A Guide to Solar Energy in Vermont's Working Landscape

February 2021

Executive Summary

A Guide to Solar Energy in Vermont's Working Landscape offers an introduction and state-of-the-field overview for the integration of solar energy and complementary land use practices in Vermont. The guide is the culmination of a one-year project, "Solar Energy within Vermont's Working Landscape," based at the University of Vermont and supported by an inaugural 2020 Apis Fund Award from the Gund Institute for Environment at UVM.

Through this guide, the project aims to consolidate and communicate knowledge and experience regarding multifunctional solar energy as shared directly by those working in this emerging and rapidly evolving field. As such, this guide presents critical understandings and insights to date, recognizing the dynamic nature of this work. The following pages draw together perspectives from researchers and practitioners to assess experiences in real-world implementation, identify challenges to integration and adoption, and create conditions necessary to enable, improve, and sustain these practices within a dynamic working landscape. Contributors cover a variety of topics including favored management practices and successful project planning, personal experiences, and policy recommendations.

While written for a general audience, this guide will be of interest for local and regional committees, organizations and non-profits working in this space, state-level policy makers, farmers, land managers and owners, and solar developers in Vermont.

The project team presents this guide as a way to improve practices of solar development in Vermont and further position the state as a leader in holistic, environmentally-friendly, solar energy.

Forward

Linda McGinnis, Senior Fellow and Board Trustee, Vermont Energy Action Network

How can we meet the growing challenges facing our working lands, our energy sector, our soils and waterways through a common strategy that also helps Vermont achieve its climate change goals? This was the question posed by a diverse group of Energy Action Network (EAN)[1] members and public partners in 2016 that led to the Pollinator-Friendly Solar Initiative. This initiative brought together bee- and bird-lovers, academics, solar developers, farmers, and policymakers. By placing solar arrays on a small segment of land and ensuring that the land under and around the arrays was planted with native flower, grasses and bushes, this initiative aimed to provide stable income and reduce costs for farmers, re-establish habitat and improve soil health, and increase local renewable energy. Rather than pitting the agricultural, energy and environmental sectors against each other, this initiative sought to show how each can benefit from a collaborative approach.

This initiative led to the Vermont legislature passing bill H.676 in 2018, establishing a voluntary pollinator-friendly standard for solar sites. Drawing on the nationally recognized expertise of Fresh Energy together with Audubon, EAN members and partners worked together to develop tools and guidelines for Vermont pilots, including a Scorecard to assess whether a site can be deemed 'pollinator-friendly' and measure progress going forward.

These efforts point us in a critical direction of collaboration rather than competition, finding innovative ways to enable Vermont to meet the challenges facing our working landscapes with the full force of our state's many attributes.

[1] EAN is a network of leading non-profits, businesses, researchers, and public partners working to achieve Vermont's commitment to 90% renewable energy by 2050 while significantly reducing greenhouse gas emissions in ways that create a more just, thriving, and sustainable future for Vermonters.

Introduction: A vision of beneficial practices

Chuck Ross, Former Director of UVM Extension and Vermont Secretary of Agriculture, Food and Markets

The choices we make around managing our working landscape will have a direct bearing on the ecology of the planet and thereby on the quality of our lives as a human species. Consequently, we must recognize the opportunity of integrating renewable energy within our working landscapes. Successful and expanded incorporation of solar technologies within agriculture and forestry can improve the viability of our businesses, grow the renewable energy sector, and increase the resilience of our communities. These choices will also help mitigate climate change, which in turn will help sustain ecological systems upon which a stable society depends.

When farmers and foresters work and manage the land, they are in fact managing energy – energy used in the process of harvesting products, transformed and stored by ecological communities. They are reaping the bounty of our living biological systems. Energy use on farms also often constitutes one of the highest operational costs. Outlining the economic margins and pragmatic attributes of renewable solar energy technologies are critical to on-farm adoption and widespread utilization. Farmers need to see that solar energy technologies are going to help them in measurable ways by reducing costs, increasing revenue, improving operations, and enhancing the quality of their lives. Finding ways to achieve these goals through energy generation will enhance farmer viability and encourage a greater expansion of renewable energy implementation across the agricultural sector. Successful integration of solar energy requires a public policy framework that both supports the utilization of solar technologies and provides ways to mitigate its potential negative impacts. We must have policies that enable solar to meet the cost effectiveness, efficiency, and logistical requirements of our operators. This will likely require some incentives for some period of time in the form of direct payments, avoided costs, or increased income. There may also be situations where the public's interest may justify more targeted or deeper investments. Additionally, the policy framework must provide mechanisms to address and mitigate potentially negative impacts, including aesthetics, conversion of prime agriculture and forest soils, and electrical grid load management. When policy frameworks and implementation mechanisms create conditions favoring adoption with appropriate safeguards, the managers of our working landscape can amplify their contributions to society. They will continue to grow food and fiber and produce wood products, now by utilizing renewable energy which will assist their businesses and communities to become more viable and resilient. The collective impact of these actions will help address climate change and provide both economic and ecological contributions to society writ large – generating multiple benefits for our working landscape, our farm managers, and society.

Management practices and their integration

Kimberly Hagen, Grazing Specialist, University of Vermont Extension, and Alex DePillis, Senior Agricultural Development Coordinator, Vermont Agency of Agriculture, Food and Markets

Can grazing livestock, pollinator-friendly plantings, crops, and bird habitat compatibly share the finite space beneath and surrounding solar array panels? Can these multiple enterprises share and operate compatibly, and even complement each other on the same parcel of land and still be productive? These are the questions now being explored in

Vermont and other northeastern states. Some Minnesota solar projects are already combining grazing and pollinator habitat. Experts and stakeholders are observing and assessing the scope of these existing practices, the barriers to adoption, as well as requirements for long-term success. With the value of land being what it is today, it's important to keep what we can in production, while protecting the resident ecosystem. With such narrow margins of profitability for farming, combining enterprises is wise, practical, and becoming imperative.

