AGRIVOLTAICS OPPORTUNITIES

BLUEWAVE

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AGRIVOLTAICS & SUSTAINABLE SOLAR

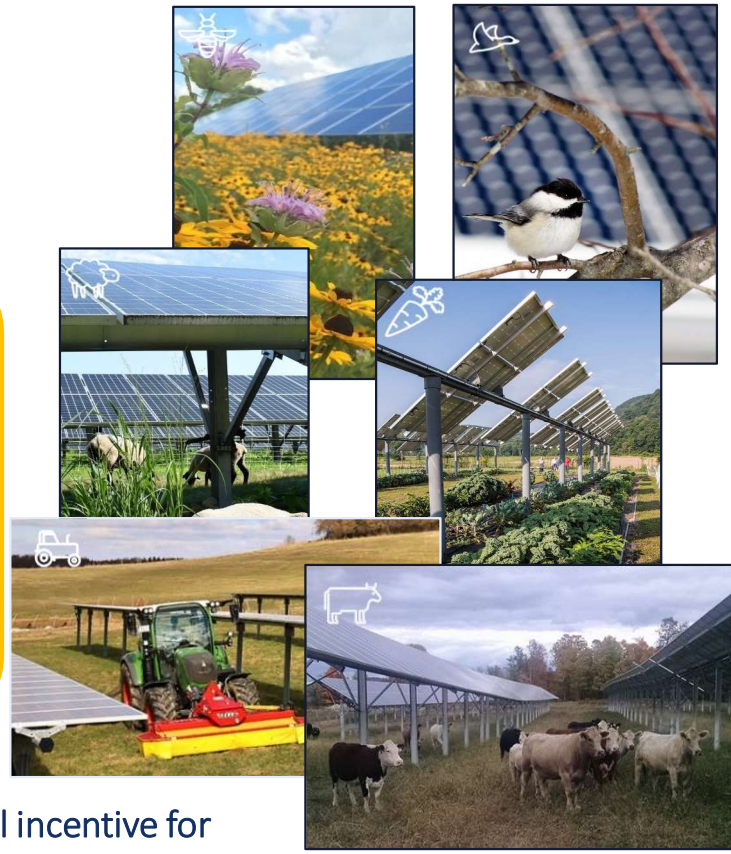
Solar design and stewardship strategies rooted in conservation and agriculture, creating multifunctional systems with a variety of ecological, agricultural, and energy benefits.

Dual Use Ecovoltaics: Pollinator-Friendly & Conservation-Focused Design

Dual-Use Agrivoltaics: Sheep Grazing

Adaptive Agrivoltaics: Crops & Cattle Grazing

Ag-Ready Agrivoltaics: Crops, Livestock & Equipment at Commercial Agricultural Scale



Massachusetts is the first state with an operational definition and financial incentive for agrivoltaics. New Jersey, New York and others are poised to follow.

DUAL-USE AGRIVOLTAICS

Solar grazing is the biggest thing in sheep farming since WWII!

- Hundreds of active solar grazing farms
- Over 100,000 acres of solar
- Existing sheep farms expanding
- Intergenerational transitions
- New sheep farmers entering agriculture

(Photos courtesy of Finicky Farm, LLC.)

ADAPTIVE AGRIVOLTAICS


Finicky Farm, LLC

Fixed tilt
- East-west rows with south-facing panels
- Banded light pattern
- Can be elevated for agrivoltaics (expensive)
- Aisles can only fit mid-scale equipment
- Works fine for specialty crops, grazing

Single-Axis Tracker
- North-south rows with panels rotating from east to west
- Current industry PV standard
- More even light distribution
- Slightly wider aisles
- 10,000s or 100,000s of acres being grazed at utility-scale solar facilities
- Can be elevated for AgPV
- Can be 1P, 2L, or 2P format


BlueWave

The most important factor in crop-focused agrivoltaics:
Shifting from E-W rows (fixed-tilt) to N-S rows (SAT/VBF).

