Agrivoltaics in New York State

Framing the Opportunity

ALLIANCE FOR CLEAN ENERGY NEW YORK, INC.

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Founded in 1979, EDR is a certified Woman-Owned Business (WBE) dedicated to creating and sustaining a better environment for our clients, employees, and communities — and doing so with integrity, a collaborative approach, and a genuine passion. EDR is comprised of a diverse group of environmental professionals, including ecologists, botanists, wildlife biologists, GIS specialists, archaeologists, historians, visualization specialists, planners, landscape architects, and engineers. EDR has been providing strategic environmental permitting services for energy generation and transmission projects throughout the Northeastern, Midwestern, and Mid-Atlantic United States for more than 25 years.

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Agrivoltaics is an evolving area regarding research, policy, and implementation. Therefore, the latest research, policies, and project development should be considered before the incorporation of any of the recommendations or considerations of the plan.

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About The Alliance for Clean Energy New York

The mission of ACE NY is to promote clean, renewable electricity technologies and energy efficiency in New York to increase energy diversity and security, boost economic development, improve public health, and reduce air pollution.

ACE NY believes that solar energy and farming can exist alongside one another, and each industry can help the other in meaningful ways while supporting individual farmers and their communities. This document is intended to be a resource to the members of ACE NY and other stakeholders that compiles considerations for agrivoltaic development in New York. This document will be updated as needed to reflect current best practices, policies, research, and program development.

Thank You To Our Members and Collaborators

A deep thank you for the time ACE NY members spent reviewing this report and providing insights during the six working sessions leading up to publication.

We are grateful for the funding support from the American Clean Power Association.

Methodology

This report was generated over the winter, spring, and summer of 2023. Working closely together, EDR and ACE NY coordinated and led a series of six interactive virtual working sessions attended by members of ACE NY, along with input from Young/Sommer LLC and NYSERDA, using digital whiteboard technology to collect feedback. These working sessions examined the challenges and opportunities for each phase of agrivoltaics development, large scale and small scale permitting trends and agrivoltaics research, incentives, and education initiatives occurring in New York State. Information sources that informed the development of this report are listed in the Bibliography and Other Recommended Resources section. Following the report's completion, participating stakeholders were invited to review the draft report and offer comments later incorporated into the final version.

List of Abbreviations

94-c	Executive Law Section 94-c as established per the Accelerated Renewable Energy Growth & Community Benefits Act, which addresses the permitting of major renewable energy facilities in New York
CLCPA	Climate Leadership and Community Protection Act
GHG	Greenhouse gas
GW	Gigawatt
MSG	Mineral Soil Group
MW	Megawatt
NYSERDA	New York State Energy Research & Development Authority
O&M	Operation and Maintenance
PV	Photovoltaic
SEQRA	State Environmental Quality Review Act
A-TWG	Agricultural Technical Working Group
FPWG	Farmland Protection Working Group

Photo announcing a proposed 500 MW sheep grazing solar facility near Glenrock, Wyoming.

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Executive Summary

Agrivoltaics in New York State: Framing the Opportunity explores the concept of agrivoltaics, the combined use of land for solar photovoltaic power generation with agricultural production, specifically in the context of New York State. Agrivoltaics offers a practical approach to meeting growing demands for renewable energy and food. To address climate change, New York has enacted the Climate Leadership and Community Protection Act (CLCPA), which mandates generating 70% renewable electricity by 2030 and 100% zero-emission electricity by 2040. This ambitious goal necessitates significant solar energy development. Solar development often occurs on farmland because it is wide open space on disturbed land that has relatively fewer impacts on habitat for wildlife. Solar development is anticipated to continue on a portion of farmland, with some stakeholders raising concerns about potential impacts on agriculture.

Solar development is expected to occur on a small portion of active farmland, meaning farmland that is in agricultural production, in New York State by 2040, estimated at 2.2% of the state's total active farmland. This calculation is based on an assumption of 5.5 acres per MW, a number that could decrease as technology advances. Agrivoltaics can further minimize the relatively small impact solar development may have on farmland in New York. Even when agrivoltaics are not deployed, solar development can preserve invaluable Natural Capital (environmental assets) by protecting farmland and allowing soil health to recover. This increases the potential for carbon sequestration and other Ecosystem Services. The land can potentially return to agriculture following the decommissioning of the facility. Of greater concern than solar development on farmland is urban or sub-urban sprawl on farmland, where land is permanently converted to residential or commercial uses. Compared to the amount of farmland anticipated to host solar energy, as described further in this document, more than four times the land area is already on track for permanent conversion to residential and commercial development.

Agrivoltaics has emerged as a strategy to minimize potential impacts on farmland while preserving its productivity. New York State has initiated policies and incentives to promote agrivoltaics, including mitigation fees for solar development on prime agricultural soils, which can be waived for developers implementing agrivoltaic design principles. Various state-level working groups and organizations actively shape agrivoltaic policies and guidelines, emphasizing collaboration between solar developers, farmers, and policymakers.

The report underscores that agrivoltaics can and should be a tool to support rural economies and keep farmland in production while still providing affordable renewable energy to ratepayers.

Acknowledging the complexities and additional costs associated with agrivoltaic projects, this report offers considerations for stakeholders involved in developing and implementing agrivoltaic projects at various scales in New York State. There is no one-size-fits-all approach, and flexibility is required for cost-effective agrivoltaics strategies appropriate for large-scale and small-scale facilities.

Agrivoltaics presents a promising pathway to achieve New York's clean energy goals while preserving production in agricultural lands. Continued collaboration between stakeholders, research and development, educational programs, and incentives will be crucial in realizing the vision of agriculturally compatible solar development that supports New York State's energy and agricultural needs. This document serves as a foundation for understanding and advancing agrivoltaics in New York State, with the potential for future updates to reflect evolving trends and best practices in this rapidly evolving field.

5 MW solar sheep grazing facility in Massachusetts.

What Does "Agrivoltaics" Mean?

Agrivoltaics is the simultaneous use of land for solar photovoltaic power generation and agricultural production of "crops, livestock, and livestock products," as that phrase is defined by New York State Agriculture & Markets Law Chapter 69, Article 25-AA §301§ (2). The New York State Agricultural Technical Working Group developed and supports this working definition. Agrivoltaics is also referred to as dual-use solar or agricultural co-utilization.

"Crops, livestock, and livestock products" refers to a variety of crops ranging from field crops, fruits, vegetables, horticultural specialties, livestock and livestock products, maple sap, Christmas trees, aquaculture, woody biomass, apiary products, woodland mushrooms, and industrial hemp[1]. Dual-use solar can be a more expansive term than agrivoltaics, and includes conservation, small-scale agriculture, pollinator plantings, or other land uses that benefit the local community.

Other Related Terms and Concepts

This report focuses on utility-scale agrivoltaic systems. In addition, these other related terms and concepts are important to understand:

Agrisolar: This primarily European term includes on-farm solar and greenhouse rooftop solar. The European Union and United Kingdom have stronger incentives based on their commitment to balance climate neutrality and agriculture.

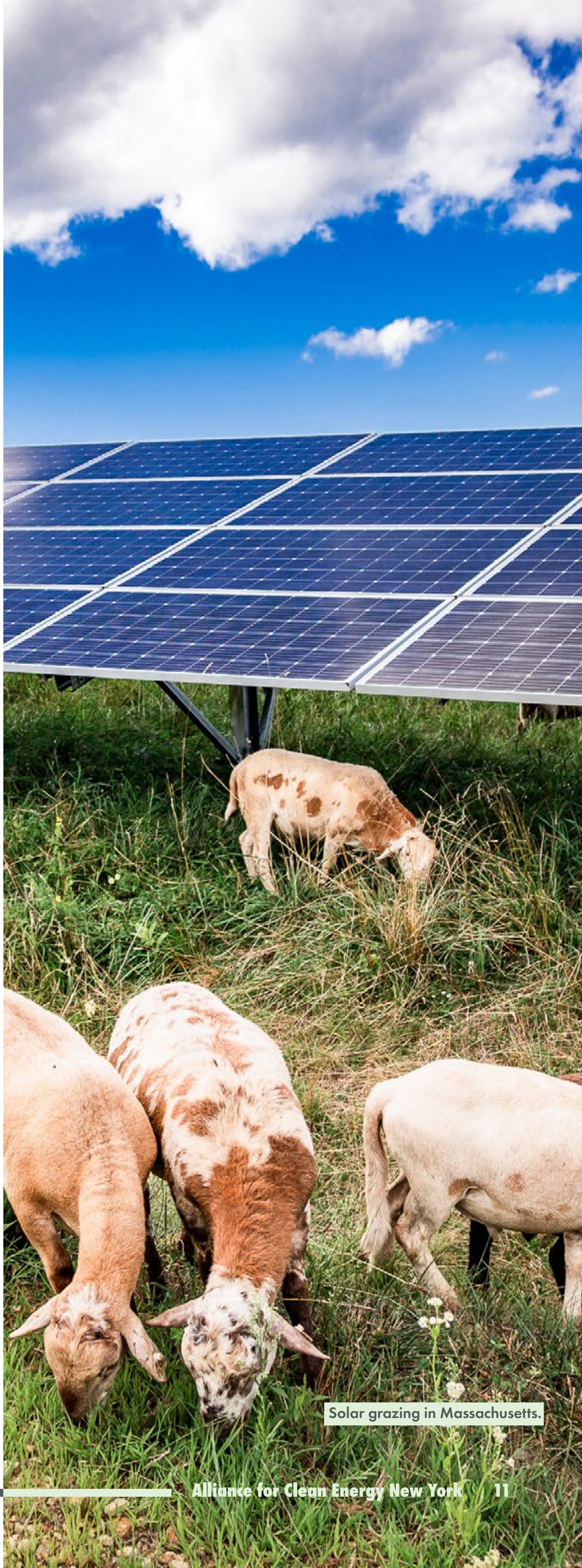
Large-scale solar: This typically refers to grid-scale solar facilities that are 20 megawatts (MW) or greater and are currently permitted through the Section 94-c regulatory process administered by the Office of Renewable Energy Siting (ORES). All projects 25 MW or larger must go through the 94-c process, whereas projects 20 to 25 MW can opt-in to 94-c. Large-scale solar projects typically participate in New York's wholesale energy markets.

Small-scale solar: This refers to solar facilities that are 20 MW or smaller and are permitted through the State Environmental Quality Review Act (SEQRA) process. Distributed solar is a subset of small-scale solar and refers to solar generated at or near where it will be used. It tends to be much smaller than 20MW and can be sited in places like rooftops, small fields, or retired landfills.

Important farmland: Currently, several initiatives define important farmland to discourage solar development in such areas. One example is the New York State Energy Research & Development Authority's (NYSERDA's) Smart Solar Siting Scorecard, which incentivizes agrivoltaics and solar development outside Mineral Soil Groups (MSGs) 1 through 4. Prime farmland, unique farmland, and farmland of statewide or local importance are other classifications of important soils used by communities and the USDA.

On-farm solar: Small-scale behind-the-meter solar energy produced on-site for a specific farm and used for farming operations.

Additional siting considerations: Solar energy development in New York State can interact with numerous resources of concern (e.g., wetlands, streams, habitat for threatened and endangered species, forestland). Therefore, responsible solar energy development must consider all sensitive resources and balance impacts while maximizing renewable energy production on a site.



Solar grazing in Massachusetts.