To combine practices successfully, rigorous planning with all the parties is needed: the owner of the solar facility, the farmer (grazier, vegetable grower, and/or beekeeper), and the environmentalists and naturalists. Conversation and clear communication of expectations and outcomes before construction or engaging in a partnership ensures a greater chance of long-term productive partnerships.

Solar companies look for sites based on access to the electricity grid, avoiding wetlands and other potential environmental hurdles as well as exposed bedrock or extremely rocky ground, and finding a willing landowner. Having support from local and regional planning agencies can also be helpful.

Sheep producers will assess a site for its existing infrastructure, and how much they will need to provide to keep their animals safe and healthy: adequate fencing, access to water, quantity and quality of the existing and potential future forage, and access.

For grazing sheep, a solar company will rarely consult on the layout of a solar site with sheep in mind[2]. A sheep farmer will generally be presented with a typical solar site, which tends to come in one of three sizes in Vermont: one acre, four acres, or 12-15 acres.

However, to be a sheep-friendly site, good forage or at least the potential for good forage is essential. Construction will have disturbed the land and likely compacted the soil. The most critical need following construction is to get the soil covered with growing material to avoid the loss of soil from water or wind erosion. Sheep can be a great tool for this work. Confining them to an area that has been seeded down, while providing hay for them, provides some organic matter to cover the seeds, a little fertilizer from their manure, while their hooves will push the seeds into good soil contact. They do need to be managed correctly – removed after an appropriate time to allow germination and time for the young plants to grow.

Knowing soil type on the site will direct choices for plant compatibility and successful seeding. Equally important are choices for compatibility with grazing sheep, pollinators, and birds that utilize plants. To find the soil types, use soil maps such as those available through the Vermont Natural Resources Atlas or through the USDA NRCS web soil survey mapping tool (see additional resources). The Vermont Agency of Agriculture has archived the soil fact sheets for Vermont, which are easier to read but are no longer available on-line.

Finding a seed mix that not only can survive in the soil type, but will also serve as good forage for sheep, and keep pollinators happy and zipping around, is a work in progress. Discussions are underway to develop mixes to meet these criteria while also maintaining economic feasibility.

Solar companies tend to plant a standard mix when finishing work on a site to stabilize soils and prevent run-off. If seeded during cool or cold weather, the standard mix consists of at least 80% winter rye with at least 3-4% each of red (creeping) fescue, perennial rye grass, and red clover. If seeded during warm weather, the mix consists of about half red

[2] In Vermont, one solar company did plan for agriculture by setting the rows more widely apart than needed. Cross Pollination, the company who developed the project and owns the land in New Haven, set the rows with almost 25 feet between rows inside the 15-acre perimeter. The original plan called for even wider spacing, but the local planning agency objected.

fescue, one quarter sheep fescue, with smaller amounts of red top, white clover, and annual rye[3]. The mix is designed to be inexpensive and to control runoff and erosion from rain but is not suitable for grazing or pollinators.

The new seed mixes contain species much more palatable for sheep and pollinators and feed the soil as well. Ernst Seeds has developed a "Fuzz and Buzz" mix, first trialed in summer of 2020. Adjustments are underway for more trials in the 2021 season and include some variations as well – to meet needs of different soil types, and quality preferences.

Both the sheep farmer and the solar company should find this partnership compelling in some manner, whether it improves finances, impacts on the environment, or utilization of the land. Payment should reflect not only the costs invested by the sheep producer to graze the site, but also the expertise this profession requires to manage a site. An expert grazier will use multiple factors to assess and then manage a site not only for the sheep, but also the pollinators and the impact on the array itself.

For the solar developer, even if grazing sheep costs the same or a bit more, there are other advantages, like less risk of mower or panel damage, positive community relations, and another pair of eyes on the site, which of course can be a huge advantage in time and labor saving. For the sheep farmer, the advantages can be multiple – home pastures can be hayed while sheep are out grazing elsewhere, less parasite issues if sheep are grazing on land that either has not had sheep on it or has had a long enough rest period to break the parasite cycle, age groups can be separated – i.e., rams or yearlings away from the rest of the flock, and a sheep producer can support a larger flock with access to more acreage for grazing.

Logistics to have in order typically include:

- Insurance
- Fencing (sheep inside, predators outside!)
- Access to the site for both parties, including for scheduled and unscheduled maintenance
- Points of contact and what means to use to communicate.
- Contract – for what and for how long.

A final note: The solar developer must keep vegetation in check *everywhere* on the site. If not, young saplings start to emerge within two or three years, especially in hard-to-mow areas, and will require hand labor to remove. If there are areas where sheep are not allowed (sensitive equipment) or for the area outside of the fenced array, there needs to be agreement on how, and by whom these areas will be maintained.

Local and regional planning

Alex DePillis, Senior Agricultural Development Coordinator, Vermont Agency of Agriculture, Food and Markets, and Jim Sullivan, Director, Bennington Country Regional Commission

Policy for the working landscape in Vermont and any changes to land are regulated largely on a statewide basis, especially when developing farmland or forest, including energy development. Recent changes in energy development law have given local and regional planning bodies an opportunity to set standards for energy development, and the local and regional plans carry more weight if they are specific and approved, again in a statewide process.

In simple terms, there are three kinds of land-use regulations in Vermont: traditional (farming and forestry), energy development, and other development. Farming and forestry are regulated

[3] This example of seed mixes comes from an actual application for a 500-kW (four-acre) solar project in Pittsford, Vermont, and the mixes are typical for such applications.

mainly to protect water quality. Forestry is subject to rules entitled "Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont,"[4] with the intent "…to provide measures for loggers, foresters, and landowners to utilize, before, during, and after logging operations to comply with the Vermont Water Quality Standards…" Agriculture has similar rules, "Required Agricultural Practices Rule for the Agricultural Nonpoint Source Pollution Control Program,"[5] which are "…intended to improve the quality of all of Vermont's waters by reducing and eliminating cropland erosion, sediment losses, and nutrient losses through improved farm management techniques, technical and compliance assistance, and, where appropriate, enforcement."