Feasibility Considerations for US Solar Markets:
- Equipment Cost
- Engineering
- Bankability
- Procurability
- Constructability
- Insurability
- Operational efficiency
- Operational economics

Knowlton Farms, Grafton, MA
Developed by BlueWave
(Built & Owned by AES)


Array Technologies, Inc

YES, IT ALSO WORKS FOR CROPS!

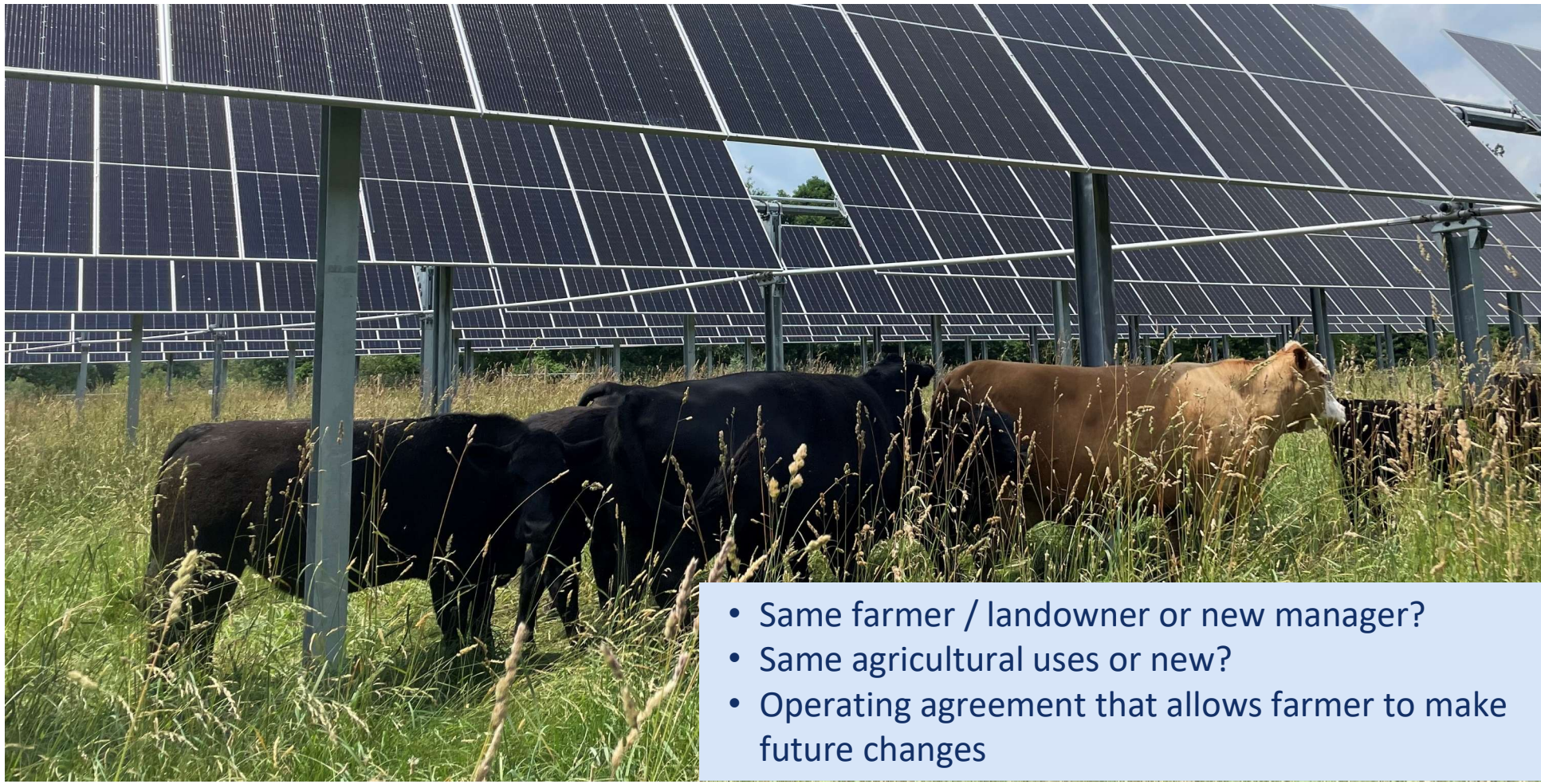
HOW DO WE GET THERE?