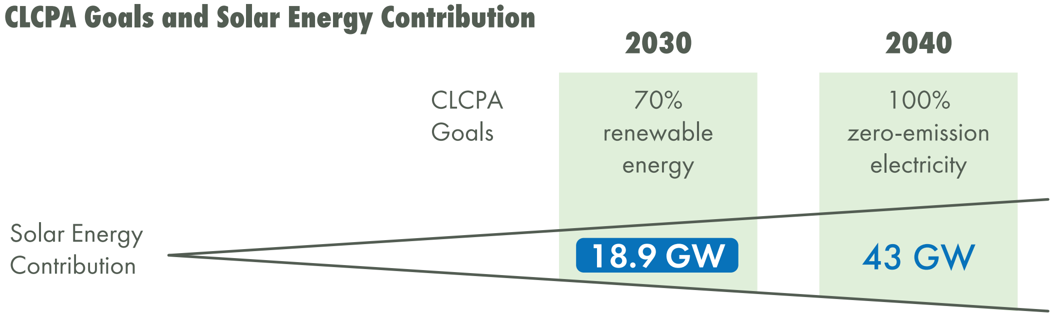
Introduction

Renewable Energy Policies in New York State

Multiple lines of evidence show that anthropogenically caused climate change is altering the natural and built environment.[2] Among the anticipated impacts of climate change are altered weather patterns that will hinder the production of basic crops. By 2040, 80% of cropland production in the contiguous United States will be at risk due to rising temperatures and shifting rainfall patterns due to climate change. New York State, in particular, has already endured climate impacts on its agriculture, reflected by a 2.4°F increase since 1970, declines in crop yields, increases in heat stress days for livestock, declines in dairy productivity, and increases in invasive species.

The extent to which the impacts of climate change worsen depends on the decisions made today to reduce greenhouse gas (GHG) emissions. Decisions to use technologies like agrivoltaics present many opportunities to mitigate the impacts of climate change on farming productivity, biodiversity, and soil health. Unfortunately, however, GHG-emitting energy sources (e.g., petroleum, coal, and natural gas) that contribute to climate change still dominate the current energy profile of the United States.

CLCPA Goals and Solar Energy Contribution



New York has approved strongly proactive legislation to combat climate change. To guide New York State's transition to renewable energy, the Climate Leadership and Community Protection Act (CLCPA) was adopted in 2019. This act establishes the mandate of generating 70% renewable electricity by 2030 and 100% zero-emission electricity by 2040.

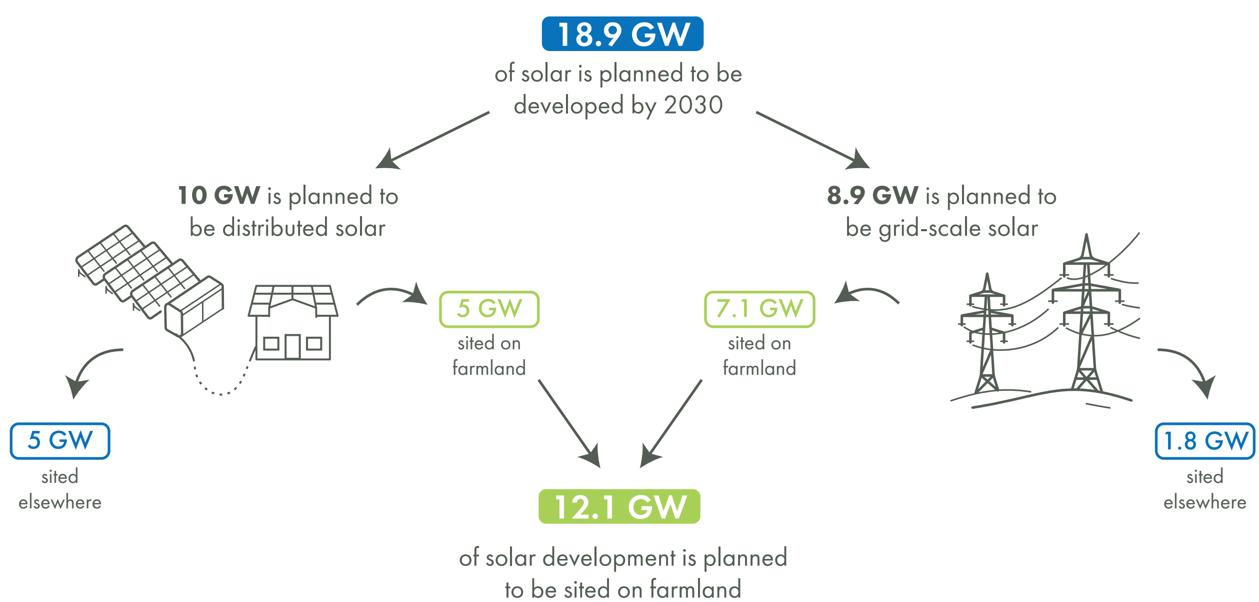
To meet its renewable energy goals, the state developed its Climate Scoping Plan, which projects that up to 18.9 gigawatts (GW) of solar-generated electricity will be needed by 2030, with an additional 24.1 GWs developed between 2030 and 2040.[3] Of the 18.9 GW needed by 2030, 10 GW is expected to come from distributed solar (a subset of small-scale solar) based on a target set by the Governor, and 8.9 GW is expected from grid-scale solar (primarily large-scale solar but also some small-scale solar).[4]

Solar Energy & Agriculture in New York State

One of the complexities of solar development as a climate solution is its tendency to be sited on farmland. Farmland offers large tracts of open, relatively flat land that is often in proximity to transmission lines and free of other land use constraints (e.g., wetlands, forested lands, etc.). Solar energy land lease payments can be an attractive additional revenue source for farmers. They provide long-term stability and can exceed the return on investment possible through traditional agricultural practices alone.

For the purpose of this analysis we assume that approximately 80% of grid-scale solar today is planned to occur on farmland based on current solar development trends[5] and review of 94-c applications. We also assume that approximately 50% of distributed solar[6] development in New York State will occur on farmland. Based on these assumptions, 12.1 GW of solar energy development will occur on farmland by 2030.

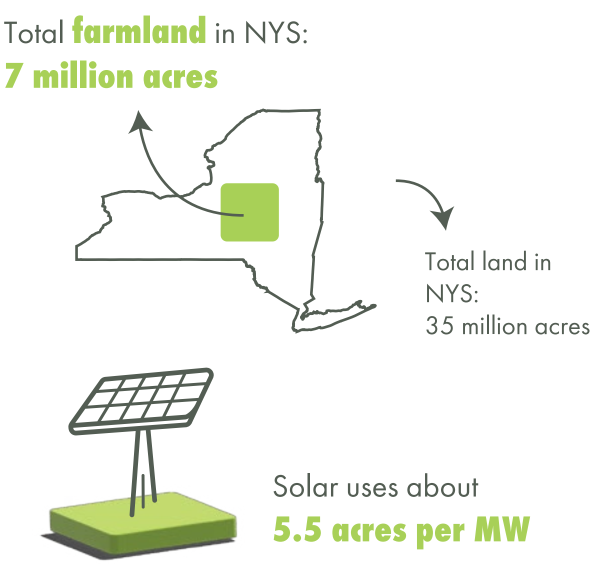
Amount of Solar Development Expected to be Sited on Farmland in NYS by 2030

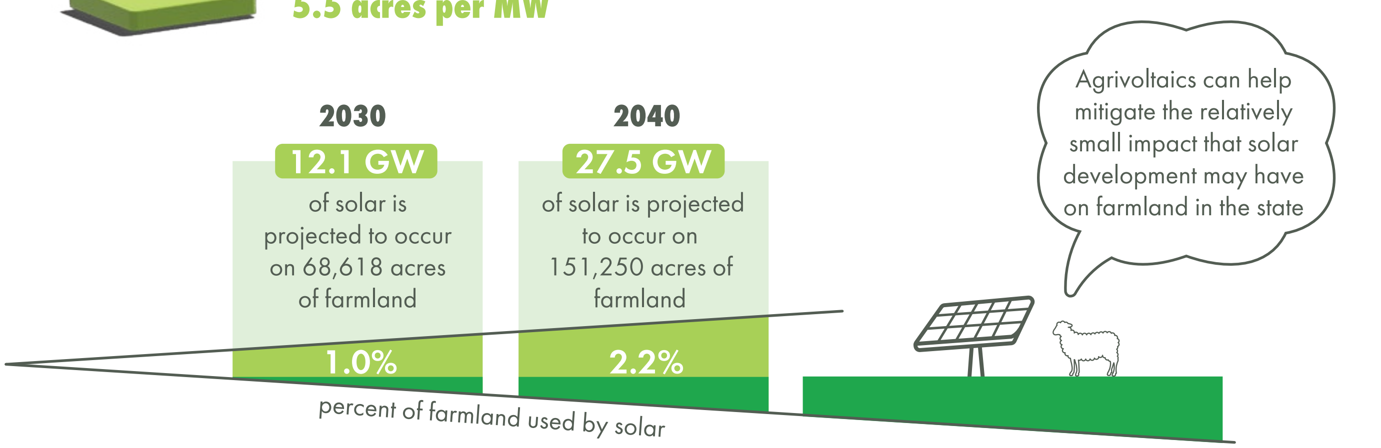


Of the 35 million acres of land in New York State, about 7 million acres are farmland[7]. The average solar development uses an estimated 5.5 acres of land per MW. Therefore, if the 2030 CLCPA goal is met, solar development will occur on approximately 66,550 acres under the above assumptions, equating to less than 1.0% of New York's farmland. By 2040, assuming the same percentage of solar development occurs on farmland, approximately 27.5 GW will be sited on farmland, representing approximately 2.2% of total farmland in the state. As noted previously, this calculation is based on an assumption of 5.5 acres per MW, a number that could decrease as technology advances. Solar energy production that occurs on farmland will provide renewable energy benefits, such as jobs, additional revenue for both local public and private entities, and clean energy. Furthermore, photovoltaic solar facilities can provide agricultural soils an opportunity to rest, preserving Natural Capital (environmental assets) beyond the facility's use.

New York State is a major agricultural state, ranking in the top ten U.S. states for its production of 30 agricultural commodities.[8] New York's moderate climate and connection to major food markets will serve to maintain its role as an agricultural leader for the foreseeable future. As such, New York State is invested in protecting farmland from conversion to other uses and promoting the viability of agricultural operations. In 2022, NYS passed legislation that supported national efforts to conserve at least 30% of U.S. land and water by 2030, and part of that effort includes the Farmland Protection Implementation Grant conservation easement program.[9] Although the total impact of solar development on farmland is small and can be further minimized through

Portion of Farmland in NYS Anticipated to be Used for Solar Development





On-farm solar at Cozy Cove Farm near Gurley Alabama.

compliance with the New York State Department of Agriculture & Markets Guidelines for Solar Energy Construction Mitigation for Agricultural Lands (NYSAGM Guidelines), the potentially competing NYS goals underlie part of the recent interest in agrivoltaics.

Agrivoltaics in New York State

Agrivoltaics is the simultaneous use of land for solar photovoltaic power generation and agricultural production of "crops, livestock, and livestock products," as that phrase is defined by New York State Agriculture & Markets Law §301 (2). Agrivoltaic practices provide potential synergies between the solar industry and the agricultural sector. New York State is at the frontier of this topic. The state's specific targets for solar energy and farmland protection provide opportunities for solar energy developers and farmers to work with policymakers to develop solutions. Policymakers have begun to provide incentives for solar development strategies that limit agricultural impacts. Agrivoltaics are one strategy that mitigates agricultural impacts by facilitating the continuation of farming practices on lands where solar energy development is proposed.

Policies for balancing and integrating agricultural production and solar development across New York State are new or in development. For example, solar energy developers who receive a Renewable Energy Credit contract from the New York State Energy Research & Development Authority (NYSERDA) are required to pay a mitigation fee on a per-acre basis for any solar development that occurs on soils within Mineral Soil Groups (MSGs) 1 through 4 (i.e., New York's most productive agricultural soils). The mitigation payments are directed to the state's farmland protection program. As an added incentive, developers who propose and implement agrivoltaic design principles can have all or a portion of this mitigation fee waived by NYSERDA.

