

Agrivoltaics & On-Farm Energy Webinar

NYSERDA Environmental Research Program
November 13, 2026

NEW YORK STATE | NYSERDA
New York State Energy Research and Development Authority

Photo credit: Jeremy Wyble

This presentation is a work in progress, in collaboration with New York State Department of Agriculture and Markets and the Agricultural Technical Working Group (A-TWG).

- A-TWG identified as a top priority more communication formats and more information for farmers, developers, and communities about agrivoltaics and energy independence for farms.
- This is our initial presentation – please ask questions and provide feedback!
- A-TWG will work on providing this webinar, and information within it, in various forms, and keep improving it in response to feedback and new information in this evolving field.

WHAT WE'LL COVER TODAY

Why agrivoltaics?

What is agrivoltaics? What can be grown/raised? What are my options? What do agrivoltaics look like in action?

What do you need to consider and do to get good outcomes for both agriculture and energy production?

How can solar power be used on-farm?

Existing resources

Questions

WHY AGRIVOLTAICS?

Agrivoltaics is the co-utilization of land for agricultural production and solar energy generation.

- Maintains access for farming by landowner or tenant farmer for lifetime of the array
- Provides additional farm revenue through vegetation management payments
- On-farm agrivoltaics may provide energy savings and energy independence
- Retains agricultural character of the land while managing vegetation to prevent shading of panels and fire risk
- Studies show agronomic benefits for certain crops and health benefits for livestock
- Managing vegetation through grazing reduces emissions from mechanical mowing

WHAT DO AGRIVOLTAICS LOOK LIKE?

DEFINING FEATURES OF AGRIVOLTAICS PROJECTS

Co-location of a ground-mounted photovoltaic solar energy system with agriculture

Agricultural production occurs beneath and/or between rows of solar panels

System has been constructed, installed, and operated to achieve integrated and simultaneous production of both solar energy and marketable agricultural products

NY's A-TWG provided considerations for developing a regulatory definition in Issue Brief: Agrivoltaics Policy, released June 2026

CANDIDATE OWNERSHIP MODELS FOR INCORPORATING SOLAR WITH AGRICULTURE

LAND LEASED TO DEVELOPER

Most common

- Developer leases land from landowner for 20-40 years.
- Landowner receives lease income, no income from solar generation, usually no energy cost savings.
- Grants developer all or most of the rights to the land.
- Developer/asset owner handles all financing, construction, ongoing maintenance of array components, and decommissioning.

DEVELOPER OWNS LAND & SOLAR

Less Common

- Developer purchases land on which to build a solar array.
- Landowner receives funds from sale.
- Due to time-limited nature of developer's interest in the land, possibility to incorporate farmland protection after decommissioning.

CANDIDATE OWNERSHIP MODELS FOR INCORPORATING SOLAR WITH AGRICULTURE (CONT.)

FARMER-OWNED SOLAR

- Usually smaller-scale behind-the-meter solar arrays designed for on-site use.
- Farmer must fund up-front and ongoing maintenance costs.
- Benefits from reduced utility bills.

COOPERATIVELY-OWNED SOLAR

Currently Uncommon

- A group of farmers could cooperatively own an array.
- A farmer could co-own a front-of-the meter array with a solar company.
- Farmer must contribute up-front capital, and benefits from ongoing income from the solar production.

RISK FACTORS THAT SOLAR DEVELOPERS MANAGE

Pertinent for farmers and communities engaging with them

- **Interconnection**
- **Permitting**
- **Financing**
- **Supply chain**
- **Change in Law/ Policies**

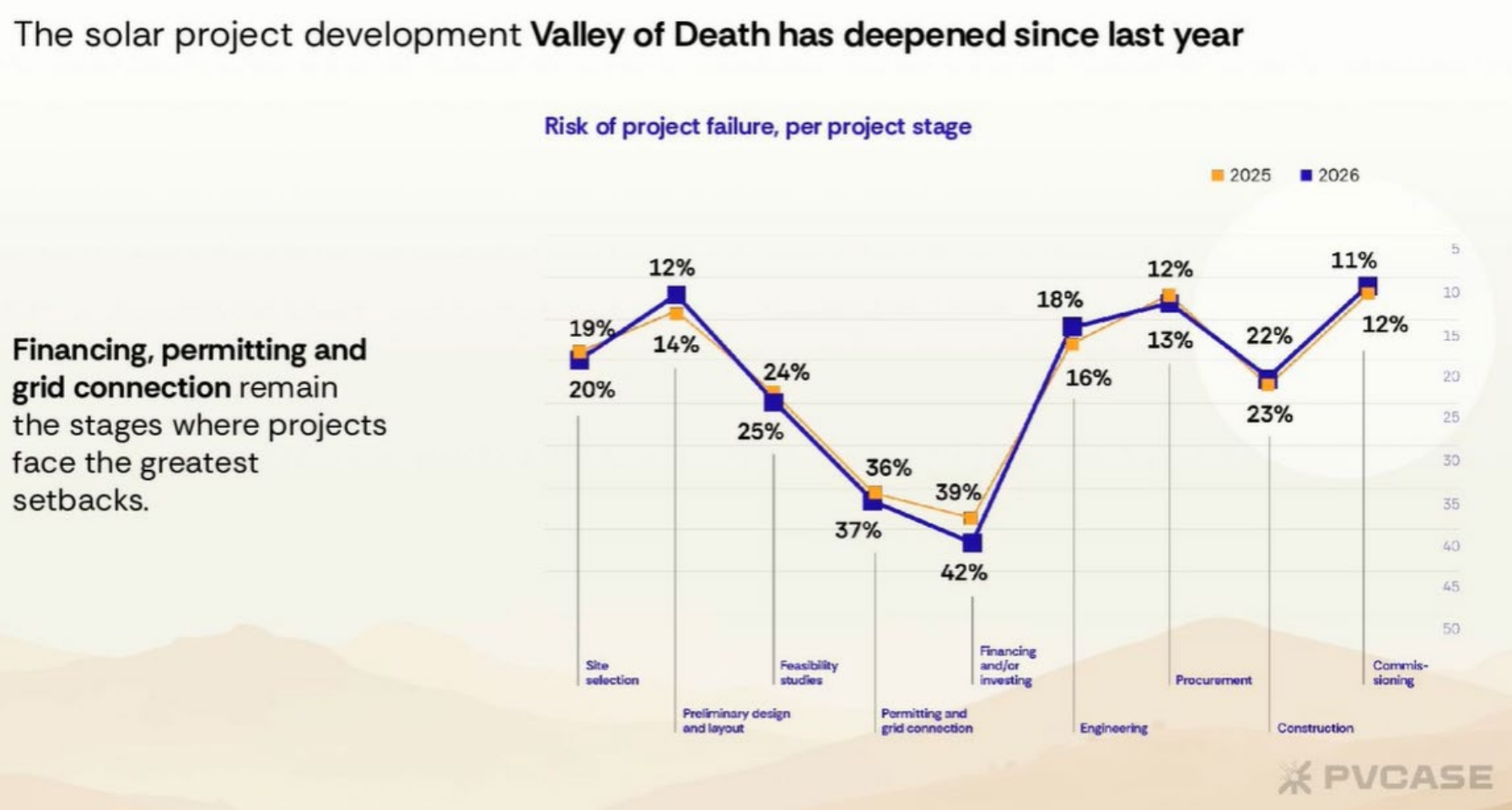


Figure source: https://pvcase.com/industry-report

WHICH CROPS AND LIVESTOCK ARE BEING GROWN IN AGRIVOLTAIC ARRAYS?