1. Leave Space
2. Allow Flexibility
3. Understand Shading
4. Operationalize

LEAVE SPACE

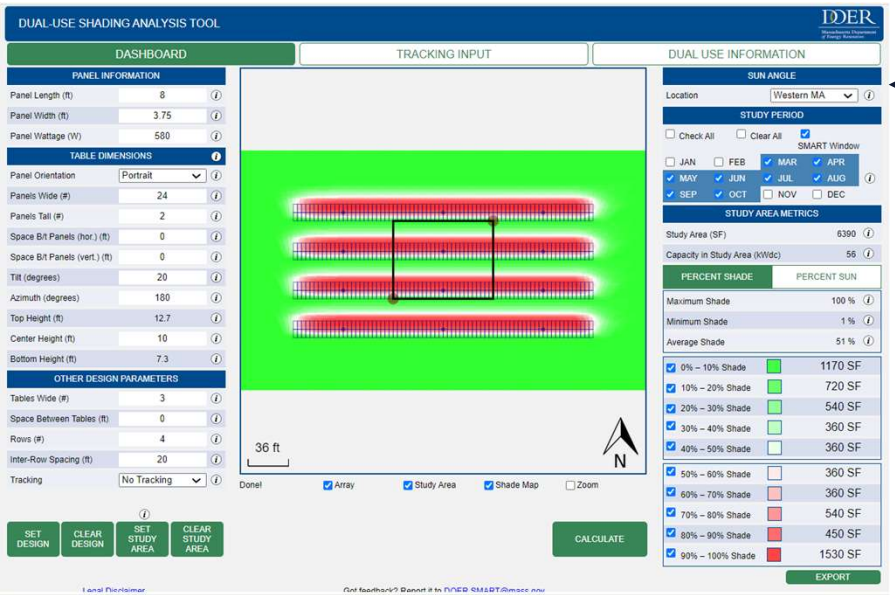
- Land space = good soils: resilient, restorable, productive
- Temporal space = preconstruction vegetation: more resilience, faster recovery, better soil health
- Operational space: wide rows, more height, clearly-located buried conduit

ALLOW FLEXIBILITY



- Same farmer / landowner or new manager?
- Same agricultural uses or new?
- Operating agreement that allows farmer to make future changes

