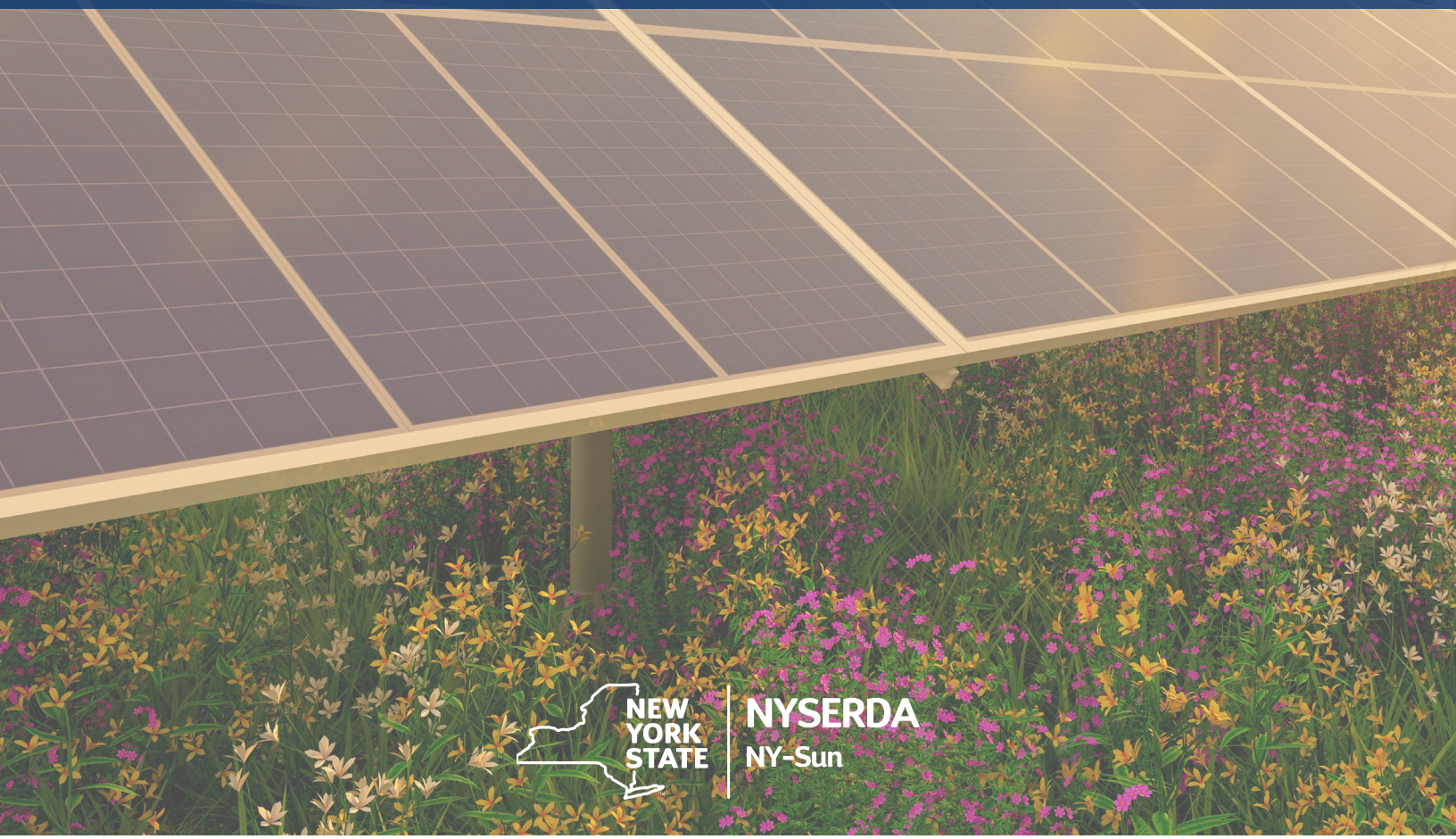
Section 4

Solar Installations on Agricultural Lands

Navigating the development of solar projects in accordance with local and New York State agricultural policies.



Section Contents

1. Solar and Agriculture in New York

In 2019, New York State (NYS) adopted the Climate Leadership and Community Protection Act ('Climate Act'), a landmark bill which codified ambitious and comprehensive climate and energy targets for the State. The Climate Act established sweeping decarbonization targets for the electricity sector, requiring New York to achieve 70% renewable electricity by 2030, and 100% emissions-free electricity by 2040. As of 2020, approximately 27.4% of the State's electricity generation came from renewable sources,[1] highlighting the need for significant expansion of New York's renewable capacity – including solar, on- and offshore wind, and other technologies – in the coming years.

Solar installations of all types will continue to play a key role in helping New York achieve its aggressive climate and energy goals. To that end, NYSERDA has and will continue to utilize a comprehensive approach to solar deployment, supporting a range of projects including ground mounted, rooftop, and canopy solar installations, as well as projects sited on landfills, brownfields, and other underutilized lands. Among these approaches, large-scale ground mounted solar is a necessary and instrumental strategy for achieving the State's mandated goal of 70% renewable electricity by 2030.

Ground mounted solar is of keen interest to communities and local governments due to its associated and/or perceived land use related impacts. Ground mounted solar installations typically occupy 4-8 acres per megawatt (MW); as such, project sizes can range from tens to hundreds of acres. In New York, the discourse around land use impacts of solar has increasingly focused on agricultural lands, perhaps unsurprising given that there are approximately 7 million acres of farmland, making up about 20 percent of the state's land area.[2] Agricultural lands are often identified as suitable locations for large-scale ground mounted solar development. Reasons include the physical characteristics of the land (relatively flat, minimal shading, cleared of vegetation), proximity to important grid infrastructure (high voltage transmission lines, substations, existing roads), social and economic considerations (fewer residential or commercial neighbors, lower land costs), and other factors.

It is important to acknowledge that prioritization and preservation of agricultural lands is a foundational principle for NYS. According to the NYS Constitution, "the policy of the State shall be to conserve and protect its natural resources and scenic beauty and encourage the development and improvement of its agricultural lands for the production of food and other agricultural products" (NYS Const. Art. XIV § 4). This exact constitutional provision also creates an inextricable link between agricultural conservation and the State's clean energy transition, noting that New York's conservation policies must "include adequate provision for the abatement of water and air pollution" alongside "the protection of agricultural lands."

As such, recognizing the importance of balancing clean energy development and the protection of our agricultural lands and industries, this section explores the interplay between solar and agriculture in NYS, including:

- Local considerations and approaches to balancing solar and agriculture, such as planning and zoning.
- Introductory strategies and suggestions for project siting, including "dual-use" approaches and other methods of mitigating impacts to agricultural lands.
- State agencies, programs, and policies relevant to the intersection of solar development and agricultural lands.
- Resources and guidance for local governments

[1] NYSERDA. Clean Energy Standard Annual Progress Report: 2020 Compliance Year. January 2022. https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Clean-Energy-Standard/CES-2020-annual.pdf

[2] Farmland Protection." Agriculture and Markets, https://agriculture.ny.gov/land-and-water/farmland-protection.

2. Balancing Solar and Agriculture Locally

When looking to balance solar and agriculture at the local level, it is important to understand the role of local governments in land use planning and regulation and in approving development applications. NYS has empowered local governments to adopt land use plans, regulate land uses, and review and approve development proposals through their various local boards. The process of addressing solar and agriculture at the local level begins with planning, proceeds to zoning and land use regulation changes, and includes addressing siting considerations for solar projects on agricultural land.

2.1 Comprehensive Planning

To promote a balance between solar development and agricultural protection, local governments should address each topic in the municipality's comprehensive plan. A comprehensive plan, also referred to as a master plan, is a written document that contains goals, objectives, and strategies to guide a community's future development. Formally adopted by the local legislature, the comprehensive plan steers the municipality's physical and economic development and accommodates its social, environmental, and regional concerns. Local governments engage in land use planning to inventory a community's need and assets, develop a shared vision for the future, and build consensus and support for actions that will implement the plan. NYS's zoning and planning enabling acts require land use regulations to be "in accordance with a comprehensive plan" or "in accordance with a well-considered plan." (NYS Village Law § 7-704; Gen. City Law § 20(25); Town Law § 263)

Comprehensive plans often incorporate environmental, economic, and sustainability strategies, including language to address balancing solar development and agricultural protection and policies that support opportunities for local farmers and related businesses. Specifically, strategies can be designed to remove barriers for solar development and mitigate impacts on agricultural lands. Whether a municipality is updating an existing comprehensive plan or developing a new plan, there are many ways that the plan can recognize both agriculture and renewable energy siting interests. The local legislature may direct a special board to prepare the comprehensive plan and lead a public engagement effort. This board should include, but not be limited to, agricultural landowners, agricultural business owners, and other interested stakeholders to provide insights and technical expertise.