Grains & Specialty Crops

- Wheat
- Kernza*
- Sweet corn*
- Berries
- Broccoli*
- Diversified vegetables*
- Flowers
- Mushrooms

Trees, Shrubs, Vines

- Kiwis
- Grapes
- Apples*
- Stone fruits
- Conifers*
- Goji berries

Livestock & Feed

- Pigs
- Turkeys*
- Goats
- Cattle*
- Sheep*
- Alfalfa
- Hay*
- Soybeans

*Implemented at scale on front-of-the-meter arrays in the U.S. May not include every example in the country. Most others are implemented at scale elsewhere in the world.

Agrivoltaic Design Considerations

SOME HELPFUL DEFINITIONS

- **Behind-the-meter:** solar that serves on-site electric load; may still export excess power to grid
- **Front-of-the-meter:** solar that is injected directly into the electric grid; no power consumed on site unless combined with behind-the-meter feed (uncommon)
- **Azimuth:** horizontal angle of solar panels relative to the equator, relevant for designing arrays to fit non-uniform field shapes
- **Racking System:** structural mounting framework that securely holds solar panels
- **Bifacial Panel:** solar panel that is capable of producing energy from light absorbed on the front and rear surfaces
- **Single Axis Tracker:** racking system that allows solar panels to track the movement of the sun throughout the day; panels face east in the morning, flat at noon, and west in the afternoon
- **Foundation:** load-bearing structural component that anchors the racking system to the ground; commonly an I-beam or ground screw

AGRIVOLTAIC DESIGN CONSIDERATION EXAMPLES

- Solar panel row spacing and azimuth
- Access road design and spacing between array elements and obstructions with respect to equipment turn arounds and access
- Height of panels in relation to equipment, animals (increases foundation burial depth, initial expense)
- Whether to design to accommodate existing equipment or replace equipment
- Racking: farmer operational control of panel tilt, tracker motor options, foundation type
- Electrical line placement and burial depth, cable management
- Placement of above ground equipment/components, such as guy wires, pad or pole mounted equipment placement (e.g., inverters, disconnects, other electrical components, battery banks, etc.)
- Erosion & sediment control measures
- Whether, how, and where to integrate agricultural infrastructure (water, gates, processing areas, storage)

FIXED TILT AGRIVOLTAIC DESIGN

Photo credit: Jeremy Wyble



Klaas & Mary-Howell Martens Farm
Penn Yan, NY

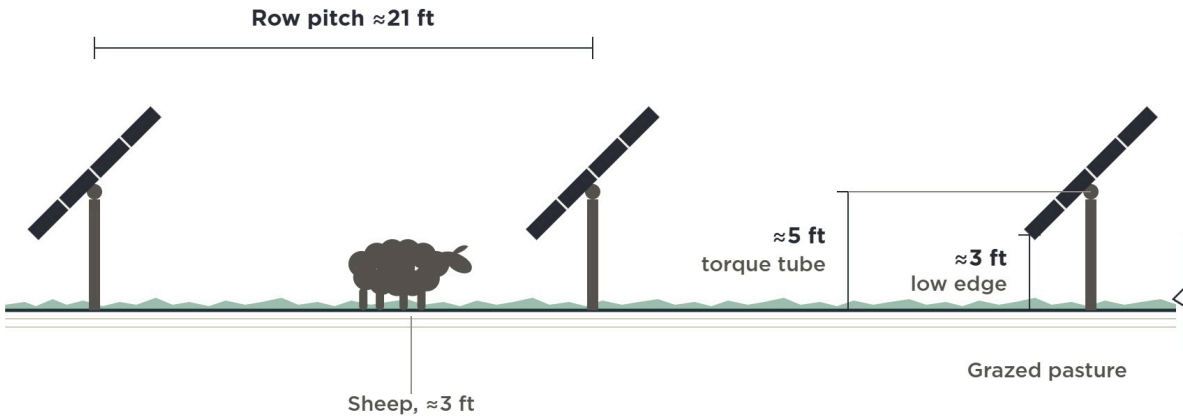
Dual azimuth
Fixed tilt racking
I-beam foundation
Raised panels
Increased row spacing

AGRIVOLTAIC SITE CONFIGURATION DIAGRAM

Livestock grazing configuration

Torque tube ≈5 ft · low edge clearance ≈3 ft · pitch ≈21 ft · GCR ≈0.35

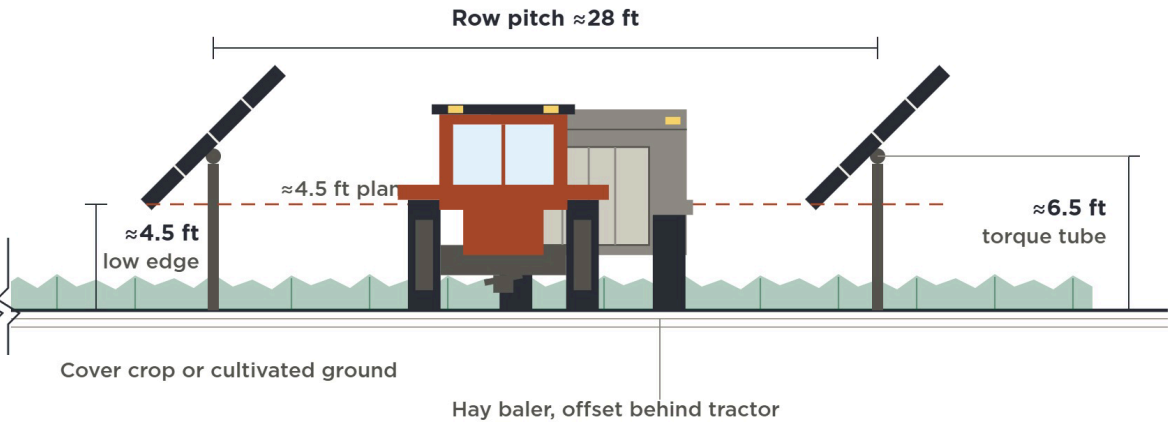
Lower tables and tighter pitch keep more panels on the same acreage. Low edges do not interfere with sheep grazing. Cattle need more.