Several entities within New York State are developing and advocating for policies supporting agrivoltaics. For example, the New York State Agricultural Technical Working Group (A-TWG) is an independent advisory body tasked with developing strategies and policies to strengthen the connections between solar energy development and agriculture.[10] This group comprises farmers, agricultural land advocates, agricultural non-governmental organizations, solar developers, state agencies, and local and regional governments. A-TWG provides science-based guidance to advance solar energy development while balancing the needs of farming operations, renewable energy developers, lands, and farmers. A-TWG recommends tools to support renewable energy development, like NYSERDA's Smart Solar Siting Scorecard.[11] A similar group, the Farmland Protection Working Group (FPWG)[12], chaired by the NYS Department of Agriculture and Markets, offers a coordinated effort among state agencies to recommend potential research topics and incentives/disincentives for renewable energy developers. Finally, another key player in the agrivoltaic policy arena in NYS is the NYSERDA Clean Energy Siting Team, which offers technical assistance and workshops and led the development of the New York Solar Guidebook for Local Governments.[13] These groups, along with others, will help to guide the future development of solar facilities on agricultural land in New York State.

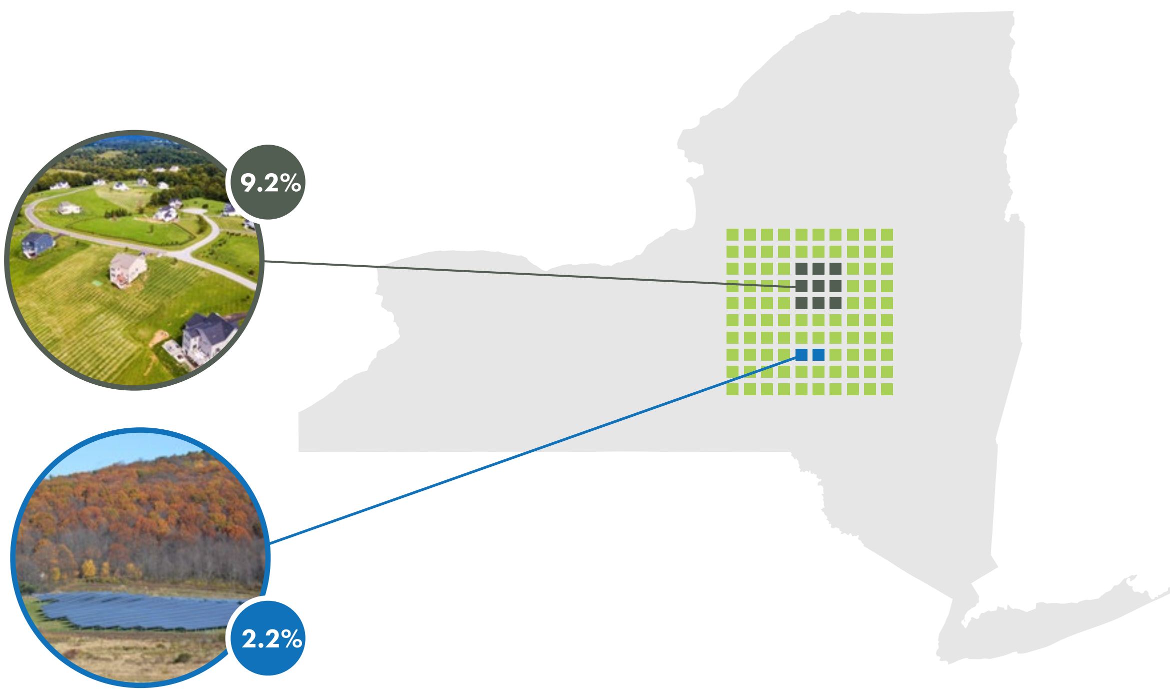
Key Factors Impacting Agriculture in New York State

It is important to note that solar energy development is not farmland's biggest threat. New York State is in the top third of states across the U.S. when it comes to the conversion of farmland, particularly from low-density development (e.g., large-lot subdivisions, large industrial facilities, and rural residences). This type of development can permanently convert land and once developed, have a multiplying effect by spurring more development because of the expansion of infrastructure (e.g., water and sewer utilities), enabling more dense development. Specifically, the American Farmland Trust anticipates that by 2040, New York will undergo anywhere from 247,500 to 642,200 acres of permanent farmland conversion to low-density development.[14] By contrast, solar energy development is anticipated to occur on 151,250 acres of farmland by 2040. Unlike low-density residential development, solar does not require a full or permanent conversion of lands away from agricultural production. Solar can strengthen the viability of existing farm operations on its own by

Farmland Conversion Projections in New York State

Up to 642,200 acres of NYS farmland is projected to be converted to low-density development by 2040.

In contrast, by the same year, only 151,250 acres of NYS farmland is projected to be converted to solar development.



providing new revenues to farmers. The benefits can be greater when paired with agrivoltaics. Even when agrivoltaics are not deployed, a solar facility can protect farmland from permanent conversion due to residential and commercial development and allow soil health to recover.

Moreover, any discussion of the nexus between agriculture and energy must also acknowledge that 45% of all corn grown in the United States is used to produce ethanol.[15] In New York State farmers have indicated that a portion of their corn is sold for ethanol, however the total amount is unclear. It should be noted that distillers grains are produced as a by-product of making ethanol which are used as animal feed. A recent study found that solar facilities can produce 100 times the energy of a comparably sized field crop of corn for ethanol after all energy inputs are included. Those inputs include building and installing solar panels and growing, harvesting, transportation, and processing costs for ethanol.[16]

Purpose of this Document

As a developing field, agrivoltaics exhibits promising potential to create synergies and minimize conflicts between agriculture and solar energy development in New York State. Agrivoltaic design principles can increase land use and resource efficiency while preserving agricultural land. Like traditional solar projects, and in some cases even more so than traditional solar projects, agrivoltaics can increase the potential for soil carbon sequestration and other ecosystem services, and contribute to rural economies, as demonstrated in this section and the following sections of this document. However, incorporating agrivoltaic principles can introduce several additional costs and operational and maintenance complexities for solar energy developers that must be carefully accounted for and incentivized.

This report outlines some of these costs and complexities, ranging from site, design, and equipment selection to maintenance practices, from plantings during construction to removing infrastructure during decommissioning. It identifies considerations to guide developers, policymakers, agricultural landowners, and other stakeholders working to develop agrivoltaic projects in New York State. The report also provides an overview of current and emerging agrivoltaic practices in the solar industry and techniques for integrating agriculture and solar development in New York State.

This document is intended to build an understanding of agrivoltaics among developers, policymakers, the agricultural community, and key stakeholders and, in doing so, support the ongoing dialogue regarding solar development and agrivoltaics. This document is also anticipated to support the development of statewide agrivoltaic policies that will in turn be implemented by ACE NY membership via the successful deployment of agrivoltaic projects across the state.

In addition to compiling information from across New York related to agrivoltaics, this document provides agrivoltaic considerations for each project phase. It also summarizes policy trends for large-scale and small-scale solar and related incentive programs, legislation, and educational programs.

Vision for Agrivoltaics in NYS

ACE NY supports a pathway for achieving New York State's clean energy and decarbonization targets that includes producing solar energy on farmland in a manner that preserves and improves soil quality, provides ecosystem services, and maintains affordable electricity prices for consumers. Solar energy production is an efficient way to generate electricity in and provide new revenues to rural host communities. Agrivoltaics provides added value by maintaining the status of active agricultural lands.

Education and Research

Agrivoltaics is an emerging practice. As of May 2023, over 2.8 GW of solar development in the United States involved agrivoltaic practices.[17,18] More intensive agrivoltaic practices (e.g., growing row crops under solar panels) have been confined to research test plots, although this is beginning to change. At least five commercial agrivoltaic sites have recently become operational in Colorado, Massachusetts, and Maine.[19] Research is particularly needed to develop scalable agrivoltaic practices that are transferable from smaller test sites to large-scale utility solar.

A small number of states are actively encouraging research on agrivoltaics and the implementation of advanced agrivoltaic practices. These research initiatives focus on productivity modeling (for both energy and agricultural productivity), evaluating the viability of specific crops, and implementing innovative solar technologies. Some technologies considered include using vertical panels to provide added space for commercial farm equipment, integrating robotics and artificial intelligence technology to monitor crop growth, adjusting solar panel tilt to promote agricultural growth, and simplifying maintenance.

Cornell University is developing a multi-disciplinary research program to study agrivoltaics. Current research focuses on the physical implications of co-locating agriculture and solar in climates representative of the Northeastern United States.[20] Recently passed legislation – Assembly A.4911, sponsored by New York State Assemblymember Anna Kelles, and S.7081, sponsored by Senator Michelle Hinchey—would set up an agrivoltaics research program through Cornell Cooperative Extension if signed into law.[21,22]

Assemblymember Kelles secured $1 million in funding in the New York State FY 2024 budget to establish the Agrivoltaics Research Program.[23] The Agrivoltaics Research Program, to be housed at the New York State College of Agricultural and Life Sciences at Cornell University, would develop science-based recommendations for the co-location of crops and solar power arrays while promoting the biodiversity of flora and fauna. The research will guide best practices on implementing agrivoltaics throughout New York State. At the federal level, Senators Heinrich (D-NM) and Braun (R-IN) introduced the Agrivoltaics Research and Demonstration Act of 2023 (S. 1778) that also supports agrivoltaics research and demonstrations of the value of such systems. The status of this legislation is pending.

The University of Massachusetts Amherst Clean Energy Extension program has a variety of programs relating to agrivoltaics, including a research program and an information hub. The university provides information on the consultation and review process for the Massachusetts Agricultural Solar Tariff Generation Unit agrivoltaics incentive program and research topics like economic impacts and specific crop feasibility for agrivoltaic facilities.[24] This program lacks full support from the developer community due to over-prescription and limited definition of qualifying facilities.

The State of New Jersey recently approved an agreement with Rutgers University Agrivoltaics Program to pilot a program that enables selected farmers with unpreserved farmland to collaborate with developers and researchers to install agrivoltaic systems for testing, observation, and research development.[25] This agreement builds upon previous agrivoltaic research at the Rutgers University New Jersey Agricultural Experiment Station, which facilitates experimentation and engineering testing not possible in a commercial setting.[26] This research will inform decisions on the applicability of various agrivoltaic approaches and identify practices most likely to meet state clean energy goals.

Productive and collaborative relationships are essential to implementing agrivoltaic research. In 2023, the Solar Farm Summit was held in Chicago.[27] This summit provided the latest information on agrivoltaics and represented a unique opportunity for the various stakeholders involved in this field to connect. Several others are occurring internationally and elsewhere in the United States. The continuous innovation in agrivoltaics makes this an exciting time for developers and farmers in New York State. This report provides an initial framework for implementation and will be updated as new research trends emerge.

Visitors learning about the Connexus Solar Garden in Big Lake, Minnesota.

Local Communities & Agrivoltaics

Agrivoltaic projects developed in New York State provide various local benefits, including supporting new farm businesses, enhancing local supply chains, providing access to affordable land, and creating opportunities for new farmers, including those from disadvantaged communities. Local communities benefit economically from renewable energy through payments to municipalities and school districts, land leases, and job creation, including prevailing wage union jobs during construction.

In New York State, agrivoltaic approaches are being incorporated into solar facilities because of their unique benefit to rural communities to produce renewable energy financial revenues and keep agricultural lands in production. Typically, rural communities want to protect their agricultural activities and farm-based economy. Solar facilities with agrivoltaics offer further certainty for communities currently characterized by agriculture that wish to see agricultural operations remain viable and in production.