As an initial step of the planning process, the special board should conduct an existing conditions study to guide the planning effort (see "Agricultural Sources for Existing Conditions Studies" commentary box). It is imperative that this study include agricultural considerations to help determine suitable areas for responsible solar development within a community. Specifically, the planning effort must consider applicable county agricultural and farmland protection plans created under Article 25-AAA of the Agriculture and Markets Law.

Commentary: Agricultural Sources for Existing Conditions Studies

- Land in NYS Certified Agricultural Districts by tax parcel, https://agriculture.ny.gov/land-and-water/agricultural-districts.
- Land receiving Real Property Agricultural Value Assessment by tax parcel, https://www.tax.ny.gov/research/property/assess/valuation/ag_overview.htm.
- United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL), https://www.usgs.gov/centers/fort/science/usda-national-agricultural-statistics-service-cropland-data-layer-0?qt-science_center_objects=0#qt-science_center_objects.
- Multi-Resolution Land Characteristics (MRLC) Consortium data, https://www.mrlc.gov/.
- USDA soil mapping, https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/
- Farms Under Threat: The State of States map, https://csp-fut.appspot.com/.

Community engagement is an essential step in the process to ensure the development of successful clean energy policies and planning activities. Buy-in from all stakeholders—including citizens, local officials and board members, local businesses, developers, environmental leaders, residents, community-based organizations, and local media—is critical to the effort's success and long-term implementation. Empowering various stakeholders to share local knowledge and preferences strengthens the process' outcomes. The implementation of several methods of public engagement to engage all citizens in the process also increases confidence and support for the resulting plan.

Using gathered information from the studies and community engagement effort, a municipality should then develop long-term solar energy and agricultural goals, along with related shorter-term objectives. A sample goal may be to "Balance solar development and continued agricultural operations." Corresponding objectives may include:

- Minimize siting of ground mounted solar arrays on farmland identified for protection (see "Commentary: Identifying Farmland for Protection").
- Prioritize solar development on farming areas with less productive soils.
- Allow solar projects in agricultural areas if mitigation for agricultural impacts have been identified and addressed.
- Encourage solar and other renewable energy production that is compatible with agricultural-related businesses and/or continued agricultural use of the land.

After selecting goals and objectives, the municipality should identify strategies or actions to accomplish each objective. For example, a locality may commit to identifying agricultural lands for protection and then review and modify zoning and/or land use regulations to minimize impacts to those lands.

For more information regarding comprehensive planning, consult NYSERDA's Clean Energy and Your Comprehensive Plan Guide, available at: www.nyserda.ny.gov/ComprehensivePlan.

2.2 Zoning and Land Use Regulation

In accordance with the comprehensive plan, local governments can amend their zoning and land use regulations to pursue a balanced approach to regulating solar and agriculture. Municipal zoning laws may be updated to address the installation, operation, maintenance, and decommissioning of solar energy systems in a way that protects priority agricultural resources and land uses. In establishing regulations to promote this balance, municipalities should consider their methodology options for identifying and protecting priority agricultural lands (see "Identifying Farmland for Protection" commentary box). While municipalities have sole permitting authority for solar projects under 25 MW, it is required for the Office of Renewable Siting and Electric Transmission (ORES) to consider any applicable local law when making a permit determination. More information regarding ORES's regulation can be found here https://dps.ny.gov/ores.

Commentary: Identifying Farmland for Protection

When considering how best to promote a balance between clean energy development and agricultural preservation, it is important to have clear, reasonable definitions regarding priority farmland for protection. Multiple factors may be considered:

- **Existing and/or historic land use:** Examining current and historic agricultural use can provide a clear and realistic assessment of priority farmland based on the land's productivity.
- **Parcel size and proximity:** Identifying and prioritizing large and/or contiguous parcels can preserve agricultural productivity and avoid agricultural fragmentation.
- **Soils:** Analysis based on soil quality is a prominent method for identifying priority agricultural lands.

There are a variety of existing local, state, and federal agricultural land classifications based on different criteria, which municipalities may use to identify and prioritize agricultural land for protection. Classifications and definitions may include:

- **Mineral Soil Groups (MSG) 1-4:** Mineral Soil Groups were established to create a uniform statewide land classification system based on the differences in soil productivity. The rating methodology is based on the differences in the inherent ability of soils to support crop production. MSG 1-4 are recognized as having the highest value based on soil productivity and capability.
- **Prime Farmland:** Soils with the best combination of physical and chemical characteristics for producing food, fiber, and/or other crops. Parameters for Prime Farmland are established on a federal basis and may include cultivated land, pastureland, forestland, or other lands.
- **Prime Farmland if Drained:** Soils which meet all necessary criteria for the Prime Farmland classification other than depth to water table. This may include lands similar to those included in the Prime Farmland definition.
- **Farmland of Statewide Importance:** Soils that do not meet the criteria for Prime Farmland or Prime Farmland if Drained, but which are classified as mineral soils in priority land capability classes. Parameters for Farmland of Statewide Importance are established on a state-by-state basis. These soils may also be referred to as "Farmland of Statewide Significance."
- **Farmland of Local Importance:** Soils that do not meet the criteria for the above classifications, but which are considered of local importance to produce food, fiber, or other crops. These soils may be identified and/or classified by the appropriate local authority and may include lands that have been designed for agricultural use by local law.

Once priority agricultural lands have been identified, zoning and land use regulations can be updated to include agriculture-specific requirements, such as special use permit standards for avoiding, minimizing, and mitigating agricultural land impacts; construction and/or decommissioning requirements for systems on priority soils; or provisions encouraging dual-use.

Specific examples of local law requirements pertaining to solar development on agricultural lands may include:

- Requiring adherence to the NYS Department of Agriculture and Markets (NYSAGM) Guidelines for Solar Energy Projects-Construction Mitigation for Agricultural Lands.
- Requiring project owners to implement dual-use solar strategies to the maximum extent feasible or otherwise offset any loss of agricultural activity.
- Adding a provision that permits the Reviewing Board to waive or modify certain bulk and area standards that result in unintended consequences.
- Encouraging consultation with a local or regional agricultural preservation board as part of the application review process.

Municipalities looking to implement requirements for solar on agricultural lands should consider how their current land use regulations, including bulk and use requirements, may be adapted to incentivize or promote preferred types of solar development. For example, a municipality might allow for relaxed setback or lot coverage requirements for projects which implement a compatible agricultural use underneath or around the solar arrays.

To learn more about zoning for solar, including example language and provisions related to balancing solar and agricultural land uses, access the Model Solar Law in NYSERDA's Solar Guidebook for Local Governments.

Commentary: Local Regulations and On-Farm Solar

In planning and establishing requirements for solar installations on agricultural lands, municipalities should be mindful of existing guidelines in NYS that encourage solar energy installations which support farm operations in Agricultural Districts.

In accordance with NYS Agriculture and Markets Law and related guidance, solar energy installations which generate no more than 110% of a farm's needs are classified as "on-farm" equipment. NYSAGM has developed guidelines for evaluating local laws with respect to impacts for on-farm clean energy projects, to ensure that on-farm solar energy installations are not subject to "overly restrictive" requirements. As such, municipalities should consider implementing land use regulations which encourage and promote farm-friendly solar energy development.

In accordance with these guidelines, reasonable local regulations for on-farm solar development include:

- Requiring a building/zoning permit and adherence to the NYS Uniform Fire Prevention and Building Code.
- Utilizing a streamlined site plan review process that involves a shorter review period and fewer submission requirements.

"Overly restrictive" requirements for on-farm solar installations may include:

- Extensive site plan regulations.
- Special use permit regulations.
- Nonconforming use requirements.
- Height restrictions and excessive setbacks from buildings and property lines.
- A Full Environmental Assessment Form (EAF) [on-farm solar development is considered a Type II action under the State Environmental Quality Review process, which does not require EAF preparation].
- Visual impact assessment requirements.
- Prohibiting the construction of on-farm solar generated electricity to offset the energy demands of the farm.

For more information, access the NYSAGM Guidelines for Review of Local Laws Affecting Small Wind Energy Production Facilities and Solar Devices at: https://agriculture.ny.gov/system/files/documents/2019/11/guidelines_for_solar_and_small_wind_energy_facilities.pdf.