Energy development is regulated separately from other kinds of development. A quasi-judicial commission of three weighs testimony and evidence from the party proposing the project as well as other parties to the case and decides whether the project is in the overall public good. Environmental considerations come from Vermont's statewide development law and are weighed along with non-environmental considerations such as effect on the cost of electricity or whether the proposed project aligns with the town plan or the regional plan.

Vermont's statewide development law, commonly known as Act 250,[6] issues land-use permits in each of nine districts that handle the applications.[7] Volunteer District Environmental Commissioners weigh the evidence and decide whether to issue the permit. The overarching regulatory body is the Natural Resources Board, which administers the program and supports the districts.

The energy development law and Act 250 both seek to protect farmland. Except for small projects, solar and wind energy projects must be decommissioned, and any farmland restored. Unlike Act 250 development, farmland is not lost forever. Act 250 requires farmland loss to be mitigated by either setting aside farmland on the site to be perpetually available for farming or payment into a fund that will conserve farmland nearby.

Vermont's renewable energy policies have sometimes been controversial. Twice in the last ten years, either the governor or the legislature has ordered a group of Vermonters to study the policy landscape and make recommendation. The Energy Generation and Siting Policy Commission worked from October 2012 to April 2013, recommending to maintain separation of the siting process from Act 250 review.[8]

Act 56 of 2015 established a renewable energy standard and a Solar Siting Task Force. The Task Force crafted recommendation in four categories: planning, incentives, regulatory process, and aesthetics/environment, with planning accounting for more than the other categories.

Act 174 of 2016 created an option under which municipalities and regional planning commissions may engage in enhanced energy planning that results in greater weight to their plans in the energy

[4] https://fpr.vermont.gov/forest/managing-your-woodlands/acceptable-management practices;

[5] https://agriculture.vermont.gov/rap

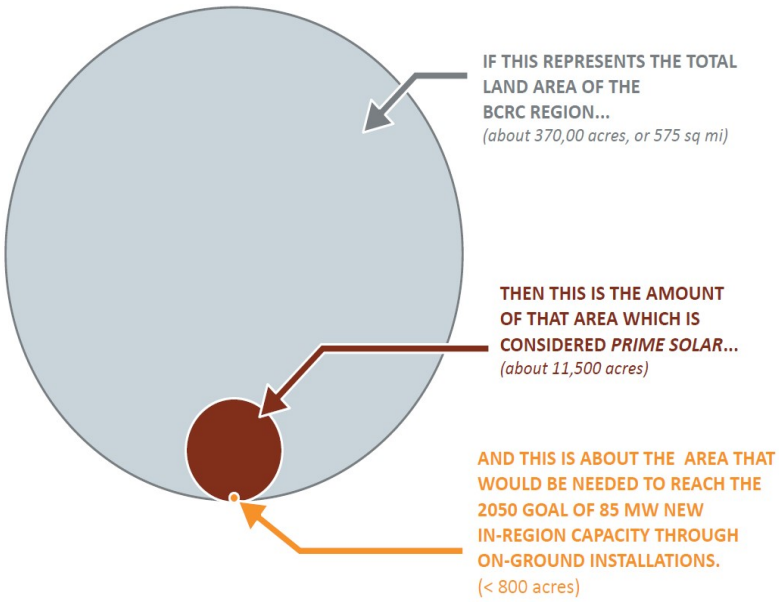
[6] 10 V.S.A. chapter 151; https://legislature.vermont.gov/statutes/fullchapter/10/151

[7] https://nrb.vermont.gov/act250-program/district-staff-and-commissions

[8] "One issue on which the Commission received significant testimony is whether to modify the electrical energy siting process to require that it undergo Act 250 review rather than the current Section 248 [energy siting law, 30 V.S.A. §248] process. The Commission would like to underscore that although important modifications to the siting process are necessary, it recommends that electric generation siting approval remain with the PSB [Public Service Board, now the Public Utility Commission] using a revised Section 248 process."

siting process. If certified as meeting the standards, the plans are afforded "substantial deference" (as opposed to "due consideration") in the energy siting process. Among other things, energy plans reference the town's and region's aspirations for land use and map the potential for renewable energy development necessary to meet their respective share of the state's goal of 90% renewable energy use by 2050. Maps exclude from the potential areas that have a low resource potential (not sunny or windy) and areas with critical environmental resources.

Bennington County's Regional Commission was one of three pilot regions to undertake the mapping[9]. It determined that about 7% of the solar land with the best potential[10] would be needed to meet the county's share of the states 2050 goal if only solar were used to meet the goal, representing about 0.2% of the total land area. Since 2017, technology and related siting advances for solar projects have reduced the amount of land required for each MW of capacity. Additional analysis is showing that up to 30% of the needed MW could be accommodated on rooftops and "backyard" installations. Thus, the amount required for new land-based solar arrays falls to closer to 400 acres.



Total land area, area considered prime solar, and area needed to reach 2050 goals through ground-mounted solar for Bennington County region (2017).

While 11,500 acres seems like a lot to choose from when the region only needs 800 acres to meet the goal, how can a region find the 800 acres that are uncontroversial? Which of the 11,500 have willing landowners or neighbors?

One option is to ask for volunteers among them, and for a matchmaker to facilitate matches between landowners and solar companies. This could be an open process that generates its own map, even with preferred locations within a parcel. A similar map exists for landowners and potential farmers, whereby landowners post land for sale or rent and farmers post what they're looking for.[11] Hiring a project facilitator or ombudsperson has been used for solar and for biogas projects,

[9] Bennington's plan of 2017 is available at https://publicservice.vermont.gov/content/act-174/BCRC-plans

[10] Prime Resource: Areas where renewable energy production/generation appears feasible based on resource availability and lack of state-identified environmental constraints; does not incorporate locally identified constraints or opportunities.

[11] Vermont Land Link https://vermontlandlink.org/about

especially as the market develops. Like other states, Vermont has had Solarize programs. The specific local conditions vary in time and place, and yet the potential for this work in Vermont now, for ground-mounted solar sites of five or more acres and owned by someone other than the landowner, is strong.

