

DRAFT Guidance for Siting Solar on Agricultural Land

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1.0 Siting Solar on Agricultural Land

This guidance document provides information for both farmers and developers considering solar development on farmland. The CT Department of Agriculture (DOAG) recommends siting solar on non-farmland, agricultural infrastructure and unclassified farmland soils not currently in production or fallow field(s) that have been previously disturbed prior to siting solar on classified farmland containing prime, statewide, and locally important farmland soils. If the previous options have been exhausted, and due diligence has been done to justify such, DOAG and the CT Department of Energy and Environmental Protection (DEEP) recommend the dual use of farmland, referred to as agrivoltaics.

DOAG's mission is to foster a healthy economic, environmental, and social climate for agriculture by developing, promoting, and regulating agricultural businesses, protecting agricultural and aquacultural resources, enforcing laws pertaining to domestic animals; and promoting an understanding among the states citizens of the diversity of Connecticut agriculture, its cultural heritage and contribution to the state's economy.

DEEP has two overarching missions: conserving, improving, and protecting the natural resources and the environment of the state of Connecticut, and making cheaper, cleaner, and more reliable energy available for the state's people and businesses. DEEP's energy procurements will use best practices for alternative siting in order to preserve prime, statewide, and locally important farmland soils.

This guidance should be used in conjunction with DOAG's [Solar Energy Project Consideration Guidelines](#). Additionally, [DEEP's Siting Solar Environmental Permitting Factsheet](#) should be used to increase certainty in project planning. DEEP also offers [pre-permit application meetings](#) to assist project applicants in understanding regulatory requirements and with permit application submittal.

The first part of this guidance addresses information that pertains specifically to agricultural considerations for these solar projects, and the latter part pertains to environmental considerations and requirements. The requirements that are mandated by law, regulation, or policy are described as items that "shall" be followed, and all other practices should be interpreted as recommended best practices.

1.1 Introduction to Agrivoltaics

Agrivoltaics refers to the practice of integrating solar energy generation and farming on the same piece of land. All dual-use applications encompass the construction of solar generating units while using land under and between panels for agricultural purposes such as crops and livestock grazing.

DEEP and DOAG recommend dual use systems that maximize crop production and minimize changes to existing vegetation management, while also incorporating solar energy production. Solar installations should be strategically designed, installed, and operated to maintain agricultural productivity and soil quality.

When agrivoltaic projects are carefully planned and executed to consider the specific geographic location and dual use proposed, there are potential benefits to the farmland that may be realized, including:

- Temperature moderation for plants and livestock under panels.
- Reducing water evaporation, water use, and intense sunlight during warmer months of agricultural production.

1.2 Solar Siting Best Practices and Design Recommendations on Agricultural Land

DEEP and DOAG strongly recommend use of the siting best practices discussed in this section to allow the continued use of productive farmland and classified soils, while advancing renewable energy in Connecticut.

Placing solar on agricultural land, especially farmland classified as having prime, statewide, or locally important farmland soils, should be avoided. Prime farmland soils are those with the best combination of physical and chemical characteristics for producing food, feed, and fiber. If other options have been exhausted, areas with classified soils that have been degraded due to activities such as gravel extraction or development should be considered next, followed by areas of the farm not currently in production and that are not classified as prime farmland.

The U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) [has identified and mapped](#) 99% of the soils in the state. The Web Soil Survey tool can assist in identifying areas that contain prime and statewide important farmland soils. Soils data can also be downloaded for use in [GIS. Locally important soils information](#) can be found on the United States Department of Agriculture's Field Office Technical Guide. "Prime Farmland" is further described in [7 CFR 657](#), as amended.

If solar energy developers are considering solar projects that exceed 2 MW AC in size and may impact prime farmland, the project must come in as a [Certificate of Environmental Compatibility and Public Need](#) to the Connecticut Siting Council. In this process, a letter from the Department of Agriculture must be obtained and projects must not materially affect the status of such land as prime farmland (see Connecticut Siting Council section below).