Row crop configuration

Torque tube ≈6.5 ft · low edge clearance ≈4.5 ft · pitch ≈28 ft · GCR ≈0.25

Tractor shown end-on — equipment travels along the row, not across it. Cab ≈8–9 ft.



Values are representative of common practices, not site-specific design.

Schematic cross-section — horizontal and vertical scale equal.

Collection lines are not shown. Bury them below anticipated tillage depth or carry them at a height safe for livestock and handling equipment.

Smart Solar℠
American Farmland Trust

PROFILE / SECTION — GRAZING VS. CROP

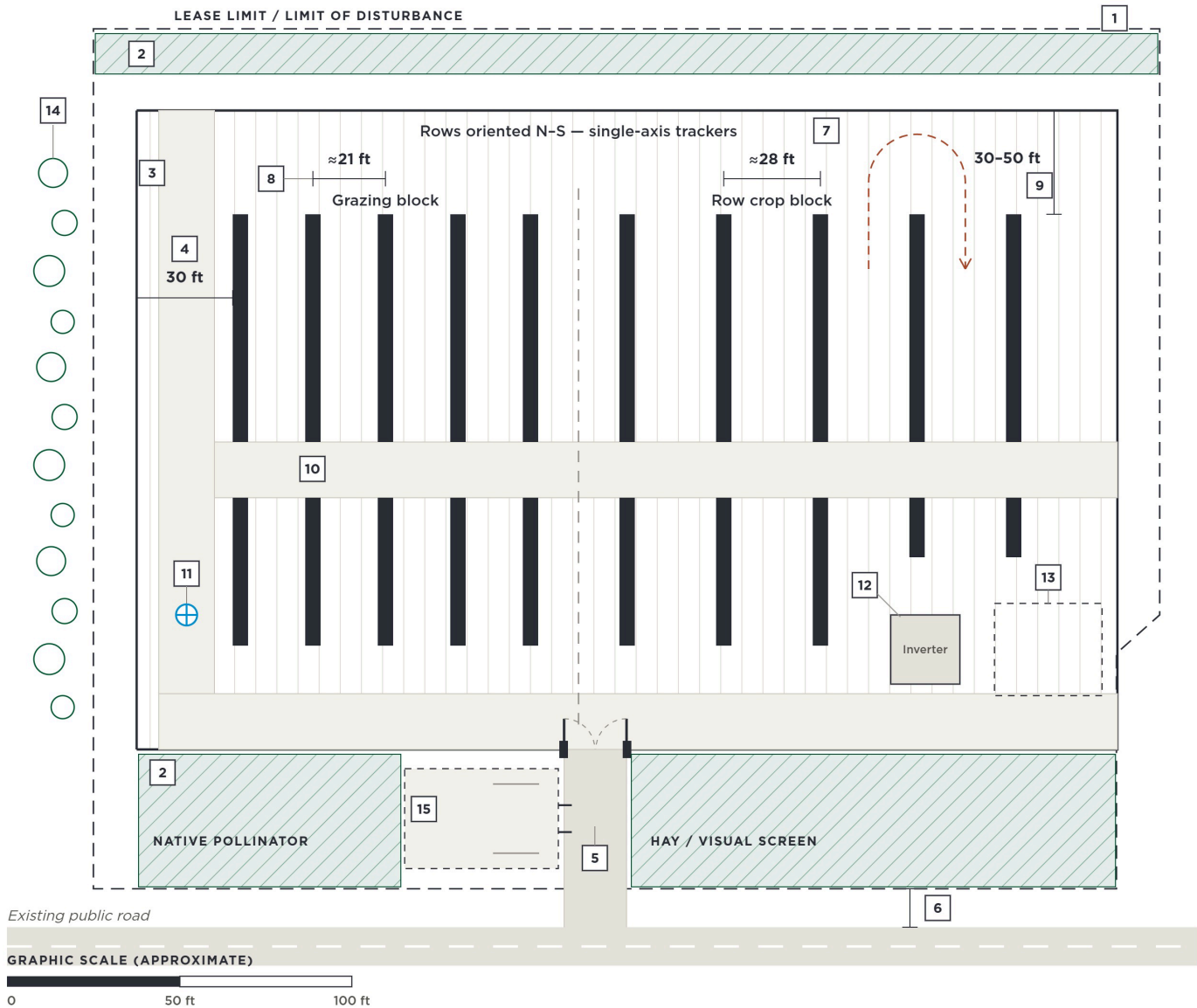
Illustrative example — not to scale, not for construction

Single-axis tracker, both configurations

Agrivoltaics 101 — education series

Rev. A · September 2026 · Scale: NTS

AGRIVOLTAIC SITE PLAN DIAGRAM



Smart Solar℠
American Farmland Trust

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KEYNOTES

1 Lease limit / limit of disturbance (typical)

2 Vegetated buffer, 20–50 ft — native pollinator planting, hay, or visual screening

3 Perimeter fence — chain link or hardware cloth livestock fence, 6–8 ft

4 Fence-to-array setback, 30 ft min — mower / flail access and fire-code access

5 Access road and equipment gate, 16–20 ft wide

6 Property line / road setback, 25–100 ft — ordinance-driven

7 Single-axis tracker rows, oriented N–S

8 Row pitch — ≈21 ft in the grazing block, ≈28 ft in the row crop block

9 Headland turning space, 30–50 ft — measured from the end of the row to the fence

10 Internal drive aisle / cross-aisle, 12–20 ft

11 Water access — livestock water and crop irrigation

12 Inverter / transformer pad, ≈20×20 ft, 5–10 ft clear

13 Equipment staging / laydown area

14 Existing tree line

15 Livestock trailer loading / unloading zone and handling chute — outside the fence, by the gate

GENERAL NOTES

Two pitches on one site: ≈21 ft grazing, ≈28 ft crop. The wider pitch admits more light to the crop and gives equipment room. Collection lines are not shown.

SITE PLAN — GRAZING + ROW CROP

Illustrative example — not to scale, not for construction

Single-axis tracker · pitch ≈21 ft grazing / ≈28 ft crop

Agrivoltaics 101 — education series

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DEVELOPMENT PROCESS CONSIDERATIONS THAT IMPACT TIMING AND DESIGN

Permitting (local zoning & state)

- Fence setback & type requirements
- Screening requirements
- Height limits
- Native plant requirements
- Maximum coverage of prime farmland by solar arrays
- Agrivoltaics exceptions
- Stormwater Pollution Prevention
- Species-related time-of-year restrictions
- Wetlands

Interconnection

- Utility payments
- Grid upgrades
- Interconnection studies
- Long lead times for interconnection equipment

New York State Solar Guidebook is a resource for local governments permitting solar energy projects.