Solar developers, landowners, and participating farmers must work closely to determine the agrivoltaic approach that is most suitable for each project. This may also evolve over the life of the project. These relationships between landowners, farmers, and solar developers can guide the development of agrivoltaics if allowable through local planning and land use regulations or input during state permitting processes. These land-use tools vary greatly between communities and should remain flexible to implement cost-effective renewable energy production using suitable agrivoltaic approaches. For instance, the 20- to 30-year duration for solar land leases is often longer than the typical business plan for farming operations, which can change every five years or even more frequently.

These farming operations change periodically due to soil quality, labor availability, consumer demand, etc. The agrivoltaic practices of farmers, developers, and landowners may need to shift with these changing conditions.

Support for agrivoltaics from local community members, farmers, and solar developers is necessary to incorporate agrivoltaics into a facility, as discussed in upcoming sections. While it is sometimes possible to build in limited agrivoltaic activities during O&M into facilities not intentionally designed for agrivoltaics, agrivoltaics often occur because of community input during the siting and design phase. The support of local communities and participating farmers drive the decisions made by developers to include agrivoltaics within individual facilities.

National Center for Appropriate Technology meets with local communities in their Follow the Sun Tour in Massachusetts.

Incentive Programs

New York State has recognized agrivoltaics as a tool that can be used to reach CLCPA goals while also supporting the state's agricultural goals. The Climate Scoping Plan recommends that the state "research and incentivize the viability of agrivoltaics" to "integrate solar into agricultural communities."[28] Agrivoltaics can be promoted through a regulatory framework combining renewable energy incentives with favorable state and local land use policies.

Agrivoltaic practices typically add to the total project costs for solar developments by adding to the labor, construction, or steel costs, making O&M more expensive and complicated, or requiring more land. Project costs depend on the proposed system, location and design, labor and farm equipment availability, and other factors. Typical costs for implementing agrivoltaics still need to be defined and can introduce uncertainty into the financial budgets of solar facilities. The following overviews existing incentive programs for encouraging the adoption of agrivoltaics and suggestions from ACE NY regarding potential future incentive programs.

Existing Incentives

New York State offers a variety of incentives for agrivoltaics. The Renewable Energy Certificate (REC) program administered by NYSERDA allows renewable energy developers to secure long-term contracts with the state via competitive solicitations to sell RECs as part of the New York State Renewable Energy Standard. Solar developers must first meet a minimum set of criteria through NYSERDA to be eligible to participate in the Large-Scale Renewable Program and to apply for a REC contract.

Policy Tools Related to Solar Siting on Farmland In New York State

Incentives

Agrivoltaic solar projects can avoid penalty fees and receive additional points on the NYSERDA Smart Solar Siting Scorecard, leading to an expansion of feasible farming options. Developers have a preference for incentives over penalty fees.

Penalty Fees

Non-agrivoltaic solar projects sited on important farmland (MSGs 1-4) are obliged to contribute to a mitigation fund administered by NYSERDA in consultation with NYS Department of Agriculture and Markets to support ongoing regional agricultural practices.

Developers competing for a REC contract through NYSERDA must submit bids and proposals for projects that identify potential impacts, including impacts on agriculture. In the last few years, NYSERDA has asked developers to populate a scorecard for their projects that assigns points based on avoiding the best farmland and for the minimization strategies a developer is willing to commit.[29] To incentivize agrivoltaics, a significant percentage of the total points are available for projects that avoid the most productive agricultural soils or, where proposed on the most productive agricultural soils, include agrivoltaic practices in their development plan.

In addition, developers that receive a REC contract from NYSERDA must pay an acreage-based mitigation fee for impacts to New York's most productive agricultural soils (i.e., soils identified by the New York State Department of Agriculture and Markets [NYSAGM] as MSGs 1 through 4).[30] Solar developers that propose and implement agrivoltaics can have this mitigation fee waived by NYSERDA. Projects are selected by NYSERDA based on price (70%) and other factors (30%). A winning bid, therefore, must be competitively priced and successfully garner points for avoiding important farmland or other characteristics.[31]

Potential Future Incentives

The NYS agricultural assessment program allows for property tax exemptions on lands that produce agricultural commodities with gross sales that total $10,000 or more annually for at least two years. Currently, local assessors can choose to maintain an agricultural assessment for a solar project if it continues to meet the gross sales threshold outlined above using agrivoltaics. Future legislation should ensure that the agricultural assessment program remains accessible to any producer meeting the state's gross sales targets, regardless of whether solar development is present or proposed within the same parcel(s) of land. When evaluating agrivoltaic compliance with an agricultural assessment, it is recommended that active agricultural land with solar panels to be treated like non-solar active agricultural land or as if no solar panels existed. Agricultural assessments should also be allowed to be re-implemented when the project is decommissioned, and land is re-converted, regardless of whether it qualified during the project . More information about ACE NY's legislative recommendations regarding agricultural assessment policy and other policy recommendations can be found at: https://www.aceny.org/legislative-actions.

Other potential incentives for agrivoltaics could be offered through Paid Purchase Agreements. Through its Solar Massachusetts Renewable Target program, Massachusetts has enacted a feed-in tariff of $0.06/kilowatt-hour for agrivoltaic projects.[32] Developer experience with this program demonstrates the importance of building flexibility for agrivoltaic operations to evolve over the facility lease duration while staying within the cost parameters necessary to provide affordable electricity to ratepayers.

ACE NY members advocate for the continued promotion of agrivoltaics by NYSERDA through the Smart Solar Siting Scorecard. The Smart Solar Siting Scorecard should encourage agricultural co-utilization but not penalize developers when implementing agrivoltaics is not practicable. Offering incentives for agrivoltaic research and development programs also provides valuable information on the potential costs and benefits of various agrivoltaic practices without exposing developers to significant risks. For instance, an R&D project could test the viability of utilizing wider spacing or high-tilt panel configurations to facilitate annual crop production within the array fence line.

The Model Solar Energy Local Law, developed by NYSERDA, supplies training and guidance to local communities on solar planning and zoning. The latest version of the Model Solar law suggests promoting agrivoltaics through incentive zoning.[33] We anticipate that NYSERDA will supply specific guidance, recommendations, or model language that incentivizes agrivoltaics in the near future. ACE NY recommends updating the Model Solar Energy Law to provide more specific direction on how local governments can incentivize agrivoltaics through zoning and other land use tools. Quality model law language can maintain the flexibility needed to implement agrivoltaics effectively. This is consistent with a recent NYS FPWG recommendation.

Regardless of how incentives are delivered, the two main goals of agrivoltaic incentives should be to safeguard against significant cost increases in efforts to keep electricity prices affordable while promoting agrivoltaic operations that are adaptable to the complexities of agriculture.

Siting and Design Practices

Agrivoltaic principles should be considered early in the development phase and incorporated into the siting and design phases to ensure effective implementation. Planning for agrivoltaics early in the development phase can allow developers to effectively make informed decisions regarding the proposed fencing layout and design, the panel configuration and spacing, the pile height, and the mounting system. Early consideration of agrivoltaics is important for developers when negotiating land leases, establishing a buildable area, developing the project budget and schedule, selecting equipment, and assessing other solar facility design factors that may be directly or indirectly related to agrivoltaics (e.g., stormwater management, facility access, or landscaping elements).

Success with agrivoltaics is contingent on the quality of soil underlying the facility. Sites with active agriculture may be relatively expensive to lease due to their agricultural productivity, increasing a project's perceived agricultural impacts and resulting in additional NYSERDA mitigation payments if projects are sited on MSGs 1 through 4. Sometimes solar projects are sited on less productive or abandoned agricultural land with successional vegetation communities (e.g., shrubs eventually leading to young forests), hindering the potential success of agrivoltaics.

Agrivoltaic developers and participating landowners must coordinate carefully to balance costs and benefits, particularly as solar leases are often much longer than the timeline of farming plans. Another factor that must be considered is site access and site safety. Large- and small-scale commercial solar facilities are subject to numerous safety and environmental regulations, and ORES is currently responsible for permitting any change to vegetation throughout the process. The site access, stormwater, and safety regulations may dictate site design elements that do not meet agricultural needs. Advance coordination between developers and potential farmers to identify and mitigate any potential issues (e.g., coordinating maintenance schedules with grazing rotations and liability insurance requirements) will help ensure the successful implementation of agrivoltaics.

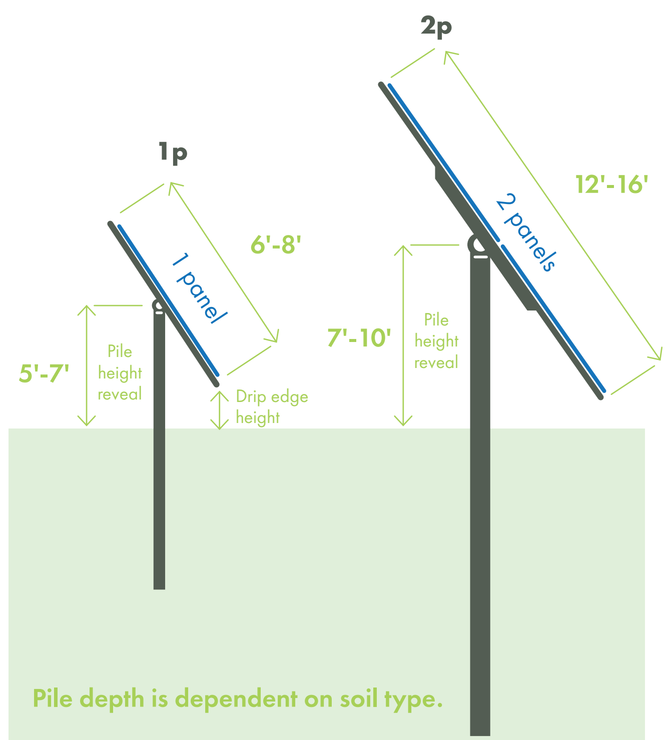
This section examines how various decisions during the siting and design phase can impact the implementation of agrivoltaics.

Panel Configuration

The configuration of panels can impact panel spacing, slope tolerances, grading requirements, and panel/pile height. All these factors have the potential to affect the implementation of agrivoltaics. The two most common panel configurations for utility-scale projects are one-in-portrait (1p) and two-in-portrait (2p). In a facility using a 1p configuration, the array is shorter at its maximum tilt angle compared to a 2p system. This reduces the maximum array height and the length of the piles needed to support the racking system. Depending on site conditions, these systems can be less expensive to install, and the lower panel height can reduce visual impacts and associated impacts on community character. However, pile height above the ground (known as the pile reveal height) and the drip edge height can challenge certain agrivoltaic practices because it brings the aboveground electrical infrastructure closer to the ground. Cable structures closer to the ground along with the height of the bottom edge of panel can impair livestock movement or conflict with farming practices. In comparison, depending on tilt, 2p systems can have a greater maximum panel height, which brings electrical infrastructure out of the range of grazing livestock.

Since the intra-row panel density of a 2p system is twice that of a 1p system, photovoltaic (PV) panel rows in a 2p system are much shorter. These shorter rows allow 2p systems to conform to the topography, reducing grading and soil disturbance requirements during construction. This reduction in soil disturbance benefits agrivoltaics by reducing impacts on soil quality. To accommodate the taller maximum panel height, 2p systems require wider spacing between rows to minimize shading production losses. The wider spacing provides additional room to grow crops between the PV rows, resulting in fewer constraints for

| Typical 1p and 2p Solar Configurations



farm equipment moving through the facility. The configuration choice must be carefully considered to support the desired type of agrivoltaics.