UNDERSTAND SHADING

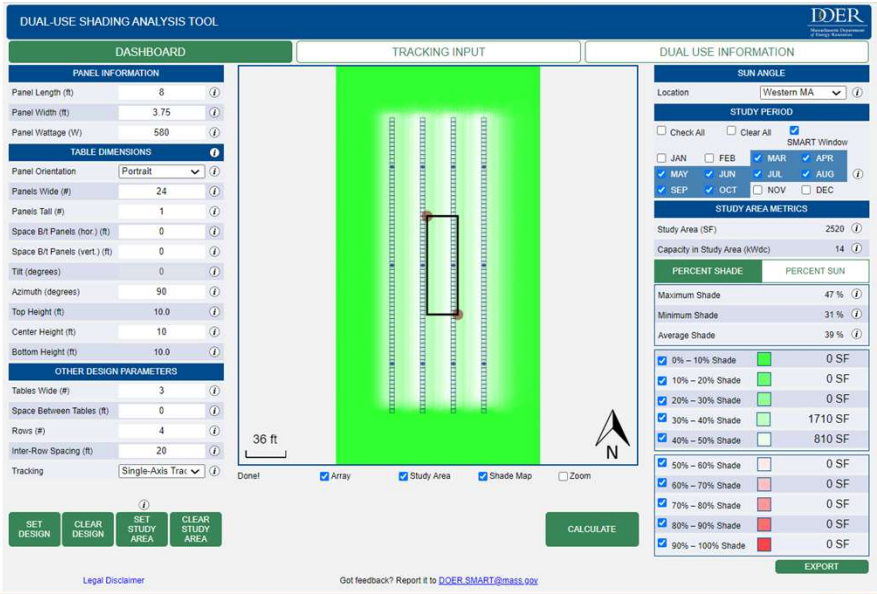


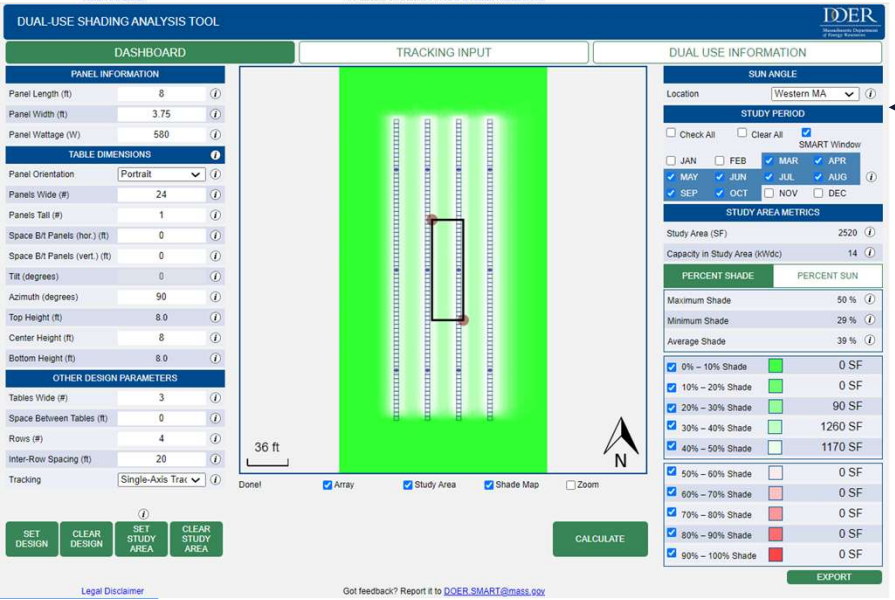
2P Fixed-tilt

- 20’ inter-row (very wide)
- ~34’ pitch
- Max 100% shade
- Min 1% shade
- Avg 51% shade

1P SAT

- 20’ inter-row
- 28’ pitch
- 10’ center height
- Max 47% shade
- Min 31% shade
- Avg 39% shade