3. Solar and Agriculture as Compatible Land Uses

Agrivoltaics is the combination of solar development with land management philosophies rooted in conservation and agriculture to create a multifunctional system with a variety of ecological, agricultural, and energy benefits. It occurs when agricultural or conservation uses are incorporated on land used for solar projects to create a harmonious development that benefits the farmer or agricultural community at-large. The New York State Agricultural Technical Working Group (A-TWG) defines agrivoltaics as "a simultaneous use of land for solar photovoltaic power generation and agricultural production of 'crops, livestock, and livestock products' as that phrase is defined by Agriculture & Markets Law (AML) §301(2).[3]" The term dual-use solar, is a type of co-utilization or "agrivoltaics" (a portmanteau of agriculture and photovoltaics).

Dual-use approaches are of increasing interest to landowners and communities who may have concerns about the development of solar on agricultural lands, for reasons such as:

- Community character: Dual-use approaches offer mutually beneficial outcomes for communities and landowners concerned about impacts to local agriculture, whether the concerns are aesthetic or economic in nature. These approaches can support local farmers, preserve continued agricultural use of the land, and ensure continued contributions to the local agricultural economy.
- Permanent farm loss: According to the American Farmland Trust, over 253,000 acres of agricultural land across New York was developed or compromised between 2001 and 2016,[4] 78% of which was converted to low-density residential (LDR) development. In contrast with LDR and other development types, solar does not require a full or permanent conversion of lands away from agricultural production.
- Future agricultural potential: Dual-use solar approaches are designed to ensure ongoing and future viability of the land for agricultural production (minimizing impervious surfaces, chemical applications, and other long-term development impacts). When paired with robust decommissioning and site mitigation requirements, dual-use solar can ensure that agricultural lands can be returned to productivity at the end of the project's useful life.

A study was conducted by Michigan Technological University in efforts to analyze the difference in public support for conventional solar and dual-use solar. As a result of this study, it showed that 81.8% of the total respondents look more favorable upon solar development in their community if it was paired with agriculture. While not feasible for every solar project, this result shows how local acceptance can be improved while continuing solar developments.[5]

Additionally, dual-use solar can also provide meaningful direct benefits to farmers, including a steady revenue stream that helps smooth impacts from market volatility. The Federal Government recognizes these benefits and incentivizes them through programs like the U.S. Department of Agriculture's Rural Energy for America Program (REAP).[6]

This section highlights four prevailing models of dual-use solar which are in various stages of research, development, and deployment throughout New York and elsewhere: solar grazing, crop production, pollinator-friendly approaches, and conservation approaches. These four models form a spectrum of complementary land uses which may be incorporated to mitigate impacts of solar development on agricultural lands. The feasibility of each dual-use model greatly varies and needs to be assessed on a site-by-site basis.

Grazing and crop production are the most prominent agricultural dual-use techniques in terms of maintained active agricultural productivity, while pollinator-friendly and conservation approaches provide more passive agricultural and impact mitigation benefits. This section discusses each model separately, addressing model-specific design, construction, establishment & maintenance, community, and feasibility criteria for each.

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[3] New York State Energy Research and Development Authority (NYSERDA). "Growing Agrivoltaics in New York State: Advancing Understanding of Opportunities to Integrate Renewables into Working Landscapes," NYSERDA Report Number 23-25. Prepared by WSP USA and Agrivoltaic Solutions LLC. 2023. https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Other-Technical-Reports/23-25-Agrovoltaics-in-New-York--acc.pdf

[4] American Farmland Trust. State of the States: Agricultural Land Conversion Highlight Summary: New York. 2020.

[5] Pascaris, Alexis S, Schelly, Chelsea, Rouleau, Mark, and Pearce, Joshua M. Do Agrivoltaics Improve Public Support for Solar Photovoltaic Development? Survey Says: Yes!. United States: N. p., 2021. Web.

[6] USDA REAP. Renewable Energy Systems and Energy Efficiency Improvements Assistance. https://www.rd.usda.gov/files/REAP%20fact%20sheet%20MA.CT_.RI_.pdf.

3.1 Guiding Principles for Dual-Use Solar

Solar installations should strive to meet baseline standards that ensure compatibility and enhance landscapes, ecosystems, and communities. As with traditional solar development, dual-use solar must consider factors such as existing zoning regulations and land use considerations, interconnection feasibility, road access to the solar project, the location's slope, and the installation costs. In addition, dual-use solar projects should strive to minimally impact the farmland's quality and productivity and be designed to achieve agricultural benefits while aiming to be economically attainable.

Key benefits of dual-use solar approaches may include:

- Collaboration between solar developers, local farms, and agricultural organizations that benefits all parties.
- Improvements in soil health and water retention.
- Farmland preservation viability, and intergenerational transfer.
- Investments in farm infrastructure and equipment.
- Land use optimization and integrated farm management.
- Opportunities for research on land management and agronomic practices.

3.2 Grazing Dual-Use Solar Approaches

In New York, and elsewhere in the United States and Europe, solar projects have successfully implemented grazing dual-use solar approaches by incorporating livestock on-site at solar projects, where the animals are able to graze and forage underneath and around solar arrays. To date implementation of dual-use strategies have largely focused on sheep grazing. However, efforts are underway to explore additional dual-use opportunities, such as with grazing cattle. Silicon Ranch Corporation, for example, was awarded a $1.8 million grant in 2020 from the Solar Energy Technologies Office (SETO) to explore pasture-based cattle grazing under solar panels, including analysis of the impact of the solar panels on cattle, solar equipment, and the grassland ecosystem under the panels.[7]

The use of grazing sheep has emerged across the United States as a cost-competitive alternative to solely mechanical and chemical control of vegetation under solar panels, because it requires minimal changes to common ground-mount solar configurations. Animal grazing can be an attractive option for communities that host solar infrastructure because it supports continued agricultural land use, aligns with sustainability mandates, and, when managed with sound grazing practices, sheep can perform as well as mechanical mowing equipment in both cost and efficiency. Solar facility operators do not generally need to adjust panel heights and spacing to integrate sheep grazing within a solar facility but may need to make other modifications to facility layout, design, and infrastructure to successfully host a viable grazing operation.

Furthermore, the use of prescribed sheep grazing within solar facilities helps to develop perennial vegetation and contributes to soil health.[8,9] Grazing can support diverse plant, insect, and pollinator habitats. In addition to improving environmental outcomes, grazing sheep flocks at solar facilities can help New York farmers to realize new economic benefits.[10] The practice may lower the barrier of entry for beginning and underserved farmers and allow new farm businesses to contribute to the economy while improving the viability of their overall farm operation.[11]

[7] SETO 2020 – Solar and Agriculture. https://www.energy.gov/eere/solar/seto-2020-solar-and-agriculture.

[8] Amsili, J.P., H.M. van Es, R.R. Schindelbeck, K.S.M. Kurtz, and D.W. Wolfe, G. Barshad. 2020. Characterization of Soil Health in New York State: Summary. New York Soil Health Initiative. Cornell University, Ithaca, NY. https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/6/7573/files/2018/04/Characterization-of-Soil-Health-in-New-York-State-Summary-Report.pdf

[9] NYSAGM (New York State Department of Agriculture and Markets). 2023. Agricultural Environmental Management Planning Resources. Tier 2: Pasture Management Worksheet. https://agriculture.ny.gov/system/files/documents/2022/07/aem_tier2_pasture-management.pdf.

[10] Kochendoerfer, N., and M.L. Thonney. 2021. Grazing Sheep on Solar Sites in New York State: Opportunities and Challenges. Scope and scaling-up of the NYS sheep industry to graze ground-mounted photovoltaic arrays for vegetation management., Cornell University Atkinson Center for a Sustainable Future, Ithaca, NY. https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/c/9310/files/2021/03/Solar-Site-Sheep-Grazing-in-NY-v2.1.pdf.

[11] Kochendoerfer, N., A. Hain, & M. Thonney. 2019. The agricultural, economic and environmental potential of co-locating utility scale solar with grazing sheep, Atkinson Center for a Sustainable Future, Cornell University Ithaca, NY. https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/c/9310/files/2020/12/Atkinson-Center-report-2018_Final-22l3c5n.pdf.pdf.

Case Study: Solar Grazing in Central NY

Cascadilla Community Solar Farm: Cornell University researchers are conducting ongoing solar grazing research at the institution's 18 MW solar project in Ithaca, NY. A collaboration between the University's Animal Science Department and the Cornell School of Integrated Plant Science, this research project is focused on both agricultural and ecological outcomes of solar grazing, including optimal grazer densities and stocking rates, creation of pollinator (bees) and predator insect (ladybugs) habitats, and soil carbon sequestration.