Panel Type

Although opaque bi-facial panels are the most commonly installed panel type, semi-transparent panels are an evolving technology that is not currently intended to be deployed at a utility-scale but may become a viable option over time. Semi-transparent panels are currently being used in greenhouse roofs in places like California, where they produce energy for the greenhouse while still maximizing crop productivity.[34] While this technology is not yet cost-effective for large-scale projects in NY, agrivoltaic practices involving row crop production may become more viable if future costs decrease for semi-transparent panels. Currently, crops can be grown cost-effectively underneath small-scale facilities in certain conditions, as discussed in other sections.

Mounting System

The type of mounting system (i.e., fixed-tilt or tracking) provides different benefits and trade-offs for agrivoltaic opportunities. From an energy generation perspective, fixed-tilt systems cannot match the capacity factor of tracking systems. However, fixed-tilt systems can be sited in areas outside the design requirements of tracking systems (e.g., high slopes), and as such, fixed-tilt systems require substantially less grading

Opaque bi-facial panels in Massachusetts.

and soil disturbance. The design flexibility minimizes impacts on soil quality and existing vegetation, simplifying some aspects of agrivoltaic implementation.

Tracking systems are designed to follow the sunlight throughout the day, maximizing power production. However, tracking systems typically require more earthwork, as the torque tube that moves the panels must be level along the length of the panel row. Where facilities are sited on flatter ground, tracking systems can require minimal earthwork and provide opportunities to implement more intensive agrivoltaic practices such as crop production.

Tracking systems can also be managed to adjust panels to tabletop positions paired with rotational grazing to accommodate larger livestock under the panels or tilted vertically at regular intervals to allow for increased sun available to crops. This approach reduces solar production and adds additional management complexities; however, it can build agrivoltaics into a facility without changing the piling or other site components. Doing so reduces the facility's overall cost and carbon footprint. This technology is in the early stages of development, so additional information is needed to verify the feasibility of these practices in New York. Additionally, novel mounting technology can rotate panels vertically or nearly vertically, allowing farm machinery to access space between piles if the panel spacing is adequate.

Both mounting systems can accommodate livestock agrivoltaic systems. Panels, whether fixed tilt or with tracking systems, provide shade that offers livestock relief from heat stress. The cost-effectiveness of each mounting system is site-specific, depending on the need for topographic flexibility or a higher project power density.

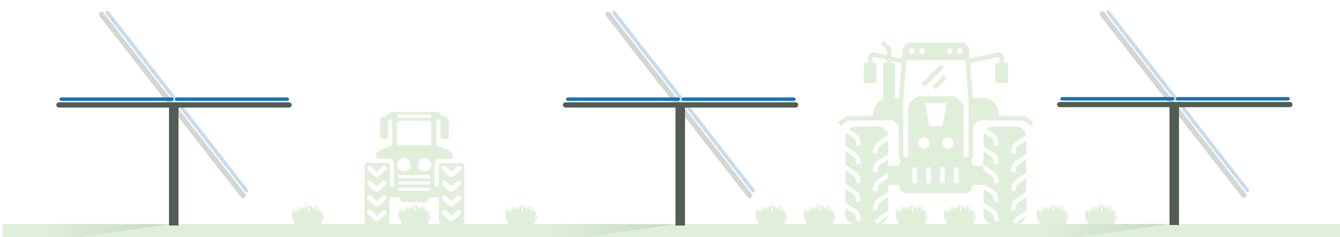
Fixed-tilt panels in Massachusetts.

Mounting Height

The mounting height of solar panels affects what types of agrivoltaic activities can occur beneath and potentially between the panels. Traditional non-agrivoltaic facilities minimize mounting heights to the extent possible to reduce materials costs associated with the racking system. Materials costs related to the racking system, like the price of steel, have constrained potential agrivoltaic designs. Additionally, mounting heights are minimized to limit the visibility of solar facilities. Consequently, large-scale agrivoltaic systems that are the farthest along in development are set up

Balancing Power Density and Agrivoltaics

Traditional solar projects minimize row spacing to increase power density or overall ground coverage ratio (GCR). This leaves space for only a few agrivoltaic activities, like sheep or crops managed with small equipment.



Some agrivoltaic solar projects increase row spacing to accommodate equipment. This decreases power density or overall GCR but allows for a wider range of agrivoltaic activities, like crops managed with large equipment.

to minimize the height of solar facilities. For example, large-scale agrivoltaic grazing systems have traditionally focused on sheep grazing, as sheep can be accommodated at standard mounting heights.

In some cases, taller mounting heights have been utilized for small-scale solar projects that planted crops underneath or between the panels. These projects found some benefits to agricultural productivity that could also be attributed to the type of panels.[35] However, scaling these taller heights to utility-sized facilities is cost-prohibitive with current market forces and procurement goals. In addition to the mounting height, the height of the bottom edge of panel at maximum tilt (i.e., drip edge height) is an important consideration when determining the best agricultural uses below the panels. More on this is demonstrated in the Panel Configuration section.

Panel Spacing

Various factors, including panel configuration, mounting type, and mounting height, passively influence panel spacing. Panel spacing can also be actively manipulated to facilitate agrivoltaics. Widely spaced panels, paired with vertical mounting where the panels can tilt horizontally when needed, can accommodate farm equipment and facilitate more conventional agricultural practices between panel rows.

However, if sufficient space between rows is left to accommodate crop production, the overall ground coverage ratio or power density of the facility will be significantly reduced, increasing the area the developer must lease and the amount of agricultural land likely to be impacted by the project. It is possible that crop production on the co-utilized farmland would effectively mitigate these impacts and offset cost increases through farm profits (and reduced land or lease costs). Additional information is needed to verify the feasibility of these practices.

Adjacent Agricultural Lands

Often solar panels only occupy part of leased fields. Agricultural lands outside the fence line can be usable and productive for continued agricultural use while the solar facility is operational. Opportunities to utilize these undeveloped sections of farmland may be limited by their shape and available access. However, careful siting and design during the development phase can identify opportunities to continue agricultural production in these areas outside of the fence line surrounding the facility. Where conventional agriculture is not possible, alternative cropping systems can utilize irregular portions of land (e.g., orchards or berry patches). These alternative systems, particularly when paired with planned pollinator habitat, may offer innovative agricultural co-utilization opportunities for developers and farmers.

Adjacent or agrivoltaic agriculture benefits from pollinator habitats and co-locating commercial-scale apiaries on solar facilities. Pollinator habitat can improve soil health, reduce stormwater runoff, minimize the spread of invasive species, and contribute to a more stable bee population, benefiting all farms in the surrounding area.[36] However, it is important to note that pollinator habitat alone does not meet the definition of agrivoltaics. Pollinator habitat must be paired with agricultural operations that reach monetary production thresholds established by the NYSAGM to be classified as agriculture and meet the definition of agrivoltaics.

Planning for the Use of Adjacent Agricultural Lands

Key Takeaways

Best practices for siting and designing agrivoltaics are still developing and advancing. Costs to incorporate agrivoltaic practices can be high, depending on the practices selected, and there are currently few incentive programs to offset such costs. Furthermore, agricultural landowners are often required to change their farming practices. With farming already operating at marginal profits, many agricultural landowners are unwilling to take on this additional risk. Agrivoltaics presents liability considerations for developers too, with added emergency response and dual-use considerations. The following is a list of conventional and emerging agrivoltaic siting and development practices based on insights provided by developers during the process of creating this report:

Conventional Practices

These practices are relatively implementable compared to emerging practices and have been utilized at existing facilities. Feasibility needs to be considered on a project-by-project basis.

- Minor modifications to the siting and design of a project to accommodate apiculture or sheep grazing
- Small increases in the pile, panel, or cable structure heights minimize obstructions to livestock
- Utilization of 2p panel configurations to minimize grading and soil disturbance
- Designing security fences and access gates, simplifying grazing rotations and livestock access across the facility area
- Including pollinating species in permanent seed mixes and designing seed mixes in coordination with a grazier (i.e., a livestock manager)
- Providing access and laydown areas for apiaries

Emerging Practices

These practices may become more popular as technology and incentives for agrivoltaic systems advance but are cost-prohibitive or are implementable only where certain unique conditions exist.

- Research on practices that today would require increased pile reveal height, reinforced infrastructure, or other modifications to conventional designs to allow grazing by traditional cattle breeds or improved access and growing conditions for cultivating vegetable crops or other high-dollar commodities
- Research on cost-effective semi-transparent panels and cleaning systems that allow for improved crop growth underneath the panels
- Widely spaced panel rows with 2p, tracking panels with near vertical tilt or table-top capabilities that provide access to more traditional farm equipment and larger livestock and allow the implementation of more traditional agricultural practices between the rows
- Water irrigation system for agrivoltaic crops that diverts and distributes rainwater using a sprinkler system connected to the solar facility.[37]
- Internal fences ready for rotational grazing and water wells with piping to troughs strategically placed within animal enclosures (i.e., paddocks).

Construction Practices

Currently all solar projects that receive a NYSERDA contract must follow the NYSAGM Guidelines regardless of whether a facility incorporates agrivoltaics. These measures are intended to preserve topsoil and reduce compaction so the land can return to productive agricultural use post-construction. This is primarily achieved by avoiding and minimizing the long-term impacts on topsoil. Soil restoration activities are often more extensive for single axis tracking facilities, as these projects typically require more grading when compared to facilities that use fixed racking systems. Opportunities to improve the NYSAGM Guidelines and other mitigation practices are actively being researched and developed.[38]

Another way to minimize agricultural impacts and facilitate agrivoltaic practices is by protecting existing agricultural infrastructure, such as drain tiles, which move water out of farmland to improve crop production. Functioning drainage systems can be a key part of maintaining agricultural production in some parts of the state. Installing solar facilities requires careful planning to prevent detrimental impacts on these systems. Underground drain tile systems are often unmapped and sometimes can only be found during construction. Regardless of how drainage infrastructure information is found, maintaining and restoring these systems post-construction in compliance with the NYSAGM Guidelines is necessary to ensure agrivoltaics can be successfully implemented at a solar project.

In addition to minimizing impacts during construction and protecting existing infrastructure, properly installing new infrastructure and restoring the site are important

Image Credit: Adobe

factors that need to be considered. Considerations may include installing new water sources (e.g., wells), selecting and constructing proper fencing to support livestock, or planting and managing vegetation in agrivoltaic facilities. Fencing is especially relevant for agrivoltaics facilities designed for livestock grazing.[39] The quality of the installation during the construction phase and the choice of fencing type, location, and crossing methods can substantively affect the success of a livestock grazing operation during construction. Fences must be installed to match the topography and otherwise minimize opportunities for predator encroachment. Fence line crossings near or across wetlands and streams must be designed and installed to maintain water quality and existing hydrology while limiting predator or livestock opportunities to breach the fence line.

Vegetation management practices during construction and restoration can vary based on the type of agrivoltaics proposed. For example, in an agrivoltaic facility designed to support apiculture (i.e., beekeeping), selected seed mixes should support pollinating species. In an agrivoltaic facility designed for livestock grazing, plantings and seed mixes should be designed in coordination with a grazier (i.e., a livestock manager) to ensure the needs of the grazing livestock are met. With all forms of agrivoltaics, and for crop production in particular, a vegetation management plan must be developed before construction and followed throughout construction and restoration to ensure the site is stabilized, the success of desirable species is maximized, and nuisance and invasive plant species are controlled.

In all cases, establishing desirable species should occur as early as possible. Where projects are sited on annual cropland, temporary seed mixes composed of sterile species (e.g., yearly ryegrass) are often installed before or during construction to achieve short-term stabilization. Typically, permanent seed mixes are installed during the restoration. However, in some cases, installing permanent seedings before the start of construction or early in the construction phase may be an effective choice. The perennial species utilized for ground cover under PV arrays have a more robust root system. The success of these plantings can be impacted by gaps occurring between the stormwater permitting process and the construction phase, along with unexpected drain tile considerations, construction activity, or invasive species. Although the success of permanent seed mixes may be compromised in some areas by construction activities, the entire site will not need to be completely reseeded, as is the case with temporary seedings. Using permanent seed mixes can minimize reseeding costs and shorten stabilization schedules during restoration.

