

Dual-Use: Crop and Livestock Considerations



The Massachusetts Department of Energy Resources has established the Solar Massachusetts Renewable Target (SMART) program, which will regulate incentives associated with new solar photovoltaic (PV) development in the state, beginning November 26, 2018. A series of fact sheets designed to help farmers navigate the program is available on the UMass Clean Energy Extension (CEE) website, <https://ag.umass.edu/clean-energy>.

Dual-use of land for agricultural and solar PV electrical production is a fairly new concept. Various systems have shown success on a small-scale on farms around the world, but it is difficult to predict at this stage what crops and solar array designs will work best at a given site, or to what degree crop yield will be reduced by shading from panels. Under the SMART program, CEE will be collecting and analyzing annual reports from qualified dual-use arrays, which will help inform farm practices in the state as the technology develops.

With the current uncertainties in mind, solar PV arrays may not be best suited to your most highly productive fields. The following tips may be helpful when considering what type(s) of agricultural activity are appropriate for your situation:

Livestock and Poultry

- Farmers in Britain have found success rearing both sheep and poultry (chickens, ducks, and geese) under solar panels, even under traditional ground-mounted arrays, where there is greater shading than would be allowed in dual-use systems under the SMART program.
- Solar panels are typically mounted high enough above the ground that domestic poultry will not roost on them – if they did this could foul the panels and lead to reduced electricity production and increased maintenance costs. The array can provide some protection for poultry from avian predators, although panels can also serve as potential roosts for hawks and owls.
- Solar panel arrays can provide shelter from the weather for a variety of livestock, but with larger or more inquisitive animals, design modifications may be necessary to accommodate them. Cows and horses are large enough that when they rub on solar panel mounts they have the potential to damage them, if racking systems are not designed with these animals in mind. Curious goats and pigs can interfere with wires and other equipment associated with the solar array. If you are interested in raising these animals in a dual-use system, be sure to work with the solar array designer and installer to ensure that wiring and conduit is contained, and that mounting systems will be constructed so as to be sufficient to withstand abuse by livestock.
- The design of a dual-use array should be done with consideration of animal handling, manure management, and fencing requirements, as well as height, width, and turning clearances for farm

equipment. Attention should be given not only to current practices and equipment, but expectations for change over the next 25 years.

Hay and Silage

- In general, additional shade, as would occur under a dual-use system, is expected to decrease growth in grasses and other plant species. Attention must be given to this shading impact when predicting harvest yields.
- Some grasses (e.g. orchardgrass) and legumes (e.g. white clover) can tolerate shade better than other species. Consider a hay mix in which these two species are dominant. A custom mix is preferred to pre-mixed bags.
- The design of a dual-use array should be done with consideration of mowing patterns and height, width, and turning clearances for planting and harvesting equipment. Attention should be given not only to current practices and equipment, but expectations for change over the next 25 years.

Grains and Vegetables

- There is very little hard scientific research available on what food crops can be successfully grown under solar panels, and what reductions in crop yield should be expected. Most studies to date have occurred under greenhouse conditions, or have investigated growth of tropical plants in more arid regions, where shading can reduce water loss.
- In general, temperate climate crops that are expected to be more shade-tolerant include greens (lettuce, spinach, kale, Swiss chard, mustard), some herbs (parsley, mint, coriander), Brassicas (broccoli, cauliflower, cabbage, Brussel sprouts), and peas and bush beans. Leeks and onions may also produce a crop in partial shade.
- Lettuce, and presumably other greens, can be expected to exhibit different growth patterns in shade, growing fewer, larger leaves than they would produce in full sunlight conditions.
- Some root vegetables (carrots, beets, rutabaga, potatoes, radishes) can produce a crop under partial shade, but the growth period is typically longer than in full sun.
- Sun-loving vegetables include tomatoes, peppers, eggplant, corn, cucumbers and squash. If incorporating these crops into a dual-use system, it is wise to plant them in the less shaded areas between panel rows.
- Look for shade-tolerant varieties or varieties from regions with shorter growing seasons, which may be more tolerant of less sunlight and cooler growing conditions.
- Shaded areas may produce a smaller crop, but plants may be less prone to bolting in hot weather.
- Viny plants should be avoided under solar panels, but could be grown along security fencing around a solar array.
- Shady areas under solar panels could be a potential selling point among consumers of pick-your-own crops on hot summer days.
- The design of a dual-use array should be done with consideration of height, width, and turning clearances for farm equipment. Attention should be given not only to current practices and equipment, but expectations for change over the next 25 years.
- When choosing which crops to grow, consider weed management and the susceptibility of crops to diseases which thrive in humid conditions. Weed management will require more time under solar arrays in annual cropping systems, since extra attention must be paid to the areas surrounding array posts. The potential for disease may also increase in the shady, humid conditions persisting under solar panels.

Fruit and Berry Production

- Many fruit crops require full-sun conditions to produce a good yield. Grapes are particularly sun-loving, and may grow poorly in partial shade.
- Currants and gooseberries are more shade-tolerant than other fruit species, but production of these fruits is restricted in some Massachusetts municipalities.
- Perennial fruit crops, which require significant investments of time and money to establish, may be a gamble for experimental dual-use systems. If you are interested in establishing perennial fruit crops under a dual-use system, it may be wise to start small and observe any changes in yield before deploying dual-use systems on a large scale.
- Fruit crops like strawberries which require less upfront investment may be a better choice for dual-use arrays, since they can be replaced after several years if yield is low.
- Viny plants should be avoided under solar panels, unless annual pruning will keep plants from growing over the array.
- Shady areas under solar panels could be a potential selling point among consumers of pick-your-own crops on hot summer days.
- The design of a dual-use array should be done with consideration of as height, width, and turning clearances for farm equipment. Attention should be given not only to current practices and equipment, but expectations for change over the next 25 years. Consider weed and pest management issues that may arise when growing under and around solar arrays.

Newsletter and More Information

To stay up to date on the latest information from UMass Clean Energy Extension, please sign up for our newsletter at <https://ag.umass.edu/clean-energy>.

Contact River Strong (gcstrong@umass.edu, 413-545-8510) with any questions related to solar PV use on your farm.