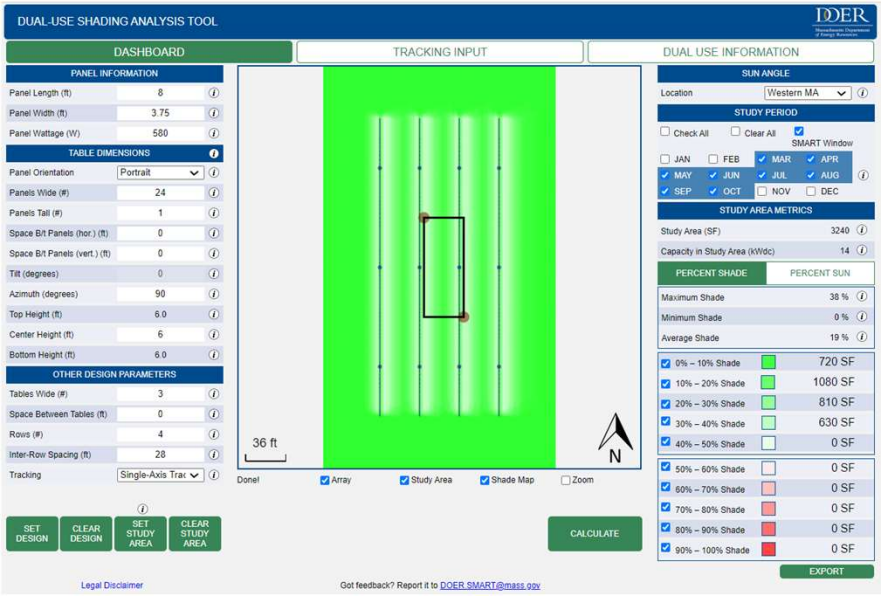


1P SAT

- 20’ inter-row (wide)
- 28’ pitch
- 8’ center height
- Max 50% shade
- Min 29% shade
- Avg 39% shade

1P VBF

- 28’ inter-row
- ~28’ pitch
- 6’ center height
