Agricultural Solar Stakeholder Group Meeting
Thursday, June 24, 2021; 9:00 am - 12:00 pm

Meeting Registration Link:
https://mainestate.zoom.us/webinar/register/WN_s1RoYWBESyOOiUwEvI7JsA

Desired Outcomes

By the end of this meeting we will have:

- Learned about the DEP review process for solar projects in Maine
- Initiated consideration of other states' solar siting approaches for Maine
- Had an opportunity to discuss the range of technical materials provided in advance
- Provided an opportunity for public input

Agenda

What	When
Welcome and Agenda Review – Jo D.	9:00 - 9:05
Overview of the Department of Environmental Protection (DEP)'s Regulatory Oversight of Solar Projects, and Efforts re: Permit by Rule – Nick Livesay & Jim Beyer, DEP	9:05 - 9:45
Further Regulatory Discussion	9:45 - 10:00
Definitions - Project Size; Dual-Use	10:00 - 10:30
Break	10:30 - 10:40
Other State Policy Approaches: MA Solar Development Policy – Emily Cole, American Farmland Trust	10:40 –11:15

Open Discussion of Other Technical Materials, and How They Inform Group's Focus	11:15 - 11:40
Public Comment	11:40 - 11:50
Follow-up and Next Meeting: Thursday, July 22, 9:00 am – 12:00 pm	11:50 - 12:00

Note: Agenda item times are subject to change based on the progress of the group.

Agricultural Solar Stakeholder Group Ground Rules

1. Meetings start and end on time.
2. Come prepared, having read all meeting materials in advance.
3. Be present and engaged.
4. Strive for equal air time, enabling everyone to participate fully.
5. Listen with curiosity and an openness to learning and understanding.
6. Adopt a creative problem solving orientation.
7. Commit to working toward consensus.
8. Meetings and materials are public, and comments are on the record.
9. Humor is welcome; it's OK to laugh while addressing a serious topic.

Decision-making: Decisions by the Stakeholder Group are advisory and represent recommendations to the Department of Agriculture, Conservation & Forestry and the Governor's Energy Office. The Stakeholder Group will strive to make decisions by consensus. Where not possible, recommendations supported by the majority will be advanced and other perspectives will be noted.

Meeting Schedule:

Th. 6/24	https://mainestate.zoom.us/webinar/register/WN_s1RoYWBESyOOiUwEv-I7JsA
Th. 7/22	https://mainestate.zoom.us/webinar/register/WN_v28U_L77S6ajgXxlIo-VpXA
Tue. 8/24	https://mainestate.zoom.us/webinar/register/WN_2KiIelblQB6G6r-Sn8_RgJw
Th. 9/23	https://mainestate.zoom.us/webinar/register/WN_qsFHsHkgQ3yDXie-L1M5Tng
Th. 10/21	https://mainestate.zoom.us/webinar/register/WN_Sj7iq73NSx2NRrGNc-YPFqQ
Th. 11/18	https://mainestate.zoom.us/webinar/register/WN_MCVJo2bzRO2tj-Hvr0pqrhg
Th. 12/16	https://mainestate.zoom.us/webinar/register/WN_5I5XIFfPTZuzYx-PZGGraYA

State of Maine Land Use Laws and Regulations

Solar Development

Jim Beyer & Nick Livesay
Bureau of Land Resources

KEY LAND USE LAWS

- Site Location of Development Law (Site Law)
  - 38 M.R.S. §§ 481 to 489-E
- Natural Resources Protection Act (NRPA)
  - 38 M.R.S. §§ 480-A to 480-JJ
- Stormwater Management Law
  - 38 M.R.S. § 420-D
- Decommissioning (P.L. 2021, ch. 151)
  - 35-A M.R.S. §§ 3491 to 3496 (not yet effective)

Site Law Jurisdiction

- Development occupies land or water area **>20 acres**
  - Examples: solar projects, ski resorts, cemeteries, golf courses
- Buildings, parking lots, roads, paved areas, areas to be stripped or graded and not revegetated w/in one year, together, **>3 acres**
  - Examples: shopping centers, industrial facilities

Site Law Statutory Standards

- No adverse effect on the natural environment
- “…developer has made adequate provision for fitting the development harmoniously into the existing environment…and will not adversely effect existing uses, scenic character, air quality, water quality or other natural resources….” 38 M.R.S. § 484.

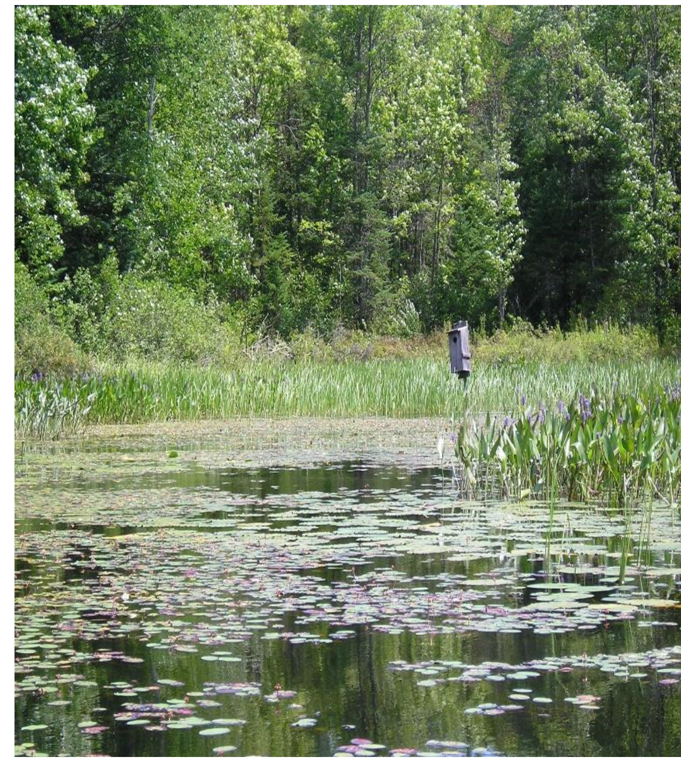
Site Law Standards

Chapter 375: No adverse environmental effect

- Erosion and sedimentation control
- Stormwater
- Buffers
- Noise
- Historic sites
- Unusual natural areas
- Scenic character
- Wildlife and fisheries
- Solid waste disposal

Natural Resources Protection Act (NRPA)

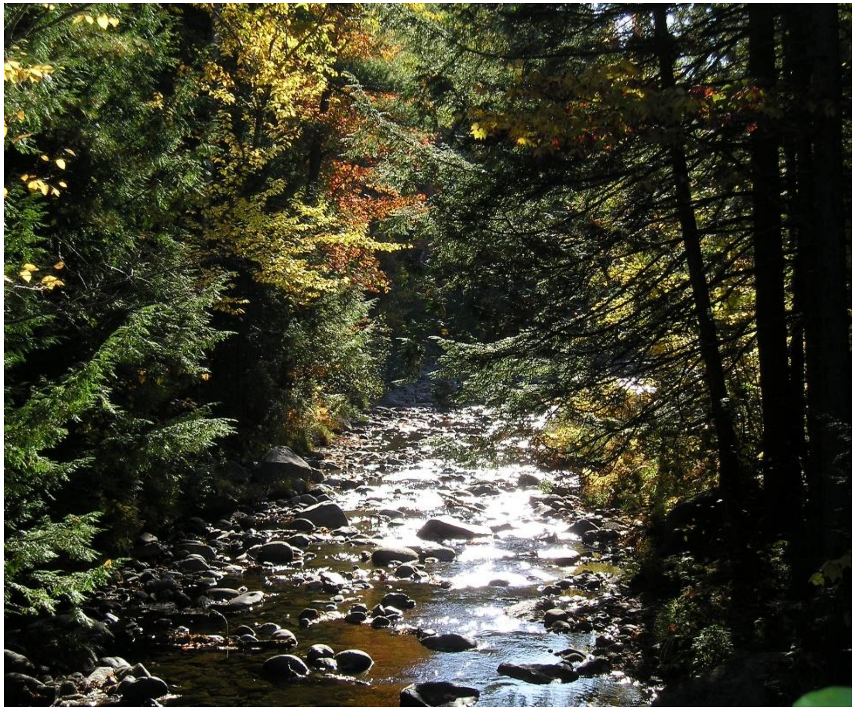
- Rivers, streams and brooks
- Lakes (Great Ponds)
- Freshwater wetlands
- Coastal wetlands
- Significant Wildlife Habitats
- Fragile Mountain Areas
- Coastal Sand Dunes