To "...not materially affect the status of such land as prime farmland..." DEEP and DOAG recommend the following:

1. Soil disturbances should be minimized, especially during construction and decommissioning, and a vegetation and soil management plan should be developed for the lifetime of the solar project.
2. The solar array should not interfere with the continued use of the land beneath the canopy for agricultural purposes.
3. The height and spacing of panels should accommodate crop-specific needs for sunlight, farm machinery, and worker accessibility.
4. Rows between panels should be made as wide as necessary to accommodate the current agricultural use.
5. If grazing animals are proposed, [DOAG's Requirements for Solar Grazing](#) should be followed.
6. The farmer/farmland owner should be engaged as a partner; installing solar on land that would displace farmers who are renting/leasing the land should be avoided.
7. The need for access to and from the site for vehicles with trailers and other livestock grazing or farming equipment should be considered.
8. Parties should plan for access to water for grazing or vegetation.
9. All dual use plans should be fully implemented and operational for the duration of the solar installation.

DOAG's specific design recommendations are contained in **Appendix A**. Additional resources can be found on DOAG's page for [On Farm Energy Resources](#).

Access to the site for the purpose of conducting scientific research and data collection related to agrivoltaics should be granted for the lifetime of the project.

Although pollinator habitats are not in and of themselves considered a dual use, DOAG and DEEP recommend that native pollinator plant species be established between the perimeter fence and the limits of the agricultural co-use. If solar grazing is selected in whole or part as an agricultural dual use,

then a species-specific pollinator friendly forage mix with nutritional health considerations should be selected as ground cover.

1.2.1 Agricultural Conservation Easements

Properties where the State of Connecticut has purchased development rights under the Farmland Preservation Program ([Connecticut General Statutes \(CGS\) section 22-26aa et seq.](#)) cannot be used for commercial energy production. If permitted under a farm's specific deed terms, a landowner may, with prior notice to and approval from the Commissioner of DOAG, install solar solely for on-farm energy demand.

1.3 Environmental Considerations

1.3.1 Wildlife

Both the Construction Stormwater General Permit (Stormwater GP) and the Connecticut Siting Council will require a [Final Determination Letter from the DEEP Natural Diversity Data Base Program](#) attesting to the presence or absence of State-listed Endangered, Threatened, or Species of Special Concern at the project site and specifying any necessary mitigation measures to avoid impacts to any such species at the site. In the case of the Stormwater GP, the developer must obtain this letter before DEEP can begin any review or processing of the permit registration.

1.3.2 Stormwater

Solar facilities, whether sited on farmland or not, will require a Stormwater Permit from DEEP for their construction. Generally, stormwater controls are required to maintain site runoff to pre-development levels, and site stabilization must be achieved after the initial clearing and grading of the site and before construction activities commence. A letter of credit also must be posted to ensure that the stormwater controls are properly maintained and, if necessary, repaired; this requirement fully expires two years after the project site is determined to be stabilized. Please review the [Stormwater Permitting webpage](#) for the latest information on permitting.

The solar developer should conduct an assessment of the impact of a proposed solar installation on [aquifer protection areas](#) and the public water supply watershed, including the extent to which the project may impair water quality and/or quantity, and consultation with water utilities (if applicable). Proper stormwater management, with erosion and sedimentation controls, is key to ensuring good water quality.

Minimal grading should be done during the construction of the solar facility to minimize soil impacts. Design decisions, including siting drainage ditches, containment ponds and access ways, should be made with the landowner and in a manner that protects future agricultural practices. Soils shall remain on the farm property, and any necessary fill brought onto the site shall be free of trash and debris. If herbicides are being used to control vegetation in or around the array, the developers shall notify the landowner and the farmer to create a plan. Vegetation must be established as soon as possible during or after construction to avoid runoff and soil loss. At the end of a solar facility's commercial life, the developer should return the project site back to its original state unless otherwise directed by the landowner.

1.3.3 Impacts to Core Forest

“Core Forest” is defined in [CGS section 16a-3k](#) as unfragmented forest land that is 300 feet or greater from the boundary between forest land and non-forest land as determined by the Commissioner of DEEP.

