

Solar-Powered Watering Systems



A solar-powered water system can be designed to accommodate all types of livestock, but you must determine whether it is a cost-effective strategy for your farm or ranch.

by *ANDREA WATTS*

Of the ways to reduce your farm's carbon footprint, finding an alternative energy source for operations that require electricity is an obvious solution. If you raise livestock, one of these energy-consuming operations is likely your water system, and switching to solar power is a viable option.

District Planner Robert DeClue, with the Chenango County Soil and Water Conservation District in New York State, has provided technical assistance on grazing-related infrastructure since 1994 and has assisted in the evaluation and planning of solar-powered watering systems throughout this 20-year period. For most of the farmers he has worked with, the deci-

sion to select solar power primarily was, and still is, an economic motivation, such as in situations when it is too expensive to connect the pumping station to the commercial grid.

According to DeClue, "Increasingly, farmers, as part of their business philosophy, want to have a softer imprint on the landscape and the environment, and that will also motivate them to choose a solar-power option, even if economics is not solely the driving force."

With examples of do-it-yourself solar-powered watering systems available online, cost-share programs offered through Natural Resources Conservation Service (NRCS) and state agricultural programs, it has never been easier to switch to solar power.

A solar-powered water system can be designed to accommodate all types of livestock, but you must first determine whether it is cost-effective for you to convert to solar power. If your animals graze in an area where electrical power isn't readily accessible to power the pumping station, then solar power is a viable option. However, for smaller operations where the animals are close to a home site or the pumping station is near a power supply, the cost benefit of installing a solar-powered system may not exist, even if there is a cost-sharing option, says Jeff Porter, P.E., National Manure Management Team Leader for the USDA NRCS East National Technology Support Center.

If it does prove cost-effective to install a solar-powered system, designing a solar-powered water system is more than just connecting the pump to a photovoltaic array; you have to assess the site's surrounding terrain and its solar availability throughout the period of use.

Solar On the Farm

Installing solar-powered watering systems has benefits in addition to reducing your farm's carbon footprint – it can also provide access to out-of-reach sources of water and protect local water systems.

Hemlock Hill Farm, in Cortlandt Manor, New York, is among the oldest family-owned working farms in Westchester County. Eighty-two-year-old John DeMaria works the farm alongside his daughter, Laura.

In 2010, a solar-powered watering system became a new feature on their farm, thanks to the collaborative efforts of John and Carrie Davis, the agricultural program coordinator with the Watershed Agricultural Council (WAC). This nonprofit works with landowners within the New York City Watershed to adopt practices that protect water quality, and Hemlock Hill Farm has been in the program since 2002. Installing the solar-powered system allowed John to access an abandoned well that was too far from the farmstead to connect to the grid.

After four years, DeMaria has learned a few things: “I advise looking to the future, have an adequate reservoir along with a power backup, and it's important to have the solar panels in the right place.”



PHOTOS COURTESY OF CARRIE DAVIS OF HEMLOCK HILL FARM

With the increased water availability, his herd grew from 35 to 100 head of cattle, but the system wasn't designed for this watering capacity. Coupled with a low volume well that requires frequent pumping to provide water for the cattle, this year will see the system redesigned to have a larger reservoir and a wind turbine to power the pump during extended periods when sunlight isn't available. Of the WAC's support for the project, DeMaria says he's very happy with the watershed agricultural council and would go through the process again.

MANZINI FARMS

On 200-acre Manzini Farms, which raises organic sheep and cattle, water for their 1,000-plus head of livestock comes from a stream.

But as of last year, the stream is no longer the watering trough; instead, the animals are watered elsewhere on the property. The solar-powered watering system was a project undertaken in conjunction with the Essex County Soil & Water Conservation District, whose mission is to encourage landowners to adopt natural resource conservation practices. Tiffany Pinheiro, a conservation technician, worked with Manzini Farms' manager, Marco Turco, to design the system and acquire the grant funds.

“Our approach has been to be part of the solution,” Turco says, as a reason why he considered installing the new system, especially when the costs made sense and the result would reduce runoff and protect the stream bank. Of the paperwork requirements that he had to supply for the grant, such as a grazing plan and the number of animals, Turco says it was not complicated.

Turco recalls that installation of the watering system took only a day, since they already had the well infrastructure in place, and the pump was running by the evening. The solar panels were angled for the highest radiance during the winter, and “we haven't had any lag in supply,” he said. The cattle adapted to the change quickly, and the increased water availability enabled our grazing manager to improve the grazing rotation.



Cattle drinking from the solar watering system at Hemlock Hill Farm in Cortlandt Manor, New York.

“There really isn’t a cookie-cutter solution,” said Porter. “You have to look at each situation.”