Our experience: pollinator-friendly solar

Mike Kiernan, Bee the Change

We started on a little 4-acre 500-kW field south of Middlebury six years ago. Since then, our small not-for-profit Bee the Change has created habitats for pollinators in solar fields equivalent to every Vermont household making an 8' x 8' pollinator garden. We are now approaching 25 solar fields across the region and have worked with the most forward-thinking solar developers in Vermont, including Encore Renewable Energy, Green Mountain Power, Aegis, Green Lantern Solar, and others.

How do we know when we have been successful? We survey the fields for flower abundance and diversity both before we install and then after installation at different points in the season. We also count unique pollinator encounters at three points on the calendar. We have seen an average of 700-1200 percent increase in pollinators at the third-year post-installation. More recently we have partnered with researchers at the Gund Institute at UVM who have begun sampling in our fields using a different methodology.

Why is this important to do? Every literate citizen and everyone who is concerned about the climate crisis should be familiar with recent studies of The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, which point to the accelerating rate of species loss as a problem for our health and well-being. These studies show that confronting species loss is as important as addressing climate change. We have not only a climate crisis but an environmental crisis.

Certain species or groups of species are "keystones" - like that top stone in an arch - because many other species depend upon them. The pollinators are a keystone group of species. Many of the carbohydrates in our diet come from plants that reproduce on the wind or through self-pollination, but most of our other essential nutrients come from flowering plants- like fruits and vegetables- that require some tiny creature, often a flying insect, to move pollen from plant to plant. Lose the pollinators and you lose those plants.

Consider the bumblebees - there are 17 species of these charismatic pollinators in our region. Only twenty-five years ago, we had all 17 species but now we are down to 10, and of the seven known to be endangered, four are now gone. They will not return, no matter what you build for habitat. Yet in this one field alone outside of New Haven we have encountered 5 different bumblebee species! These impacts will increase the productivity of plants beyond the boundaries of the solar field and support downstream species who rely on that productivity- birds, fish, other wildlife and, of course, human beings.

Come visit us! We have four fields across the region that are designed for visitors. Contact us at www.beethechangehoney.com

Our experience: solar grazing

Judy St. Leger, Dutch Barn Farm (NY)

The growth of solar grazing offers a real opportunity for both experienced and new shepherds. Keeping vegetation under the arrays controlled is important. If it shades the solar panels, the panels produce less energy. To prevent this, the vegetation needs to be kept low to the ground. This is where the sheep come in. Using sheep to graze and browse the vegetation instead of relying on mechanical

management, solar companies can increase their green footprint, improve site management – especially when the terrain is rough or wet, and sometimes reduce costs for operations and management.

Our 100-acre farm has a grazing capacity of about 100 ewes and their lambs, when you take into consideration the pasture size and quality, as well as the fields we use for making hay. This capacity is based on a rotational grazing plan. Through solar grazing contracts, we can access additional grazing land and thus increase the farm's actual capacity. For every 20-acre solar site we graze from May to October, we have an additional 10-30 ewe capacity for our main flock. As long as we have barn space for these extra sheep to access in their winter holding, and we make more hay, we can carry more sheep on the same sized farm and still have finished lambs on the schedule we established before solar grazing.

Solar grazing diversifies the farm income stream. Most of the income from our flock comes from sales of lamb or purebred animals for breeding and showing. The added income from grazing increases total revenue and provides a buffer against reductions on lamb prices. I often speak to my neighbors going out of dairying due to lower milk prices. If they could shift from cows to sheep, they might be able to stay in farming – just in a new enterprise. They already have barns and pasture that are becoming empty once they sell the dairy herd. The thought of sheep is tough for many of these farmers, but I see opportunities to save family farms through the growth of solar grazing.

What do you need to become a solar grazier? First and foremost, you need to be (or become) a good shepherd. You need a healthy flock with good ewe, lamb, and ram management. You need to consider what animals will go on solar sites and when. Efficient grazing and trampling of vegetation mean rotational grazing, often with a high stocking density. We figure a stocking rate of at least 1-5 sheep per acre per solar field. The use of internal pens made with electric netting creates smaller spaces for more intensive grazing and an effective stocking density of 3-15 sheep per acre. Just like at home, a well-considered grazing plan is important. As vegetation growth rates change through the grazing season, the sheep rotations need to change as well. It's easiest to use non-lactating ewes. Consider using open yearlings or ewes after weaning. If you are looking to have dry ewes out in May, you need to schedule lambing accordingly so the ewes can be dried off before placement in the solar array. Foot care and parasite management are as important at the solar site as it is on the home farm. If not observing these animals daily, you need to know that they will remain healthy on the site.

Solar arrays generally have a tall wire mesh perimeter fence that is capable of safely holding the flock. But beware! While most predators don't breach the outside fence, regular monitoring to assure that no coyotes or dogs can get into the array is still important. We always add a sign to the entry gates so that folks can easily contact us if there are any questions or concerns.

Once they are at the solar array, the shepherd needs to assure that all of the sheep's needs are met. This includes water and salt/minerals. Most solar sites do not have on-sight water. Getting water to the flock requires hauling water or making arrangements with a nearby neighbor. One positive side-effect of the abundant shade under the solar panels is a reduction in water consumption by more than 50%, so providing daily water may be easier than on the home farm.

You also need to have the ability to move those sheep around. Transport likely means having a good truck, a trailer and often some sort of handling system or dog to make getting animals onto the array and then back into your trailer efficiently and safely. Most solar sites weren't designed with sheep in mind. You may need to be able to back up and turn that trailer to get the sheep where you need them. You may also need to move more than just sheep. If there is vegetation that the sheep don't effectively control, you may need to do additional

mowing or trimming. Consider how you would get equipment to the site.