For State-sponsored energy procurements, any impacts to core forest blocks of 250 acres or more are generally prohibited, depending upon the terms of the solicitation. For any solar facility in excess of 2 MW AC capacity, if core forest blocks of any size are impacted, application to the Siting Council must be in the form of a Certificate of Environmental Compatibility and Public Need unless a letter is obtained from the [DEEP Forestry Division](#) that the proposal will have “no material effect” on the relevant block of core forest, in which case the proposal may be submitted to the Siting Council as a Petition for Declaratory Ruling, as discussed below.

Applicants can obtain a letter of "No Material Effect" from the DEEP Forestry Division, pursuant to [CGS section 16-50k\(a\)](#), by submitting their letter request to DEEP's [State Forester](#) for review. Such requests should include the footprint size of the project and a map of the project site, including the interconnection, overlaid on the [Forestland Habitat Impact Map](#). Applicants should use this map as a screening tool to take a first look at which sites might have core forest impacts. DEEP's Forestry Division and Wildlife Division staff review the submittal to assess what habitat effects might be present. The map's scale often requires a closer, more precise look to see if a mapped area will actually be affected by the proposed facility. DEEP sends the letter directly to the Siting Council, with copies sent to the developer and DOAG.

1.3.4 Wetlands

In general, a 100-foot buffer is required between the footprint of the facility and adjacent wetlands and watercourses. Both the [Stormwater GP](#) and the Connecticut Siting Council specify this requirement. Under certain circumstances, a lesser buffer width may be acceptable.

1.3.5 Local Zoning Considerations

Other potential environmental impacts of concern include visual impacts to abutting or nearby residences and public areas that may require landscaping or design elements to avoid such visual impacts; the extent of tree clearing necessary both for the construction of the facility itself and to avoid shading impacts to the solar panels; and inverter noise impacts to receptors near the facility. Local/municipal permitting and ordinances may apply and are not covered in this guidance. Applicants should contact the local planning office to ensure their project meets all applicable local requirements.

1.4 Connecticut Siting Council

Projects under 1 MW AC must apply to the local municipal authority. All projects greater than 1 MW AC must apply to the Connecticut Siting Council. For most solar facility projects, application to the Siting Council can be made as a [Petition for a Declaratory Ruling](#) that no [Certificate of Environmental Compatibility and Public Need](#) is required.

Projects over 2 MW AC that impact prime farmland, in whole or part, or in core forests require submission to the Siting Council as an application for a [Certificate of Environmental Compatibility and Public Need](#), pursuant to [Public Act 17-218](#), amending [CGS Section 16-50k\(a\)](#). A Petition for Declaratory Ruling may be pursued if the following documents are included in the application package submitted to the Siting Council:

1. A letter from DOAG stating that the project will "...not materially affect the status of such land as prime farmland..."
2. A letter from DEEP stating that the project will "...not materially affect the status of such land as core forest..."

Potential applicants to the Siting Council are encouraged to visit the [Connecticut Siting Council website](#).

1.5 Interconnections

The solar developer should ensure that the selected site has sufficient [Hosting Capacity](#) because agricultural land may be more remote with fewer or farther away points of interconnection. "Hosting Capacity" refers to an estimated maximum amount of distributed generation that can be accommodated on the transmission or distribution system at a given location under existing grid conditions and operations, without adversely impacting safety, power quality, reliability, or other operational criteria, and without requiring significant infrastructure upgrades.

Per [PURA Docket No. 03-01-15RE02](#) (Compliance Order No. 1, May 12, 2010 Attachment 1) and [PURA Docket No. 03-01-15RE03](#) (Guidelines for the Interconnection of Residential Single Phase Certified Inverter-Based Generating Facilities of 20 kW(ac) or Less), Connecticut electric distribution companies (EDCs) "are responsible for the distribution of electric power throughout most of the state of Connecticut. In order to carry out their responsibilities to all customers, each Electric Distribution Company must assure that all Interconnections are made to certain protocols and procedures," as further described in the [Guidelines for Generator Interconnection](#). Interconnection applications are required; the application fee for projects greater than two (2) MW is \$1,000. The [Guidelines for Generator Interconnection](#) provide general guidance for interconnections of generating facilities.

