

**Rutgers**  
**Agrivoltaics**  
**Program**

New Jersey Agricultural Experiment Station



# Agrivoltaics 101

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**Agrivoltaics** simultaneously combines agriculture with solar energy generation on the same piece of land

- Keeps the land in agricultural production
- Contributes to the state's renewable energy mandate

Challenges:

- How to pay for the installation?
- How to connect to the local utility grid?
- What agricultural adjustments are needed?
- Does the electricity generation cover yield reductions?
- How best to address opposition to agrivoltaics?

Excluded here: Grazing small animals and pollinator habitats

# Different types of agrivoltaic systems

- Fixed-tilt (low to the ground, South facing)
- Seasonally adjustable tilt (manual, on posts, South facing)
- Single-axis trackers (North-South rows, various post heights)
- Dual-axis trackers (always pointed perpendicular to the Sun)
- Vertical bifacial (no moving parts, bifaciality factor)
- Elevated fixed-tilt or trackers on support structures

Other photovoltaic options (without using agricultural land):

- Mounted on (shade) structures (e.g., barns, greenhouses)
- Floating on (irrigation) ponds



# Fixed-tilt





# Seasonally adjustable tilt



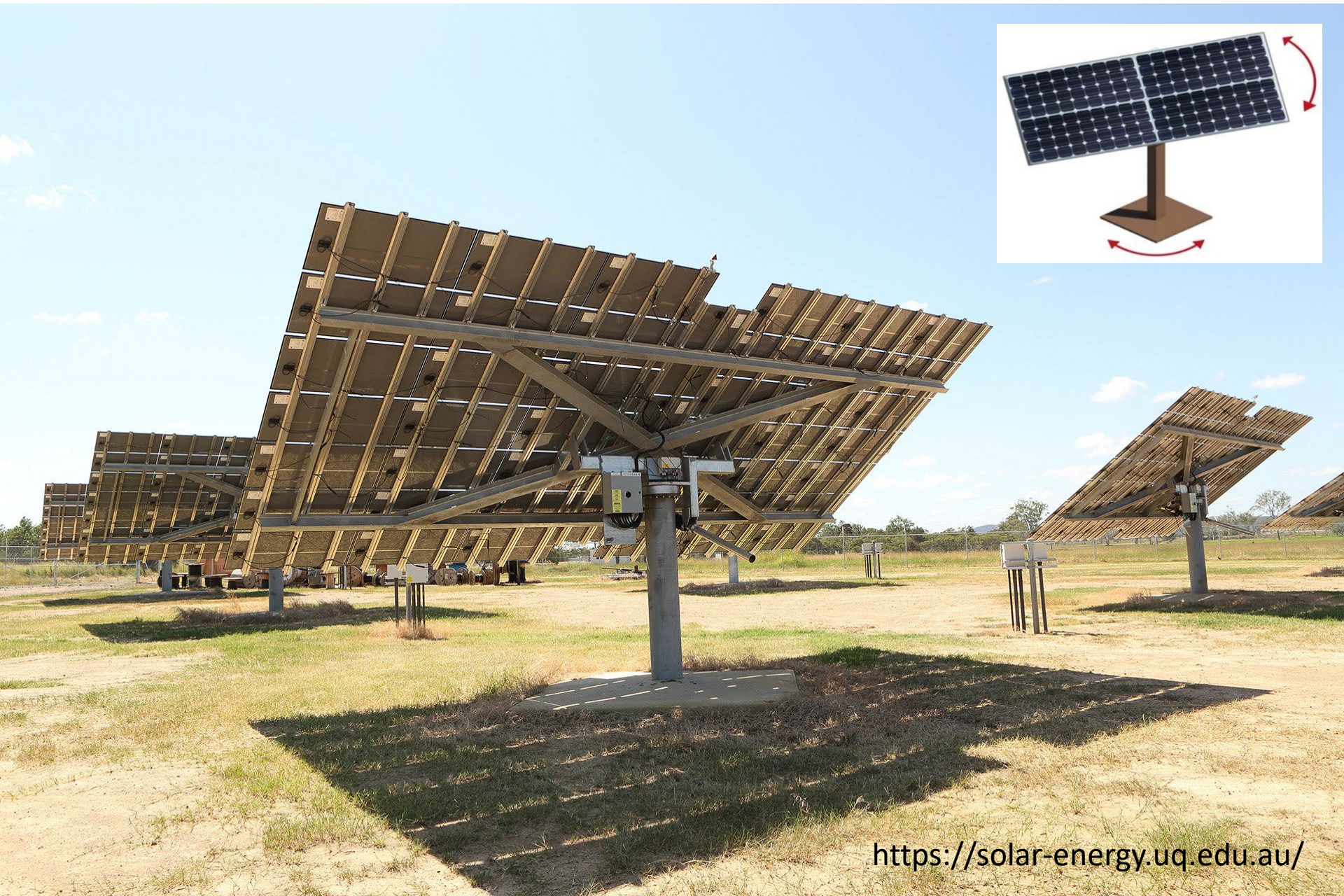


# Single-axis trackers





# Dual-axis trackers





# Vertical bifacial





# Elevated agrivoltaics



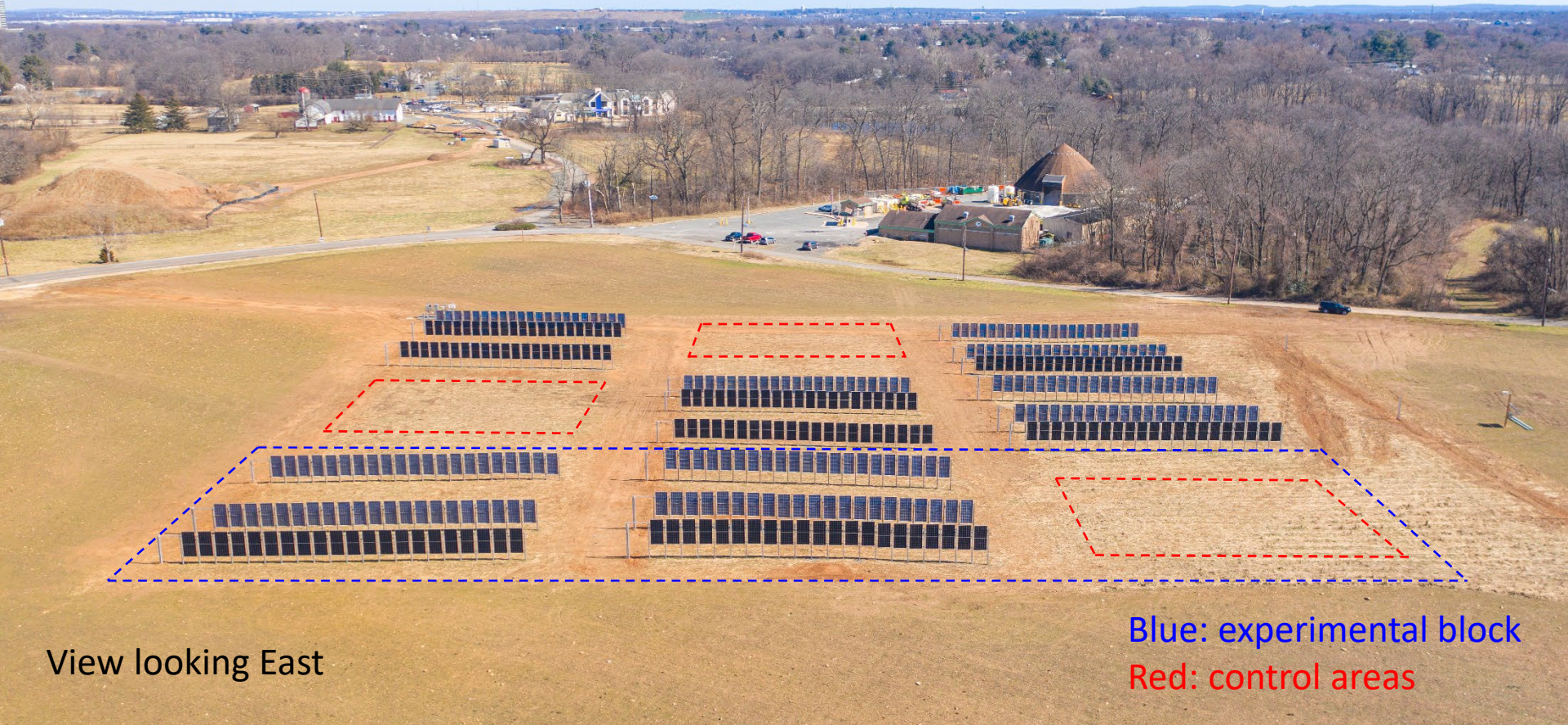
<https://www.reuters.com/>



# Animal Farm, New Brunswick, NJ



Vertical bifacial panels



View looking East

Blue: experimental block  
Red: control areas

*170 kW<sub>DC</sub>: Grazing large animals and forage production. Three randomized blocks, each with a control area, three rows with 61 cm (2 feet) clearance height, and three rows with 1.22 m (4 feet) clearance height. Row spacing: 6.1 or 12.2 m (20 or 40 feet). Each row has 21 vertical bifacial panels (oriented East or West).*