Key Takeaways

The NYSAGM Guidelines were designed to protect topsoil and ensure the land can be returned to farming following decommissioning. Maintaining soil quality and quickly reestablishing desirable vegetation are important keys to successfully implementing agrivoltaic practices. The following is a list of conventional and emerging agrivoltaic construction practices based on solar developers' contributions and insights during this report's creation.

Conventional Practices

These practices are relatively implementable compared to emerging practices and have been utilized at existing facilities. Feasibility needs to be considered on a project-by-project basis.

- Follow NYSAGM Guidelines during construction and restoration.
- Protect existing agricultural infrastructure (e.g., drain tiles), and repair damaged infrastructure during construction.
- Install stabilizing seed mixes before construction in annual cropland and install permanent seed mixes as soon as practical.
- Design seed mixes to match the proposed agrivoltaic practices; work with farmers, graziers (i.e., livestock managers), or other agriculturalists who know local growing conditions.
- Construct fences to minimize opportunities for predator entry.

Emerging Practices

These practices could increase as knowledge of agrivoltaics advances, but are currently cost-prohibitive or implementable only where certain unique conditions exist.

- Establishing permanent seed mixes in annual row cropland before construction to stabilize the site and minimize restoration timelines.
- Burying inter-row cabling and racking systems that maintain a clear path between rows of panels for access by farming machinery. Note that the facility design and development process can greatly impact feasibility.

Case Study: Sheep Grazing + Solar

Vegetation management under and around solar panels is required to minimize panel shading and prevent the establishment of woody species. However, vegetation management can be labor intensive, representing a substantial long-term cost for solar facility operators. Sheep grazing is a vegetation management technique that provides an agricultural commodity, does not require extensive heavy equipment operation, reduces fossil fuel and direct human labor costs, and diversifies the economic benefits. According to a Cornell University report, solar developers find that grazing is more inexpensive than traditional vegetation management and could save up to $300 per acre annually for solar site operators.[40] Sheep are generally preferable in comparison to other livestock species for agrivoltaic solar facilities because their size allows them to access the areas underneath the panels easily, and they do not attempt to climb on solar panels or infrastructure, chew on cable systems, or scratch themselves on the racking systems or solar panels.[41] In addition, unlike cattle, sheep actively graze forb (i.e., non-grass) and shrub species and can be used to control invasive species. At EDF Renewables' Arnprior solar site in southern Ontario, sheep management has saved EDF Renewables 35% on weed abatement costs.

Integrating sheep grazing begins early in the development phase with consultations between the solar developer, the project landowners, and potential grazing managers. One useful resource for planning solar grazing is the American Solar Grazing Association website, which hosts an interactive map connecting solar operators with sheep farmers by providing contact information for different grazing operations that may be looking to partner with agrivoltaic facilities.[42]

EDF Renewables is planning New York State's first large-scale agrivoltaic facility incorporating sheep grazing: the Morris Ridge Solar Energy Center. Construction on this project has started and is scheduled to become operational in 2024. The Morris Ridge Solar Energy Center developed a preliminary Agricultural Integration and Grazing Plan for the project during permitting and has designed the facility to integrate managed sheep grazing.[43] The project's publicly filed preliminary plan and future final agrivoltaic plan(s) serve as tools for other facilities to understand how to integrate a managed sheep grazing system in a utility-scale solar power generating facility.

The lamb industry in the U.S. is nascent, leading to challenges in having access to enough sheep to make the practice viable. Solar developers aspire to increase the growth of US lamb and mutton markets through agrivoltaics, decreasing current dependence on Australian and New Zealand supply.[44] More project information is available at: https://www.edf-re.com/project/morris-ridge-solar-project/ and in the Mount Morris Agrivoltaics Study, available at: https://www.agrisolarclearinghouse.org/mount-morris-agrivoltaics-study-co-locating-solar-and-agriculture-at-the-morris-ridge-solar-energy-center-2/.

Project Details

Location:
Town of Mount Morris, Livingston County, NY

Size:
Approximately 1,000 acres

Generation Capacity:
177 MW

Sheep grazing in the Minnesota.
Image Credit: Heidi Kolbeck-Urlacher and Center for Rural Affairs, 2021

Case Study: Crops + Solar

Lightstar Renewables, a Boston-based community solar developer, is partnering with American Farmland Trust (AFT) to promote and implement agrivoltaics on community solar projects in New York and other states. Under the partnership, Lightstar will utilize AFT's Smart Solar principles to guide policy, research, and farmer engagement initiatives to accelerate agriculturally compatible solar energy development and promote sustainable farming and ranching practices.

Lightstar Renewables, LLC (Lightstar) is a solar developer that has a pipeline of 1,000MW across the country, at least 300MW of which will be agrivoltaic projects. Lightstar develops, builds, and operates distributed generation community solar projects that range in size from 10 MW to 1MW. The company offers farmers the opportunity to keep farming under solar arrays by designing facilities for dual use which allows for crops and livestock grazing. Lightstar also creates pollinator habitats by planting pollinator mixes, native shrubs, and deep-root grass mixes to promote carbon sequestration and robust food production. Projects typically implement taller solar panel racking systems that allow room for cultivating crops with wider spacing between the rows of solar panels and build crop rotation and regenerative agriculture into the project's design.

Lightstar currently has at least two projects in New York State that implement or will implement agrivoltaic solar (i.e., grazing or crops). One of those projects, the Old Myers Project, is in Wappingers Falls near Poughkeepsie in Dutchess County. This site spans 15 acres and is expected to produce around 2 MW. Old Myers has been permitted and is expected to start construction in the Fall of 2023. The project will pay stipends to the farmers leasing their property for solar power production. The racking is 7.5 feet high with a maximum tilt height of 14 feet. The system tracks from east to west throughout the day, allowing for a balanced distribution of sunlight. The spacing and angle of the panels allow light to reach the plants below and provide shade for crops, improving productivity. Compaction and grading will be avoided and minimized during construction and throughout project operations to protect soil health and productivity. Lightstar will work with AFT and other research institutions to assess the best methods for establishing soil health baseline conditions for monitoring during project operations.

The Old Myers project will harvest strawberries, tomatoes, peppers, and lavender, among other crops, resulting in arguably the most diversified cropping plan for a megawatt-scale agrivoltaics project in the Northeast. The project will be designed to sustain farming activity, create long-term farm income, and enhance food security for the local community by selling produce directly to local markets and consumers while generating solar energy to make the local grid cleaner and more reliable. More project information is available at: https://www.lightstar.com.

Project Details

Location:
Village of Wappingers Falls, Town of Poughkeepsie, Dutchess County, NY

Size:
15 acres

Generation Capacity:
2 MW

Proposed Solar Facility in Maryland.
Image Credit: Lightstar, 2023

Case Study: Dairy + Solar

New York State has more than 500 dairy farms, each with more than 300 cows. These farms are required to develop a management plan to handle manure properly. Manure has traditionally been spread over agricultural fields to enhance soil nutrients and improve crop production. Another method for distributing manure in agricultural fields is through injection at or below the soil surface.

The long-term practice of spreading manure on agricultural fields provides numerous benefits to dairy farmers and can make a difference in helping sustain small and large dairy farms. Injecting manure directly into the ground addresses some of the common challenges of manure management by reducing odors, nitrogen emissions, phosphorus runoff, and air particulate matter. This reduction in airborne debris can in turn improve solar efficiencies by reducing panel soiling. Manure injection also reduces the need to till the soil, which preserves more organic matter in the soil structure. Equipment cost and operational time are key challenges associated with manure injection.[45]

Boralex, at its Greens Corners Solar Project, is piloting manure injection as an agrivoltaic practice. At Greens Corners, Boralex has proposed a comprehensive Agricultural Multi-Use Plan, which includes a manure injection plan among other things. Solar farms provide large acreage that can be used for manure dispersion throughout the operation of the facility. Solar developers that lease lands from local dairy farmers help provide an alternative source of income for family-run operations in the challenging dairy business. Injecting manure between the arrays can improve soil fertility and quality,

thereby supporting the growth of desirable stabilizing vegetation. Boralex and the farm operation intend to maintain a crop between rows of solar panels that can be harvested to feed dairy cows, such as haylage (i.e., hay baled at a higher moisture content than dry hay and stored in a sealed plastic wrap). Because of the high moisture level and air-tight environment, the hay ferments and is preserved by acid production during fermentation.[46] Manure injection combined with haylage is one potential strategy to co-locate agricultural activities at Greens Corners.[47]
More project information is available at: https://www.boralex.com/projects/greens-corners/

Project Details

Location:
Towns of Watertown and Hounsfield, Jefferson County, NY

Size:
1,177acres

Generation Capacity:
120 MW

Image Credit: Adobe

Operations and Maintenance Practices

All solar power projects, including those that incorporate agrivoltaic systems, require regular operation and maintenance (O&M) to ensure they operate optimally and reliably. Needs include managing vegetation to prevent shading of the panels, maintaining and replacing solar panels, motors, and electrical components, and general maintenance, monitoring, and data analysis. However, integrating agrivoltaic practices into O&M adds another level of complexity. Additional attention is required for vegetation management, site access security, infrastructure (e.g., irrigation systems), insurance, and the logistical needs of solar facility staff and farmers.

Vegetation management costs for solar facilities can be a substantive portion of the operational budget. Mechanical mowing is the primary form of vegetation management for non-agrivoltaic facilities. In agrivoltaic facilities, multiple vegetation management techniques can apply (e.g., livestock grazing, strategic mowing, and crop harvesting), and the design of the facility can directly impact the types of vegetation management practices that are possible during operations.

Categorizing a site as an agrivoltaic facility during operations and maintenance is not always clear. For instance, smaller undeveloped portions of farmland located outside the fence line can be used for crop production or apiaries if partnering farmers are interested and able to access and harvest these areas cost-effectively. This can happen regardless of whether agricultural practices occur within the facility's fence line (i.e., under solar panels). As farmland outside the security fence may be advantageous to both the farmer and the developer (e.g., to ensure these areas do not transition to young forests over the facility's life), implementing agrivoltaics into facilities with these surrounding agricultural areas can achieve multiple goals for the project and the community.

Another O&M consideration for agrivoltaic facilities is the duration of typical agricultural contracts compared to solar lease agreements. Solar leases typically have a 20- to 30-year term, whereas typical agricultural business plans may be built with a five-year term or less. In setting up agrivoltaic contracts, considering these disparate timelines may be important to ensure coverage over the facility's lifespan. Other O&M best practices vary based on the type of agrivoltaics. This section provides an overview of suggested O&M best practices associated with various types of agrivoltaics.

Apiaries

Commercial apiaries require minimal vegetation management to maintain quality pollinator habitats. Although annual fall or early winter mowing of native pollinating species is optimal, depending on the height of the established species and regulatory requirements, more frequent mowing may be required to avoid shading of the panels or non-compliance with permit conditions. Appropriate seed mixes should be considered during the siting and design phase and installed during restoration to minimize the potential for panel shading. Where limits on vegetation height or maintenance schedules are imposed by permitting authorities, low-height pollinating species should be installed to minimize maintenance requirements and maximize the establishment and proliferation of pollinating species. Hives should be located away from inverters to limit bee interactions with equipment. Hive entry points should located in a way that limits health and safety risks for O&M staff and neighboring residents.