1.6 Decommissioning

Decommissioning means that when a solar facility will be closed, all photovoltaic equipment is completely removed, and the land is restored to its original condition. The Connecticut Siting Council requires a decommissioning plan to be submitted as part of any Application or Petition. The developer should be responsible for decommissioning costs.

[CGS Section 16-50k\(a\)](#), (AN ACT CONCERNING CERTAIN SOLAR PHOTOVOLTAIC FACILITIES LOCATED ON PRIME FARMLAND, FARMLAND OF STATE-WIDE IMPORTANCE OR CORE FOREST LANDS), requires a bond to cover all costs associated with the decommissioning of solar projects 2 MW AC or greater sited on prime farmland and the "restoration of such prime farmland, including, but not limited to, an inspection by a qualified soil scientist or other agricultural soils professional to assess and assure that the soils of such prime farmland are restored and will be suitable for farming. Such an assessment

shall include, but need not be limited to, consideration of topsoil and subsoil depths, soil compaction, alteration in surface and subsurface drainage, erosion and sedimentation control measures and soil fertility.”

During decommissioning pursuant to CGS section 16-50k, solar developers will be required return the land to productive agricultural use by completing the following:

- Removal of solar arrays;
- Removal of racking posts completely from the ground by pulling them out. They cannot be cut at ground level;
- Removal of foundations for inverters and transformers;
- De-compaction of compacted soils;
- Backfilling excavations only with native soils;
- Revegetation, if vegetation disturbance takes place as a result of decommissioning;
- Unless agreed upon by the landowner, removal of access roads, fencing, drainage ditches and detention ponds, with backfilling using native soils to level the terrain; and
- Soil testing and incorporation of needed amendments to restore the soil to be suitable for farming.

2.0 Additional Resources

- [DoAg's On Farm Energy Resources](#)
- [DoAg's Requirements for Solar Grazing](#)
- [DEEP's Solar Permitting Factsheet](#)
- [Connecticut Farm Energy Program](#)
- UConn's Ag Experiment Station Soil Testing information:
 - [Soil testing locations in Connecticut](#)
 - [Web Soil Survey](#)
 - [Locally Important Soils information](#)
- American Farmland Trust:
 - [Solar Leasing: A Guide for Agricultural Landowners in the Pacific Northwest](#)
 - [Smart Solar in Connecticut: Farmer Survey Findings and Initial Recommendations](#)
 - [Examples of Dual-use Solar Arrays](#)
 - [Solar Siting Guidelines for Farmland](#)
- American Solar Grazing Association
 - [American Solar Grazing Association \(ASGA\)](#)
 - [ASGA Sample Grazing Contract Template](#)
- [Agrisolar Clearinghouse](#)
- [DOE's Farmer's Guide to Going Solar](#)
- [Farmland Solar Policy Design Toolkit](#)
- [Agricultural Good Practice for Solar Farms](#)
- Progressive Designs
 - [Vertical Solar Panels](#)
 - [Transparent Solar Panels](#)