Getting to the solar site on a regular basis is a given. This travel costs you in terms of professional time, vehicle wear and tear, and fuel. When considering bids for grazing contracts, it is important to estimate the cost for your time travelling back and forth to the array as well as the time for animal management and movements. We estimate a minimum site visitation of 3 times/week. We include an estimate for fuel based on our miles per gallon and include the wear and tear at $0.37 per mile. These figures are important in assuring that the grazing contract covers costs and provides an income. It also keeps us from bidding on contracts too far from home.

Solar grazing is more than just grazing. Shepherds need to be comfortable with contracts, bidding, and working professionally. You are being paid for your professional management as well as the vegetation management the sheep are doing. The shepherd provides the "eyes on the ground" at the array. Contacting and communicating with energy companies may mean presenting your farm in a manner that's new as a service provider, but contracts and billing aren't hard to learn.

Remember that having sheep away from the farm means that they have a new set of eyes on them. It's important for the future of solar grazing that everyone working in this field is seen to provide good animal care while the sheep are doing their job. They serve as agricultural ambassadors.

Insurance can present another new element for many farmers. The standard policy you have on the farm isn't likely to cover solar grazing. Many solar companies request or require an umbrella liability policy, which covers claims in excess of regular farm coverage. It covers you if the sheep should injure someone on the solar array, and if they should do damage to the infrastructure by rubbing, jumping, or chewing. This insurance doesn't cover injury to the sheep.

As more farmland is used for solar arrays, there are more opportunities for solar grazing. We've just touched on the topic here. To learn more about solar grazing, consider joining the American Solar Grazing Association (ASGA). Made up of solar professionals and farmers interested in solar grazing, ASGA members are developing best practices to effectively manage solar installations and create new farm business opportunities.

Our experience: solar development and agriculture

David G. Carpenter, Esq., General Counsel and Director of Development, Green Lantern Development, LLC

For solar developers, the siting of solar arrays on agricultural land presents both opportunities and challenges. Agricultural land often checks many of the boxes that developers look for when seeking sites: large tracts of flat, open land with few obstructions. Yet, every state has its own rules and regulations for environmental permitting, and states vary in terms of how much local control is retained by local municipal governing bodies.

Vermont has two main statutory programs that encourage the development of distributed solar generation: the Standard Offer program and the Net Metering program. The Standard Offer program is an annual bid process where developers propose projects of up to 2.2 MW and vie to offer into set blocks at the lowest bid prices.

Vermont's Net Metering program has resulted in an enormous boost in solar development over the past decade, bringing thousands of jobs and enormous outside investment. Each net metering project must be 500 kW or less, occupying about 3-4 acres. The Public Utility Commission (PUC) sets both the base rate that the utility must pay the developer and additional adjustors for siting on "preferred sites" and transfer of renewable energy certificates. The generation is credited to the owner of the array. These credits can be used to offset the generator's own electricity bills or are freely transferable within

utility service territories. Thus, net metering project owners can sell up to 100% of those credits to other users allowing those electricity users to save money on their electricity bills and participate in the renewable energy economy. The vast majority of Green Lantern's 90-plus projects are net metering projects.

All Vermont solar projects are subject to a long list of criteria, which the PUC examines with input from other state agencies including the Department of Public Service (DPS), Agency of Natural Resources (ANR), Agency of Agriculture, Food & Markets (AAFM), and Division of Historic Preservation (DHP). In order to obtain an approval, or a "Certificate of Public Good" from the PUC, a project cannot create an "undue adverse impact" on any of the criteria listed in 30 V.S.A. Section 248.[12] Many of the environmental review criteria in Section 248 reference Vermont's Act 250 criteria – though the Commission has developed its own body of administrative caselaw interpreting those criteria apart from Act 250.

We have found that compliance with these criteria is not an overly complex affair for a well-sited, well-planned project. Some criteria, such as visual impacts and consistency with a community's development plans can be controversial, but developers should be able to work with agencies and localities to address concerns. Avoidance of or mitigation for any adverse impacts in order to render them not "undue" is also a common occurrence, as it is in a developer's interest to avoid the time and expense of a contested hearing on any of the criteria. Developers and landowners are mutually incentivized to develop projects (landowners typically receive annual rent payments on a long-term lease of usually 20-35 years), so developing a strong relationship with a project host is crucial.

It is critical to hire knowledgeable natural resource consultants early in the process and to be aware of the seasonal restrictions on certain investigations (particularly wetlands and rare plants). Projects that do not complete natural resource assessments by late October/early November will be delayed until Vermont's long winters end, as the PUC will not deem an application "complete" without evidence that impacts to natural resources will not be unduly adverse. Also, an issue particular to projects situated on large (>20 acre) agricultural tracts, even fields that are actively hayed, can be subjected to ANR scrutiny for potential grassland bird impacts, and required to mitigate potential impacts.

Though regulatory trends are sometimes clear, agency interpretations of various internal guidance documents and rules sometimes change without warning, which can catch developers and landowners by surprise. This can be frustrating, leading to delays and sometimes litigation. Gradual changes in agency interpretations, on the other hand, often become standard over time as agencies see more and more projects of a particular type.

For example, with regard to projects that might impact prime agricultural soils (PAS), developers are routinely required to stockpile PAS that are removed for the installation. The PAS must be stockpiled on site for the life of the project and re-laid in the order they were removed during decommissioning. Also, PAS excavated for trenching is required to be removed and backfilled in a way such that the original soil layers are maintained. To protect soils generally, projects are required to comply with the Vermont Standards & Specifications for Erosion Prevention and Sediment Control, and perform a risk assessment for, and

[12] It is worth noting that most of the environmental review criteria in Section 248 reference Vermont's Act 250 criteria – though the Commission has developed its own body of administrative caselaw interpreting those criteria apart from Act 250.

obtain, a stormwater permit. These types of requirements become expected embedded costs for developers.

During a project's review, a developer and agricultural landowner can be caught between competing state policies. Many farmers view wet fields as marginal at best, but they continue to keep those wet fields in agricultural use – because under state wetland rules, if those wet fields are not in active farming, it seems that they will become regulated wetlands. The Wetland Rules do contain certain agricultural use exceptions, and developers have worked with ANR and landowners to ensure that land stays in agricultural use to preserve that exemption.