- Max 38% shade
- Min 0% shade
- Avg 19% shade



OPERATIONALIZE

AG-READY AGRIVOLTAICS

<u>Keep It Simple:</u> Just farm between the rows!

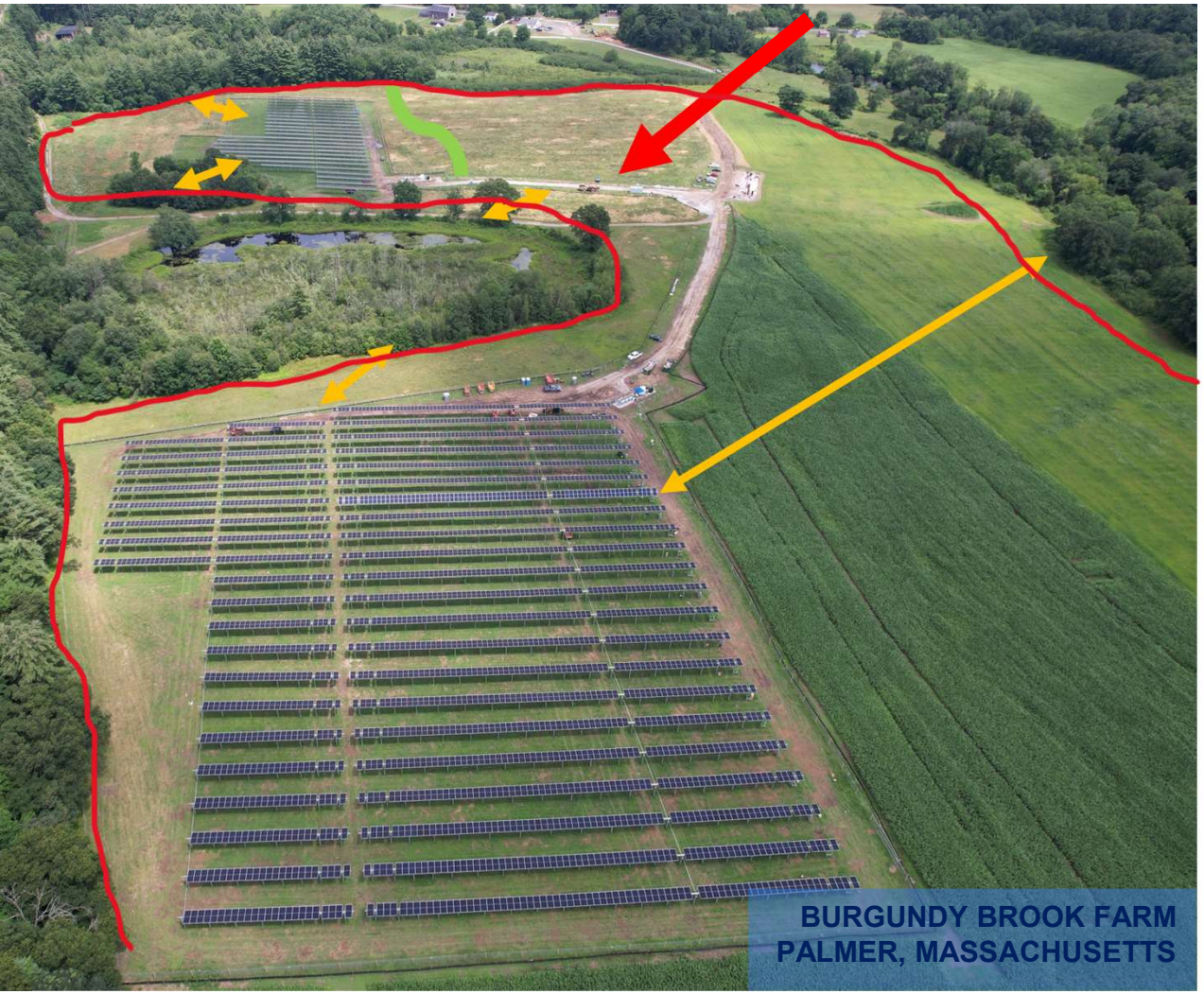
Pay attention to equipment combinations!