NRPA Jurisdiction

Activities that require a permit:

- Alteration within 75 feet of certain resources
- Placing fill in a resource
- Construction of any permanent structure in or over a resource



Freshwater Wetland Alterations

- All projects must avoid and minimize impacts to the greatest extent possible.
- **Tier 1** 0 - 14,999 sq. ft.
- **Tier 2** 15,000 - 43,560 sq. ft.
- **Tier 3** > 1 acre

Activities that result in 15,000 square feet or more of wetland alteration generally requires compensation in the form of In-Lieu Fee or wetland restoration, creation, enhancement, or preservation.

Significant Wildlife Habitat

- Significant vernal pool habitat
  - Evaluation of significance can only be done in spring
- High and moderate value waterfowl and wading bird habitat (e.g., IWWH)

Stormwater Management Law

Need to obtain a Stormwater permit if disturbing 1 acre or more of area on a project site in organized towns

Public Notice – Chapter 2

- Public information meeting – required prior to filing new Site Law and select NRPA applications (e.g., Tier 3, compensation required)
- Public notice requirements – mailing & newspaper publication
- Public comment is allowed during application processing
- File is available for public inspection

Permit Processing

- Pre-application meeting – for all Site Law applications and select NRPA applications
- Pre-submission meeting
- Completeness determination w/in 15 working days
- Resource agency comments:
  - Dept. Inland Fisheries & Wildlife
  - Maine Natural Areas Program
  - Maine Historic Preservation Commission
- DEP review and written decision covering all applicable laws

Permit Processing Times

- Site Law: 150 days
- NRPA
  - Permit-by-Rule: 14 days
  - Tier I/II/III: 45/60/120 days
  - IWWH/SVP: 90/120 days
- Stormwater
  - Permit-by-Rule: 14 days
  - Individual permit: 45 days
- Receipt of Site Law applications for 15 or more solar projects or NRPA application for 25 or more solar projects, adds:
  - 45 days to Site Law processing time
  - 25 days to NRPA processing times (except Tier I and II)

How to Promote Efficiency

- Site Selection – pick a site where development will avoid impacts
- Early Consultation
  - Meet with DEP staff to discuss your project and identify any permitting challenges early
  - Meet with resource agencies, such as DIFW, before filing an application to identify and resolve any wildlife or habitat concerns
- Application Quality – prepare a quality application that address the applicable standards and minimizes the need for additional information requests

Decommissioning

- Applies to projects occupying 3 or more acres
- DEP or LUPC must approve:
  - Decommissioning plan
  - Financial assurance
- Applies to projects:
  - On which construction begins on or after Oct. 1, 2021
  - Transferred to new owner on or after Oct. 1, 2021
- Heightened decommissioning for projects located on "farmland" as defined in 36 M.R.S. § 1102(4)

AGRICULTURE SOLAR SITING STAKEHOLDER GROUP - PROJECT CLASSIFICATIONS
Governor's Energy Office
June 21, 2021

This document outlines three common approaches to defining solar projects by size. Working definitions from several Maine municipalities are provided for additional background.

Solar Project Classification by Size

Solar projects are categorized differently across the industry and various jurisdictions. Typically, projects are broken down by energy capacity or amount of land used. Additionally, entities such as municipalities delineate projects by size from small to utility scale and may have different guidance or standards for each size. Three common approaches include:

1) **Nameplate Capacity**, or energy capacity, is the maximum electric output a specific project can produce. It is described in kilowatts or megawatts (kW or MW) and is used primarily in reference to interconnection and other electrical domains.[1]
2) **Project footprint** is the total amount of vertically projected airspace a project takes up (often in square feet). As a result, it is partially a function of the number of panels, as well as the angle and manner in which they are mounted. Project footprint is a flexible approach in that it is agnostic to the location of the panels (e.g. on a rooftop vs. floating vs. ground-mounted) and generally proxies impervious panel surface, but does not account for additional impacted area from a land use perspective. Vegetation growth beneath ground-mounted panels may absorb stormwater and provide other ecosystem services.
3) **Land use area** is often defined in terms of the acreage of a project's total land impact. Land use differs from "project footprint" in that it is inclusive of additional land required to host a project beyond the panels, such as an enclosed area.

The total solar nameplate capacity that can be installed on a given acre of land varies. Factors such as panel efficiency, yield, and site design influence the capacity of a project. Furthermore, solar cell efficiency continues to improve, increasing the amount of sunlight that can be converted into electricity.[2] As additional efficiency gains occur, metrics such as nameplate capacity and project footprint will change as well.

Acreage as a unit of measure provides a common thread that grounds future changes in the capacity-to-acreage or footprint-to-acreage conversion. For this reason, using "land use area" definitions that employ acreage to describe the total land required to host a solar project may be the most salient of the three approaches.

Size Classifications in Maine Law

Two relevant size classifications applying to solar projects include Site Law and decommissioning planning. These requirements are not discussed extensively in this memo because representatives from the Department of Environmental Protection will provide more detailed information separately.

- Projects occupying more than 20 acres are generally subject to Site Location of Development, administered by the Department of Environmental Protection.[3]
- Projects occupying more than 3 acres will soon be subject to decommissioning plan requirements administered by the Department of Environmental Protection.[4]

[1] Also relevant to project capacity units is whether nameplate capacity is expressed in wattage of direct current (DC) or alternating current (AC). Photovoltaic panels generate direct current, which must be converted to alternating current using an inverter prior to use by most electrical appliances or export to the grid. DC nameplate capacity is generally higher than AC capacity, and aligns directly to the number of PV modules and therefore with module area. AC capacity ratings are related to inverter specifications.
[2] "Best Research-Cell Efficiency Chart." https://www.nrel.gov/pv/cell-efficiency.html
[3] https://www.maine.gov/dep/land/sitelaw/index.html
[4] http://legislature.maine.gov/legis/bills/getPDF.asp?paper=SP0113&item=3&snum=130

Existing Size Classifications in Other Jurisdictions

In addition to either the footprint or energy produced, some entities separate projects qualitatively by size. For instance, some municipalities across the state have adopted solar ordinances, which often categorize projects by size into some combination of "small," "medium," "large" and "utility" scale. The definitions for these terms vary widely. The categories set forth in ordinance by South Portland included in Table 1 are fairly typical and could be a helpful reference for this stakeholder group. The column "Reference Points" contains general guidance based on industry experience to inform a high-level conversion between categories.

