Photovoltaics & Farmland

How Solar Power Enhances Rural Ecosystems

As more American households, businesses and utilities invest in clean energy to provide long-term price certainty, support economic development, and secure a cleaner environment, rural communities will see increased opportunities to host solar facilities. Developers often look to rural communities to find enough land to lease to construct and operate facilities of sufficient size to keep costs low, prices affordable, and to contribute to grid reliability. While tax revenue, construction jobs, and lease payments provide economic support to the community, solar facilities also present benefits to the local environment. These benefits are especially important to landowners and neighboring farmers, who rely on the long-term vitality of the land for their livelihood.

Below are important components to preserving and enhancing a healthy environment for farming, and how a solar facility may support a rural community over a generation.

Improved Soil Health

Healthy soil is vital to maintaining clean air and water, as well as ensuring productive lands for growing crops and grazing livestock.

A solar facility can passively enhance the soil through the establishment of regionally-appropriate perennial vegetation underneath and around the panels. Thus, solar facilities can improve soil quality by increasing nitrogen retention, total nitrogen, and soil organic carbon.[1] Healthy soil is obviously important to crop growth and grass growth for grazing livestock. Developers may also use vegetative buffers or prairie strips at the facility, resulting in a reduction in water, phosphorus, nitrate-nitrogen runoff, as well as soil loss.[2]

The solar industry is currently partnering with Argonne National Laboratory to further understand how site development, vegetation management, and other practices affect soil health over time, and compare to other land uses.[3]

Reduced Nutrient Runoff

Vegetation at solar facilities does not typically require long-term or routine applications of soil amendments, such as fertilizer. Thus, residual nutrients are less likely to be mobilized during runoff events compared to conventional agriculture. Perennial grasses and legumes further stabilize the soil, decrease runoff and erosion potential, and improve water quality by intercepting sediment and nutrients.

1 Missouri Prairie Foundation. Build Healthy Soil. Available: https://grownative.org/learn/build-healthy-soil/

2 Walston, et al. Modeling the ecosystem services of native vegetation management practices at solar energy facilities in the Midwestern United States. Ecosystem Services. February 2021. Available: https://www.sciencedirect.com/science/article/pii/S2212041620301698

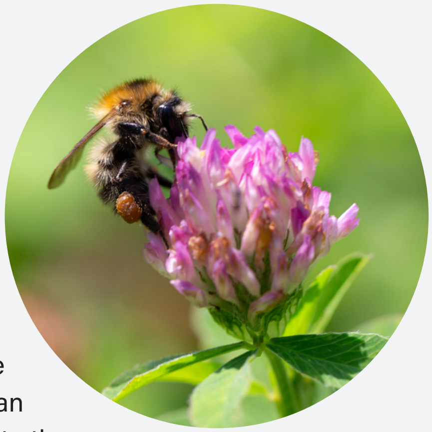
3 Department of Energy. Deploying Solar with Wildlife and Ecosystem Services Benefits (SolWEB) Funding Program. 2022. Available: https://www.energy.gov/eere/solar/deploying-solar-wildlife-and-ecosystem-services-benefits-solweb-funding-program

Enhanced Stormwater Management

From a bird's eye view, solar panels can appear as an impenetrable, or impervious, surface. In fact, once operational, a typical solar facility will maintain permanent vegetation on site and the spacing between individual panels and rows enables water to flow underneath and between panels. Perennial vegetation at a solar site reduces erosion and increases water retention, as the root system stabilizes the soil and helps absorb water. Researchers found that sediment export, a technical term for erosion, was 95% lower at a solar facility with native grass underneath than that of agricultural land, and water retention was also 9.5% higher. The study revealed that a solar facility paired with turf grasses also led to less sediment export and greater water retention than conventional agriculture.[4]

To regulate erosion and stormwater runoff concerns, a locality or state typically requires an erosion and sedimentation control plan before issuing a permit to a solar project. Some sites require grading prior to the construction process; if topsoil is removed, it can be stockpiled and redistributed to support soil stabilization and maintain quality. Some developers use preconstruction seeding as a mechanism to stabilize soil early in the installation process. The local authority or relevant state agency may often monitor the site until vegetative groundcover is established.

What is planted at a solar facility?