Livestock Grazing

Agrivoltaic practices that involve livestock grazing provide their own vegetation management, potentially building in cost efficiencies for O&M. To ensure vegetation management is conducted effectively using livestock, a rotational grazing plan should be developed during the siting and design phase or before integration of the livestock during operation. Vegetation growth rates need to be carefully monitored throughout the growing season. Site access and logistics must be considered to ensure no conflicts arise between the facility staff, livestock, and their grazers (i.e., livestock managers). Livestock requires essential

Solar grown honey from Biosphere 2 in Arizona.

resources like water and necessary supplements. Temporary and permanent fence maintenance may need to occur at least annually to prevent predator access. Pastures may need to be reseeded and fertilized occasionally to maintain a palatable food source for the livestock. Undesirable or unconsumed vegetation may need to be controlled to maximize grazing potential. Seed mixes should be selected based on their nutrient capabilities for specific livestock. Permit conditions should accommodate changes in seed mixes used if better options arise.

Sheep are currently the most viable grazers because their behaviors do not interfere with solar operations. While there may be a shortage of sheep grazing managers if the practice increases significantly in the coming years, this is likely to change as the supply of lamb localizes, potentially with the help of New York's solar developers. Nearly half of the U.S. lamb and mutton supply is imported from other countries, primarily Australia and New Zealand.[48]

Low-line cattle—a shorter, smaller breed of cattle developed in Australia—are also currently being studied for use in solar facilities with appropriate substructures designed to accommodate them. These cattle are approximately 40% shorter than typical beef cattle breeds, more productive in meat and dairy per unit of food or land, and their smaller size minimizes their impact on solar infrastructure. However, the smaller size of this cattle breed and limited availability in NY makes commercial processing more difficult, which will change if the breed gains local popularity. Regardless of the livestock breed, regular monitoring of the panels and associated infrastructure (e.g., cable management systems) is needed to ensure safety.

Haying and Grain Crops

Haying and annual crop operations require heavy equipment for harvesting. For haying operations, communities may have concerns with the aesthetics as these facilities may appear overgrown. However, these concerns can be mitigated by communicating the intentions of the facility with the community. With annual crop operations, soil disturbance due to plowing and planting may need to be evaluated in application materials (e.g., the stormwater pollution prevention plan) and permitting agencies should work with developers to allow these activities without jeopardizing getting/maintaining permit conditions. The design of these facilities will need to consider these agrivoltaic practices to prevent panel shading and the interruption of facility operations due to agricultural practices.

Fruits and Vegetables

Fruit and vegetable production is among the most labor-intensive farming practices, requiring people or machinery to access the area underneath panels to plant, manage, or harvest the plants growing underneath the solar panels. This requires higher piling, special tracking technology to allow panels to rotate enough for tractors to access between rows, or translucent solar panels that may require additional cleaning to maintain cost-effectiveness (as discussed in the siting/design section). This results in added expenses for agrivoltaic practices compared to non-agrivoltaic practices.

On a small scale, fruits and vegetables can be cost-effective, as evidenced by Jack's Solar Garden, a commercially active 1.2 MW community/research solar facility near Boulder, Colorado. The facility has a design only 1' higher off the ground than typical New York facilities (i.e., the leading edge of panels is about 4' off the ground versus 3' off the ground at max tilt and spacing optimized for maximized energy production). The facility successfully grows a robust array of vegetables, like lettuce, mushrooms, kale, tomatoes, etc. Another benefit is that the farmers spend time in the shade, which is better than being in the open sun all day. Crop production has also improved by the partial shade at this facility and at others like it.[49] While fruit and vegetable agrivoltaic practices are typically only economically viable for solar facilities with significant external support (e.g., at research facilities), this is changing as research and awareness build.

Key Takeaways

Best practices for agrivoltaics during O&M are still developing. Costs to operate and maintain agrivoltaic practices can be high, depending on the practices selected and the labor available, and there are currently few incentive programs to offset such costs. The following is a list of conventional and emerging agrivoltaic O&M practices based on developers' insights provided while creating this report. Feasibility needs to be considered on a project-by-project basis.

Conventional Practices

These practices are relatively implementable compared to emerging practices and have been utilized at existing facilities.

- Incorporate appropriate low-height species to reduce mowing needs for specific operations.
- Utilize sheep grazing to manage vegetation during operations.
- Monitor changes in available seed mixes used if better options arise.
- Coordinate closely between solar facilities operations staff and farmers to manage maintenance and operational safety.
- Communicate the intentions of agrivoltaic facilities with the community to ensure awareness about planting and harvesting needs.
- Pair research programs with fruit or vegetable crop approaches for agrivoltaic facilities.

Emerging Practices

These practices could increase as agrivoltaics advance, but are currently implementable only where certain unique conditions exist.

- Develop management solutions for low-line cattle (including meat processing facilities).
- Continue to partner with innovative farmers that present innovative and viable agricultural opportunities for agrivoltaic production.
- Implement cost-effective cleaning solutions for semi-translucent panels.
- Account for novel ecosystems that develop throughout the facility's lifetime (e.g., wetlands may develop in and around installed surface water sources).

Decommissioning Practices

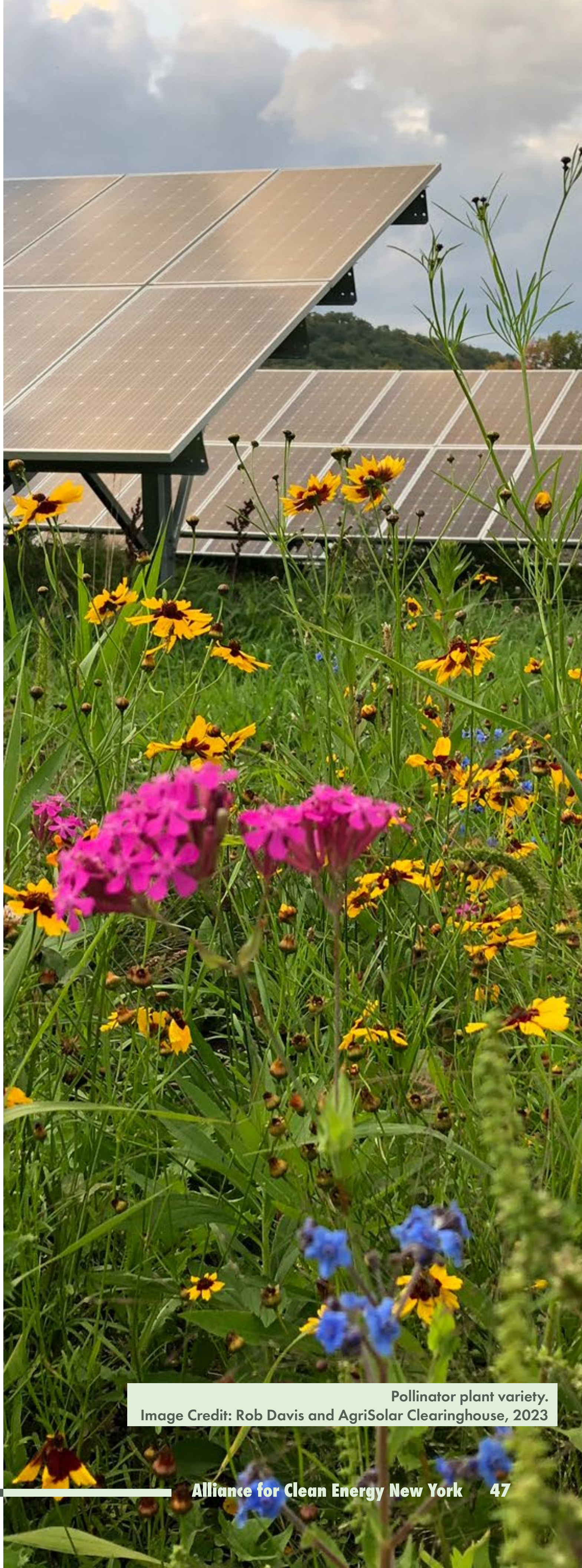
Decommissioning is the process of uninstalling all equipment, removing all infrastructure associated with a facility, and restoring the site to pre-construction conditions to the extent practicable. Whether the facility uses agrivoltaics or not, decommissioning can be disruptive if not done carefully. All large-scale solar facilities in New York must follow the decommissioning requirements outlined in the NYSAGM Guidelines. These requirements include the following:

- Removing all aboveground and below-ground infrastructure less than 48 inches below the ground surface.
- Sealing or capping conduits more than 48 inches below the ground surface.
- Removing all roads unless otherwise specified by the landowner.
- Restoring soil quality in Mineral Soil Groups 1-4 in areas planned to be used for agriculture.
- Following specific permit conditions to restore or maintain agricultural productivity post-decommissioning.

NYSERDA has more information about decommissioning plans, including guidance language on financial mechanisms to pay for decommissioning.[50] Like non-agrivoltaic facilities, the priority during decommissioning an agrivoltaic facility is preserving farmland quality and associated infrastructure (e.g., drainage tiles). Other considerations include removing all agrivoltaic-related infrastructure (e.g., livestock watering facilities) unless otherwise specified by the landowner, removing planting that does not comport with intended continuing agricultural uses (e.g., fruit trees), and stabilizing the site. Further research, coordination with the landowner, and regulatory guidance are needed to inform decisions about decommissioning these resources.

Key Takeaways

Best practices for agrivoltaics decommissioning are far away from development since there are few agrivoltaic facilities in New York State. It will be important to coordinate closely with the landowner and farmer upon decommissioning to understand the future desired uses of the facility's underlying land and whether keeping some of the solar infrastructure may benefit future farming practices. For example, it may benefit the farmer to keep some of the roads for ease of access of farm equipment into the field or some of the fences if grazing activities may continue on-site. While certain decommissioning commitments need to be made at the permitting stage of a project to meet NYS regulations and guidelines, the exact scope of decommissioning will not be known until closer to the end of the project, depending on the intended farming to take place at that time.



Pollinator plant variety.
Image Credit: Rob Davis and AgriSolar Clearinghouse, 2023

Permitting Trends - Section 94-c

All large-scale solar facilities (25 MW or larger) in New York State are permitted through Section 94-c of the New York State Executive Law. Projects 20 to 25 MW can opt-in to 94-c. As of June 2023, a total of 13 projects have received Final Siting Permits from ORES, and of these 13 projects, seven included an agricultural co-utilization plan. Sheep grazing, as shown by the following table, is the most common practice, followed by beekeeping/ apiaries.

ORES has not established any set thresholds or standards for agrivoltaics beyond the general requirements in Section 94-c Siting Permit conditions. According to the Document and Matter Management system, of the 13 issued permits, seven prepared an agricultural co-utilization plan as a Site-Specific Condition. Generally, developers may propose, or ORES may require, an agricultural co-utilization plan for projects that have substantive impacts to farmland generally or MSGs 1 through 4 specifically. Although developers remain uncertain about which projects may be required to develop a co-utilization plan—thresholds and definitions for "substantive impacts" have not yet been defined —the approach taken by ORES to date provides developers the flexibility needed to design a site-specific co-utilization plan that matches the capabilities of an individual project.

As the viability of specific agrivoltaic practices can evolve significantly over a facility's lifetime, Section 94-c Siting Permit conditions should remain flexible. Changing market dynamics, incentive programs, crop values, and technology yet to be developed can significantly affect the economics of various practices. For further discussion of incentive programs, see earlier discussions in this report. Facility operators and contracted agricultural producers need the flexibility to respond to these changes to maintain a viable agrivoltaic business model. Additionally, business relationships and farm ownership change over time, and permit conditions should account for these changes.