Table 1: *South Portland Solar Project Terms and Definitions with Reference Points*

Term	Definition[5]	Reference Points
Small	< 1,500 sq ft projected area	• Approximately 30 kW. • Approximately 0.15 Acres. • Typically residential or rooftop system size.
Medium	< 17,000 sq ft projected area	• Approximately 350 kW. • Approximately 1.7 Acres. • Typically commercial rooftop or ground-mount system size.
Large	< 300,000 sq ft projected area	• Approximately 5 MW AC. • Approximately 25 Acres. • Typically industrial or primary use system size. • The maximum project size for a distributed generation project is 5 MW under M.R.S. Title 35-A §3481 (5).
Utility	Everything larger than "large"	• Greater than approximately 5 MW. • Greater than approximately 25 Acres. • Typically designed to serve wholesale power markets.

Appendix: Solar Project Definitions in Local Land Use Ordinances

A sampling of municipal solar ordinances is provided to illustrate various approaches used to classify solar projects. Many local ordinances apply size distinctions only in the case of ground-mounted projects. Rooftop projects of any size are often permitted by rule in any zone.

Chapter 9 Subchapter I of Hallowell's Land Use Control's Ordinance.
Hancock, Maine Solar Systems Ordinance. November 2020.
Rumford, Maine Revised Code of Ordinances (Including Amendments and Adoptions up to July 14 2020).
South Portland Solar Energy Zoning Amendments.

[5] All kW and MW units are in alternating current (AC).

Dual-Use and Co-Location-Related Terminology

- **Pollinator friendly**: solar sites that maintain or seed wildflowers, pollinator-friendly plants, and native species to create habitat for native pollinators to thrive in.
- **Grazing**: solar sites that incorporate livestock grazing (e.g. sheep) and forage as part of the overall landscape maintenance plan to replace mowing.
- **Agrivoltaics**: solar sites that facilitate crop cultivation and other labor-intensive farm plans underneath and around the panels (e.g. via people and equipment).
- **Conservation**: solar sites designed in consultation with conservation groups focused on restoring ecosystem integrity/vitality via on-site and off-site measures.

Proposed Definition of Dual-Use and Co-Location

"Dual-use" projects involve the installation of solar photovoltaic panels on farmland in such a manner that primary agricultural activities (such as animal grazing and crop/vegetable production) are maintained simultaneously on the farmland. To qualify as dual-use, the solar installation must (1) retain or enhance the land's agricultural productivity, both short term and long term, (2) be built, maintained, and have provisions for decommissioning to protect the land's agricultural resources and utility, and (3) support the viability of a farming operation. In contrast, "co-location" generally involves traditional ground-mounted solar installations that host non-agricultural plantings with additional environmental benefits. For example, co-location can include grazing of animals as part of planned vegetation management, planting pollinator habitat, or planting ground cover or other plant species to benefit the surrounding ecosystems. Co-location may also involve siting a more traditional solar installation on a portion of farmland, while retaining other farmland for agricultural use. This may prove to be one way to help support the continued viability of farm operations; but it is not dual-use solar.

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

What is Dual-Use Solar?

Dual-use solar installation at the University of Massachusetts Amherst

The term "dual-use" refers to a solar installation that (1) retains or enhances the land's agricultural productivity, both short term and long term, (2) is built, maintained, and has provisions for decommissioning to protect the land's agricultural resources and utility, and (3) supports the viability of a farming operation.

It is solar photovoltaic panels installed on farmland in such a manner that agricultural activities (such as animal grazing and crop/vegetable production) are maintained simultaneously and protected for the future on that farmland.

<u>Benefits of siting solar energy as dual-use:</u>

- Supports solar development and renewable energy production goals
- Protects farmland from permanent solar or other development
- Protects farmland access for farmers leasing land as well as for new farmers
- Provides strong incentive for exiting farmers to transition land to another farmer to maintain on-site agricultural activity
- Provides income diversification and improved income stability
- Panels can improve moisture retention in soil and plants in times of high heat and low precipitation,* leading to:
  - Reports of increased yields for some vegetables under dual-use arrays (including potatoes, celery, kale, and others)**
  - Increases in pasture grass biomass under arrays during summer months as compared to areas in full-sun*
- Panels can reduce heat-stress in livestock by providing added shade in summer
- Protects the land's potential for increased carbon sequestration

American Farmland Trust's (AFT) mission is to save the land that sustains us by protecting farmland, promoting sound farming practices, and keeping farmers on the land. AFT supports accelerated solar development and believes that, with proper planning and siting, our agricultural lands can also play a meaningful role in hosting solar energy while maintaining active, productive agriculture. **However, AFT does not support solar siting that displaces agriculture from the landscape.**

The rapid expansion of renewable energy installations across the region in recent years has brought new and pressing challenges. Solar deployment is becoming constrained because of increasing conflict over the pressure that projects are putting on farms and forests. This new pressure compounds the severe "competition for land" in New England due to residential development, expanded local food production, and climate change. Dual-use solar arrays provide a productive alternative to traditional ground mount solar – one that maintains agriculture on site, under or around the solar installation itself.

What is Dual-Use Solar?

The definition of dual-use solar varies across state lines, industries, and organizations. For this project we use the following working definition:

Dual-use solar is the practice of installing solar photovoltaic panels on farmland in such a manner that primary agricultural activities (such as animal grazing and crop/vegetable production) are maintained simultaneously and protected for the future on that farmland.

The term "dual-use" refers to a solar installation that (1) retains or enhances the land's agricultural productivity, both short term and long term, (2) is built, maintained, and has provisions for decommissioning to protect the land's agricultural resources and utility, and (3) supports the viability of a farming operation. In contrast, "co-location" generally involves traditional ground-mounted solar installations that host non-agricultural plantings with additional environmental benefits.

Examples of Dual-Use Solar Arrays

1. **French National Institute for Agricultural Research, Montpellier, France[1]**


Figure 1: Photos by Hélène Marrou

Excerpt from The Resurgence of Solar Agriculture - Harvesting food and energy side by side[2]

Researcher Hélène Marrou explained, for example, that the lettuce adapted to low light by increasing leaf size. She also wrote in a 2013 paper that in a warming world where water could be in short supply, shading plants under solar panels could reduce the need for water. "We showed in this experiment that shading irrigated vegetable crops with PVPs (photovoltaic power systems) allowed a saving of 14 percent to 29 percent of evapotranspired water, depending on the level of shade created and the crop grown.

"The takeaway is that too much shade can hurt the crops. And too little can hurt electricity generation. Proper spacing between the solar panels, together with the tilt of the arrays, is key to getting the right mix of electricity and crop production."

[1] Marrou, H. Co-locating food and energy. Nat Sustain 2, 793–794 (2019). https://doi.org/10.1038/s41893-019-0377-0
[2] https://anthropocenemagazine.org/2018/09/the-resurgence-of-solar-agriculture/

2. University of Massachusetts Amherst Research Farm, South Deerfield, MA

Excerpt from Agriculture and Solar Energy Dual Use[3]

Figure 2: Photo by Emily Cole

This research project is grounded in the understanding that there is a need for sustainable renewable energy sources for Massachusetts and the U.S. and we suggest solar power as an area of great promise…Only solar has the potential to substantially power the state while only using a reasonable amount of the state's land mass. Traditional ground mounted solar installations on farmland, however, remove arable land from potential agricultural use.

In the project's first phase, installation techniques were developed as 106 panels were installed in livestock pasture areas. New techniques were developed to install (drive) poles with no disturbance to the soil or crop underneath. At the same time, methods were developed to create stable structures without the use of large concrete bases which would have also created excess disturbance to the soil. Panels were installed about 7.5ft (2.3m) off the ground with spaces between panel clusters varying from 2 to 5ft.