CONSTRUCTION PROCESS CONSIDERATIONS THAT IMPACT AGRICULTURAL USE

- Construction schedule is often dictated by factors that may be less than ideal for optimizing for future agricultural activities
- Construction contractor(s) familiarity with implementation of NYSAGM's Guidelines for Solar Energy Projects - Construction Mitigation for Agricultural Lands
- A project's permitted limits of disturbance or a site-specific condition issued by a permitting authority may be limiting
- If livestock are present, may need to move during construction
- Underground conditions may complicate or delay execution of site plans
- Post-construction stormwater approvals for vegetation stabilization may take time, could delay agricultural implementation



Photo credit: Jeremy Wyble

Agrivoltaic Design Options

Racking Systems
Foundations



Photo credit: ClearPath Energy

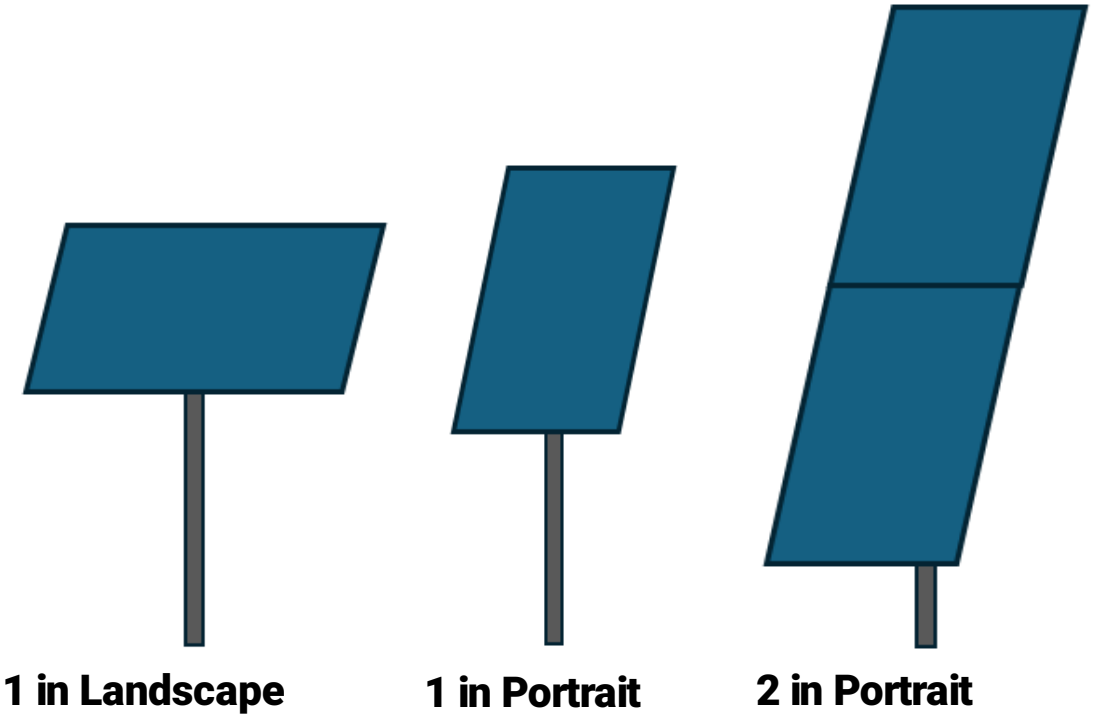
RACKING SYSTEM: Structural mounting framework that securely holds solar panels

Most common systems used for agrivoltaics

- **Fixed tilt**
- **Single-axis Tracker**
- **Vertical**

Panel orientation

- **Landscape or portrait**
- **1P, 2P, 2L**



RACKING SYSTEM OPTIONS: FIXED TILT (EAST-WEST ROWS)

Benefits

- Simpler installation and ongoing maintenance than tracking systems
- Fixed shade pattern may be beneficial for small scale diversified operations

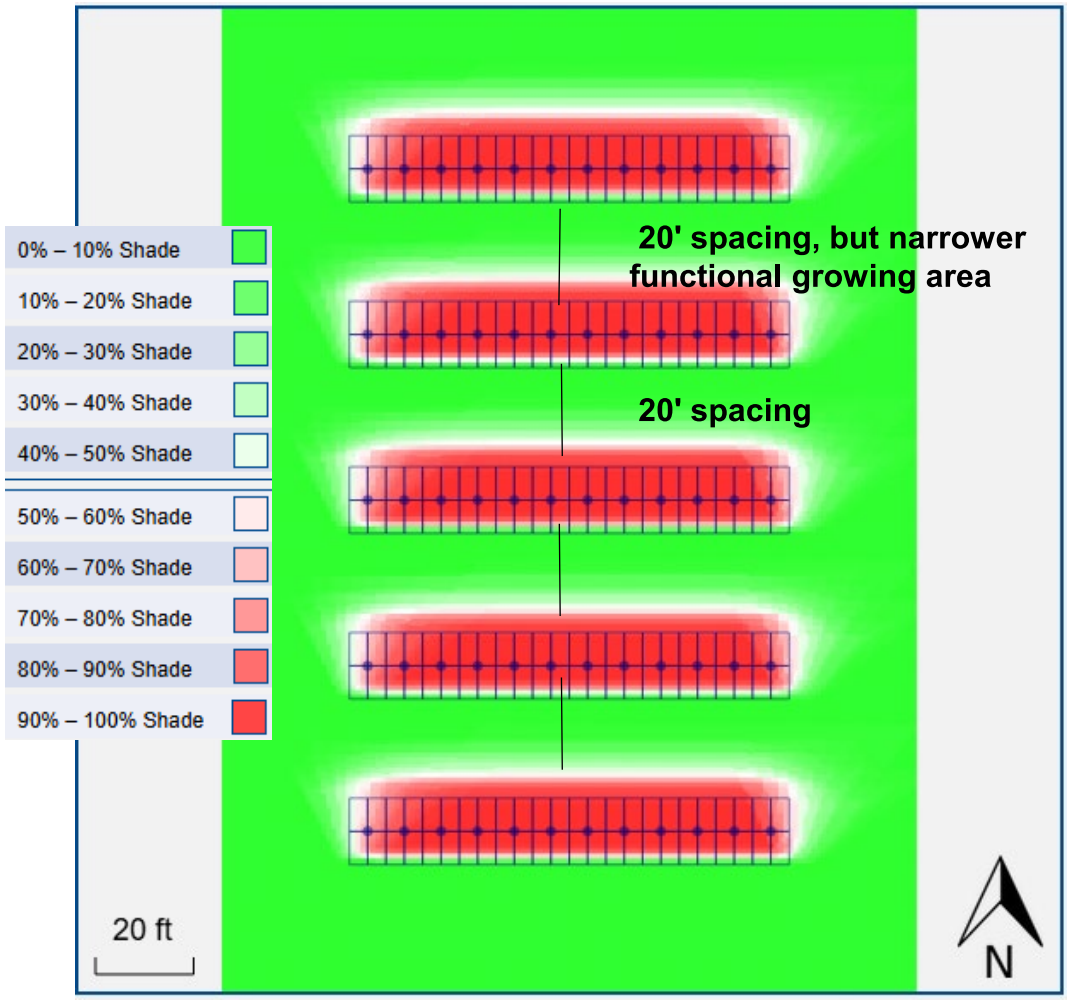
Potential Uses

- Diversified specialty farms that use hand labor
- Grazing, including on challenging terrain (higher slope tolerance than tracking system)

