees but also bats, birds, butterflies, and some other insects. Additionally, 28,000 medicinal plants depend on pollinators.

Some see solar's rapid development as an opportunity to protect pollinator habitat. Several energy companies and solar developers are exploring ways to leverage the large swaths of land taken up by PV plants to support healthy biodiversity. For example, Enel Green Power's 150-megawatt Aurora Solar Farm in Minnesota integrates low-growing pollinator habitat.

Developing stakeholder processes that balance community concerns with the needs of the industry is critical. But there is also a knowledge gap around the technical and environmental feasibility of emerging applications like utility-scale pollinator-solar. "A basic issue we wanted to understand was the financial feasibility of these projects, particularly in terms of the ultimate cost per kilowatt-hour," said engineer and EPRI Principal Technical leader Cara Libby.

MODELING FOCUSED ON THE COST OF POLLINATOR-SOLAR

To answer those and other questions, EPRI conducted techno-economic modeling to understand better the design, cost, and performance considerations involved with co-locating solar and pollinator habitats. EPRI used the well-established System Advisor Model (SAM) developed by the National Renewable Energy Laboratory to assess changes in the levelized cost of electricity (LCOE) over 30 years for a 150-megawatt solar facility.

The modeling included factors such as array height, the cost of establishing pollinator habitat, operations, and maintenance (O&M) costs over the lifetime of the solar facility's operation, the module technology used, and the location of the project. To incorporate variations in climate and albedo (a measure of the reflection of solar radiation), the research modeled projects in Columbus, Ohio; Jacksonville, Florida; and Las Vegas, Nevada. The impact on LCOE of a pollinator-solar facility was compared to that of a typical non-pollinator solar facility in each location.

The feasibility of co-locating solar and pollinator habitats largely depends on balancing upfront capital expenditures (CAPEX) and ongoing O&M costs. "Sometimes the native seeds can cost more upfront," Libby said, "but their long-term ecological and vegetation management benefits may outweigh the investment. This is useful to evaluate, particularly at the time of initial solar panel installation, when the costs can be covered by the larger CAPEX budget." For example, planting native plants under, between, or around the perimeter of

solar arrays may result in long-term O&M savings by reducing costs for mowing. Traditional turf grass may require mowing monthly, while native, pollinator-supporting plants may only need it annually.

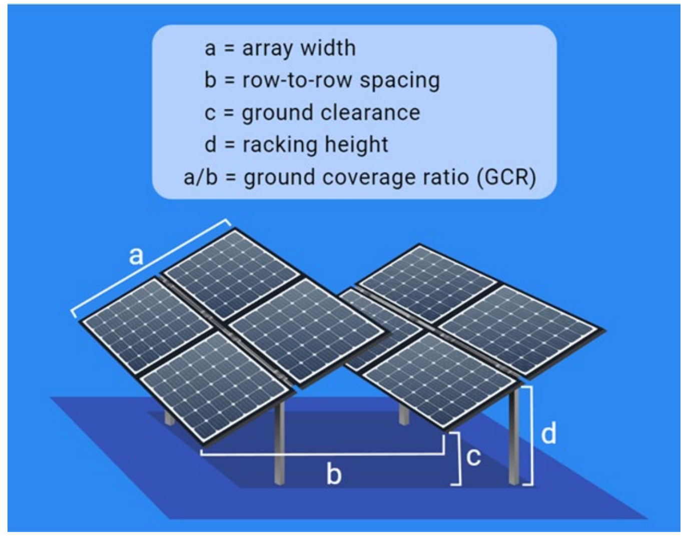
Another issue is the careful selection of pollinator plants of suitable height. "You don't want to include plant species that will grow higher than the solar arrays and shade them because that has energy production and system reliability implications," said EPRI senior technical executive and conservation biologist Jessica Fox. "It's important to choose a native seed mix with mature heights that do not exceed the minimum ground clearance height of the lower edge of arrays."

There is also an incentive to re-establish vegetation under panels quickly to close stormwater permits. Native vegetation tends to be deep-rooted, and its presence helps control stormwater runoff so that water more easily infiltrates the soil over the longer term. Native vegetation also supports soil structure, associated soil-dwelling species, and soil carbon sequestration. In addition, planning is needed to account for the additional time for native vegetation to establish fully.

PANEL TECHNOLOGY CHOICE AND ARRAY HEIGHT IMPACT ON LCOE

The modeling EPRI completed offers insights about LCOE and also illustrates the need for additional research. At a very high level, the answer to whether or not O&M savings exceed any additional CAPEX is that it depends on a range of factors.

For example, the modeling demonstrated that the choice of array height was particularly important to the LCOE of solar projects. The standard minimum array ground clearance is between 18 and 24 inches. Raising the height of the racking can prevent shading from taller pollinator plants, but building and maintaining elevated racking systems requires more steel and labor. Racking height was a main driver of LCOE across all 315 cases EPRI modeled. None of the 36- or 48-inch ground clearance designs broke even financially with the non-pollinator base design.



Module choice is also significant. Monofacial modules generate electricity using sunlight incident only on the top side of the panel. Bifacial modules, by contrast, can utilize sunlight received on both sides of the panel. Planting white or light-colored pollinator plants can increase the amount of sunlight reflected off the ground or albedo. Using bifacial modules in conjunction with such high-albedo vegetation can boost the performance of a solar power plant.

MANY QUESTIONS REMAIN

Careful techno-economic modeling work is the first step in better understanding the financial feasibility of co-locating solar and pollinator habitats. There are limitations to the research findings that will be addressed in future work. For example, the modeling relied on best-available cost estimates and design assumptions rather than data reported by individual solar developers, which tend to be proprietary.

To address that gap, EPRI plans to conduct a survey of utilities, solar developers, vegetation consultants, and others to gather data, insights, and experience that can be incorporated into the model. Those data will be used to refine the assumptions used in the first round of modeling. The results will be updated and published, along with the perspectives of those pursuing or considering solar and pollinator habitat co-location.

There are also myriad unresolved questions that need to be addressed to inform decisions about co-location. These include determining which native pollinator species are best suited to thrive in a partial-shade environment under arrays with 18- to 24-inch ground clearance. Other areas needing improved understanding are the albedo associated with pollinator vegetation and, at a very basic level, the measurable ecological criteria that backs "pollinator-friendly solar" designations.

Important economic questions are how the LCOE for solar projects co-located with pollinator habitat differs between community and large-scale developments, the difference in costs to establish and manage vegetation at pollinator versus non-pollinator sites, and the cost of electricity to the customer.

There is concern that incorporating pollinator habitat could slow solar development and inject additional complexity. Others argue that there is an opportunity to use the rapidly increasing pace of solar deployment to create and protect critical ecological systems. There may be a middle ground where we can accomplish climate, business, and biodiversity goals. "Solar is positioned to play a critical role in decarbonizing our energy systems," Fox said. "Especially with the United Nations' sweeping commitment in December to protect 30% of the world's biodiversity by 2030, if there are ways to build out solar quickly and affordably and also demonstrate biodiversity stewardship through dual land use, that's an even bigger win."

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