To-date, preliminary data has supported the viability of solar grazing on this site for flocks of up to 150 ewes, demonstrating numerous positive outcomes and externalities, including:

- Increased income for the flock owner, as well as new on-site labor requirements during the growing season.
- Excellent health and welfare outcomes for the grazing sheep.
- High conception rates for sheep bred and grazed on-site, leading to the sale of 134 lambs and the retention of another 106 lambs to expand the grazing flock.
- Avoidance of panel shading due to vegetative growth.
- Creation of diverse pastures, including many native and perennial species.
- Provision of habitat for a variety of pollinator and other insect species.

To read more about the research conducted at the Cascadilla Community Solar Farm, visit: https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/c/9310/files/2021/03/Solar-Site-Sheep-Grazing-in-NY-v2.1.pdf

NYSERDA has developed *Considerations for "Grazing-Ready" Solar Facilities: Planning for Integration of Sheep* to support integration of design and construction elements at the facility planning and design stage to help promote "grazing-ready" site conditions that enable integration of grazing at any point in the lifespan of a solar facility. The guide is intended to help to educate the solar development community, substantiate co-location of animal agriculture with solar, and encourage discussions among the farming and solar development communities to expand farmer involvement in agrivoltaics.

The guide does not cover development of a grazing management plan, which would include site-specific standards for daily management and operations. However, it will be important for this plan to be developed at a later project phase by the solar developer; engineering, procurement, and construction (EPC) contractor; and operations and maintenance contractor, in collaboration with the farmer/flock manager servicing the solar facility. Example plans in New York State include the Morris Ridge Solar Energy Center Agricultural Integration Plan: Managed Sheep Grazing & Beekeeping and the Horseshoe Solar Agricultural Integration Plan. It will also be important for collaborators to clearly delineate where responsibilities lie for maintenance activities (e.g., maintenance of an installed well, vegetation management outside of grazing periods, etc.).

Grazing Dual-Use Examples[12]

- **Newfield Solar (Newfield, NY):** Nexamp's Newfield Solar is a 5 MW community solar array located on 30 acres, where all landscaping maintenance is performed by sheep, in the warmer months, via a contract with a sheep farmer.[13]
- **Cornell University's Musgrave Research Farm (Aurora, NY):** During a research trial in 2018, a flock of 56 sheep provided all vegetation management at Cornell's 22-acre, 4 MW solar farm. Researchers noted numerous positive outcomes from this trial, including the cost-effectiveness and decreased labor-intensity of solar grazing compared to traditional solar landscaping.[14]
- **Maple Ridge Meats (Benson, VT):** This cattle farm and commercial slaughterhouse features a 150 kW solar array under which cattle graze.[15]

[12] American Solar Grazing Association (ASGA), Guide to Farming Friendly Solar, https://solargrazing.org/wp-content/uploads/2019/06/On-Pasture-Co-location-of-solar-agriculture.pdf

[13] O'Connor, Kelsey, The Ithaca Voice, Sheep Get to Work Maintaining Newfield Solar Array, May 21, 2019, https://ithacavoice.com/2019/05/sheep-get-to-work-maintaining-newfield-solar-array/

[14] Koechendoerfer, Nikola, et al. Atkinson Center for a Sustainable Future, Cornell University "The agricultural, economic and environmental potential of co-locating utility scale solar with grazing sheep". 2019. https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/c/9310/files/2020/12/Atkinson-Center-report-2018_Final-22l3c5n.pdf.pdf

[15] AgriTech Tomorrow, Agriculture + Solar, the Perfect Pair for Modern Farming, https://www.agritechtomorrow.com/article/2023/06/agriculture-solar-the-perfect-pair-for-modern-farming/14626

Case Study: Bancroft Station Solar Farm (Early County, GA)

The Bancroft Station Solar Farm, a 102.5 MW project developed by Silicon Ranch, has partnered with nearby White Oak Pastures to incorporate sheep grazing and free-range chickens as part of the solar farm's restorative land use strategy. This mutually beneficial partnership has allowed White Oak Pastures, once a solely cattle-focused operation, to further expand its presence as a leader in pasture-raised livestock and regenerative agricultural practices.

In Spring 2020, White Oak introduced a flock of over 400 sheep to the solar farm, a first step in its plan to eventually introduce 1,000 or more grazing animals on the site. The flock is intended to graze on a rotational schedule throughout Bancroft Station's 700 acres, land which was historically used for peanut and cotton production, as well as cattle grazing.

Only months after the sheep were introduced to the solar farm, White Oak added a flock of over 7,000 free-range chickens to the rotational grazing schedule at Bancroft Station. The introduction of chickens to the site brings about additional mutual benefits, including natural pest control, as well the solar arrays providing shade and protection from predators.

For additional information, please visit:

- Natural Resources Defense Council: "Sheep (and Soil Scientists) Juice Up the Solar Farm" https://www.nrdc.org/stories/sheep-and-soil-scientists-juice-solar-farm
- The National Provisioner: "White Oak Pastures has become a leading advocate for regenerative animal agriculture" https://www.provisioneronline.com/articles/110046-white-oak-pastures-has-become-a-leading-advocate-for-regenerative-animal-agriculture
- Silicon Ranch: "#bignEWES: Welcome to Bancroft Station's new workforce" https://www.siliconranch.com/bignewes-welcome-to-bancroft-stations-new-workforce/

3.3 Crop Production Dual-Use Solar Approaches

Crop production dual-use solar projects, sometimes more directly referred to as agrivoltaics, are designed to accommodate the cultivation and production of vegetables and other crops, as well as other farm activities, beneath or around solar panels and other system components. This approach allows for the prioritization of a site's continued agriculture use, as the project may be designed to enable both solar production and crop yields. Depending on the growing climate and crops selected, this dual-use approach can even provide key agricultural benefits, including increased soil moisture retention and reduced heat stress on crops.

Although a number of studies have examined this approach in Europe, crop production dual-use has yet to be deployed at scale throughout the United States. There are currently a multitude of test sites across the US examining viability and system design considerations for crop production dual-use; in most cases, these projects remain in a research phase. Available data and research from sites in the United States has demonstrated that shade-tolerant, temperate climate crops including spinach, kale, swiss chard, broccoli, cauliflower, cabbage, peas, and bush beans can successfully grow under solar panels.[16] Additionally, the same research has shown that some root vegetables, such as carrots, potatoes, and radishes, can also be grown under panels with a longer growth period.

It is imperative that proposers of crop production dual-use projects examine the site or region's growing history to understand and learn from previous successes and failures, which may help assess crop suitability and future growing potential.

[16] Dual-Use: Crops and Livestock Considerations, https://ag.umass.edu/clean-energy/fact-sheets/dual-use-crop-livestock-considerations

Case Study: Crop Cultivation Meets Solar in the Northeast

University of Massachusetts Amherst Research Farm (South Deerfield, MA): For over a decade, Professor Stephen Herbert of UMass Amherst has been studying crop cultivation underneath an elevated 25 kW solar array at the University's Crop and Animal Research and Education Center in South Deerfield, MA.

Though his research initially focused on cultivating pasture for livestock grazing underneath the solar array, Professor Herbert's work has shifted to explore opportunities for vegetable production under the University's solar panels. In various trials, his team has demonstrated successful growth of kale, swiss chard, beans, broccoli, and other crops underneath the solar array.

Professor Herbert's research found that the benefits of crop cultivation underneath solar arrays may be particularly noticeable during a dry, hot growing season, when shade from the panels can help reduce heat stress and contribute to higher yields.

Additionally, having received a grant from the US Department of Energy in 2020, the University will be expanding its dual-use solar research at up to eight additional farms through Massachusetts, with intent to study a variety of new crops including pumpkins, winter squash, berries, and others.

To read more about UMass Amherst's ongoing and forthcoming dual-use solar research, visit: https://ag.umass.edu/clean-energy/research-new-initiatives/dual-use-solar-agriculture

Crop Production Dual-Use Solar – Planning, Design, and Feasibility Criteria:

Design	• Include farmers in the design process from the start. • Design solar site to integrate viable farming activities throughout project life. • Consider the impact the system will have on the microclimate under the panels and between the rows of panels, the anticipated available sunlight, and any changes to soil moisture & temperature. • Design the site with the future in mind, considering the land's current and anticipated farming uses, capabilities, and needs.
Construction	• Install solar arrays in a minimally impactful manner[17] and consider the height and width of farm equipment that will be used on the site. • Remediate any soil and site impacts in accordance with state regulations before construction completion.
Establishment & Maintenance	• Develop any solar equipment maintenance and vegetation management plans with farmer cooperation to ensure compatibility with the site's planned agricultural activities and to minimize disturbances to agricultural uses.
Community Impacts	• Crop production dual-use promotes farmland preservation, production, and investment. • Can create education, training, employment, and income opportunities for new and existing farmers. • May increase community support and acceptance for solar development.
Feasibility	• Crop production dual-use is largely in early stages of research and development, including a variety of pilot and demonstration projects. As such, it may not be feasible for every project in NYS. • Project-specific feasibility may depend on criteria including, but not limited to: - Incremental capital and operating costs of the solar facility's design, equipment, hardware, labor, etc. to accommodate crop production. - Increased costs associated with crop cultivation (labor, equipment, etc.). - Finding knowledgeable experts on how to develop a successful dual-use project.

