American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

Smart Solar Siting for New England

The rapid expansion of renewable energy installations across the region in recent years has brought new and pressing challenges. Solar deployment is becoming constrained because of increasing conflict over the pressure that projects are putting on farms and forests. This new pressure compounds the severe "competition for land" in New England due to residential development, expanded local food production, and climate change. Dual-use solar arrays provide a productive alternative to traditional ground mount solar – one that maintains agriculture on site, under or around the solar installation itself.

What is Dual-Use Solar?

The definition of dual-use solar varies across state lines, industries, and organizations. For this project we use the following working definition:

Dual-use solar, also known as **agrivoltaics** or **co-location** of solar, is the practice of installing solar photovoltaic panels on farmland in such a manner that primary agricultural activities (such as animal grazing and crop/vegetable production) are maintained simultaneously on that farmland.

The following examples of dual-use solar projects vary in design, size, agricultural production, and location. This document is meant to highlight the variety of settings dual-use can work.

Examples of Dual-Use Solar Arrays

French National Institute for Agricultural Research, Montpellier, France[1]

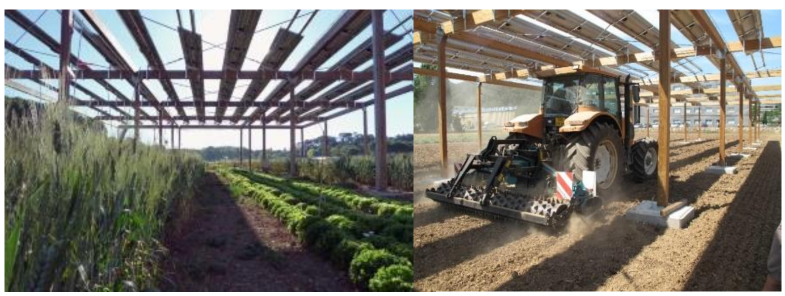

Figure 1: Photos by Hélène Marrou

Excerpt from The Resurgence of Solar Agriculture - Harvesting food and energy side by side[2]

Researcher Hélène Marrou explained, for example, that the lettuce adapted to low light by increasing leaf size. She also wrote in a 2013 paper that in a warming world where water could be in short supply, shading plants under solar panels could reduce the need for water. "We showed in this experiment that shading irrigated vegetable crops with PVPs (photovoltaic power systems) allowed a saving of 14 percent to 29 percent of evapotranspired water, depending on the level of shade created and the crop grown.

"The takeaway is that too much shade can hurt the crops. And too little can hurt electricity generation. Proper spacing between the solar panels, together with the tilt of the arrays, is key to getting the right mix of electricity and crop production."

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[1] Marrou, H. Co-locating food and energy. Nat Sustain 2, 793–794 (2019). https://doi.org/10.1038/s41893-019-0377-0
[2] https://anthropocenemagazine.org/2018/09/the-resurgence-of-solar-agriculture/

University of Massachusetts Amherst Research Farm, South Deerfield, MA

Excerpt from Agriculture and Solar Energy Dual Use[3]

This research project is grounded in the understanding that there is a need for sustainable renewable energy sources for Massachusetts and the U.S. and we suggest solar power as an area of great promise…Only solar has the potential to substantially power the state while only using a reasonable amount of the state's land mass. Traditional ground mounted solar installations on farmland, however, remove arable land from potential agricultural use.

Figure 2: Photo by Emily Cole

In the project's first phase, installation techniques were developed as 106 panels were installed in livestock pasture areas. New techniques were developed to install (drive) poles with no disturbance to the soil or crop underneath. At the same time, methods were developed to create stable structures without the use of large concrete bases which would have also created excess disturbance to the soil. Panels were installed about 7.5ft (2.3m) off the ground with spaces between panel clusters varying from 2 to 5ft.

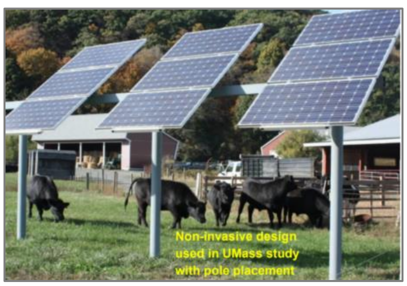

Figure 3: Herbert et al., 2017.

Preliminary results show minimal effect of biomass when land under the panels is in pasture; benefits in vegetable production during drought conditions; and depressed harvest under normal conditions. While a formal report is not yet released, it has been reported, preliminarily, that peppers, broccoli, and Swiss chard grew to about 60 percent of the volume they would in full sun, while the panels produced half the power per acre of a traditional system.