Another regulatory consideration for agrivoltaics is balancing mitigation for agricultural impacts against potential impacts to other resources. Agrivoltaic practices that potentially involve soil disturbance (e.g., annual row crop production and sheep grazing, in some cases) need to be sited carefully to avoid conflicts with wetland and water resources and minimize erosion, sedimentation, and stormwater runoff. ACE NY members encourage state agencies, like the NYS Department of Environmental Conservation, to accommodate agrivoltaics facilities that incorporate traditional farming practices on current or historic farmland. For State Pollutant Discharge Elimination System permit program requirements, these facilities should be treated like any other agricultural operation.


Grazed solar site in Massachusetts.

Permitting Trends for Large-Scale Solar Facilities (Over 25 MW) with Agrivoltaics

Project	Location	Date of NYSERDA Award
Morris Ridge Solar EDF (filed on January 12, 2021)	Town of Mount Morris Livingston County	2018
Horseshoe Solar Invenergy (filed on December 23, 2021)	Towns of Caledonia and Rush Livingston, and Monroe Counties	2018
Shepard's Run Solar Hecate (filed on March 8, 2022)*	Town of Copake Columbia County	2017
Moraine Solar EDF (filed on March 15, 2022)	Town of Burns, Allegany County	2020
Greens Corners Solar Boralex (filed on June 11, 2021)	Towns of Hounsfield and Watertown Jefferson County	2019
Cider Solar Hecate (filed on September 3, 2021)**	Towns of Oakfield and Elba Genesee County	2020
Hemlock Ridge Solar AES (filed on January 12, 2021)**	Towns of Barre and Shelby Orleans County	2020

* = Incomplete application, **= Co-Utilization Plans will be required for these projects and are currently in development. Note: Although pollinator-friendly plantings are listed in the co-utilization plans for some of these facilities, this practice does not fit the definition of "agrivoltaics" according to this report and A-TWG as it needs to meet the definition of "agriculture" set by the NYSAGM. This table represents information available on the NYS Department of Public Service Document and Matter Management (DMM) system as of August 1, 2023.

MSGs 1-4 Impact Listed in Original Permit Application	Portion of Facility Impact to MSGs 1-4	Co-Utilization Plan	Sheep Grazing	Beekeeping / Apiaries	Pollinator Friendly Plantings	Carbon Enhancement and Manure Injection
No	Not specified	Yes	Yes	Yes	Yes	No
No	Not specified	Yes	Yes	Potentially	No	No
Yes	126 ac or 14% Facility Site	Yes	Yes	Yes	Yes	No
Yes	590 ac or 36% Facility Site	Yes	Yes	No	Yes	No
Yes	616 ac or 52% Facility Site	Yes	No	Yes	Yes	Yes
Yes	1,208 ac or 49% Facility Site	Yes	No	No	No	No
Yes	586 ac or 28% Facility Site	Yes	No	No	No	No

Permitting Trends for Large-Scale Solar Facilities (Over 25 MW) without Agrivoltaics

Project	Location	Date of NYSERDA Award	MSGs 1-4 Impact Listed in Original Permit Application	Portion of Facility Impact to MSGs 1-4	Co-Utilization Plan
Homer Solar EDF (filed on March 18, 2022)	Towns of Homer, Cortlandville; Solon, Cortland County	2020	Yes	49 ac or 8% Facility Site	No
Tracy Solar EDF (filed on October 13, 2021)	Towns of Orleans & Clayton; Jefferson County	2020	Yes	4 ac or <1% Facility Site	No
Riverside Solar AES (filed on October 18, 2021)	Towns of Lyme & Brownville; Jefferson County	N/A	Yes	362 ac or 31% Facility Site	No
Bear Ridge Solar Cypress Creek (filed on December 1, 2021)*	Towns of Cambria & Pendleton, Niagara County	2021	Yes	105 ac or 11% Facility Site	No
South Ripley Solar ConnectGen (filed on August 10, 2021)	Town of Ripley; Chautauqua County	2019	Yes	199 ac or 6% Facility Site	No
Watkins Glen Solar NextEra (filed on June 8, 2021)	Towns of Dix & Orange, Schuyler County	2018	No	Not specified	No
Riverhead Solar 2 AES (filed on January 8, 2021)	Town of Riverhead; Suffolk County	N/A	No	Not specified	No
Alfred Oaks Solar Northland Power (filed on April 14, 2023)**	Town of Alfred; Allegany County	2021	Yes	0 ac or 0% Facility Site	No
Brookside Solar AES (filed on February 18, 2022)*	Towns of Burke & Chateaugay; Franklin County	N/A	Yes	0 ac or 0% Facility Site	No

* = Incomplete application, **= Co-Utilization Plans will be required for these projects and are currently in development.
Note: Although pollinator-friendly plantings are listed in the co-utilization plans for some of these facilities, this practice does not fit the definition of "agrivoltaics" according to this report and A-TWG as it needs to meet the definition of "agriculture" set by the NYSAGM. This table represents information available on the NYS Department of Public Service Document and Matter Management (DMM) system as of August 1, 2023.

Solar Facility in Colorado.

Permitting Trends - SEQRA

Most solar facilities permitted through the State Environmental Quality Review Act (SEQRA) process are relatively small (e.g., 5 MW) compared to those typically permitted under Section 94-c, and their energy distribution models can include distributed, community, and utility-scale systems. These projects are typically sited on individual parcels or a small cluster of parcels, brownfield sites, or the rooftops of residences or businesses. Since these projects are permitted through SEQRA, they are heavily influenced by local regulations. While not always the case, local solar laws with restrictive design or technological requirements can hinder the implementation of agrivoltaics.

Recently, during this report's development, there has been an uptick in local laws that include language about agrivoltaics, dual-use, or co-agriculture. With a few exceptions, local laws that mention agrivoltaics were adopted in the last two or three years. This trend corresponds temporally with the recent trend in municipalities passing moratoriums on utility-scale solar projects in the state. Interestingly, several of these moratoriums were resolved when laws supporting agrivoltaics were introduced in their respective communities. Of the laws that include agrivoltaic provisions, only one community (the Town of Montgomery) is known to have agrivoltaic development planned for early 2024.

To improve the predictability of permitting through local regulations, ACE NY recommends updating the NYS Model Solar Energy Law to provide more specific direction on how local governments can promote agrivoltaics through zoning and other means and provide model language for use by municipalities. This is consistent with a recent NYS FPWG recommendation.

Spotlight on Local Communities

The subsections below summarize local laws developed in four towns in New York State that include language regarding agrivoltaics. These examples of local laws are not an exhaustive list.

Town of Ancram, Columbia County

The Town of Ancram Local Law No. 1 of 2021 gives authority to the Planning Board to allow a solar energy system to use the land for energy generation and farming concurrently or dual-use solar. Any information regarding dual-use solar must be submitted to the Planning Board as part of its special use permit application. The law also specifies that a solar system designed for dual use should result in less than 50% shading of the underlying land.

Town of Dunkirk, Chautauqua County

The Town of Dunkirk Local Law No. 4 of 2021[51] specifies that where dual agricultural use is proposed, an O&M plan shall also include an agricultural monitor to ensure that agricultural uses within the project area are active, maintained, and productive.[52] There are two small-scale solar projects that Solar Liberty of Buffalo has proposed in the Town of Dunkirk under this law. They are currently under review.

Town of Mohawk, Montgomery County

The Town of Mohawk Local Law No. 1 of 2023 defines agrivoltaic facilities in the local law and requires a Property Operation and Maintenance Plan describing ongoing site maintenance, anticipated dual use, and property upkeep, such as mowing and trimming.[53] CS Energy developed two 20 MW solar facilities in the Town of Mohawk, however, these were constructed prior to the 2023 agrivoltaic law. These projects are currently owned and operated by MN8 Energy.

Town of Montgomery, Orange County

The Town of Montgomery Local Law No. 11 of 2022 is the most robust of the existing local agrivoltaic laws in New York State.[54] The law specifies that utility-scale solar facilities are not permitted in residential or agricultural zoning districts where solar energy system disturbs more than 30% of land classified as having National Resources Conservation Service (NRCS) Class I or Class II soils[55] unless the system is classified as a dual-use system. For dual-use systems, a farm plan shall be prepared by a qualified agricultural expert deemed acceptable by the Planning Board. This plan shall adequately demonstrate the feasibility of a dual-use system, including the access necessary to provide sufficient water, labor, and equipment. The law describes the total acreage limits of the parent parcel for utility-scale solar energy systems (45%; maximum 20 acres per parcel) and those for dual-use systems (80%; maximum 40 acres per parcel). A parent parcel shall only be subdivided for utility-scale energy systems if such a system is a dual-use system and the Planning Board has evidence to demonstrate the necessity of the subdivision to achieve such a system's agricultural productivity. Dual-use systems also receive extra allowances for clearing trees compared to non-dual-use systems.

The Path Forward

This report provides an overview of agrivoltaics and summary information on current trends. This document reaffirms and complements the National Renewable Energy Laboratory (NREL) Five Cs of Agrivoltaics. These central elements represent six years of research through a project called Innovative Solar Practices Integrated with Rural Economies and Ecosystems (InSPIRE).[56]

Agrivoltaics in New York State is a rapidly evolving field due to new research and development and changing technology, funding mechanisms, and regulatory tools.

- Climate, Soil, and Environmental Conditions — As NREL states, a location's ambient conditions must be appropriate for solar generation and the desired crops or ground cover. Understanding these conditions, as discussed in the development, construction, and operation practices sections of this report is key to implementing effective agrivoltaics.
- Configurations, Solar Technologies, and Designs — The choice of solar technology, the site layout, and other infrastructure can affect everything from how much light reaches the solar panels to whether a tractor can drive under the panels,per NREL guidelines. Site design for agrivoltaic facilities, as described in this document's siting and design section, impacts the productivity of solar and agriculture in agrivoltaic operations.

- Crop Selection and Cultivation Methods, Seed and Vegetation Designs, and Management Approaches— According to NREL, agrivoltaic projects should select crops or ground covers that will thrive under panels in their local climate and are profitable in local markets. Understanding agricultural practices in the varied climates and markets of New York State, as discussed in the operations and maintenance section of this report, is important to implement agrivoltaics successfully.
- Compatibility and Flexibility — Per NREL, agrivoltaics should be designed to accommodate the competing needs of landowners, solar O&M staff, and farmers to allow for efficient agrivoltaic activities. Allowing flexibility of farming operations is key to the success of agrivoltaics in New York State, as discussed in the O&M, incentive structures, and permitting trends sections of this report.
- Collaboration and Partnerships — According to NREL, communication and understanding between stakeholders are crucial for solar projects to succeed. Continued communication and collaboration between developers, farmers, and local communities in New York State will help to develop and strengthen agrivoltaic practices, as described in the section entitled Local Communities + Agrivoltaics.

As the implementation of agrivoltaics continues to evolve and expand in New York State, there is an opportunity for collaboration between developers, farmers, municipalities, and policymakers. This is a key moment for lifecycle analysis research, development, and implementation of agrivoltaics, and the effective application of agrivoltaic practices today and in the future requires educating stakeholders and establishing technological know-how, permitting flexibility, and incentive programs for developers and farmers.

Productive and collaborative relationships are essential to implementing agrivoltaics in New York State. Agrivoltaics research and development best practices are evolving by the day, and this represents a unique opportunity for stakeholders to connect internationally, nationally, and across the state. Holding an agrivoltaics summit in New York State would be beneficial in fostering relationships and collaboration. The American Solar Grazing Association, which provides multiple services to connect solar grazers and developers in New York State (and beyond), could be a key partner in such a summit, along with Cornell University, the University of Massachusetts, Rutgers University, and Jack's Solar Garden or other operational agrivoltaics facilities from outside of New York State.[57]

The continuous innovation in agrivoltaics makes this an exciting time for New York State. This report provides an initial framework for implementation and will be updated as new research and development trends emerge.

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Pollinator plants and solar grazing.
Image Credit: Rob Davis and AgriSolar Clearinghouse, 2023

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