Considerations

- Fixed shade pattern
- Limited agricultural utility of land underneath and directly north of panels
- Gapping panels to increase sunlight increases cost per installed watt

FIXED TILT SHADING ANALYSIS: COMMON ROW SPACING



Shade profile for standard fixed tilt design:

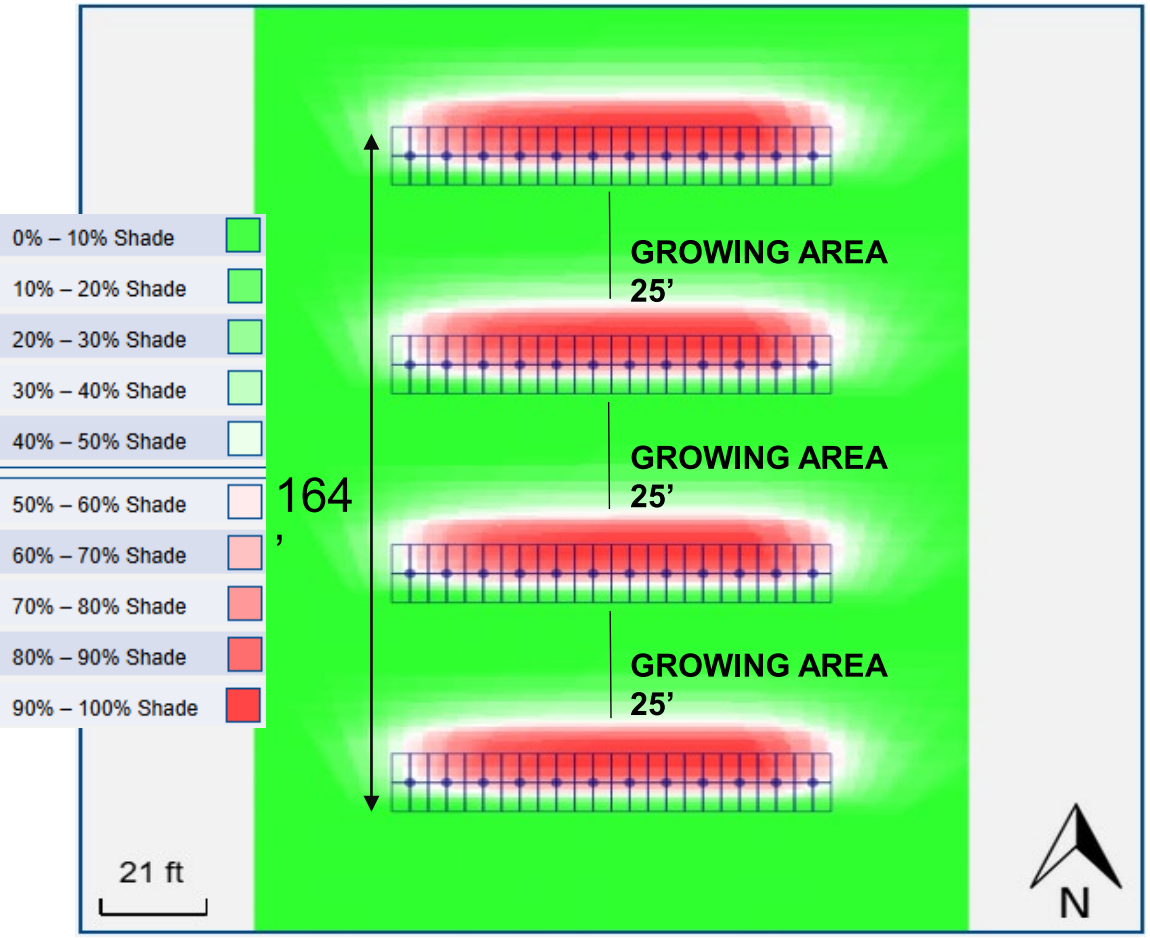
- 25° tilt
- 20’ inter-row spacing (panel edge to panel edge)
- 2.4’ bottom edge height

Minimum Shade	0%
Average Shade	50%
Maximum Shade	100%

	% of Interior Array Area
0-20% Shade	38%
20 - 30% Shade	5%
30 - 50% Shade	8%
50 - 80% Shade	8%
80 - 100% Shade	40%

Growing season shading analysis completed using MA DOER Dual-Use Shading Analysis Tool with sunlight of western MA substituted for NY.
Shade percentages do not consider indirect or diffuse light.

FIXED TILT SHADING ANALYSIS: AGRIVOLTAIC DESIGN



Shade profile for agrivoltaics tilt design:

- 25° tilt
- 35’ inter-row spacing (panel edge to panel edge)
- 8’ bottom edge height

- *~46% of the area is available for growing if planning for a tall crop like corn*
- *54% is either obstructed by panels or too shady*

PERCENT SHADE	PERCENT SUN
Minimum Sun	1 %
Maximum Sun	100 %
Average Sun	66 %

Growing season shading analysis completed using MA DOER Dual-Use Shading Analysis Tool with sunlight of western MA substituted for NY. **Shade percentages do not consider indirect or diffuse light.**

Photo credit: Linda Garrett

NYSERDA-FUNDED AGRIVOLTAICS DEMONSTRATION PROJECT - FIXED TILT DESIGN



K&MH Martens Farm Agrivoltaics Project
Penn Yan, NY

300 kW
Fixed tilt
2P design
Lower panel edge min 6’6”
36’ interrow spacing
4 rows face south
4 rows face southwest
Planned agrivoltaics:
Dairy cattle grazing

GAPPED PANEL DESIGN

AGRIVOLTAICS FIXED TILT DESIGN WITH GAPPED PANELS

Massachusetts

Lower panel edge min. 10'6"
Planned agrivoltaics: cattle, vegetables
Very early agrivoltaics array, research by UMass



Photo credit: Massachusetts Department of Energy Resources



Photo credit: AES

RACKING SYSTEM OPTIONS: SINGLE-AXIS TRACKER (NORTH-SOUTH ROWS)