Figure 3: Herbert et al., 2017.

Preliminary results show minimal effect of biomass when land under the panels is in pasture; benefits in vegetable production during drought conditions; and depressed harvest under normal conditions. While a formal report is not yet released, it has been reported, preliminarily, that peppers, broccoli, and Swiss chard grew to about 60 percent of the volume they would in full sun, while the panels produced half the power per acre of a traditional system.

3. Grazing Cattle at Maple Ridge Meats, Benson, Vermont

From Rural Solar Stories, a project of Environmental Law & Policy Center[4]
A new Vermont project demonstrates how to maintain agricultural use of the land with on-site solar. When Greg Hathaway started his organic beef processing plant, Maple Ridge Meats, he sought to lower their power costs and increase sustainability with solar. Working with the Vermont Agency of Agriculture and a local renewable energy developer, they pioneered a new style of solar array to be built on their pasture to partly power their operations.

On hot summer days the cattle seek relief from the sun, lined up in the shade of the panels. It's even become a local attraction for passersby who park along the country road. This approach could be used for cattle grazing elsewhere in the country, especially the Midwest and Great Plains.

Figure 7: Raised Array at Maple Ridge Meats. Source: ruralsolarstories.org

[3] Herbert, S. J., Ghazi, P., Gervias, K., Cole, E., & Weis, S. (2017). Agriculture and Solar Energy Dual Land Use.
[4] ruralsolarstories.org/farm-friendly

4. Solar Sharing in Japan

Figure 4: Photo of Solar Sharing Field Test via Akira Nagashima[3]

Excerpt from Japan Next-Generation Farmers Cultivate Crops and Solar Energy[5]

At first glance, the structure may seem to be rather "skimpy." One of reasons is the MAFF [Ministry of Ag, Forestry, and Fisheries] *requires that PV systems have a simple structure (without concrete footings) and should be easily dismantled. MAFF also requires that PV mounting structures must be designed and built to secure adequate sunlight for crops and space for agricultural machinery to be able to move around.*

However, Nagashima said that the point of these guidelines are for farmers to remain "farming" and prevent farmers from fully converting productive farmland to solar facilities. Based on the tests conducted at his solar testing sites in Chiba Prefecture, he recommends about 32% shading rate for a farmland space to reach adequate growth of crops. In other words, there is twice as much empty space for each PV module installed. To ensure continuous farming, municipal agricultural committees require farmers to report annual amounts of cultivation and demand to take down the PV system from the land if the amount of crops cultivated on the solar shared farmland gets reduced by more than 20%, compared to the pre-PV installation.

Figure 5: Solar sharing Power Plant Oo in Tsukuba, Japan[5]

[5] https://www.renewableenergyworld.com/2013/10/10/japan-next-generation-farmers-cultivate-agriculture-and-solar-energy/#gref
[6] https://solar-sharing-japan.blogspot.com/

The following pages are excerpted from:

Horowitz, Kelsey, Vignesh Ramasamy, Jordan Macknick and Robert Margolis. 2020. *Capital Costs for Dual-Use Photovoltaic Installations: 2020 Benchmark for Ground-Mounted PV Systems with Pollinator-Friendly Vegetation, Grazing, and Crops*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-77811. https://www.nrel.gov/docs/fy21osti/77811.pdf.

1. Introduction

Today, most utility-scale solar photovoltaic (PV) systems are sited over bare ground, with existing vegetation removed and new vegetation discouraged using herbicides or gravel. This practice is also employed for many smaller, ground-mounted commercial or community solar facilities. However, doing so can result in environmental degradation and habitat loss (Hernandez et al. 2014). In addition, although U.S. and global electricity needs could be offset with PV systems that use only a small fraction of available land (Ong et al. 2013), land-use competition still arises because agricultural or conservation lands are also often very desirable PV development sites.

PV systems are most productive in areas with high irradiance, light wind, low humidity, and moderate temperatures, where the conditions can correlate with croplands (Elnaz H. Adeh et al. 2019). Agricultural land also tends to be flat and cleared of trees, and thus desirable for PV installations. The resulting land-use competition is particularly pronounced in smaller countries and states. Also, the inclusion of distributed generation requirements as part of state renewable portfolio standards (Donalds 2017) could increase land use competition depending on the amount of rooftop PV installed.

There can also be benefits to colocation of PV and other land uses, even where land use competition is not a concern (Hernandez et al. 2019; Macknick et al. 2013; Schindele et al. 2020). Colocating PV with farmland, known as “agrivoltaics,” can provide a steady source of income to complement farm revenue, which can be volatile (Key, Prager, and Burns 2017). Early studies also suggest that agrivoltaics installations could also provide other benefits. For example, water usage for some crops and grasses appears to decrease when the crops are located below PV panels, with greater water savings achieved in arid regions (Elnaz Hassanpour Adeh, Selker, and Higgins 2018; Liu et al. 2019; Marrou, Dufour, and Wery 2013; Elamri et al. 2018; Barron-Gafford et al. 2019). One study found that PV panels with crops grown below were on average 8.9 °C cooler during daylight hours than panels without crops. Because PV panels run more efficiently at lower temperatures, this finding has potential implications for PV energy yield, particularly in hot climates (Barron-Gafford et al. 2019). Early studies have also indicated that yields of some crops can increase under PV panel shade depending on climate and agrivoltaic system design, particularly in arid regions (Barron-Gafford et al. 2019) (Amaducci, Yin, and Colauzzi 2018). Although yields decrease for some crops, climates, and system designs (Dupraz et al. 2011; Marrou et al. 2013; Valle et al. 2017), overall the studies to date indicate that agrivoltaics can provide synergistic benefits, particularly with further understanding and optimization of dual-use site designs.

PV installations and animal activities can also be complementary. Increased water efficiency and biomass yield along with the shade of the PV panels can also improve the environment for sheep or cows grazing below the panels, while grazing animals can assist in vegetation management for PV sites (Elnaz Hassanpour Adeh, Selker, Hernandez et al. 2019 and Higgins 2018). Colocating PV with pollinator-friendly groundcover can expand habitat for the dwindling bee population; decline of pollinators has serious implications for global ecosystems and food production (Vanbergen 2018). Pollinator-friendly groundcover can also benefit local agriculture, with a recent study (Walston et al. 2018) showing more than 3,500 km^2 of agricultural land near existing and planned utility-scale solar sties would benefit if those solar projects had pollinator-friendly groundcover.

Several states have begun implementing policies that encourage pollinator-friendly land practices (Terry 2020), and the Solar Massachusetts Renewable Target (SMART) program provides an Agricultural Solar Tariff Generation Unit[1] to incentivize dual-use of agriculture and solar. These programs provide additional benefits to the PV system owners in dual-use applications. Also, the interest in dual-use systems is not limited to the United States; the latest European Commission tender for opportunities in research and innovation specifically mentioned agrivoltaics. Furthermore, Japan has implemented programs for PV and crop applications, called "solar sharing" (Sugibuchi 2019), and China has support policies for controlled environmental agriculture as well as rural economic stimulation that could encourage these dual-use approaches (Xue 2017).

Despite the potential benefits of dual-use PV, little is currently known about its cost. This includes both the capital costs and the operation and maintenance (O&M) costs. There are several ongoing studies around the O&M costs of different dual-use approaches, but to-date there is insufficient data to make firm conclusions. So, in this report, we focus on improving understanding of the capital costs for these projects. We do this by utilizing NREL's bottom-up system installed cost model (Fu et al. 2018) to analyze costs of different designs applicable to three dual-use categories: PV colocated with pollinator habitat (without grazing), PV colocated with crops, and PV colocated with grazing. We are specifically focused on ground-mounted applications and not those where PV is located on farm building rooftops, greenhouses, or other structures.