Sometimes, however, projects on agricultural properties run up against Vermont policies without any statutory exemptions. As explained in the University of Vermont's 2017 "Guide to Farming Friendly Solar", to be eligible for the Vermont current use land valuation program, a solar array must be owned or leased by the farmer, with half or more of the electricity used on the farm. Otherwise, the landowner must unenroll the land from the current use program and pay the change in use tax.[13] The economic margins for farming operations are traditionally razor-thin. Most farmers, particularly small family farmers, do not have access to the capital required to build solar arrays as a farm "improvement" that would allow them to retain the current use status of the land.

There is a growing number of solar projects that do provide specific agricultural benefits, however. More and more solar projects, including a number of Green Lantern's projects, are planting pollinator species between the rows of panels, or allowing sheep to be grazed among solar panels. Appropriate state policy could encourage and recognize both uses or allow "dual-use" sites to be given "preferred site" status under the net metering rules.

Development of solar projects on marginal land can help preserve larger agricultural parcels, and revenue from a solar lease may mean the difference between an older generation farmer keeping their property or splitting it off and selling it for residential or other uses. As the number of small Vermont farms dwindles, the State has an opportunity to find better ways to merge the policies of encouraging renewable energy and protecting farming and farmland for future Vermonters by leveraging the creativity and capital that solar project developers can bring to the state.

Policies for multi-functional solar in Vermont

Genevieve Byrne, Staff Attorney and Assistant Professor, Farm and Energy Initiative, Vermont Law School

Vermont's multi-functional solar policies are not found in any individual law or regulation. Rather, the state has eased regulatory requirements or established incentives for certain kinds of multi-functional solar within existing state programs. Within its solar development laws, Vermont defines and promotes specific multi-functional designs, including roof-mounted arrays, those sited on a list of "preferred" locations, and arrays designed to support agricultural land uses.

Vermont has streamlined the regulatory oversight of all solar arrays in the state by delegating nearly all siting, permitting and array approval decisions to

[13] The Department of Taxes technical bulletin " Solar Generating Facilities Constructed on Land Enrolled in the Current Use Program" of 2015 explains how to interpret the law. https://tax.vermont.gov/sites/tax/files/documents/TB69.pdf

the state Public Utility Commission (PUC).[14] The permitting and approval process itself can be expensive and time-consuming, and often requires legal assistance and expertise. Easing project permitting requirements for preferred or low-impact solar arrays can help incentivize projects of a preferred type, including multi-functional solar. In Vermont, all solar projects are required to obtain a Certificate of Public Good (CPG) from the Vermont PUC.[15] However, the review requirements and criteria for approval differ based on proposed project capacity, with increased oversight of larger-scale projects, and eased requirements for small-scale and roof-mounted projects.[16]

While Vermont does not currently ease permitting costs or requirements for multi-functional solar beyond roof-mounted arrays, the centralized permitting authority of the PUC and its familiarity with applying different review criteria to different types of solar arrays may offer opportunities to create a specialized approval process for arrays of this type in the future.

Vermont incentivizes multi-functional solar beyond roof-mounted arrays within its net-metering[17] program by offering additional compensation (or relief from reduced compensation) to projects located on "preferred sites."[18] In 2017, the PUC added two compensation rate modifiers that increase or decrease the compensation rate offered to new net-metered customers for excess solar energy contributed to the grid: the "REC adjustor" [19] and the "siting adjustor."[20] The siting adjustor opened the door for more diverse multi-functional solar arrays by creating an incentive for net-metering systems to be installed on "preferred sites," including previously disturbed terrain, rooftops, landfills, and parking lot canopies, among others.[21] The "overall purpose of the adjustors is to

[14] 24 V.S.A. § 4413(b) (2016); 30 V.S.A. §§ 224 (2017) and 248 (2019).

[15] 30 V.S.A. § 248 (2019). In most other states, solar siting and interconnection approvals are issued by a variety of different state agencies and local planning and zoning boards. Vermont is unique in requiring all solar arrays be permitted solely by the PUC.

[16] *30 V.S.A. § 248 (2019); Projects 15-50 kW in capacity participate in an "application" process, in which they need to submit evidence of compliance with a limited set of criteria to obtain a CPG. Projects above 50 kW must submit a full "petition" to the PUC and submit evidence of compliance with all of the criteria found in 30 V.S.A. § 248. These projects are also subject to decommissioning requirements not applied to smaller projects. VT PUC Rule 5.901 (2017).*

[17] Net-metering "means measuring the difference between the electricity supplied to a customer and the electricity fed back by the customer's net-metering system during the customer's billing period." 30 V.S.A. § 8002(15) (2019). Vermont has steadily increased the overall capacity of the net metering program and expanded customer eligibility since enactment of its first net-metering law in 1998. Vermont Public Utility Commission, *Order in Re: Biennial Update of the Net-Metering Program*, November 12, 2020, 4-5 (hereinafter, "2020 Biennial Report").

[18] VT PUC Rule 5.103 and 5.127 (2017).

[19] "RECs" refer to "renewable energy credits," which represent the environmental attributes of solar energy and are used by Vermont utilities to show compliance with state Renewable Portfolio Standard goals. The REC adjustor encourages customers to transfer their RECs to the interconnecting utility to be used for utility compliance with these goals. The original 2017 REC adjustor provided an additional $0.03/kWh to customers transferring their RECs to the utility and reduced compensation by -$0.03/kWh for customers electing to keep their RECs. VT PUC Rule 5.127(B)(1)-(3) (2017). When customers transfer RECs, they lose the ability to make claims about "going solar" or "using solar energy" at their home.

[20] VT PUC Rule 5.127(C)(1)-(2) (2017).