Benefits

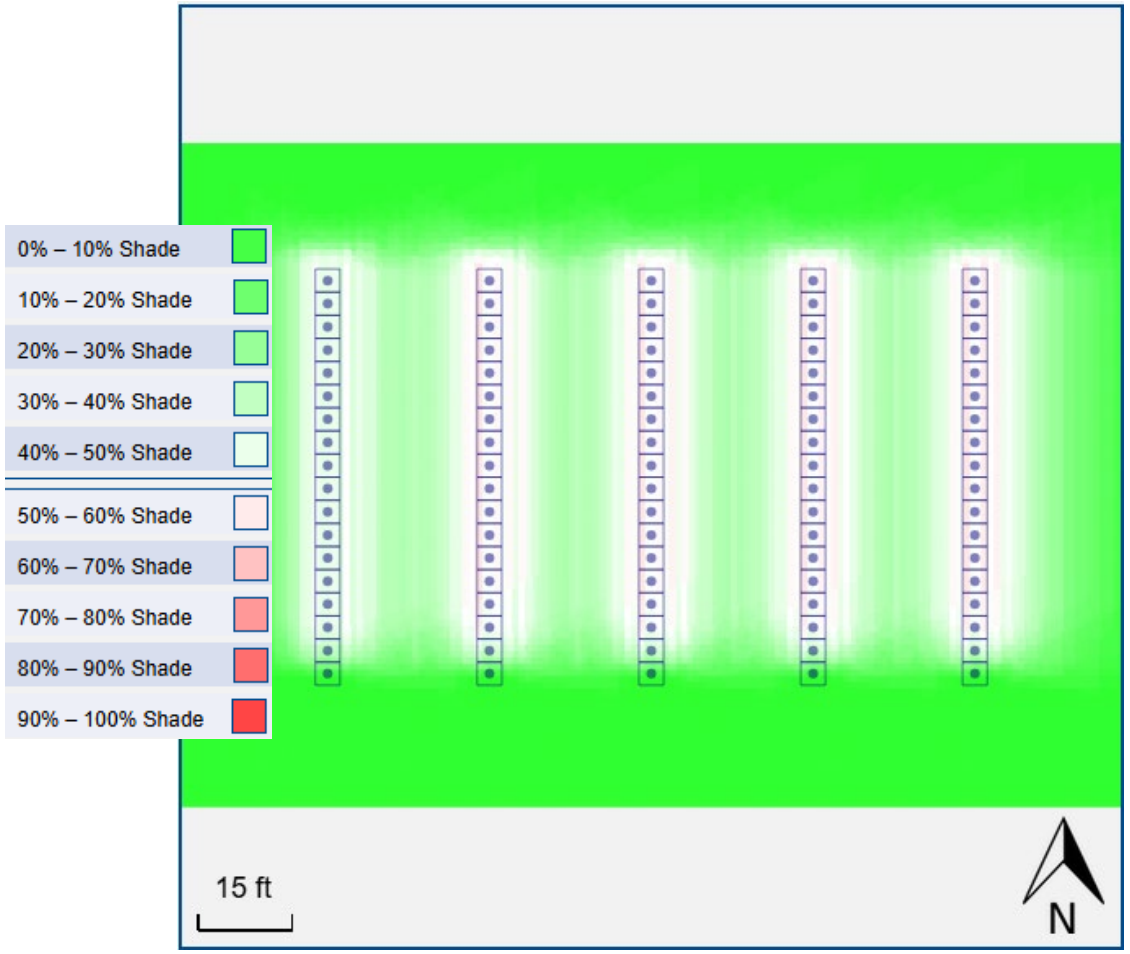
- With 1P, relatively uniform shade pattern across entire array
- Increased efficiency of panels, more energy output
- Industry standard, commercial availability

Potential Uses

- Suitable for diverse forms of agriculture, including mechanized

Considerations

- More complex ongoing maintenance than fixed tilt
- Increased torque tube height increases foundation depth and cost, installation labor cost
- If possible with technology used, farmer control over panel tilt increases agricultural utility; may reduce energy output



SINGLE AXIS TRACKER (SAT) SHADING ANALYSIS – 1P

Shade profile for 1P SAT design:

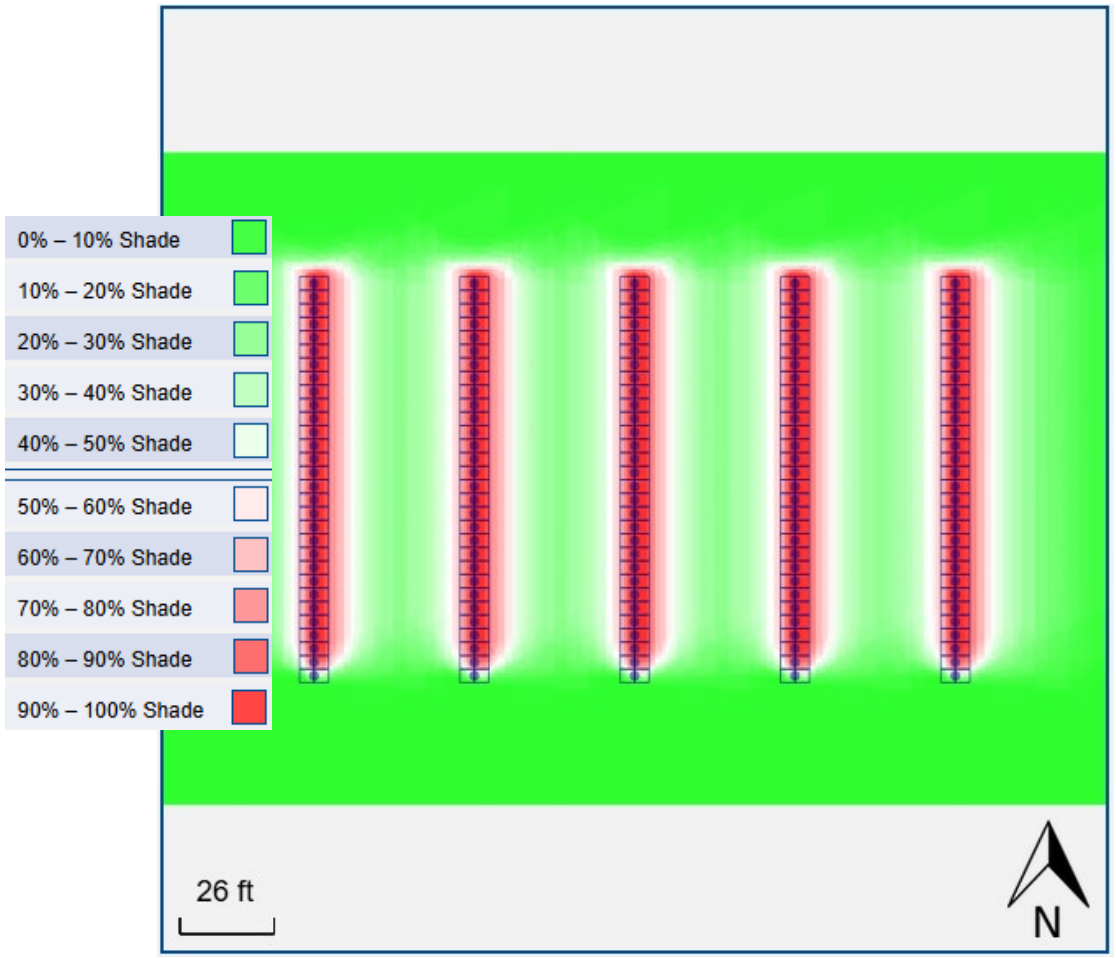
- 18’ inter-row spacing (panel edge to panel edge)
- Slightly increased from standard design
- Shade decreases with increased torque tube height
- Image shows analysis for 7’ height