Crop Production Dual-Use Examples:[18]

- Jack's Solar Garden is a 1.2 MW agrivoltaic project in Boulder County, Colorado with research partnerships with the National Renewable Energy Laboratory (NREL), Colorado State University, and the University of Arizona. Research includes looking at crop production and irrigation to study different crop yields at different locations throughout the solar site. The site has seen success with lettuce, sage, and raspberries all being grown under the panels. There are multiple research projects currently ongoing at the site.[19]
- Since 2016, researchers at the Biosphere 2 Agrivoltaics Learning Lab in Oracle, Arizona – a collaborative effort between the University of Arizona, the National Renewable Energy Laboratory (NREL), and other partners – have studied crop cultivation under solar panels. Their research (focused on crops suitable for dryland, such as tomatoes and peppers) has identified a number of potential benefits, including increased crop yields, more efficient water use, and improved temperature regulation.
- The Fraunhofer Institute has a research farm at Lake Constance, Germany, where they installed 720 bi-facial solar panels (catching rays from above and below) on a third of a hectare of cropland. After the first year, the combined yield of food and electricity was 60 percent higher per square meter than it would have been had food and electricity been harvested on two separate fields.[15]

[17] https://openei.org/wiki/InSPIRE/Primer
[18] Case Study: Jack's Solar Garden – AgriSolar Clearinghouse. https://www.agrisolarclearinghouse.org/case-study-jacks-solar-garden
[19] AGROPHOTOVOLTAICS increases land use efficiency by over 60 percent. pv Europe. (2017, November 29). Retrieved December 13, 2022, from https://www.pveurope.eu/solar-modules/agrophotovoltaics-increases-land-use-efficiency-over-60-percent

3.4 Pollinator-Friendly Dual-Use Approaches

Pollinator-friendly approaches involves the practice of seeding and maintaining pollinator-friendly plants, such as wildflowers and native species, within a solar project site to create a large pollinator habitat in which bees and/or native pollinators can thrive. There are two categories of pollinator-friendly approaches: (1) solar projects that have active apiaries onsite that are attended to by beekeepers, and (2) solar projects that create habitat for native pollinators.

The NYS Pollinator-Friendly Solar Act was passed unanimously in 2018. This legislation directed the Commissioner of the NYS Department of Agriculture and Markets (NYSAGM) to develop guidelines for vegetation management plans for use by citizens, corporations, or other groups who claim that their property, including solar electric generating systems, is pollinator friendly or provides benefits and protection to pollinators. NYSAGM issued their NYS Utility Corridor Pollinator Habitat Guidelines in 2020 to provide the minimum criteria for a site to be considered "pollinator friendly," available here, https://agriculture.ny.gov/utility-corridor-pollinator-habitat-guidelines.

NYSAGM also offers other pollinator protection resources, including a Pollinator Protection Plan that recommends the development of Voluntary Best Management Practices for all pollinator stakeholders, including beekeepers, growers, landowners, state agencies and the general public. Access the plan at https://agriculture.ny.gov/plant-industry/pollinator-protection.

Additionally, pollinator scorecards can be used to assess site suitability and design for pollinators. A pollinator scorecard uses science-based standards to evaluate qualities beneficial to pollinators in the context of a solar development project. Many states have adopted pollinator scorecards for use in the planning and permitting process. Fresh Energy, a non-profit that promotes pollinator friendly plantings on solar sites, has created a model scorecard for this assessment, which is available at https://fresh-energy.org/wp-content/uploads/2020/01/Pollinator_FriendlySolar_Scorecard.pdf.

Pollinator-Friendly Dual-Use Solar – Planning, Design, and Feasibility Criteria:

Design	• Use vegetation mixes that provide overwintering habitat and season-long pollen and nectar. • Implement site-adjacent features, such as trim/fence vegetative corridors, basins and wetlands, in lieu of inside array fencing. • In selective portions of the array where appropriate, plant forbs like clover and asters instead of grasses (e.g., between rows of panels, as opposed to on the margins). • For solar apiaries, there is an additional consideration of where the apiary will be located on the solar project site. Some apiaries are located within the fenced facility area, oftentimes the apiary is in its own fenced-in area on the perimeter of the project for ease of access to the beekeeper and to create a buffer from Operations & Maintenance personnel.
Construction	• Install vegetation mixes after solar project construction is complete. • Avoid seed mixes that are pre-treated with pesticides and herbicides. • If placing a solar apiary onsite, it may be beneficial to consult with a beekeeper to see if there are any needs that could be best addressed during the construction process.
Establishment & Maintenance	• Allow for one to three years for vegetation mixes to establish roots and control the density of fast-growing plants. • Begin long-term maintenance by year three, which may consist of spot mowing, strip disking, spot spraying and controlled use of selective herbicides to promote plant regrowth and reduce competition from woody and other vegetation.
Community Impacts	• Vegetation may provide food, cover, and nesting habitat for small mammals, birds, reptiles, and amphibians. • Vegetation can significantly reduce erosion due to healthy, deep root systems. • Reduced use of fertilizers, herbicides, and pesticides may help maintain and improve water quality. • Perennial planting improves soil health and sequesters carbon. • Pollinator-friendly dual-use solar promotes continued production and investment.
Feasibility	• Pollinator-friendly dual-use solar is highly feasible and occurring throughout New York. • This approach may require certain project design and maintenance criteria – such as designing and/or procuring appropriate local seed mixes – but is unlikely to significantly affect project costs.

Pollinator-Friendly Dual-Use Examples

- **NYS Department of Environmental Conservation (Stamford, NY):** DEC installed a 44 kW solar array that includes a pollinator garden planted underneath the panels along with two large bee colonies at its Region 4 Stamford office. The solar array will offset approximately 56% of the building's annual electricity needs.[20]
- **Underhill Community Solar Farm (Poughkeepsie, NY):** The first operational community solar farm in the Central Hudson Gas & Electric utility service territory, the Underhill project offers nearly 20 acres of native pollinator-friendly habitat. This habitat aids in food production, including the locally made honey and craft beers produced at nearby Plan Bee Farms and Brewery.[21]
- **Eagle Point Solar (Jackson County, OR):** A collaboration between Pine Gate Renewables and Old Sol Apiaries, this 9.9 MW solar farm saw 41 acres of land turned into pollinator-friendly habitat and is now home to 48 honeybee hives.[22]

[20] NYS Department of Agriculture and Markets. "New York State Issues Guidelines to Promote Creation of Pollinator Habitats on Commercial Properties." June 22, 2020. https://agriculture.ny.gov/news/new-york-state-issues-guidelines-promote-creation-pollinator-habitats-commercial-properties

[21] Watson, Emily. The Poughkeepsie Journal. "Pollinator-friendly solar practices can benefit farmers: Valley Views", Opinion. February 9, 2018. https://www.poughkeepsiejournal.com/story/opinion/2018/02/09/pollinator-friendly-solar-practices-can-benefit-farmers-valley-views/308033002/

[22] Davis, Rob. Fresh Energy. "Case Study: The 9.9 MW Solar Project in Science Magazine." June 2, 2021. https://fresh-energy.org/case-study-the-9-9-mw-solar-project-in-science-magazine

3.5 Conservation Dual-Use Approaches

While the construction of solar projects almost always involves an invariably degree of short-term land and other disturbances, responsibly developed solar projects can offer a variety of ecological and biodiversity benefits, which may not otherwise be realized on lands remaining in conventional agricultural use. The conservation dual-use approach recognizes that there are meaningful benefits to utilizing underlying land for creating or replenishing habitat. Solar projects featuring conservation approaches are designed in consultation with conservation organizations focused on restoring ecosystem vitality and function through sustainable site design and long-term conservation efforts. Conservation dual-use solar projects should be customized to regional and site-specific needs, including but not limited to:

- Protection of species categorized as endangered, threatened, or another special conservation status.
- Removal and/or mitigation of invasive species.
- Avoidance of biologically sensitive areas, such as nesting or reproductive areas.
- Creation of new habitat designed to support biodiversity.