Grazing Cattle at Maple Ridge Meats, Benson, Vermont

From Rural Solar Stories, a project of Environmental Law & Policy Center[4]
A new Vermont project demonstrates how to maintain agricultural use of the land with on-site solar. When Greg Hathaway started his organic beef processing plant, Maple Ridge Meats, he sought to lower their power costs and increase sustainability with solar. Working with the Vermont Agency of Agriculture and a local renewable energy developer, they pioneered a new style of solar array to be built on their pasture to partly power their operations.

On hot summer days the cattle seek relief from the sun, lined up in the shade of the panels. It's even become a local attraction for passersby who park along the country road. This approach could be used for cattle grazing elsewhere in the country, especially the Midwest and Great Plains.

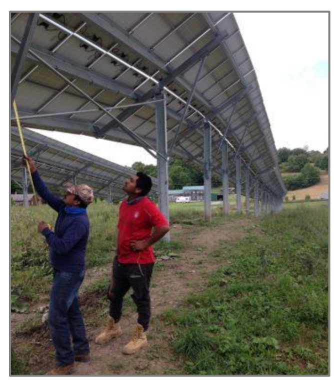

Figure 7: Raised Array at Maple Ridge Meats. Source: ruralsolarstories.org

[3] Herbert, S. J., Ghazi, P., Gervias, K., Cole, E., & Weis, S. (2017). Agriculture and Solar Energy Dual Land Use.
[4] ruralsolarstories.org/farm-friendly

Solar Sharing in Japan

Figure 4: Photo of Solar Sharing Field Test via Akira Nagashima[3]

Excerpt from Japan Next-Generation Farmers Cultivate Crops and Solar Energy[5]

At first glance, the structure may seem to be rather "skimpy." One of reasons is the MAFF [Ministry of Ag, Forestry, and Fisheries] *requires that PV systems have a simple structure (without concrete footings) and should be easily dismantled. MAFF also requires that PV mounting structures must be designed and built to secure adequate sunlight for crops and space for agricultural machinery to be able to move around.*

However, Nagashima said that the point of these guidelines are for farmers to remain "farming" and prevent farmers from fully converting productive farmland to solar facilities. Based on the tests conducted at his solar testing sites in Chiba Prefecture, he recommends about 32% shading rate for a farmland space to reach adequate growth of crops. In other words, there is twice as much empty space for each PV module installed. To ensure continuous farming, municipal agricultural committees require farmers to report annual amounts of cultivation and demand to take down the PV system from the land if the amount of crops cultivated on the solar shared farmland gets reduced by more than 20%, compared to the pre-PV installation.

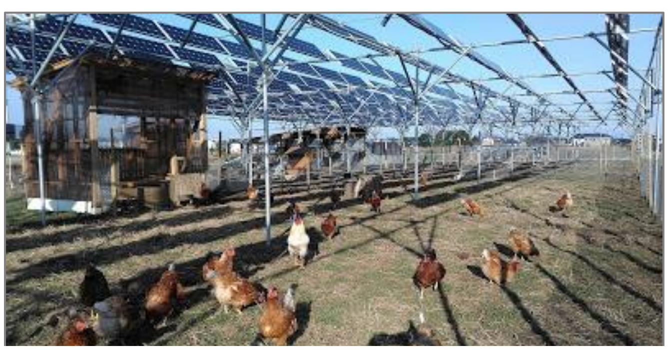

Figure 5: Solar sharing Power Plant Oo in Tsukuba, Japan[5]

[5] https://www.renewableenergyworld.com/2013/10/10/japan-next-generation-farmers-cultivate-agriculture-and-solar-energy/#gref
[6] https://solar-sharing-japan.blogspot.com/

Grazing Sheep at Open View Farm, New Haven, Vermont

Open View Farm is home to a 2.49 Megawatt DC solar array, which produces enough energy annually to power 350 to 400 homes. From the beginning, one of the project goals was to incorporate sustainable energy with sustainable agriculture and have sheep graze within the solar array, mitigating the need for the grass beneath the panels to be mowed regularly, while providing prime pasture for sheep.

Figure 6: © Openview Farm

From VT Guide to Farming-Friendly Solar, by Vermont Agency of Ag, Food, Markets[7]

Once constructed, a woven wire fence was placed around the entire array. The disturbed ground beneath was seeded with a sheep-grazing mix, with some additional birdsfoot trefoil and clovers added as it is a clay type soil that dries out quickly in late summer if there is no precipitation. Anna has noticed that the bees also benefit from the clover blossoms in the solar array, especially after the surrounding hay has been harvested. Anna and Ben partition the acreage inside the fence for a rotational grazing system, aligning their fences with the rows of solar panels.

[7] https://www.uvm.edu/extension/sustainableagriculture/guide-farming-friendly-solar