In this report, we first provide a brief overview of the current landscape for dual-use PV. Then we present our analysis of capital costs for a set of benchmark dual-use designs compared to conventional PV systems installed over bare ground. Finally, we conduct extensive sensitivity analysis of various system design parameters, which are not currently standardized. We also look at the sensitivity of results to cost inputs that still contain uncertainty given the nascent stage of this industry.

[1] "Solar Massachusetts Renewable Target (SMART) Program," https://www.mass.gov/info-details/solar-massachusetts-renewable-target-smart-program

2. Current Landscape of Ground-Mounted Dual-Use PV

2.1 PV + Crops

The dual-use PV industry is still relatively immature compared with the PV industry at large. Approximately 2.8 GW of PV + crop installations exist globally, with most of the capacity located in China, Japan, and South Korea (Schindele 2020). The number of PV + crop projects has increased 16-fold over 4 years in Japan, with a total of 1,511 sites as of 2017 (Sugibuchi 2019). Many of these existing projects are smaller in size than a conventional utility-scale PV project, with a 4.4 MW system being the largest PV + crop project in Japan as of 2019, but a 480 MW project in Nagasaki is under development. Japan requires annual reporting of crop yield impacts for PV + crop sites. No comprehensive public data on PV + crop sites in China or South Korea appear to exist, but a 700-MW PV plant in China's Gobi desert has been converted to an agrivoltaics site with berry bushes grown below the panels ("Agrivoltaics – Solar Panels on Top, Potatoes down Below" 2019).

In the United States, Massachusetts is encouraging dual-use PV applications through its SMART program incentives. As of the writing of this report, the total installed capacity approved under the SMART qualified Agricultural Solar Tariff Generation Unit (includes PV + crops and PV + grazing) is 20.25 MW_{AC} of projects (Palano 2020). These projects, as well as PV + crop projects we are aware of in Europe, range in size from 20 kW to several MW. France has the largest PV + crops capacity in Europe, totaling around 40 MW which includes many small pilot projects (Schindele 2020). Total Quandran announced a goal of developing 500 MW of PV on agricultural lands in France by 2025 (Bhambhani 2020).

PV + crop system designs and applications are not standardized, and a variety of diverse approaches are being explored. System designs are not yet fully mature and are still being iterated on and optimized. These range from bifacial, vertical panels with crops grown between and/or used as fencing for crops or livestock to much more traditional PV system structures without elevated panels and with crops planted only between the panels. There are also multiple designs involving elevated structures that allow harvesting equipment to pass beneath the panels, including "stilt-mounted" designs with thin posts at a lower density, PV panels that allow more light to pass through and traditional PV structures that are reinforced and elevated. We will explore the upfront capital costs of three of these different designs for PV + crops in this report.

2.2 PV + Grazing

A comprehensive set of data on PV + grazing sites installed globally does not currently exist. One challenge is that grazing activities can be alternated with mowing activities, and a site that is grazed one year might not be grazed the next year. Based on primary interviews and web searches, we estimate the U.S. capacity of PV + grazing sites at over 100 MW. The most common type of PV + grazing site involves sheep grazing; however, grazing with other livestock, such as cattle or rabbits, exist as well. A 2.8 MW cattle grazing project is currently under development in Massachusetts. While sheep can fit under the panels without having to modify conventional PV structures, PV + cattle grazing requires elevated and sometimes reinforced structures if the cattle are grazing beneath the panels. Grazing can be provided as an

O&M service to PV companies. Additional information on the current status of and knowledge around PV + grazing can be found on the American Solar Grazing Association's website.[2]

2.3 PV + Pollinator Habitat

Pollinator-friendly PV is much more established in the United States than PV + crop or PV + grazing applications. Based on data collected through primary interviews and web searches, NREL estimates over 1 GW of PV + pollinator habitat has been installed in the United States. Some of this development is driven by the pollinator-friendly PV policies discussed in the introduction (Terry 2020). Although PV system designs for this application are relatively standardized, best practices are still not established for seeding, types of seed to use, soil care, herbicide application and vegetation management, erosion control, and other factors. Hence, site preparation activities for PV+ pollinator habitat facilities vary much more across sites than do site preparation activities of traditional PV facilities over bare ground or turf grass.

[2] "Research," American Solar Grazing Association, https://solargrazing.org/resources/

3. Scenarios Modeled and PV Design Assumptions

We model PV installed costs for the following different scenarios (Figure 1) in this report:

- **Conventional PV** installed over bare ground as a baseline. We look at both fixed and 1-axis tracking conventional PV designs. This is the default configuration used in NREL PV system cost analyses.
- **PV + grazing**, including both fixed-tilt and 1-axis tracking approaches. These scenarios have the same configuration as conventional PV, but they use pasture grasses or in some cases use both pasture grasses and pollinator-friendly vegetation below the panels instead of bare ground.
- **PV + pollinator habitat**, including fixed-tilt and 1-axis tracking designs, with the same structure as conventional PV but with pollinator-friendly vegetation below the panels instead of bare ground.
- **PV + crops**. We look at the following three designs for PV + crops: 1) vertical mount structures with bifacial PV panels, 2) a stilt-mount design with tracking, and 3) a structure similar to that of conventional PV but reinforced to enable increased panel height. For all of these designs, the crops can be grown under and/or between the panels at different densities.

For each scenario, we benchmark a 500 kW_{DC} system as a base case system and explore the sensitivity of installed system cost to system size in MW_{DC}. Each scenario has a set of benchmark assumptions (Table 1), which include the design parameters (Table 2) illustrated in Figure 2. These assumptions are based on current typical or median values based on our interviews with dual-use PV developers and installers. However, these parameters can vary across systems depending on the needs of a specific project, so we conduct sensitivity analyses in Section 5.2 to the panel spacing, ground clearance, and ground coverage ratio (GCR).