The following guiding principles should steer the design and evaluation of conservation dual-use solar sites:

1. Prioritize habitat connectivity and quality and wildlife migration within the area's broader watershed and ecosystem.
2. Identify and implement baseline measures for ecosystem value.
3. Strive for net-positive outcomes on and off site.

Case Study: Conservation and Large-Scale Solar

Topaz Solar Farm (San Luis Obispo County, CA): Nestled in the grasslands of California's Carrizo Plain, the Topaz Solar Farm is one of the world's largest solar energy facilities, with a rated capacity of 550 megawatts. It is also the site of ongoing research examining the impacts of responsible land use and conservation strategies on biodiversity at solar facilities.

Primarily sited on both active and fallow dry-land farmed fields, the Topaz project implemented several conservation dual-use approaches during and after project construction, including:

- Eliminating the use of fertilizers and rodenticides
- Ceasing annual tilling and land disturbance
- Inclusion of wildlife corridors throughout the project design
- Implementation of fencing designed to provide valuable habitat for the San Joaquin kit fox (an endangered species), while excluding larger predators
- Reseeding of project areas with a native seed mix (locally sourced from grasslands of the Carrizo Plain)
- Pre-construction biodiversity training for workers, as well as daily biological field monitoring
- Rotational livestock grazing for vegetation management

To-date, these approaches have created positive outcomes in terms of biodiversity and conservation goals for the project. In comparison to nearby Stewardship Lands which are not part of the Topaz project, areas underneath and around the solar arrays have demonstrated increased vegetative species diversity, as well as increased live vegetative groundcover (important from a dust control perspective). The facility has also seen a continued presence of San Joaquin kit foxes on-site, demonstrating the value of effective project design and management on endangered or threatened species.

To read more about the conservation approaches in place at the Topaz Solar Farm, please visit: https://www.researchgate.net/publication/325572446_Best_Practices_in_Responsible_Land_Use_for_Improving_Biodiversity_at_a_Utility-Scale_Solar_Facility

Conservation Dual-Use Solar – Planning, Design, and Feasibility Criteria:

Design	• Improve on-site hydrology through the construction of green infrastructure like bioswales. • Reintroduce native and pollinator flora, as well as small mammal habitat, and integrate all in solar site design. • Consult local/regional expertise to ensure the site is tailored to the local habitat, species, and conservation goals.
Construction	• Complete construction in a minimally impactful manner, including through low-impact selective cutting plans and burying lines. • Any soil and site impacts should be promptly remediated and improved.
Establishment & Maintenance	• Manage the site first and foremost as a restored ecosystem, not as a solar array. • Minimize pesticide use and mechanical maintenance in the solar maintenance plan.
Community Impacts	• Helps protect and improve sensitive ecosystems on and surrounding the site. • Decommissioning plans should address ecosystem restoration and protection at end of system lifecycle.
Feasibility	• Highly Dependent on site-specific and/or regional considerations and needs. • Reliant on certain design and maintenance considerations which will affect project costs and logistics, including but not limited to: - Consultation with knowledgeable local or regional experts - Project-specific environmental research and studies - Changes to site design to minimize or mitigate impacts to environmental resources

Conservation Dual-Use Example

- **Demonstration project at the National Wind Technology Center (Boulder, CO):** In 2010, NREL began conducting studies on restorative vegetation at its 1.1 MW solar array in Colorado. Situated on grassland habitat, the site was revegetated using a local seed mix designed to achieve positive ecological outcomes. Over a 3-year period, researchers found that revegetation using native species was "not only possible, but [could] achieve ground cover sufficient to control erosion and to begin to restore wildlife habitat."[23]
- **"Solinator Garden" (Fort Collins, CO):** This 1 MW solar farm, built by Solaris Energy and Namasté Solar, features a pollinator garden along the perimeter of the system and a flower and grass blend spread through the site.

[23] NREL. Native Vegetation Performance under a Solar PV Array at the National Wind Technology Center. May 2017. https://www.nrel.gov/docs/fy13osti/56290.pdf

4. Solar and Agriculture in NYS Programs and Regulations

4.1 Office of Renewable Energy Siting and Electric Transmission (ORES)

Given the importance of balancing solar and agriculture for local governments, this section highlights critical and relevant requirements as they appear in the state-level renewables siting process administered by the Office of Renewable Energy Siting and Electric Transmission (ORES). This information is intended to aid local governments in understanding the degree to which agricultural resources are considered by ORES.

In April 2020, the NYS legislature enacted the Accelerated Renewable Energy Growth and Community Benefit Act (the Act) to advance renewable energy development pursuant to the State's ambitious climate and energy goals. This legislation created ORES to serve as a central office responsible for implementing a consolidated and timely review and approval process for major renewable energy generating facilities, inclusive of solar. Under the Act, new renewable facilities with a nameplate capacity of 25 MW or more must obtain a permit through ORES. In April 2024, the Renewable Action through Project Interconnection and Deployment (RAPID) Act updated ORES responsibilities and moved the office to the Department of Public Service.

ORES utilizes a set of regulations and uniform standards and conditions in reviewing and permitting major renewable generating facilities. These standards and conditions were developed based on the comprehensive certificate conditions established under the Article 10 and previous 94-c permitting process, as well as in consultation with numerous state agencies and public input.

Agricultural lands, impact mitigation, and consultation with NYSAGM are highlighted throughout the ORES application and review process, including but not limited to the following standards and requirements:

- Applicants must submit a robust assessment of the project study area in order to catalogue and examine agricultural impacts.
- Projects proposed on active agricultural lands consisting of MSG 1-4 shall adhere to NYSAGM's *Guidelines for Solar Energy Projects-Construction Mitigation for Agricultural Lands* to the maximum extent practicable, and must hire an independent, third-party agricultural monitor approved by ORES/NYSAGM to oversee compliance with agricultural conditions and requirements.

ORES regulations also require applicants to provide a list of relevant substantive local laws and requirements applicable to the facility's construction and operation which may include local zoning and land use regulations pertaining to agricultural lands. If granted approval, the applicant shall be required to construct and operate a permitted facility in accordance with applicable local laws unless ORES determines that the laws are unreasonably burdensome.

For more information about ORES, including regulations and permit applications, visit https://dps.ny.gov/ores.

4.2 NYS Department of Agriculture and Markets (NYSAGM)

4.2.1 Solar Installations in State Certified Agricultural Districts

Article 25AA of NYS Agriculture and Markets Law (AML) provides a bottom-up approach to protecting farmland by establishing State Certified Agricultural Districts (Agricultural Districts). Landowners petition the County Legislature to include their farmland in an Agricultural District, affected municipalities are notified, a public hearing is held, and the County Legislature creates or modifies an Agricultural District by removing or adding land to the District. Farm operations located within an Agricultural District receive certain benefits, including limited protection from eminent domain, condemnation, and unreasonably restrictive local rules, regulations, laws, and ordinances; an agricultural assessment (see NYS Department of Taxation and Finance section below); protection from private nuisance lawsuits; and other benefits. A landowner receiving annual agricultural assessments inside an Agricultural District commits their land to an agricultural use for the next five years. Farmland outside Agricultural Districts are generally not eligible for other Agricultural District benefits and protections. The following sections further detail protections in place for farm-related solar projects, the environmental review process for solar projects in Agricultural Districts, and Notice of Intent (NOI) process for solar projects sited in Agricultural Districts.

Learn more about the Agricultural District Law at https://agriculture.ny.gov/system/files/documents/2020/01/summary-agrdistrict-law.pdf.

4.2.1.1 Farm-Related Solar in Agricultural Districts

As previously covered, in accordance with NYS AML, solar installations in Agricultural Districts which are considered on-farm equipment are protected from unreasonably restrictive local laws. NYSAGM considers solar projects to be “on-farm” equipment when they are designed, installed, and operated so that the anticipated annual total amounts of electrical energy generated does not exceed 110% of the anticipated annual electricity needs of the farm. Solar equipment is considered on-farm buildings in jurisdictions where local law classifies this equipment as structures or buildings. To ensure that electrical output from solar equipment does not exceed the 110% threshold, an initial energy assessment may be required to separate farm-related electricity consumption from other uses. If solar equipment is connected by remote net metering, combined multiple meters must determine the on-farm equipment’s electrical needs.

