# Michigan Agrivoltaics Information Guide

## Part 1: An introduction to agrivoltaics

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This resource is intended to serve as an introduction to agrivoltaics for Michigan communities and farmers interested in local solar opportunities. Other parties who may also find this resource useful include community members seeking information on solar energy in rural areas, local officials interested in renewable energy, and emerging farmers looking to access land. Agrivoltaics is a relevant opportunity to achieve Michigan's climate commitments, offering an integrated solution to address land use tensions while supporting rural vitality, agricultural innovation, carbon reduction efforts, and energy independence.

## Key takeaways

1. Agrivoltaics integrates solar photovoltaic electricity production with agricultural activities, reducing land use conflicts and producing a range of economic, environmental, and community benefits.
2. Agrivoltaics can incorporate a wide diversity of agricultural activities, from specialty and commodity crops to animal grazing and apiculture.
3. Agrivoltaics systems vary in size and in the complexity of their agricultural and business-model arrangements, from small-scale, single-farmer operations to large, utility-scale projects incorporating multiple land leases and agricultural operations.

## Agrivoltaics defined

Agrivoltaics is the practice of producing energy from solar photovoltaics and agricultural products on the same plot of land. While the practice goes by many names—agrisolar, dual-use solar, agrophotovoltaics—the concept is the same: a wide range of agricultural activities taking place within a solar array.

By combining multiple uses on a single plot of land, agrivoltaics helps to address land use conflicts, particularly between energy and food production. Agrivoltaics is closely related to ecovoltaics (or conservation solar) and is sometimes used as an umbrella term incorporating the latter.

Ecovoltaics is the practice of producing energy from solar photovoltaics and ecosystem services (additional benefits to the environment, land owner, or community beyond energy generation) on the same plot of land. An example of an ecovoltaics ecosystem service is improved soil carbon sequestration and reduced erosion from deep-rooted native grasses and vegetation.

# Agricultural activities in agrivoltaics systems

Agrivoltaics projects incorporate a wide range of agricultural activities, including crop production, animal husbandry, and apiculture. Agrivoltaics projects may combine elements from different types of agricultural activities to create synergies. For example, bees kept on-site can pollinate tomato plants, while well-timed sheep grazing can promote regeneration of the habitat these bees rely on for pollination and honey production.

Within crop-production activities, horticultural crops tend to be the most common (e.g., lettuce, cilantro, carrots, radishes, broccoli, cauliflower). For example, one Massachusetts farm has been successfully growing broccoli on a 2.2-acre solar array since 2023.[1]

However, certain specialty crops, such as currants,[2] grapes,[3] and pears,[4] are becoming more common. Cornell University's Hudson Valley Research Laboratory is considering installing a 12-foot-tall, 300-kilowatt (kW) solar array over 1,100 apple trees by summer 2025, while in Ravena, New York, Cornell Extension has planted strawberries and raspberries within a solar array.[5]

While hand-harvested crops are most common, numerous pilot projects are underway with commodity crops, such as wheat,[6] soybeans, and corn,[7] that require large machinery to harvest.

Many agrivoltaics projects also incorporate animal husbandry. Sheep are often used to graze sites with native vegetation. Since 2021, sheep have been grazing Heritage Sustainable Energy's 30-acre solar farm in Traverse City, Michigan.[8] In addition to sheep, cattle,[9] chickens,[10] and rabbits[11] have also been used to graze sites.

# Size and composition of agrivoltaics systems

Agrivoltaics projects occur on a range of scales. Most existing projects are relatively small (30 kW–1 megawatt (MW), particularly those with hand-harvested crops, with many using the electricity generated to offset the energy demands of farm operations.

However, there has been a recent shift toward larger, utility-scale projects. On March 21, 2024, the Ohio Power Siting Board approved what will be one of the nation's largest agrivoltaics projects, the Oak Run Solar Project.[12] An even larger development, the Mammoth Solar project, is set to be built in neighboring Indiana.[13] At 800 MW and 1.6 GW, respectively, these projects dwarf the next largest development, the 180-MW Madison Fields project (also located in Ohio).[14]

Mid-scale projects (1 MW–100 MW) are also becoming more common. In one particularly innovative project on Knowlton Farms in Grafton, Massachusetts, BlueWave Solar built a 2-MW community solar array with 1.4 MW of battery storage, incorporating rotational grazing with lettuce and squash cultivation.[15] This community solar garden offers solar subscriptions to local residents, with subscribers receiving a credit on their electricity bills for their share of the solar electricity produced by the array.