	10' Torque Tube	7' Torque Tube
Minimum Shade	28%	29%
Average Shade	41%	42%
Maximum Shade	50%	56%

	% of Interior Array Area (10')	% of Interior Array Area (7')
0-20% Shade	0%	0%
20 - 30% Shade	0%	3%
30 - 40% Shade	44%	44%
40 - 50% Shade	56%	36%
50 - 100% Shade	0%	17%

Growing season shading analysis completed using MA DOER Dual-Use Shading Analysis Tool with sunlight of western MA substituted for NY. **Shade percentages do not consider indirect or diffuse light.**

SINGLE AXIS TRACKER (SAT) SHADING ANALYSIS – 2P



Shade profile for 2P SAT design:

- 28’ inter-row spacing (panel edge to panel edge)
- 8’ torque tube height

	8' Torque Tube
Minimum Shade	22%
Average Shade	49%
Maximum Shade	100%

	% of Interior Array Area
0-20% Shade	0%
20 - 30% Shade	30%
30 - 50% Shade	34%
50 - 80% Shade	21%
80 - 100% Shade	15%

Growing season shading analysis completed using MA DOER Dual-Use Shading Analysis Tool with sunlight of western MA substituted for NY. **Shade percentages do not consider indirect or diffuse light.**

Photo credit: Lightstar Renewables

NYSERDA-FUNDED AGRIVOLTAICS DEMONSTRATION PROJECT – 2P SAT DESIGN



Agrivoltaics SAT Design
Montgomery, NY

Torque tube height: 8'
Interrow spacing: 43.5'
Planned agrivoltaics:
Hay, vegetables

Photo credit: Pieter Coetzee



Agrivoltaics SAT Design

Massachusetts

Torque tube height: 10'
Interrow spacing: 18'
Planned agrivoltaics: vegetables





Photo credit (bottom left):
Hyperion Systems
Photo credit (right):
Massachusetts Department of Energy Resources



Agrivoltaics SAT Design

Colorado

Jack's Solar Garden
Torque tube height: 6' and 8'
Interrow spacing: 17'
Planned agrivoltaics: vegetables, livestock, berries



Photos credit: Colorado Sun

RACKING SYSTEM OPTIONS: VERTICAL BIFACIAL (NORTH-SOUTH ROWS)

Benefits

- Compact footprint reduces the amount of dense shade and spatial obstructions

Potential Uses

- Windbreak
- Fence
- Specific crops including corn

Considerations

- Efficiency increases at higher latitudes and with shorter or defoliated crops
- Limited benefits from shade in hottest part of the day

Rutgers Cook College Animal Farm Agrivoltaics Demo Site

New Jersey

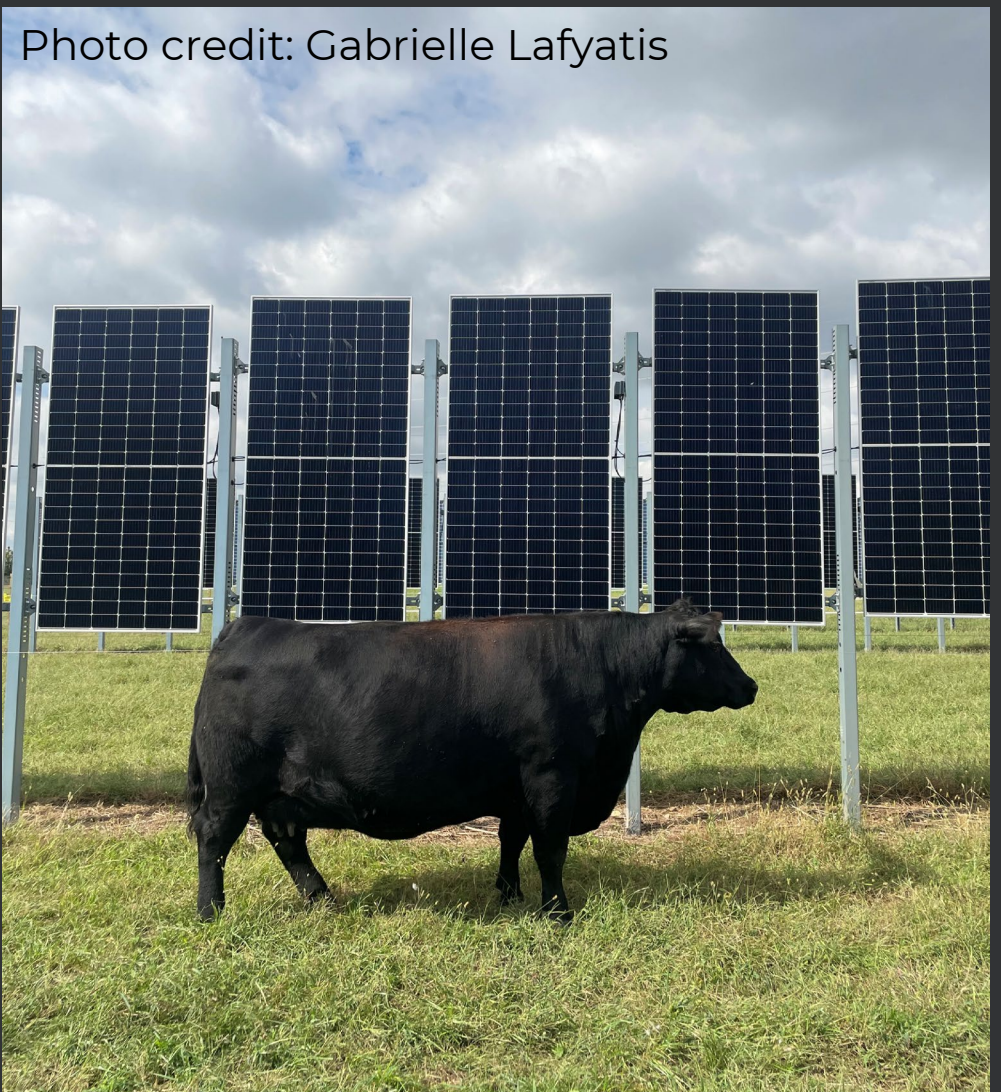


Photo credit: Gabrielle Lafyatis



Photo credit: Jennifer Manierre

VERTICAL BIFACIAL TEST SITE

Colorado State University Agrivoltaics Demo Site

Colorado





Photo credit: Colorado State University



Photo credit: Next2Sun

Vertical Bifacial Agrivoltaics Project
Germany



Photo credit: SunZaun

23 kW Vertical Bifacial Array at Somerset Gourmet Farms winery
California

FOUNDATIONS: Load-bearing structural components that anchors racking system to the ground; increased height above ground increases depth below ground