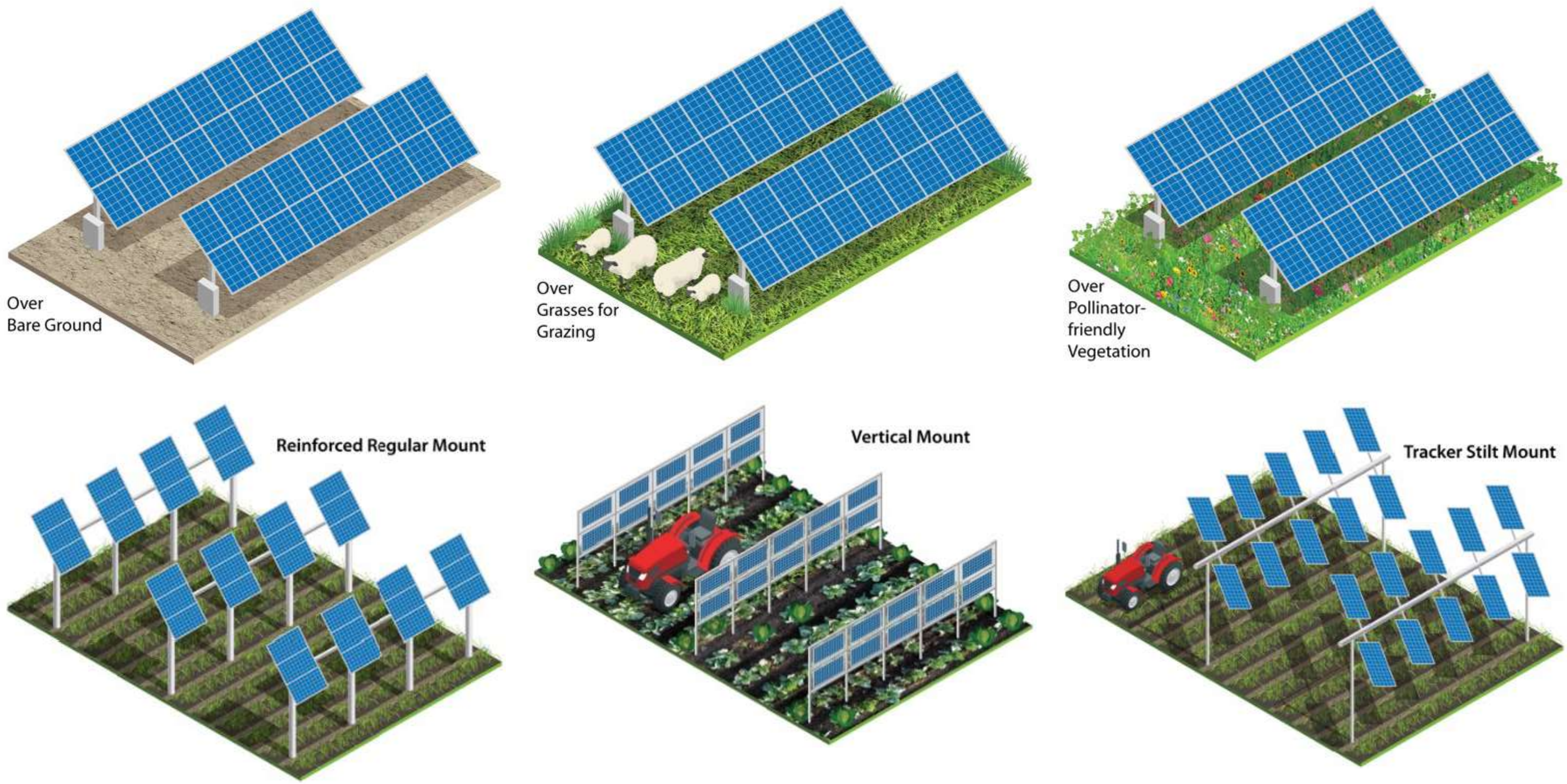


Figure 1. Illustrations of the system designs modeled for each dual-use PV scenario

Dual-Use Cost Examples – BlueWave Solar

Project Size – Financial Disadvantages

EPC and interconnection fixed costs tend to be spread over a smaller number of kW for dual-use designs as opposed to standard solar layouts. Dual-use projects typically have less density and therefore less revenue/profit than standard solar.

Structure – Different Design Needs – EPC Cost Increases

Retrofitting farm fields and customizing aisle widths for each dual-use design means that developers take on greater structural engineering challenges in addition to added labor and material costs.

- Additional steel to mount panels 9 ft off the ground vs. 3-4 ft for standard solar.
- Labor duration approximately twice as long due to requirements of working on scissor lifts to mount and connect panels.
- Higher EPC costs for scissor lifts include repair and higher worker's comp insurance.
- Posts are driven approximately twice as deep to support the higher panel height.

Solar Operations – Greater Requirements – Solar O&M Increases

Long-term solar owner/operators must adapt to the added complexity of having a farmer on-site cultivating crops. Additional costs can include special equipment, training, higher insurance premiums, monitoring, new levels and forms of coordination, and other unknowns due to the novelty of each design.

Risk & Complexity – Different Asset Class – Risk Premium

Dual-use requires additional legal and operational complexity, as well as additional risk to the solar equipment while farming takes place on-site. Debt and tax equity investors require additional return in order to establish this new approach, take risks, and manage uncertainty.

Farm Operations & Supporting the Farmer – Farm Asset Management Costs

Farmer insurance premiums cover routine solar site access, cultivation activities, and equipment operating around the panels. Developers also work with farmers to invest in capital improvements, hire farm managers, provide technical assistance, and subsidize inputs and equipment.

Farm Production Subsidy

A farmer's production cost per acre for crops with dual-use solar averages 2-3x higher than the cost for an open field. Facing uncertainty about individual crop costs and yield, farmers lacking outside investment are forced to choose lower cost crops. Developers provide a per-acre payment to farmers to defray increased production costs, encourage innovation and risk-taking, and support the transition to dual-use.

Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
DEPARTMENT OF ENERGY RESOURCES
DEPARTMENT OF AGRICULTURAL RESOURCES

SOLAR MASSACHUSETTS RENEWABLE TARGET PROGRAM (225 CMR 20.00)

GUIDELINE

Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units

Effective Date: April 26, 2018

PURPOSE

This document provides guidance regarding the manner in which a solar photovoltaic facility may qualify as an Agricultural Solar Tariff Generation Unit ("ASTGU") under the Department of Energy Resource's (Department) Solar Massachusetts Renewable Target (SMART) Program.

BACKGROUND

On April 11, 2016, Governor Baker signed Chapter 75 of the Acts of 2016 into law. The Act directs the Department to create a long-term sustainable solar incentive program to promote cost-effective solar in the Commonwealth. The Act further directed the Department to "…differentiate incentive levels to support diverse installation types and sizes that provide unique benefits..." In developing the SMART Program, the Department established six types of location based Compensation Rate Adders, one of which is provided for ASTGUs.

Given the small number of solar facilities that meet the objectives and criteria outlined in the definition of ASTGU in the Commonwealth today, but the desire to see the installation of such systems that can provide the dual-use benefits, the Department, in consultation with the Massachusetts Department of Agricultural Resources (MDAR), has developed this Guideline to clarify additional eligibility criteria not prescribed in regulation.

Adopting these provisions via Guideline, as was requested by many commenters in the initial stakeholder process that led to the promulgation of the regulation, will provide the necessary flexibility for the Department, in consultation with MDAR, to make modifications to key eligibility criteria as lessons are learned in constructing and operating ASTGUs.

Any modifications to this Guideline will only be made following an opportunity for public comment that shall remain open for at least two weeks. All capitalized terms in this Guideline are defined in 225 CMR 20.02.

225 CMR 20.00 Regulatory Provisions Specific to ASTGUs

Under the SMART program, Solar Tariff Generation Units are eligible to qualify as an ASTGU, which is defined under 225 CMR 20.02 as follows:

> Agricultural Solar Tariff Generation Unit. A Solar Tariff Generation Unit located on Land in Agricultural Use or Prime Agricultural Farmland that allows the continued use of the land for agriculture.