[21] VT PUC Rule 5.103. Preferred sites include: (1) new or existing structures; (2) a parking lot canopy over a paved parking lot, provided that the location remains in use as a parking lot; (3) certain previously developed land; (4) brownfields (5) suitable landfills; (6) the disturbed portion of a lawful gravel pit, quarry, or similar site; (7) locations designated in a duly adopted municipal plan; (8) suitable CERCLA sites; and (9) the same parcel as, or an adjacent parcel to, a customer using at least 50% of the system output.

encourage the beneficial siting of net-metering systems and to provide a mechanism for the Commission to better tailor net-metering compensation to reflect the cost of technology."[22] However, the PUC significantly reduced these incentives in its most recent order setting compensation rates for the net-metering program, reducing overall compensation for multi-functional and other preferred projects.

The PUC's net-metering rules define four categories for proposed solar arrays, each of which receives a different per-kilowatt-hour rate modification through the siting adjustor, which is "intended to reflect whether the project is on a preferred site and the lower cost of development enjoyed by larger projects due to economies of scale."[23] Category I net-metering systems are residential systems with capacities of 15 kW or less, regardless of where they are sited.[24] Category II systems include medium-scale arrays (>15 kW to 150 kW) located on the list of preferred sites. Category III includes larger arrays (>150 kW to 500 kW) located on preferred sites, and Category IV includes medium-scale arrays (>15 kW to 150 kW) that are *not* located on preferred sites.

Under the original siting adjustor values set in 2017, Categories I and II were each eligible to receive an additional $0.01/kWh,[25] Category III systems received a rate decrease of -$0.01/kWh and Category IV systems received a rate decrease of -$0.03/kWh.[26] While projects are eligible for positive rate adjustments for ten years, negative rate adjustments last for the lifetime of the solar array.

In 2018, the PUC "decided to gradually scale back net-metering compensation," and reduced the siting adjustor for Category III systems by one cent.[27] In November 2020, the PUC again reduced the siting adjustors for all categories of net-metering systems by one cent beginning in February 2021 and by an additional one cent beginning in September 2021.[28] The PUC found that the "siting adjustors are accomplishing the goal of steering development to better locations," and that the reduced compensation would "help better align the cost of net-metering and the value that new net-metering systems provide, while narrowing the gap between the cost of net-metering and the cost of other sources of in-state distributed renewable energy." [29] It also noted that the overall cost of installing solar energy has significantly decreased.

While Vermont has reduced its financial incentives for multifunctional solar in the net-metering program, with increased advocacy and political will, new or increased incentives could be established either by legislative action or through the PUC's next biennial review of the net-metering program, scheduled to occur in 2022. Additionally, the state could encourage multi-functional solar in larger-scale projects by creating incentives for such projects within its "Standard Offer" program, which provides long-term contracts to eligible projects up to 2.2 MW in capacity.[30]

Vermont's solar policies include relatively strong support for multi-functional solar arrays designed to support agricultural land uses. First, Vermont's Land Use Value Appraisal Program[31] (also referred to as the "current use" program) offers opportunities for developing solar arrays on enrolled farmland without triggering tax penalties otherwise applied to non-agricultural "development" on enrolled

[22] 2020 Biennial Report, 14.
[23] *Id.*
[24] VT PUC Rule 5.103
[25] The siting adjustor and REC adjustor rate modifications are applied to the "blended base rate" established by the PUC.
[26] VT PUC Rule 5.127(C)(1)-(2) (2017).
[27] The REC adjustor was also reduced by one cent in 2018 and another one cent in 2019. 2020 Biennial Report, 11.
[28] 2020 Biennial Report, 40.
[29] *Id.*
[30] 30 V.S.A. §8005a (2019).
[31] 32 V.S.A. §§ 3752, 3755, 3757, 3802, and 8701 (2019).

land.[32] In Vermont, any solar array that is less than 50 kW in capacity and either net-metered or not connected to the electrical grid may be located on enrolled land without triggering tax penalties. Larger solar arrays are also permissible, so long as they qualify as a "farm improvement."[33] Solar arrays are generally considered to be a permissible "farm improvement" when fifty percent or more of the electricity generated from the solar array is consumed on-site by enrolled farm buildings. These rules promote the siting of solar next to active agricultural uses and help support farm viability by reducing electric bills.

Vermont further supports multi-functional solar and agriculture through its voluntary certification program for "pollinator friendly" solar arrays. Developers may submit a Solar Site Pollinator Habitat Scorecard identifying project details including vegetative cover, blooming and perennial species, pollinator nesting habitat, buffers, and pesticide use. Projects achieving certain criteria are certified as "pollinator friendly" or "excellent habitat," with certification lasting three years.[34]

Priorities for future research

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Over the past decade, rapid proliferation of solar development on agricultural land has led to unprecedented overlap in food and energy production nationwide. In response, solar developers, landowners, farmers, graziers, and scientists have been working to integrate novel technologies and practices into traditionally agricultural landscapes. As policymakers and developers work toward the mainstream adoption of these practices, researchers and site managers continue to address questions surrounding cost, feasibility, and best practices to ground truth the myriad benefits of multifunctional solar.

The Department of Energy's National Renewable Energy Lab (NREL) has emerged as a clear leader in the field of agrivoltaics through its Innovative Site Preparation and Impact Reductions on the Environment (InSPIRE) project. Their team — working at 25 sites across the country — has explored everything from soil health and crop yield, to optimum panel height and spacing across a wide range of emerging practices. Yale's school of Forestry and Environmental Studies has also focused on the economic and social ramifications of pollinator-friendly solar in the Midwest with an analysis published in 2019 highlighting private economic benefits of the practice. Meanwhile, a joint effort between UVM's Gund Institute and Audubon Vermont seeks to explore the role of pollinator-friendly solar in reversing habitat loss and biodiversity decline throughout the region.

While the growing body of research has thus far supported the ecological and economic benefits of multifunctional solar, there is still much to learn. How will the landscape respond over the lifetime of the panels? What are the long-term effects on soil health, water quality, and microclimate at each site? Would benefits from multiple practices

[32] The Land Use Value Appraisal Program is a beneficial taxation programs in which farmland is assessed and taxed at its agricultural value instead of its market value while meeting program criteria. Solar development may jeopardize enrollment in the program and subject landowners to tax penalties if not designed in compliance with current use program rules.