- **I-Beams:** limits the amount of lost agricultural land, can be pre-drilled if soil is rocky though will increase cost
- **A-Frames**: not ideal for agriculture but used in very rocky or very sandy soils; removes ~6 ft from non-livestock agricultural production in every panel row
- **Poured concrete piers or concrete ballasts**: use not recommended on farmland, uncommon in greenfield arrays

Photo credit: Massachusetts Department of Energy Resources

I-Beams




Photo credit: Jeremy Wyble
A-Frames

RETROFITTING ARRAYS FOR AGRIVOLTAICS

Common agricultural uses:

- Livestock grazing
- Small-scale forage production

Considerations:

- Soil type and health
- Seed mix
- Water supply
- Gates & fencing
- Cable management system





Photo credit: Caleb Scott

RETROFIT – CATTLE AGRIVOLTAICS

New York

14-acre site
Drip edge 2 – 4'
Interrow spacing 14'
Not designed for agriculture, now grazed by cattle, sheep and chickens

Photo credit: Jeremy Wyble





Retrofit - Sheep



Photo credit: Jeremy Wyble

How can solar power be used on-farm?

ON-FARM SOLAR OPTIONS

Net-metering/VDER

- Ensure adequate space and grade for safe maneuvering of farm equipment
- Ensure adequate availability of sunlight for intended agricultural use
- Align design with soil resource capability
- Agriculture compatible permanent erosion and sediment control features

Integrated Solar + Batteries

- For some farms with a relatively continuous year-round electrical load, solar power can be stored in batteries to directly offset grid power and potentially provide power during an outage.

INTEGRATED SOLAR + BATTERIES FOR ON-FARM POWERING

Potential Benefits

- May reduce energy costs from lower cost of solar power and reduced demand charges
- Provides a long-term fixed cost for power
- Can provide uninterrupted power backup and microgrid (or "nanogrid") operation during grid outages
- May provide an on-site power option to avoid costly grid service upgrades for an expansion of farm operations
- May improve power quality, provide consistent voltages and 3 phase power resulting in fewer motor issues



Photo credit
Jeremy Wyble



Photo credit
Stephen Hoyt

INTEGRATED SOLAR + BATTERIES FOR ON-FARM POWERING (CONT.)

Potential uses

- Mill, dairy farm or other operations with significant electrical load
- Could potentially support dairy farm renewable natural gas (RNG) or greenhouse installations

Considerations

- A relatively consistent year-round electrical load profile is necessary
- Requires feasibility analysis and engineering planning





Photo credits
Stephen Hoyt

What do you need to consider and do to get good outcomes for both agriculture and energy production?

FARMER INPUT

Successful agrivoltaic design, construction and operation requires the input of farmer(s) or agrivoltaic experts on:

- **Array design to:**
  - Ensure adequate space and grade for safe maneuvering of farm equipment
  - Ensure adequate availability of sunlight for intended agricultural use
  - Align design with soil resource capability
  - Agriculture compatible permanent erosion and sediment control features
- **Seed mixes used during construction and in final seedings**
- **Ideally, construction timing to avoid destruction of soil structure during wet weather**



Photo credit: Jeremy Wyble



Photo credit: Jeremy Wyble


Photo credit: Jeremy Wyble



Photo credit: Massachusetts Department of Energy Resources

MITIGATING CONSTRUCTION IMPACTS
NEW YORK STATE DEPARTMENT OF AGRICULTURE AND MARKETS GUIDELINES

NEW YORK STATE DEPARTMENT OF AGRICULTURE AND MARKETS

Guidelines for
Solar Energy Projects - Construction Mitigation for Agricultural Lands
(Revision 10/18/2019)

The following are guidelines for mitigating construction impacts on agricultural land during the following stages of a solar energy project: Construction, Post-Construction Restoration, Monitoring and Remediation, and Decommissioning. These guidelines apply to project areas subject to ground disturbance[1] within agricultural lands including:

- Lands where agriculture use will continue or resume following the completion of construction (typically those lands outside of the developed project's security fence);
- Lands where the proposed solar development will be returning to agricultural use upon decommissioning, (typically those lands inside of the developed project's security fence);
- Applicable Area under review pursuant to Public Service Law Article 10 Siting of Major Electric Facilities.

ADDITIONAL SOIL PROTECTIVE PRACTICES

- **Preconstruction seeding**: Established pasture or cover crop withstands the solar construction process much better than bare ground.
- **Soil amendments:** If needed, should be spread during construction, especially ones that take time to take effect.
- **Minimizing grading:** Existing leveled field areas should be left intact.
- **Travel lanes:** Restrict movement of equipment to limit compaction. Severely compacted soil must be decompacted to support agricultural production.
- **Matting:** May be useful in specific instances. In Maine, did not lessen yield impact on wild blueberry plants vs. dedicated travel lanes.
- **Education for contractors:** The importance of maintaining soil health for agricultural use must be communicated.

Photo credit: Kristin France

NYSERDA-FUNDED AGRIVOLTAICS DEMONSTRATION PROJECT - 2P



MINIMIZING GRADING AND SOIL DISTURBANCE

Lightstar Renewables
Montgomery, NY

Hay pasture site was not graded during construction and soil disturbance minimized

Vegetation recovered rapidly - 2 months after construction completed

ADDITIONAL CONSIDERATIONS

- **Fencing**
- **Obstructions (steeply sloped areas, stormwater features, access roads, equipment pads, drivelines)**
- **Conduit**
  - Depth may vary by solar developer risk tolerance, town zoning, soil conditions, expected agricultural use; for safety, must be communicated to farmers and accurately noted on as-builts
- **Cable Management**

AGRIVOLTAICS RESEARCH INFORMATION

NYSERDA Sun and Soil Program

Cornell CALS Agrivoltaics

Rutgers Agrivoltaic Program

InSPIRE Data Portal

Solar Farm Summit

STATE RESOURCES

NYSERDA Sun and Soil Program

NYSERDA Agrivoltaics Resources

NYSERDA Sun and Soil Program Partner Table

- Find collaborators and technical assistance

NYSERDA Regional Clean Energy Hubs

NY Agricultural Technical Working Group

Ag Energy NY

Cornell Cooperative Extension

NATIONAL RESOURCES

American Farmland Trust

American Solar Grazing Association

The InSPIRE Project Map

NLR Clean Energy to Communities

Renewable Energy Farmers of America

Questions?



Photo credit: Jeremy Wyble