- [Designing Plant-Transparent Agrivoltaics](#)
- YouTube Videos
 - [Solar Grazing 101](#)
 - [Grazing in Solar Farms – Teaching Tools for Beginning Farmers](#)
 - [Solar Grazing with Cattle in Massachusetts](#)
- Benchmarking information from other states:
 - Maine
 - [Maine Dual-Use \(Agrivoltaic\) Solar Installation Fact Sheet](#)
 - [Maine Sustainable Agricultural Society's Dual Use Research Page](#)
 - [Commercial Solar Projects: Foundation and Installation Types Fact Sheet](#)
 - Massachusetts
 - [UMass Amherst Clean Energy Extension Research Page for Dual Use](#)
 - Vermont
 - [Vermont Solar Grazing Best Practices Checklist](#)
 - [Vermont Land Link](#)
 - [UVM Extension Guide to Farming-Friendly Solar](#)
 - Rhode Island
 - [RI Energy Efficiency and Renewable Energy Programs for Farms](#)
 - Pennsylvania
 - [PA Farmland Considerations for Siting Grid-Scale Solar Panels](#)
 - New Jersey
 - [Rutgers Agrivoltaics Program](#)
- [Mount Morris Agrivoltaics Study: Co-locating Solar and Agriculture](#)
- Vertical Solar Panels Technical Information:
 - [Clean Technica Article: New Research Says Vertical Solar Panels Have Improved Performance](#)
 - [Smart Energy Journal Article: Integration of Vertical Solar Power Plants into a Future German Energy System](#)

Appendix A: Design Recommendations for Agrivoltaics

Stewardship and Soil Conservation

The developer and farmer should work with an agri-solar consultant on a vegetation and soil management plan for the life of the solar installation. Minimal grading should be done during the construction of the solar facility to minimize soil impacts. Design decisions, including siting drainage ditches, containment ponds and access ways, should be made with the farmer and landowner as a partner and in a manner that protects and enables future agricultural practices.

Soils must remain on the farm property, and any necessary fill brought onto the site shall be free of trash and debris. The soils should not be stripped during re-grading, and disturbances must be kept to a minimum. Vegetation should be established and maintained as soon as possible during and after construction to avoid runoff and soil loss. Soil sterilization and gravel underlayment should be avoided. Installation methods with minimum soil impacts should be utilized.

If herbicides are being used to control vegetation in or around the array, the developers shall notify the landowner and the farmer to create an application plan in accordance with DEEP's [Certificate to Engage in Use of Pesticides](#).

Panel Height Recommendations

For fixed tilt arrays, the minimum height of the lowest panel point should be eight (8) feet above ground.

For tracking arrays, the minimum height of the panel at its horizontal position should be ten (10) feet above ground.

Row width between panels should allow for the continued production of crops, and accommodate farming equipment to continue agricultural production.

Sunlight Recommendations

Documentation should be provided to establish the maximum sunlight reduction from panel shading on every square foot of land directly beneath, behind, and in the areas adjacent to and within the array's design. Project proposals should demonstrate how this sunlight reduction is based upon compatibility with the proposed agricultural products and will sustain continued productivity.

Growing Season/Time of Day Considerations: The typical growing season should be March/April through October/November, with sunlight reduction to be measured between 10AM and 5PM for March and October, and from 9AM to 6PM from April through September.

Considerations for Progressive Designs

Emerging research suggests there may be beneficial applications for agrivoltaics using transparent or vertical photovoltaic (PV) panels.

Transparent panels have the potential to allow agrivoltaics systems to support crops with high sunlight needs. Placement of vertical arrays on the periphery of agricultural fields also allows high sunlight penetration and may cause minimal disturbance to existing agricultural activities. Installing bifacial modules in a predominantly east-west configuration has the potential to produce the same amount of electricity as south facing panels. These systems may also reduce the need for on-site storage of excess electricity by distributing electrical generation across the morning and evening.

Access to sites for the purpose of conducting scientific research and data collection related to agrivoltaics should be granted for the lifetime of each project. Collaborative support between stakeholders is critical to the advancement of dual use best practices.

Inability to Adhere to System Design Parameters

DEEP and DOAG recognize the variety and, in some cases, the uniqueness of farming operations. If there is an inability to adhere to the system design parameters, justification to show all compliance efforts were made must be provided when applying for a letter from DOAG stating that the project will not materially affect the status of such land as prime farmland.

Justification should include the following:

1. An alternative plan that demonstrates how this application will "...not materially affect the status of such land as prime farmland..."
2. Applicant should provide justification as to why the alternative dual use design is necessary for the proposed agricultural operations on the relevant parcel of land.
3. The alternative plan should describe how each square foot of land will be used for agriculture production.