Many factors influence what type of seed mix is used and how it is planted and maintained. There is no one-size-fits all choice for vegetation on solar sites. Developers prepare site-specific plans. In general, developers aim to incorporate natural landscaping practices[5] into the solar facility to capture various ecosystem services at the site.[6] Tall grasses are not appropriate to plant underneath or between solar panels, as shading will limit the power output of the solar facility. Denser vegetation can also increase the risk of a fire. Some plant species with deeper root systems can take longer to grow compared to turf grasses and clover, which can establish quickly to manage runoff. As many native plant species can be expensive or challenging to procure at higher seeding rates, a diverse mix of species of grasses, sedges and forbs can provide a cost competitive seed mix that provides valuable ecosystem services to the land. Thus, developers need to balance these benefits and impacts of seed mixes accordingly.

4 Walston, et al. Modeling the ecosystem services of native vegetation management practices at solar energy facilities in the Midwestern United States. Ecosystem Services. February 2021. Available: https://www.sciencedirect.com/science/article/pii/S2212041620301698

5 Environmental Protection Agency. Green Landscaping: Greenacres. Available: https://archive.epa.gov/greenacres/web/html/chap2.html

6 American Clean Power Association. Beneficial Practices for Establishment and Maintenance of Vegetation at Utility-Scale Solar Sites. Available: https://cleanpower.org/wp-content/uploads/2022/05/Beneficial-Practices-for-Establishment-and-Maintenance-of-Vegetation-at-Utility-Scale-Solar-Sites_Final.pdf

Soil Formation and Retention

Soil compaction occurs when heavy machinery, livestock grazing, or inappropriate tillage practices are applied to a site. If not managed, compaction of topsoil or subsoil can limit future crop production, water filtration, and stormwater retention.

Given that construction involves installation of posts, beams, and access roads, farmers may be interested in the degree of soil compaction at solar sites. In general, compaction may occur at select parts of the project site: specifically, trenches, access roads, and pads for electrical equipment, such as inverters or transformers. Where compaction can occur, developers may aerate or till the soil, or plant deep rooted vegetation to mitigate these impacts.[7] This is consistent with federal and state construction permitting requirements, that require decompaction needs to occur where the permittee intends to use vegetation to stabilize the soil.[8]

Furthermore, tillage does not occur after construction. Thus, by reducing tillage practices, a landowner can reduce nitrous oxide emissions and increase carbon sequestration in many circumstances.[9]

Reduced Pesticide Use

Solar development does not require insecticides. Herbicides may be used during the site preparation process but is applied more targeted once the facility is in operation.

Furthermore, solar panels and racking systems upon which the panels are installed do not pose danger of leaking chemicals or other hazardous materials into the soil.[10] For more information on solar panel safety, please visit "Solar Panels in Your Community."

Image provided courtesy of Pattern Energy Group LP

Reduced Water Use

Solar facilities typically require little water during construction or operations, as rainfall is generally sufficient to settle dust and clean the panels. For regions where water access and supply are limited, converting farmland to solar generation for a period of time reduces irrigation needs and saves the community an important resource during operation. As noted above, the vegetation underneath a solar facility can also help retain stormwater and manage runoff.

Preserving Future Farm Opportunities

Given the challenges of modern farming, many families are choosing to lease land for solar generation to preserve their farm for the next generation by securing a stable source of income and avoiding pressures to sell land to developers who will permanently alter it and remove it from agriculture. Unlike residential or commercial real estate development, land set aside for solar energy can be returned to farming after the project's useful lifespan, if the landowner so chooses.[11] The subsequent income from solar lease payments can support other portions of the farming operation that can fluctuate based on commodity prices and weather events. Solar provides a stable, low-impact option for farmers who wish to keep the land in the family for at least a generation.

7 North Carolina State University. Balancing Agricultural Productivity with Ground-Based Solar Photovoltaic (PV) Development. 2017. Available: http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2017/10/Balancing-Ag-and-Solar-final-version-update.pdf

8 Environmental Protection Agency. 2012 Construction General Permit (CGP). 2021. Available: https://www.epa.gov/sites/default/files/2017-07/documents/2012_construction_general_permit_factsheet.pdf

9 Jayaraman S, Dang YP, Naorem A, Page KL, Dalal RC. Conservation Agriculture as a System to Enhance Ecosystem Services. Agriculture. 2021; 11(8):718. https://doi.org/10.3390/agriculture11080718

10 North Carolina State University. Health and Safety of Photovoltaics. May 2017. Available: https://content.ces.ncsu.edu/health-and-safety-impacts-of-solar-photovoltaics

11 Department of Energy. Farmer's Guide to Going Solar. Accessible: https://www.energy.gov/eere/solar/farmers-guide-going-solar