- Hay/forage mowers
- Smaller square balers
- Vegetable harvesters (potatoes, onions, etc)
- Consider centerline alternatives
- Harvesting may require trucks or hoppers

Ag Equipment is Expensive…

Operational Inefficiencies are More Expensive!

PERMITTING CONSTRAINTS

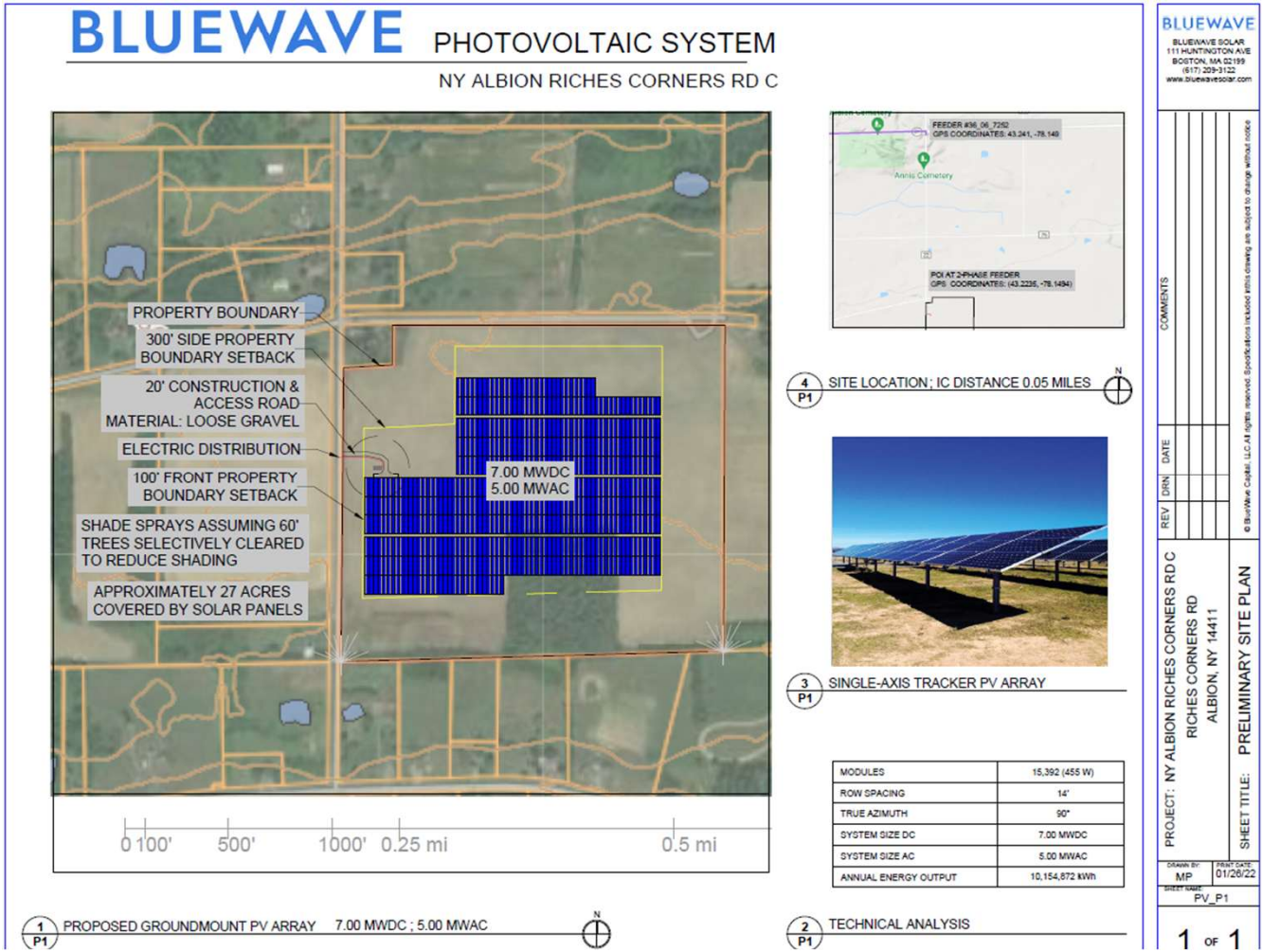


The Best-Laid Plans…

- 2017 design was 7 MWDC
- Interconnection was viable
- Town opposed the project
- Setbacks from floodplain, wetlands, property lines
- Viewshed across neighboring property
- Screening requirements
- Fence requirements
- As-built: 2.0MW in 2 small arrays