Additionally, 225 CMR 20.06(1)(d) contains special provisions pertaining specifically to the eligibility of ASTGUs:

> (d) Special Provisions for Agricultural Solar Tariff Generation Units. In order to qualify as an Agricultural Solar Tariff Generation Unit, a Solar Tariff Generation Unit must submit documentation itemized in 225 CMR 20.06(1)(d) below. All final determinations regarding the eligibility of such facilities will be made by the Department, in consultation with MDAR. A Solar Tariff Generation Unit must also submit satisfactory documentation to the Department as detailed in the Department's *Guideline Regarding the Definition of Agricultural Solar Tariff Generation Units*.
>
> 1. the Solar Tariff Generation Unit will not interfere with the continued use of the land beneath the canopy for agricultural purposes;
> 2. the Solar Tariff Generation Unit is designed to optimize a balance between the generation of electricity and the agricultural productive capacity of the soils beneath;
> 3. the Solar Tariff Generation Unit is a raised structure allowing for continuous growth of crops underneath the solar photovoltaic modules, with height enough for labor and/or machinery as it relates to tilling, cultivating, soil amendments, harvesting, *etc.* and grazing animals;
> 4. crop(s) to be grown to be provided by the farmer or farm agronomist in conjunction with UMass Amherst agricultural extension services, including compatibility with the design of the agricultural solar system for such factors as crop selection, sunlight percentage, *etc.*;
> 5. annual reporting to the Department and MDAR of the productivity of the crop(s) and herd, including pounds harvested and/or grazed, herd size growth, success of the crop, potential changes, *etc.*, shall be provided after project implementation and throughout the SMART incentive period; and
> 6. other system design information, which shall include, but not be limited to:
>   a. dual-use type, *e.g.*, ground mount racking, pole towers, tracking, *etc.*;
>   b. total gross acres of open farmland to be integrated with the project;
>   c. type of crop(s) to be grown, including grazing crops;
>   d. pounds of crop(s) projected to be grown and harvested, or grazed;
>   e. animals to be grazed with herd size(s); and
>   f. design drawing including mounting system type (fixed, tracking), panel tilt, panel row spacing, individual panel spacing, for pole towers tower spacing and mounting height, *etc.*

Additional Provisions for ASTGUs

Provided a Solar Tariff Generation Unit meets all program eligibility criteria in 225 CMR 20.00, in particular the provisions relating to ASTGUs prescribed in 225 CMR 20.02 and 20.06(1)(d), a Solar Tariff Generation Units must also satisfy the following provisions to qualify as an ASTGU. Note that these provisions take into account the entire useful life of the solar photovoltaic array with consideration for the variety of possible agricultural activities and crops that could take place on farm land over that timeframe. In other words, they do not simply consider present use.

The parameters defined in Section A below will allow for the variety and flexibility of potential farming operations at any given farm throughout the life of the solar photovoltaic array. These parameters are stated as minimums, giving farms the flexibility to determine and finalize farming operations. Applicants complying with the additional provisions in Section A below will be reviewed in an expedited process.

DOER intends to develop a standard design tool (SMART Tool) to be mandated for use by all Agricultural Solar Generation Tariff Unit applicants, and to be used by developers and farmers alike to demonstrate meeting the SMART regulations and Guidelines. The SMART Tool will be designed to:

a) assist in the design of an Agricultural Solar Generation Tariff Unit by understanding the shading impact on all the land beneath, behind, and throughout the farmed area, of various dual-use array system designs and layouts;

b) provide a farm plan template to be used by the landowner to propose their active agricultural production plan consistent with the array configuration and shading profile and compliant with the Guideline requirements; and

c) provide an annual reporting form template compliant with the Guideline requirements.

A. System Design Parameters:

1. Panel Height Requirements

   a. For fixed tilt ASTGUs, the minimum height of the lowest panel point shall be eight (8) feet above ground;

   b. For tracking ASTGUs, the minimum height of the panel at its horizontal position shall be 10 feet above ground;

2. Maximum Direct Sunlight Reduction Requirements

   All ASTGUs must demonstrate that the maximum sunlight reduction from the panel shading on every square foot of land directly beneath, behind and in the areas adjacent to and within the ASTGU's design shall not be more than 50% of baseline field conditions;

3. Growing Season/Time of Day Considerations

   The typical growing season shall be considered to be March through October, with sunlight hour conditions with maximum 50% sunlight reduction to be between 10AM and 5PM for March and October, and from 9AM to 6PM from April through September;

4. Maximum Size

   The maximum AC rated capacity of an ASTGU shall be two MW in the first two Capacity Blocks of each Distribution Company's service territory. The Department, in consultation with MDAR, will make an evaluation as to whether or not this provision shall be adjusted in subsequent Capacity Blocks.

B. Waiver from Additional Provisions

DOER recognizes the variety and, in some cases, the uniqueness of farming operations where some of the Additional Provisions for an ASTGU may not be required to achieve the objectives of the ASTGU. To address this issue, a landowner may request that DOER issue a waiver from any of the Additional Provisions for an ASTGU that is not contrary to the law or the intent of the regulations. All waiver requests should be submitted to DOER.SMART@state.ma.us.

In order to request a waiver, the applicant must provide the Department with the following:

1. Plan Development

   Develop a plan that:

   a. describes how the applicant will integrate the ASTGU into their farming operation;

   b. demonstrates that a waiver does not result in a diminishment in the agricultural production capacity of the land; and

   c. demonstrates that the primary use of the land is for agricultural or horticultural production, as defined under M.G.L. Chapter 61A.

2. Justification and Substantiation

   An applicant must provide justification as to why an ASTGU design is necessary for the proposed agricultural operations on the relevant parcel of land.

3. Additional Documentation

   An applicant must provide documentation for each specific aspect of the design parameters from Section A of this Guideline for which the ASTGU requires a waiver as follows:

   a. Panel Height Requirements: Provide documentation demonstrating how the proposed design will allow for the variety and flexibility of a variety of potential farming operations at the farm throughout the term of the SMART Tariff.

   b. Maximum Direct Sunlight Reduction Requirements:

      i. Demonstrate how the proposed dual use design will provide equal or greater total agricultural yields than if both the agricultural crop and the solar array were grown and installed separately, utilizing the same amount of total land area for the comparison;

      ii. Demonstrate how each square foot of land will be used for agriculture production;

      iii. Demonstrate how the design will be able to accommodate a variety of potential agricultural products throughout the twenty year term of the SMART Tariff.

   c. Growing Season/Time of Day Considerations: Provide documentation on how the time of season and day data in Section A is not relevant to the farming practice and operation, currently, and for the term of the SMART Tariff.

   d. Other: For all other requirements for which a waiver is being sought, please describe the waiver(s) requested, why the proposed alternatives require a waiver, and how these alternatives will meet the intention of the ASTGU regulations.

This document is provided in response to a stakeholder group request. It summarizes the authorization, selection criteria, and results of recent state renewable energy procurements relevant to the development of solar energy in Maine and provides links to additional supporting materials.

Renewable Portfolio Standard procurements

Maine's renewable portfolio standard (RPS) requires that 80% of Maine's electricity come from renewable sources by 2030, with a goal of 100% by 2050. To support its achievement, the PUC is directed to procure through two tranches a total of 14% of Maine's retail electric sales from calendar year 2018.

Authorization and selection criteria (*35-A M.R.S. §3210-G*)

The commission shall direct investor-owned transmission and distribution utilities to enter into one or more contracts for energy or renewable energy credits from Class IA resources[1] in accordance with this section…

C. In conducting a solicitation and selecting Class IA resources for contracts under this section, the commission shall weigh the benefits to ratepayers and the benefits to the State's economy as follows:

(1) A weight of 70% must be given to the benefits to ratepayers; and

(2) A weight of 30% must be given to benefits to the economy, which may include, but are not limited to:

(a) Capital investments by the Class IA resource to improve long-term viability of an existing facility;

(b) Payments by the Class IA resource for the harvest of wood fuel;

(c) Employment resulting from the Class IA resource;

(d) Payments by the Class IA resource to a host community, whether or not required by law or rule;

(e) Excise, income, property and sales taxes paid by the Class IA resource;

(f) Purchases of goods and services by the Class IA resource; and

(g) Avoided emissions resulting from the operation of the Class IA resource.