Key factors include terrain, shadow-causing vegetation, structures surrounding the water source, solar availability and, most important, yearly water requirements. DeClue advises to determine, very specifically, the number and type of livestock requiring water so you can calculate their total water needs throughout the year. This calculation is important because it determines the design of the system and whether a water source may be used.

“Essentially, wherever the water source is, be it drill well, a spring development, a pond ... dictates to a large degree whether solar is even an option, because if it is a north-facing slope where the pond is, that’s not going to work out for a solar setup.”

A suitable site should have southern exposure and acceptable water quality.

“Some of the pumps that are employed or available for photovoltaic powered systems are not conducive to dirty water,” said DeClue. “Particulates, any kind of sand particles, will ruin pumps in a short order.”

RESOURCES

Solar-Powered Livestock Watering Systems. University of Tennessee: utextension.tennessee.edu/publications/documents/pb1640.pdf

Design of Small Photovoltaic (PV) Solar-Powered Water Pump Systems. USDA NRCS: www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_046471.pdf

Guide to Solar-Powered Watering Systems in New York State. NYSERDA: water.epa.gov/infrastructure/sustain/upload/2005_1_27_publications_solarpumpingguide.pdf

Solar-Powered Water Systems for Grazing Operations, available through Conservation Webinars: www.conservationwebinars.net/webinars/solar-powered-water-systems-for-grazing-operations

Water Pumping — The Solar Alternative. Sandia National Laboratories: prod.sandia.gov/techlib/access-control.cgi/1987/870804.pdf

Once you have identified an existing or future water source, determine the installation method of the photovoltaic array; the method is based upon how frequently the water system requires power. The array may be either mounted in a fixed position or have tracking capabilities. As the name suggests, a fixed mount means the array only faces one angle while a tracking system adjusts to follow the sun’s angle throughout the day and year. The advantage of a fixed array is a lower cost of installation and ease of use; however, it will lose efficiency throughout the day and year as the sun’s angle (azimuth and altitude) changes.

There are two types of tracking systems: a single axis tracks the sun as it travels from east to west; the double axis tracks both the sun’s daily arc and its change of angle throughout the year. Drawbacks to using a tracking system, “Are significant additional costs and more maintenance is involved,” said DeClue.

A tracking system is also more vulnerable to damage from wind, especially gusts. If you only need to water your livestock during the growing months, selecting a tracking system rather than fixed system may be more worthwhile since DeClue reports that efficiency can be boosted by upward of 40 percent in the summer. In northern states, where cloud cover during the fall, winter and even spring months will limit solar avail-

ability and consequently the powering of the pump, a tracking system offers only about a 15 percent increase.

Yet even using a tracking system cannot overcome the challenges of cloudy days. What if you have a period of prolonged overcast skies? What are your backups? The two options are a bank of batteries to store excess energy or a water storage reservoir located on higher ground, which is the typical approach used, DeClue says.

“The problem with the batteries is they are generally expensive, and batteries, generally speaking, don’t have a long lifespan, so you may need to replace them, and there’s a much higher maintenance issue with a battery bank.” He adds that energy loss will result from the conversion of electrical energy to chemical energy.

One issue you might not expect when converting to solar power is vandalism. The solar panel makes for a nice target, and you need to consider how to protect the system, especially if it is remote, Porter cautions. Snowfall is another issue, especially in remote areas. After a heavy snowfall, you may have to visit the array to clean the panel.

Both DeClue and Porter see more farmers interested in switching to solar power but often farmers are more willing to make the switch after seeing firsthand success of the operation.

“You have your innovative landowners who come in first, and then once landowners see something go in,

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then the interest grows,” said Porter. “Usually it takes that first person.”

If you decide to be an innovative landowner, you can choose the do-it-yourself route or contact a local NRCS office and apply to participate in the Environmental Quality Incentives Program (EQIP) which provides partial compensation when a solar-powered water system is installed according to conservation standards. If you choose the latter option, already knowing the total water requirements and a suitable water source will aid the NRCS staff in designing the system.

When designing this system, the landowner is very much a part of the

planning process, Porter says. In addition to designing a system that meets your livestock’s needs, he adds that the plan is also conservation-minded and incorporates ways to reduce the impact on soil, water, plant, air, animals and energy. For example, the designs account for soil compaction resulting from livestock visiting the watering trough, along with reducing the blue-green algae that can result if the water remains stagnant for too long. After the planning process, the technical staff might even find that solar power may not be the best solution; oftentimes a gravity-fed water source is the simplest, easiest option when it is feasible, DeClue said.

Once the technical staff presents you with a design, you can select a qualified contractor to install the system. The technical staff will verify the work to ensure it was installed properly and a reimbursement will then be issued. With a solar-powered water system, you will likely find yourself having more time for other chores since you don’t have to work on the system as often as with an electric-powered system.

“There is generally very low maintenance involved with a solar-powered system,” said Porter. “Once you get it running, it usually takes care of itself.”