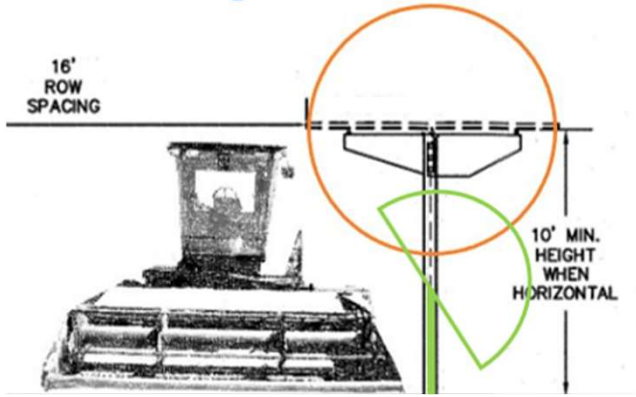
“CONVENTIONAL” DESIGN

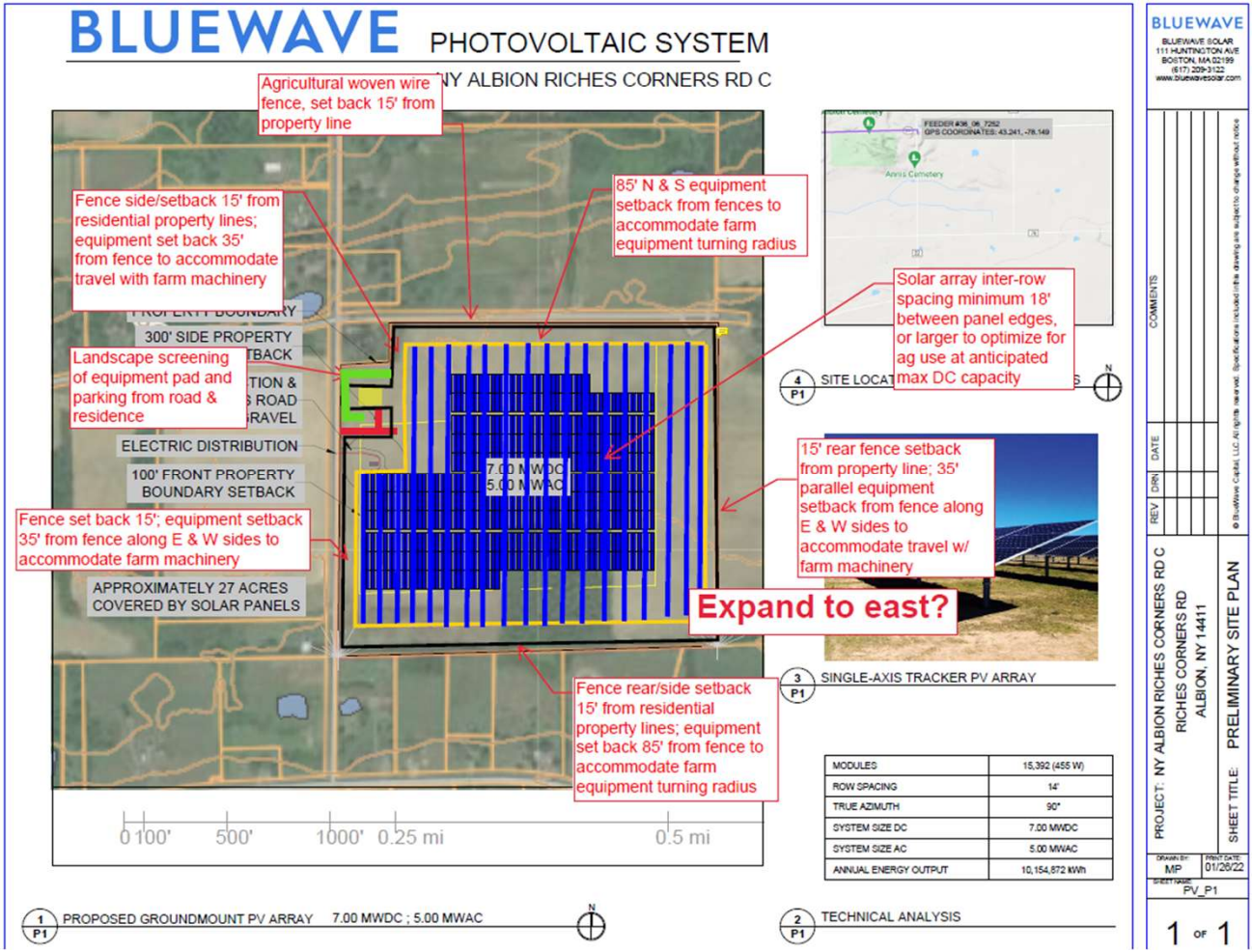
- Driven by ease of permitting, construction
- Large setbacks
- Tight solar footprint
- Extensive vegetative screening



FARM-FOCUSED DESIGN

- Fence the field
- Wider row spacings are usually better than more height
- Match setbacks to ag equipment clearance
- Design a consistent, convenient ag management unit





ENGAGING WITH AGRIVOLTAICS

Support operationalizing incentives

- Grants won't support commercial agrivoltaics, one-off demonstrations won't change industry practices
- Developers and banks need predictable permitting and reliable revenue

Prioritize farm-first design & construction strategies

- Fence the field, not the array
- Optimize field layout, including width and turn radius of tractors, equipment
- Locate and protect farm infrastructure (tile drains, irrigation, etc)
- Avoid extra roads, pads, etc
- Utilize pre-construction seeding & post-construction decompaction

Advocate for farm-first permitting flexibility

- Minimize setbacks and screening for fences & panels
- Distinguish between ag-friendly solar panels & racking versus other equipment (equipment pads, batteries)
- Focus visual impact review on inverters and other electrical equipment
- Allow continued responsible use of wetland buffer setbacks, existing wet areas
- Reduce unnecessary stormwater features, using PV-SMaRT Stormwater design

Incorporate conservation outcomes

- Work with landowners and developers to ensure permanent conservation prior to facility decommissioning
- Considering facilitating farm management & ownership transitions