4.2.1.2 State Environmental Quality Review (SEQR) for Solar Projects in Agricultural Districts

Due to a solar project's potential impacts on sensitive land, actions in State Certified Agricultural Districts generally require more stringent environmental review. Upon receiving an application for a solar project, the relevant municipal board must determine whether it will engage in discretionary decision making ("[all] decisions of an agency to approve, fund, or directly undertake an action that may affect the environment"[24]), which may establish the project as subject to State Environmental Quality Review (SEQR). If the project is deemed subject to SEQR review, the board must classify the project under one of three SEQR action "types": Type I, Type II or Unlisted. Action type may depend on project size and, to some extent, proximity to sensitive environmental or social-cultural resources.

A non-agricultural use, such as a solar project which is not "on-farm" equipment, occurring wholly or partially within an Agricultural District is a Type I action if it exceeds 25 percent of any Type I threshold established under SEQR. For example, a Type I threshold of 10 acres for a particular physical alteration would be reduced to 2.5 acres in an Agricultural District, elevating review for any solar installation requiring more than 2.5 acres of land in an Agricultural District to a Type I action unless the installation is deemed "on-farm" equipment or building. NYSAGM may be an Interested Agency in the SEQR process and may become an Involved Agency depending on the nature of the impact.

To learn more, access the 'SEQR for Solar' section of NYSERDA's Solar Guidebook for Local Governments.

4.2.2 Notice of Intent (NOI) Process

NYSAGM considers non-residential solar arrays to be commercial facilities; accordingly, any such project located in a State Certified Agricultural District receiving funding from NYSERDA under the Clean Energy Standard or the NY-Sun Commercial/ Industrial Program must complete the Notice of Intent (NOI) process as detailed in NYS AML Section 305(4).

The project sponsor is required to submit a completed NOI Form to NYSERDA to examine and address the project's impacts on land, farm enterprises, and agricultural resources in the Agricultural District, and to demonstrate how project impacts may be avoided or minimized. NYSERDA will determine if sufficient information has been provided and submit this information to NYSAGM. The NOI process allows NYSAGM to conduct detailed, site-specific reviews of relevant filings, and to recommend project changes, mitigation strategies, or remedial action where necessary.

Additionally, in conjunction with NYSAGM, NYSERDA has adopted program rules that require certain projects to make an agricultural mitigation payment to the agricultural and farmland viability protection fund[25], based on both the size of the project and the extent to which the project overlaps with priority high-quality soils. This requirement incentivizes projects to minimize impacts on high quality agricultural lands, while simultaneously providing monetary contributions that will contribute to agricultural and farmland protection activities pursuant to Article twenty-five-AAA of the Agriculture and Markets Law.

For more information about the NOI process, visit https://agriculture.ny.gov/land-and-water/notice-intent-requirement.

For more information about agricultural mitigation requirements for projects participating in a NYSERDA incentive program, visit:

- NY-Sun Program: https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Contractors/Resources-for-Contractors.
- NYSERDA Solicitations for Large-Scale Renewables: https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Standard/Renewable-Generators-and-Developers/RES-Tier-One-Eligibility/Solicitations-for-Long-term-Contracts.

4.2.3 NYSAGM Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands

NYSAGM provides guidance for minimizing solar energy project construction impacts on agricultural lands via their *Guidelines for Solar Energy Projects - Construction Mitigation for Agricultural Lands* resource. These guidelines are highly technical and are designed to ensure the future and continued agricultural productivity of agricultural lands hosting solar projects.

Currently, adherence to the guidelines is required for all projects located in a State-Certified Agricultural District which are participating in a NYSERDA solar incentive program, including the NY-Sun Commercial/Industrial Program, as well as any Tier 1 Solicitation for Large-Scale Renewables. Projects permitted through ORES are also required to adhere to the guidelines. Additionally, as suggested in the Model Solar Law located in this Solar Guidebook, local governments may choose to require adherence to the guidelines for all ground-mounted solar installations located on highly productive or priority soils, such as MSG 1-4.

[24] NYS Department of Environmental Conservation. The SEQR Handbook, Fourth Edition. 2020. https://www.dec.ny.gov/docs/permits_ej_operations_pdf/seqrhandbook.pdf

[25] https://www.nysenate.gov/legislation/laws/STF/99-PP*2

The NYSAGM Guidelines are highly prescriptive, addressing agricultural impacts throughout the lifespan of a solar project by including requirements for key stages of project development, including:

- **Project Construction**: addresses treatment of topsoil, trenching and underground cable management, soil drainage management, and other topics.
- **Post-construction Restoration:** covers disposal of construction debris, site repair, soil decompaction, vegetation management, and other topics.
- **Monitoring and Remediation:** examines any continued impacts to site ecology and productivity during the growing season(s) following project construction.
- **Project Decommissioning:** ensures adequate removal of equipment (to specific depths), replacement of topsoil, agricultural restoration, and other actions.

To access these guidelines, visit: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/NY-Sun/Contractor-Resources/NYSAGM-guidelines-for-solar-construction-mitigation-ag.pdf.

4.2.4 Farmland Protection Plans

Pursuant to Administrative Rule 1 NYCCR 390, NYSAGM provides funding for municipalities and counties to develop agricultural and farmland protection plans in conjunction with the Cornell Cooperative Extension, local farmers, and other stakeholders. These plans, which are intended to identify priority lands and areas for preservation within the community, must:

- Include a statement of the municipality's goal(s) with respect to agricultural and farmland protection.
- Identify the general location of any lands or other designation of areas that are proposed to be protected.
- Analyze the lands or areas to be protected, such as their value to the agricultural economy of the municipality, their open space value, the level of conversion pressure being experienced, and the consequences of possible conversion.
- Describe activities, programs, and strategies intended to be used by the municipality to promote continued agricultural use, including how they are to be financed, and which may include but not be limited to revisions to the municipality's comprehensive plan.
- Describe and identify other municipal and county planning and land use programs, if any (such as economic development, zoning, and comprehensive land use planning), which may be shown to complement and be consistent with the municipal agricultural and farmland protection plan, as well as identification of any plans, policies, or objectives which are inconsistent with or conflict with the plan.

For more information on Farmland Protection Planning and Implementation Grants visit: https://agriculture.ny.gov/land-and-water/farmland-protection.

4.3 NYS Department of Taxation and Finance

4.3.1 Agricultural Assessments

An agricultural assessment is an adjustment to a property's assessed value based on a land's ability to produce a crop, livestock or livestock product associated with eligible Farm Operations rather than full development value. The property tax that will be paid by the owner is based on agricultural assessment adjustments associated with production values of soil in active agricultural production. Land inside and outside of an Agricultural District may be eligible for an agricultural assessment. To qualify, farmers must produce crops, livestock, or livestock products on seven or more acres of land and have average annual gross sales of $10,000 or more for the prior two years. Land with less than seven acres in agricultural production must have average gross sales of $50,000 or more for the prior two years. Farmland that has received an agricultural assessment must remain in agricultural use for the next five years if located inside an Agricultural District or eight years if located outside of an Agricultural District.

For more information regarding agricultural assessments, visit:

- NYSAGM Agricultural Assessments Information: https://agriculture.ny.gov/land-and-water/tax-credits-and-agricultural-assessments#agricultural-assessment-information.
- Department of Tax & Finance Agricultural Assessment Information: www.tax.ny.gov/research/property/assess/valuation/agindex.htm.

4.3.2 Converting Farmland to Solar

AML Section 301(8) defines "conversion" as "an outward or affirmative act changing the use of agricultural land" to a nonagricultural use. When a conversion occurs or updates are necessary, the landowner is responsible to notify town assessor. A conversion penalty will likely be imposed if farmland located within an Agricultural District is converted to a nonagricultural use within five years of an agricultural assessment, or eight years if located outside of an Agricultural District. Conversion penalties are equal to five times the taxes saved in the most recent year that the land received an agricultural assessment, plus interest.[26] No conversion penalty is imposed if agricultural land is converted for oil, gas, or wind energy development that does not support agricultural production. However, because solar energy is not included in this exemption, a conversion payment would apply if the electrical output of solar equipment substantially exceeds (e.g., is more than 110% of) a farm's anticipated electrical needs.

When only a portion of a parcel is converted to a nonagricultural use, the assessor apportions the real property tax assessment and the agricultural assessment, determines the tax savings attributable to the converted portion, and computes the conversion payment based on that portion. If the remaining land within a parcel is used for agricultural purposes and the eligibility criteria are met, that land may still receive an agricultural assessment. Assessors can work with landowners to determine the conversion payment. Landowners should know where solar projects are sited on their land to work with the associated Soil and Water Conservation District to revise the amended Soil Group Work Sheet, which will enable a comparative analysis of benefited acres versus total converted acres by mineral, organic, and farm woodland soil groups.