# Benefits of agrivoltaics

## Economic:

- Solar leases can provide financial stability to farmers, with many receiving lease payments of $1,000 or more per acre.[16]
- Agrivoltaics can help offset any on-farm electricity loads (e.g., irrigation pumps) and help reduce farm operating costs.
- Excess electricity generated by the solar array may be sold to a utility through Michigan's Distributed Generation Program and is an additional source of revenue.[17] Each regulated utility sets its own tariff (or rate) for any distributed generation. Customers receive a monetary credit for each kilowatt-hour (kWh) of excess electricity they export to the grid. Credit rates vary by category or capacity threshold (solar array size) and are based on the customer's retail rate, which varies by the utility and the customer's specific rate schedule.
- Using animals for grazing can reduce the costs associated with mowing a solar photovoltaic site.[18]
- Creating additional value from the resulting animal products (e.g., mutton, wool). Sheep grazing on solar sites has generated $262 per acre in the Eastern United States,[19] with solar grazers in New York state averaging $509.[20]
- The vegetation underneath solar panels lowers the surrounding air temperature, resulting in increased efficiency and durability of panels.[21]
- Solar panels have temperature-regulating effects, which can increase the number of growing days, reduce heat stress, and prevent frost damage to crops.[22]
- The shade from solar panels can help lower the body temperature of animals, reducing stress caused by excessive heat.[23]
- Solar panels can provide shelter to crops and animals from extreme weather events, such as heavy rain and hail.

## Community:

- By keeping agricultural land in production, agrivoltaics prevents the displacement of agricultural activities, avoiding greenfield development.
- Communities can work with solar developers to negotiate community benefits agreements (CBAs). CBAs are legally binding contracts that detail how the solar project and the developer will provide communities with additional benefits. Benefits can include local hiring and procurement provisions during project construction, payments in lieu of taxes, the creation of renewable energy educational and workforce development programs, and financial support for a wide array of community services.
- Agrivoltaics sites can provide land access for emerging farmers, helping to grow the next generation of agricultural producers. States that tie solar financial incentives (e.g., property tax exemptions) to continuing production on agricultural lands create a market environment more conducive to tenant farmers. For example, a solar developer that has purchased land for solar development could use the extra electricity premium paid to agrivoltaics projects in Massachusetts by offering the land to a tenant farmer at a reduced rate.[24]
- The rise in insect and bird populations resulting from planting native pollinator vegetation can lead to the increased production of pollinator-dependent crops in the surrounding area.[25]

## Environmental:

- Ecovoltaics can improve water quality by reducing stormwater runoff.[26] The thick root mat of native pollinator plants can improve water infiltration, reduce soil erosion, and filter out excess nutrients, such as nitrogen and phosphorus.[27] These projects can be strategically sited in vulnerable drinking water management areas within rural settings, simultaneously preserving and restoring the land's agricultural productivity while preventing costly upgrades to local drinking water supply infrastructure.[28]
- The shade from solar panels reduces evapotranspiration from crops, lowering irrigation requirements and conserving water.[29]
- Projects incorporating native pollinator vegetation increase local biodiversity by boosting bee and other insect populations, as well as those of birds and bats.[30]
- Using livestock to graze solar sites can help to regenerate pastureland and control invasive species.[31] While grazing, livestock push seeds into the soil with their hooves, and their waste acts as fertilizer.
- Sheep reared by grazing agrivoltaic sites produce 25% less lifecycle emissions than sheep reared with corn and soybean feed.[32]
- Planting native vegetation on a solar site can improve soil health and its ability to sequester carbon.[33]
- Solar energy reduces carbon dioxide ($CO_2$) emissions, helping to mitigate the effects of climate change.[34]

# Endnotes


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