DRAFT Guidance for Siting Solar on Agricultural Land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 Department of Energy and Environmental Protection (DEEP) and the Department of Agriculture (DoAg) recommend the dual use of farmland, referred to as agrivoltaics. This guidance should be used in conjunction with DoAg's Solar Energy Project Consideration Guidelines.

1.1 Introduction

"Agrivoltaics" is the simultaneous use, or dual use, of agricultural land for primary agricultural production and electricity generation from photovoltaic (PV) panels. The agricultural use may include grazing, row crops, fruit crops, older apple orchards, vineyards, in combination with roof installations on greenhouses and barns or field installations under which crops can be grown or grazing can occur.

DoAg and DEEP recommend dual use systems that maximize biomass 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.

The benefits of agrivoltaics may include:

- Protecting land for later agricultural use by preventing land from being permanently developed for commercial, housing, or other non-agricultural uses;
- Diversifying farm income while continuing agricultural production;
- Applying community farming models within or around solar arrays;

- Cooling plants and livestock under panels;
- Reducing water evaporation, water use, and intense sunlight during warmer months;
- Providing additional revenue for livestock grazers;
- Protecting livestock from predators with proper fencing;
- Providing habitat for pollinators;
- Meeting climate goals and energy demands while also protecting our food supply;
- Recharging nutrients on degraded lands;
- Extending growing seasons;
- Encouraging greater acceptance for solar development in the community;
- Reducing installation costs due to utilizing previously cleared, tilled land; and
- Giving incentives to future energy procurements.

1.2 Siting Best Practices

DEEP and DoAg strongly recommend the use of the siting best practices discussed in this section in order to preserve productive farmland while advancing renewable energy in Connecticut. Requirements that are mandated by law, regulation, or policy are described as items that "must" be followed, and all other practices should be interpreted as being recommended best practices.

Part of DoAg's mission is to foster a healthy economic, environmental, and social climate for agriculture by developing, promoting, and regulating agricultural businesses, protecting agricultural resources, and promoting an understanding of Connecticut's agricultural 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 strive to discourage use of prime farmland soils.

DoAg strongly encourages projects sited on farmland to avoid siting on Prime farmland soils. Prime farmland soils are those with the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The U.S. Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) has identified and mapped 99% of the soils in the state. Soils data can also be downloaded for use in GIS: https://cteco.uconn.edu/guides/Soils.htm. "Prime Farmland" means land that meets the criteria for prime farmland, as described in 7 CFR 657, as amended.

When planning for solar development on farmland, areas of the farm with no Prime or other Important Farmland soils should be considered first. Important Farmlands include farmland of statewide importance and farmland of local importance. Areas with Prime and Important Farmland soils that have been degraded due to activities, such as gravel extraction or development, should be considered next. Placing solar on prime and important farmland soils should be avoided. NRCS mapping can assist in identifying these locations and soil testing can be done for a more site-specific analysis. If a project is sited on non-prime farmland soils, DoAg prefers that the land chosen remains actively farmed in whatever capacity is suitable for those soil types, i.e., dual use. NRCS mapping can assist in identifying these locations and soil testing can be done for a more site-specific analysis. If a project is sited on non-prime farmland soils, DoAg prefers that the land chosen remains actively farmed in whatever capacity is suitable for those soil types, i.e., dual use.

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If solar energy developers are considering solar projects that may impact prime farmland resources, the project must come in as a Certificate of Environmental Compatibility and Public Need to the Connecticut Siting Council if the project exceeds 2 MW AC in size, unless the Department of Agriculture issues a letter of No Material Effect for the project (see Siting Council section below).

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. A landowner may, with prior notice to and permission from the Commissioner of DoAg, install solar solely for on-farm energy demand.

1.2.2 Environmental Considerations

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 to DoAg.

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).

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Proper stormwater management, with erosion and sedimentation controls, is key to ensuring good water quality.

Wetlands

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

Wildlife

Both the Stormwater Permit and the 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 Permit, the developer must obtain this letter before DEEP can begin any review or processing of the permit registration.

Land Management

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 should 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.

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.

1.2.3 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 "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 EDC 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.

1.3 Planning for Agrivoltaics

The following considerations should also be taken into account when planning for dual use of farmland:

- If dual use is part of the project when it begins, then DEEP, DoAg, and the Siting Council expect the dual use to continue for the duration of the solar installation.
- DEEP's Siting Solar Environmental Permitting Factsheet should be used to increase certainty in project planning. Additionally, DEEP offers pre-permit application meetings to assist project applicants in understanding regulatory requirements and with permit submittal.
- Solar placement is recommended on farm rooftops, irrigation ditches, or other land not well suited for agriculture.
- If solar is to be sited on farmland, the least productive or most degraded farmland should be utilized.
- If solar energy is developed on farmland, policies and practices should protect soil health, especially during construction and decommissioning, to ensure opportunities for farming in the future.
- Installing solar on land that would threaten farmer-renters who could be displaced should be avoided.
- The need for access to and from the site for vehicles with trailers and other livestock grazing or farming equipment should be considered.
- Parties should plan for access to water for grazing or vegetation.

Pollinator plant species should be established either between the perimeter fence and the limits of disturbance of construction and clearing activities, or, where grazing animals are not being employed for vegetation management, pollinator plant species may be an appropriate ground cover within the perimeter fence, particularly for facilities on level or very gently sloping sites.