[33] A solar array qualifies as a farm improvement when it is actively used by a "farmer," as part of a "farming operation," is owned by a farmer or leased to a farmer for at least 3 years, and is located on enrolled land or an adjoining house site. Vermont Department of Taxes, Technical Bulletin 69, *Solar Generating Facilities Constructed on Land Enrolled in the Current Use Program*, July 13, 2015.

[34] 6 V.S.A. §§ 5101-5102 (2017).

compound or inhibit each other if used in combination? The following topics have been identified as priorities for future research from those who are currently working in the field.

Compatibility & Integrated Practices — Can grazing practices and pollinator-friendly habitat co-exist beneath PV arrays? Most examples of this combination to date exclusively focus on the co-location of domesticated honeybees and grazing livestock. But is it possible to achieve the benefits of grazing – such as reduced operation and maintenance costs – without compromising components essential for supporting specialist bees, butterflies, and other insects that are most impacted by habitat loss? A cost-effective solution that features primarily native forbs and grasses would not only benefit biodiversity preservation in the context of solar grazing, but across working landscapes throughout the northeast.

Lifetime of Photovoltaic Arrays — Since utility-scale solar is a relatively new addition to Vermont's landscape, little information exists regarding the typical lifespan of PV arrays, and the condition of the land after a site has been decommissioned. Incorporating solar grazing practices or pollinator-friendly perennials within the footprint of a solar installation invites the opportunity for increased biomass, carbon sequestration, and groundwater filtration services. Some civil engineers have even proposed long-term rotation schemes, where decommissioned sites can be returned to active agricultural practices with improved soil quality and potential for greater yield. Current studies, spearheaded by NREL, hope to quantify some of these speculations by monitoring sites over the course of a typical 20–30-year lease period.

Ecosystem Services — Conventional wisdom suggests that solar grazing and pollinator-friendly solar provide added value to each site in the form of enhanced pollination services, carbon sequestration, water quality, and erosion control. But how does this compare to conventional "turfgrass" solar or conventional agriculture? For researchers investigating these added benefits, the sample size is continuously growing. Each year, as more sites come online and vegetation at existing sites continues to flourish, concepts that were once hypothetical are becoming realized. In parts of the country where multifunctional solar has become more mainstream, researchers have already begun the work of modelling ecosystem services, but there is still a long way to go before these processes are fully understood, particularly in the context of New England's climate and ecology.

Aesthetics — From the public's perspective, how does multifunctional solar compare to conventional solar practices? Aesthetics over the 2–3-year establishment phase are often cited as a barrier to the adoption of pollinator-friendly solar, but how does perception change once the site is well-established and perennials have begun to bloom? Now that agrivoltaic practices have become more widespread -- and in some states approach normalization -- it is worth reassessing public perceptions of solar grazing or pollinator-friendly solar when compared to turfgrass alternatives.

Biodiversity & Conservation — In order to effectively reverse regional biodiversity loss, significant interventions across Vermont's working landscape must be considered. One strategy that has been widely promoted in agricultural settings is the implementation of buffers, windbreaks, and hedgerows to serve as additional habitat and as corridors for wildlife. These features can be incorporated into existing solar projects by using flowering shrubs as screening buffers. Current industry standards prefer conifers such as arborvitae (white cedar) for their low-cost and ability to thrive in a wide variety of conditions. Opting instead for flowering shrubs would provide food and habitat for shrubland birds, pollinators, and other beneficial insects and thereby maximize biodiversity potential. Is this an effective management strategy, and how does it influence

key factors such as aesthetics, cost, and landscape connectivity? Are there readily available, cost-effective alternatives that function as an effective screen while still supporting native wildlife?

Demonstration Sites — Education plays a vital role in pioneering novel land-use practices, and perhaps the most feasible way to address the above questions is through demonstration. Sites located in publicly accessible, visible locations not only serve as resources for scientists to test hypotheses, but also as proofs-of-concept for developers, and as visuals for neighboring communities. Economic feasibility, high up-front costs, and aesthetics are often significant barriers to adopting these practices. With the benefits of multi-functional solar easily visible and accessible at demonstration sites, developers, landowners, and other stakeholders within the community may be more willing to invest in achieving long-term benefits.

Additional resources

2017 *Guide to Farming-Friendly Solar* by UVM Extension Center for Sustainable Agriculture: https://www.uvm.edu/extension/sustainableagriculture/guide-farming-friendly-solar

2020 Workshop on Solar Energy in Vermont's Working Landscape: https://www.uvm.edu/extension/sustainableagriculture/news/grazing-and-solar-energy-vermonts-working-landscape

American Farmland Trust Smart Solar Siting for New England: https://farmland.org/project/smart-solar-siting-for-new-england/

American Solar Grazing Association (ASGA): https://solargrazing.org/

ASGA Solar Grazing Map: https://map.solargrazing.org/

ASGA Solar Grazing Contract Templates: https://solargrazing.org/contract/

Center for Pollinators in Energy: https://fresh-energy.org/beeslovesolar/

Natural Resources Atlas of the Vermont Agency of Natural (Geology layer > Soils – Prime Agricultural): http://anrmaps.vermont.gov/websites/anra5/

Pollinator-Friendly Solar Resources (UVM Extension Center for Sustainable Agriculture) with link to VT scorecard: https://www.uvm.edu/extension/agriculture/pollinator-friendly-solar

USDA NRCS Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

University of Vermont Gund Institute for Environment: https://www.uvm.edu/gund

University of Vermont Pasture and Livestock Program (grazing plans and resources): https://www.uvm.edu/extension/sustainableagriculture/pasture-livestock-program

Vermont Law School Institute for Energy and the Environment: https://www.vermontlaw.edu/academics/centers-and-programs/Institute-for-Energy-and-the-Environment

Vermont Land Link (connecting farmers to available solar land): https://vermontlandlink.org/

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