Results

The Public Utilities Commission (PUC) announced the results of Tranche 1 of the RPS procurement in September 2020. Additional details about the selected projects are available on the PUC's website. The projects are generally listed including the town where they will be located: https://www.maine.gov/mpuc/electricity/rfps/class1a2020/index.shtml

The PUC is currently conducting Tranche 2 of the RPS procurement, with results expected later this summer. Additional details are available on the PUC's website: https://www.maine.gov/mpuc/electricity/rfps/class1a2021/index.shtml

[1] Class 1A resources are certain new renewable resources, including solar power installations, defined in 35-A M.R.S. §3210.

Distributed Generation Procurement

To support the development of distributed generation resources,[2] the PUC was directed to procure a total of 375 megawatts (MW) of distributed generation through five procurement blocks.

Authorization and selection criteria (*35-A M.R.S. §3484*)

> 6. … In evaluating bids in a competitive solicitation, the commission shall evaluate a qualified bid for a project that is located on previously developed or impacted land at 90% of the offered rate. For the purposes of this subsection, "previously developed or impacted land" means areas covered by impervious surfaces, capped landfills or brownfield sites as defined by the Department of Environmental Protection. If a bid under this subsection is accepted, the contract rate for each accepted bid for a project located on previously developed or impacted land must be paid a rate equal to the clearing price.

Maine Public Utilities Commission Rules Chapter 312 (I)

> For any procurement round after the initial procurement round (Blocks 2-5), the Commission may establish additional incentives, including block incentive rates, for certain attributes of distributed generation resources including, but not limited to, incentives to support resources that pair with energy storage systems, development of dual-use projects, siting of resources that provide locational benefits to the distribution system and other siting criteria developed in consultation with the Department of Environmental Protection and the Department of Agriculture, Conservation and Forestry. Any such incentives shall be described in the procurement announcement for the block.

Results

The PUC established Siting Attribute selection criteria for the first procurement block under the Distributed generation procurement.[3] Additional information, including the procurement announcement, are available on the PUC's website: https://www.maine.gov/mpuc/electricity/rfps/dg-procurement/index.shtml

In August 2020, the Commission issued an order finding the first block of the distributed generation procurement was not competitive, and therefore no contracts were awarded. The PUC's report explaining this finding is available on its website: https://www.maine.gov/tools/whatsnew/attach.php?id=3590211&an=1

[2] A distributed generation resource is a renewable resource with nameplate capacity less than 5 megawatts, defined in 35-A M.R.S. §3481 subsection 5.

[3] https://www.maine.gov/mpuc/electricity/rfps/dg-procurement/documents/PA-for-DG-AppendixA-SitingAttributes.pdf

Maine Agricultural Solar Stakeholder Group
Meeting #1 Summary - June 3, 2021

Stakeholder Member Attendance: Nick Armentrout (Spring Creek Farm), Emily Cole (American Farmland Trust), Heather Donahue (Balfour Farm), Ellen Griswold (Maine Farmland Trust), Sarah Haggerty (Maine Audubon), Kaitlin Hollinger (BlueWave), Matt Kearns (Longroad Energy), Fortunat Mueller (ReVision Energy), George O'Keefe (Town of Rumford), Andy Smith (The Milkhouse), Julie Ann Smith (Maine Farm Bureau), Patrick Wynne (City of Hallowell), Celina Cunningham (Governor's Energy Office); Nancy McBrady (Department of Agriculture, Conservation and Forestry)

On June 3, 2021 the Maine Department of Agriculture, Conservation and Forestry (DACF) and the Governor's Energy Office (GEO) virtually hosted the first meeting of the Agricultural Solar Stakeholder Group meeting. Through these meetings the group will assess the potential impact of solar development on Maine's prime farmland and soils of statewide importance and develop a set of recommendations to balance the need to protect Maine's current and future farmland against the need to develop sources of renewable solar energy.

Introduction
After a brief welcome from the Facilitator, Jo D. Saffeir, the meeting was kicked off by DACF Commissioner Amanda Beal. DACF acknowledged that agricultural land is an important tool in our response to climate change. While expressing support for renewable energy development in Maine and recognizing the financial opportunity solar brings to farmers, it was cautioned that farmland could be negatively impacted without guardrails. DACF and GEO expressed resolve in the expertise of the stakeholders to develop recommendations to support solar development and protect agricultural land.

Current Scope of Solar Development and Drivers in Maine
GEO provided an overview of recent laws, policies, and procurements associated with the advancement of renewable energy, including specific solar programs. The full presentation can be viewed here. Following the presentation, there was a discussion about potential changes to the Net Energy Billing and distributed generation programs, both of which are still under review by the current legislature. Stakeholders were also interested in learning more about the locations of the 17 renewable energy projects, which were recently approved by the Public Utilities Commission; at this time there is limited details on the specific location/land type for individual projects.

Maine Audubon's Solar Siting Mapping Tool
Maine Audubon presented the Maine Renewable Energy Siting Tool, which is an updated version of their original GIS-tool that now includes wind siting and is to be launched in June. The GIS-tool aggregates Maine's mapped natural resources, developed/previously impacted land (such as landfills and Brownfields), as well as solar siting constraints (such as proximity to transmission lines) to aid in identifying areas with lower wildlife and habitat impacts.

Using this tool Maine Audubon has mapped all 180 solar projects submitted to DEP for review, noting that there are many smaller projects not triggering a DEP review and that not all projects reviewed will be built. Of the 180 projects: 43% intersect high value plant and animal habitat and 49% intersect with large forest blocks. 58% intersect with large agricultural land (5 acres of continuous crop land or 10 acres of pasture) and 89% intersect with high value agricultural blocks. More information was requested about the intersection of prime ag land vs ag land of statewide significance. Only 6% of the projects intersect with gravel pits and 3% with capped landfills. The utilization of these sites tend to be limited by the lack of transmission lines nearby.

Articulation of Problem Statement and Shared Principles
In advance of the meeting, DACF/GEO provided Stakeholder Members a draft problem statement and shared principles. Reviewing these, the group:

- Identified a need to better understand the different types of land available for development and whether it was possible to identify a hierarchy of importance;
- Discussed the role of forested land, including its role in carbon sequestration and protecting water resources;
- Discussed other stressors on farmland, including housing development and whether solar could help preserve agricultural soils for the future; and
- Discussed the life of solar projects and whether they can be reverted to agriculture; members articulated that demand for land for solar projects would continue beyond the life of the first projects.

The group did not propose any additions or changes to the problem statement/principles. See recording for full discussion.

Identification of Solar Siting Levers for Group's Future Consideration
After a discussion of the problem statement, the group discussed various avenues to explore potential tools to promote balance between the two sectors. Generally, the group was in support of considering levers/buckets in the categories of regulatory, guidance, and incentives.

Statutory/Regulatory – Various regulatory considerations were discussed including a DEP Permit By Rule (PBR) application for solar development of Brownfields, PFAS contaminated sites, and dual-use projects. DEP is undertaking a rulemaking process for PBRs and a presentation from DEP on its role and rulemaking was requested. Another tool could be including additional siting considerations to future PUC procurement processes to influence development. There was caution against further narrowing the opportunities for farmers and complicating existing municipal regulatory processes. More information was requested about municipal ordinance processes and current use taxation impacts. Outside the scope of this group's work, there is interest in integrated resource planning for the transmission and distribution planning to make Brownfields more viable for solar development.

Incentives – The group was interested in exploring opportunities for incentives. The example of adders used in Massachusetts' SMART program should be reviewed with a caveat that the solar markets between the states are very different. The group requested information on the financials of dual use.

Best Management Practices/Voluntary Guidance – They are considered helpful and there is a significant amount of existing BMPs available from state agencies and NGOs that could be utilized in the state in combination with the other buckets, but these alone are likely insufficient.