1.4 Factors for Success

There are several key success factors identified by the National Renewable Energy Laboratory (NREL) in optimizing co-location of solar and agriculture.

1. Location and identifying climate, soil, and environmental conditions that are appropriate for both solar generation and the desired crops.
2. Selecting configurations, technologies, and designs to calibrate how these factors may impact the light that reaches the panels or the ability of mechanical harvesting equipment to continue operations beneath arrays.
3. Crop selection and cultivation methods, seed and vegetation designs, and management approaches to select crops or ground covers that are suited to the local climate and are shade tolerant or can grow under panel cover.
4. Compatibility and flexibility to ensure that dual use accommodates the competing needs of solar, agriculture, and stakeholder priorities.
5. Collaboration and partnerships with transparent communication and engagement between stakeholders.

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1.5 Matchmaking Resources

Agrivoltaics should accommodate **competing solar, agriculture, and stakeholder priorities**. As flagged by NREL, collaboration and partnerships where communication and engagement between stakeholders is transparent is a large factor in the success of an agrivoltaics project.

CT Farmlink is a program funded by the Community Investment Act and administered jointly by the Connecticut Department of Agriculture and Connecticut Farmland Trust with the goal of connecting farmland owners with farmland seekers. Farmland owners and seekers can create profiles and connect on the program's website.

New England Farm Finder is a similar regional program that covers Vermont, New Hampshire, Maine, Massachusetts and Connecticut and where dual-use farming opportunities can be advertised.

1.6 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 in part, or in core forest require submission to the Siting Council as an application for a Certificate of Environmental Compatibility and Public Need, pursuant to Public Act 17-218, modified CGS Section 16-50k(a), rather than as a Petition for Declaratory Ruling, unless the Commissioner of DoAg submits a letter to the Siting Council that the project will have No Material Effect on prime farmland soils and DEEP submits a letter to the Siting Council that the project will have No Material Effect on core forest.

Potential applicants to the Siting Council are encouraged to visit the Connecticut Siting Council website to review applications for projects of similar scale and design to see the level of detail and range of topics of review involved.

1.7 Design Recommendations

Certain crops may benefit from dual use if the solar panels are designed and installed in a manner that supports the crop. The following design practices are recommended:

- Solar projects on farmland should be developed with the farmer as a partner. The solar array should not interfere with the continued use of the land beneath the canopy for agricultural purposes.
- During the installation of a solar array, the developer should avoid activities such as land grading, vegetation removal, soil sterilization and gravel underlayment. Caution should also be taken in the placement of drainage ditches and containment ponds.
- The height of panels should be raised, and the row width increased to allow more sunlight for row crops to be planted and tended within the array footprint and to accommodate labor and machinery. According to the Farmland Solar Policy Design Toolkit, the solar array would need to be raised at least four meters to allow space for farm machinery to safely maneuver underneath it, compared to two meters for grazing cattle.
- If installing a vertical array, the majority of vertical solar panels should be oriented in an East/West fashion. Orienting some vertical panels North/South increases the winter output of a solar facility. Further, the East/West orientation of the solar panels can smooth out morning

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and evening ramping of electricity generation (i.e., as traditionally oriented panels are less efficient), which should lead to greater GHG reductions. The rows between the vertical panels can be made as wide as necessary to accommodate the agricultural use at issue.

- The developer and farmer should work with a consultant on a vegetation and soil management plan for the life of the solar installation. The field soils should not be stripped during re-grading, and disturbances should be kept to a minimum. Vegetative cover should be maintained to prevent soil erosion.
- Installation methods, such as ballasts, screw-type, or post driven pilings, should be used for minimal soil impacts.
- If grazing animals are proposed instead of mechanical mowing for vegetation control:
    - Farmers who provide grazing animals should be compensated for their vegetation management services.
    - Follow DoAg's Requirements for Solar Grazing.

1.8 Decommissioning

Full decommissioning means that, after its useful generating life, the solar facility will be closed, all photovoltaic equipment will be completely removed, and the land will be 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.

The passage of House Bill 5608 in 2023 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, solar developers should return the land to productive agricultural use by completing the following:

- Removal of solar arrays;
- Removal of racking posts by pulling them out of the ground completely instead of cutting at ground level;
- Removal of foundations for inverters and transformers;
- Removal of exterior fencing and posts;
- De-compaction of compacted soils;
- Backfilling excavations only with native soils;
- If vegetation disturbance takes place as a result of decommissioning, revegetation;
- Unless agreed upon by the landowner, removal of access roads, drainage ditches and detention ponds, with backfilling using native soils to level the terrain; and
- Soil testing and incorporation of needed amendments.

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2.0 Resources

- DEEP's Solar Permitting Factsheet
- DoAg's Requirements for Solar Grazing
- DoAg's On Farm Energy Resources
- Connecticut Farm Energy Program
- UConn's Ag Experiment Station Soil Testing information:
    - Soil testing locations in Connecticut
    - Web Soil Survey
- 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
- YouTube videos:
    - Solar Grazing 101
    - Grazing in Solar Farms – Teaching Tools for Beginning Farmers
- 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:
    - https://cleantechnica.com/2022/07/25/new-research-says-vertical-solar-panels-have-improved-performance/
    - https://www.sciencedirect.com/science/article/pii/S2666955222000211

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