Conversion payments are added to the converted land's taxes. Properties may be subject to a tax sale if conversion payments are not made. These payments generally become the landowner's responsibility at the time of conversion, although solar project developers will typically cover these costs as a part of their contract with the landowner.

Finally, landowners must notify the assessor within 90 days whenever a parcel receiving an agricultural assessment is converted to a nonagricultural use. Failure to notify may result in a penalty of two times the payments owed, up to a maximum of $1,000.

For more information regarding agricultural land conversions, access the Department's Conversion of Agricultural Lands guidance at: https://www.tax.ny.gov/research/property/assess/valuation/ag_conversion.htm.

4.4 NYS Working Groups

4.4.1 Agricultural Technical Working Group

Early in 2021, NYSERDA organized and hosted the first meeting of the NYS Agricultural Technical Working Group (A-TWG). The A-TWG was founded to identify opportunities, navigate conflicts, and promote best practices around issues at the intersection of solar development and agriculture, with consideration of other land use concerns.

A-TWG members represent a variety of stakeholder groups, including agricultural land and farm advocates, solar developers and operators, climate and environmental organizations, local government officials, academia, and state agencies. The group's intention is to bring together science and socio-economic subject matter experts to develop collaborative advice, guidelines, or other products which consider the State's agricultural land and farm economy while responsibly advancing the State's renewable energy and greenhouse gas emissions reduction goals.

The A-TWG acts as a forum where stakeholders can openly communicate concerns, identify information needs, and learn of actions being taken by the State and other stakeholders to improve outcomes around solar and agriculture. The group also serves as an advisory body to relevant state agencies and other participating entities, providing advice and guidance to help steer efforts to advance responsible renewable energy development while appropriately balancing the needs and contributions of New York agricultural operations, lands, and farmers.

The A-TWG has formed three separate specialist committees each with its unique focus. one committee is focused on advancing agrivoltaics that is beneficial to farmers and their communities to encourage further development of solar while maintaining and demonstrating viable commercial agriculture operations. A second committee provides input on NYSERDA's Smart Solar Siting Scorecard for NYSERDA's Tier 1 Solicitation for Large-Scale Renewables to encourage a balanced approach between renewable energy siting and other New York State policies, goals, and objectives. The third and newest committee is the Regional Agronomic Impacts from Solar Energy Specialist Committee, or the RAISE Committee.

[26] AML 305(1)(d), AML §306(2)(a)(i): https://www.nysenate.gov/legislation/laws/AGM

The purpose of this specialist committee is to support the A-TWG in its advisory function to the State of New York and other participating entities, and to provide advice and guidance to help steer efforts to advance renewable energy development in a responsible way that supports New York State's agricultural operations, lands, farmers, and communities. In carrying out its mission, the RAISE Committee will advise and inform development of a study (or suite of studies) that can be undertaken to assess the relative benefits and impacts of solar energy development on regional farmland economies.

For more information regarding the A-TWG, including meeting materials and announcements, visit: www.nyatwg.com/.

4.4.2 Farmland Protection Working Group

Adopted in April 2021, the State's Fiscal Year 2021/2022 Budget included a provision to establish a statewide Farmland Protection Working Group (FPWG). The FPWG was tasked with recommending strategies to minimize the impacts of renewable energy development on productive agricultural soils and working farms, and to facilitate and promote input from local governments in the renewable energy siting process. The FPWG, which held its first meeting in December 2021, is administered by NYSAGM, and included executive representation from state agencies including NYSDEC, NYSERDA, ORES, and the NYS Department of Public Service. Other appointed Working Group members included representatives from local and county governments, farm advocates, and County Agriculture and Farmland Protection Boards. In 2022, the FPWG published an interim report which focused on strategies to integrate renewable energy sources into working landscapes with minimal impact on agriculture, including the need for more research; the potential for financial incentives; and proposed tools for State and local governments. The Interim Report can be found online at agriculture.ny.gov/land-and-water/2022-interim-report-new-york-state-farmland-protection-working-group.

For more information regarding the Farmland Protection Working Group, visit: https://agriculture.ny.gov/land-and-water/farmland-protection-working-group.

5. Resources for Local Governments

The following guidance documents, resources, and articles provide additional information for local governments looking to implement a balanced approach toward regulating solar development on agricultural lands.

5.1 Solar and Agriculture Guidance Documents

Farmland Solar Policy Design Toolkit
U.S. Department of Agriculture (2020)
https://farmandenergyinitiative.org/wp-content/uploads/2020/08/Final-FSPP-Toolkit-Report.pdf

Farmer's Guide to Going Solar
Solar Energy Technologies Office, DOE Office of Energy Efficiency & Renewable Energy
https://www.energy.gov/eere/solar/farmers-guide-going-solar

Smart Solar Siting Principles and Examples of Land Use Laws that Support Renewable Energy While Protecting Farmland
American Farmland Trust (2019)
https://s30428.pcdn.co/wp-content/uploads/2019/05/AFT-Smart-Solar-Siting-Principles-and-Examples-of-Local-Solar-Laws-that-Protect-Farmland.pdf

Low-Impact Solar Development Strategies Guidebook
InSPIRE
https://openei.org/wiki/InSPIRE/Guidebook

Commercial Solar Development on Farmlands
Sustainable Development Code (2020)
https://sustainablecitycode.org/brief/commercial-solar-development-on-farmlands-2/

Considerations When Leasing Agricultural Land to Solar Developers
Cornell University (2019)
http://ccetompkins.org/resources/considerations-when-leasing-agricultural-lands-to-solar-developers

Sustainable Farm Energy
Cornell Small Farms Program (2019)
https://smallfarms.cornell.edu/projects/farm-energy/

5.2 New York Regional Resources

Solar Ready, Climate Resilient: Best Practices and Recommendations for Solar Zoning in the Hudson Valley
Scenic Hudson (2020)
https://www.scenichudson.org/wp-content/uploads/2021/01/solar-zoning-in-the-hudson-valley.pdf

Planning for Offsite Solar Energy Projects
NYS Tug Hill Commission (2020)
https://tughill.org/wp-content/uploads/2020/02/Planning-for-Offsite-Solar-Energy-Projects.pdf

5.3 Dual-Use Solar Information and Resources

Combining Solar Photovoltaic Energy and Agriculture Production
NYSERDA
https://www.nyserda.ny.gov/PutEnergyToWork/Industry-Energy-Solutions/Agriculture/Agrivoltaics

Agrivoltaics
Fraunhofer Institute for Solar Energy Systems
https://www.ise.fraunhofer.de/en/key-topics/integrated-photovoltaics/agrivoltaics.html

AgriSolar Clearinghouse
Connecting businesses, land managers, and researchers with trusted resources to support the growth of co-located solar a nd sustainable agriculture
https://www.agrisolarclearinghouse.org/

Smart Solar Siting for New England: Policy Strategies for Farmland Protection
American Farmland Trust (2020)
https://s30428.pcdn.co/wp-content/uploads/sites/2/2020/09/NE-SSS-Solar-Policy-Strategies-for-Farmland-Protection-FINAL.pdf

How Community Solar Supports American Farmers
Solar Energy Industries Association (2020)
https://www.seia.org/sites/default/files/2020-02/SEIA-Report-Community-Solar-Support-American-Farms-2020.pdf

Solar and Agricultural Land Use
Solar Energy Industries Association (2019)
https://www.seia.org/sites/default/files/2019-11/Solar%20Ag%20Land%20Usage%20FactSheet%202019-PRINT.pdf

Clean Energy Home
UMass Amherst, The Center for Agriculture, Food and the Environment
https://ag.umass.edu/clean-energy

Impacts and Opportunities from Large-Scale Solar Photovoltaic (PV) Electricity Generation on Agricultural Production
Environmental Quality Management Journal (2019)
https://onlinelibrary.wiley.com/doi/abs/10.1002/tqem.21629

Examining the Potential for Agriculture Benefits from Pollinator Habitat at Solar Facilities in the United States
Environmental Science and Technology (2018)
https://pubs.acs.org/doi/pdf/10.1021/acs.est.8b00020

Solar Panels Cast Shade on Agriculture in a Good Way
Science Daily (2019)
https://www.sciencedaily.com/releases/2019/07/190729123751.htm

Growing Crops Under Solar Panels? Now There's a Bright Idea
Wired (2021)
https://www.wired.com/story/growing-crops-under-solar-panels-now-theres-a-bright-idea/?utm_source=facebook&utm_medium=news_tab&utm_content=algorithm

Questions?

If you have any questions regarding the solar Installations on agricultural lands, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/SolarGuidebook. The NYSERDA team looks forward to partnering with communities across the state to help them meet their solar energy goals.