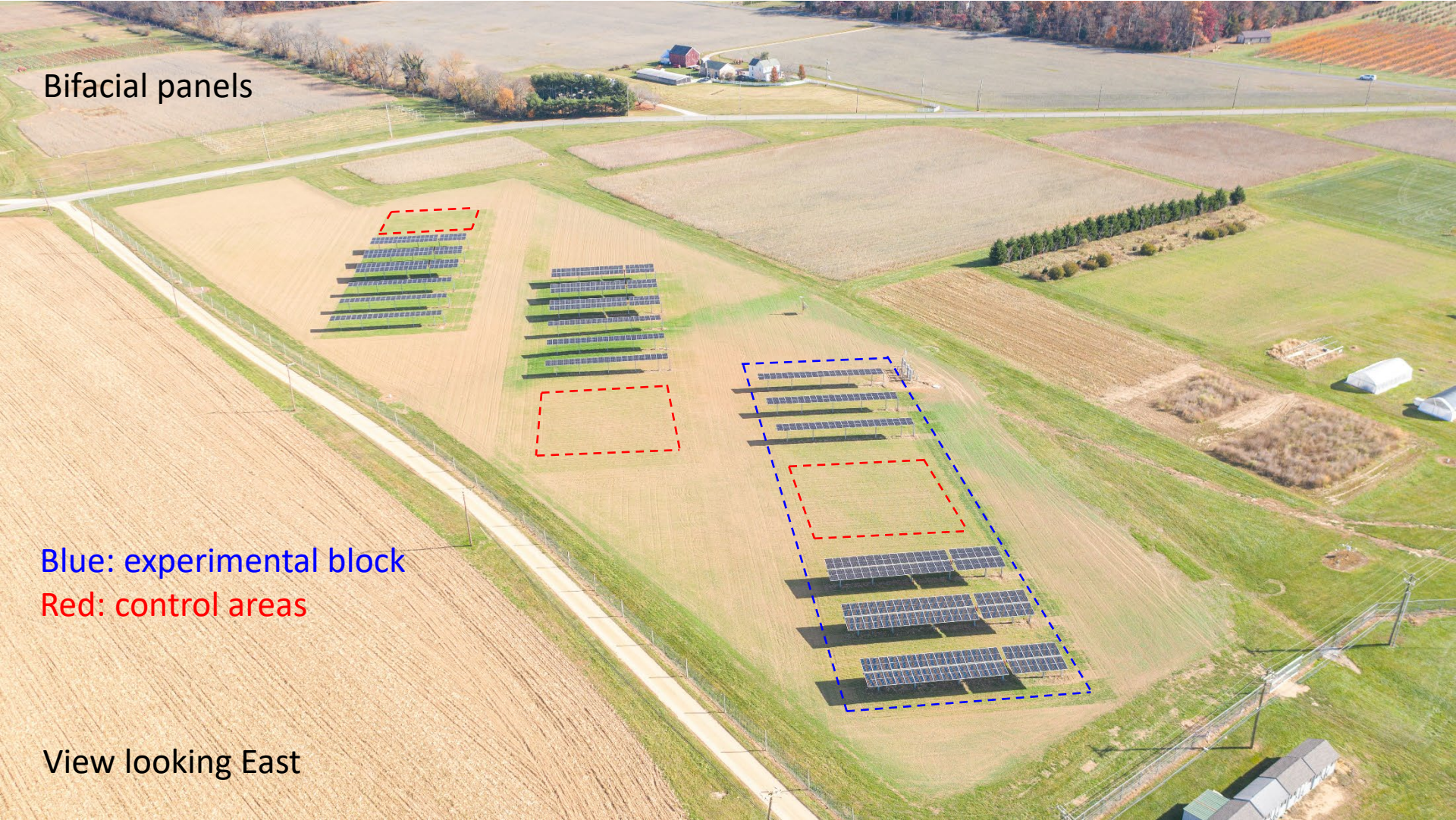


# RAREC, Upper Deerfield, NJ

Bifacial panels

Blue: experimental block  
Red: control areas

View looking East



*255 kW<sub>DC</sub> installed, 48.6 kW<sub>DC</sub> grid-connected, single-axis trackers with a pivot point 2.4 m (8 feet) above ground level: Staple and vegetable crop production. Three randomized blocks, each with a control area, three rows with single rows of panels, and three rows with double rows of panels. Row spacing: 10.4 m (34 feet).*



# Snyder Farm, Pittstown, NJ

Bifacial panels

Blue: experimental block  
Red: control areas

View looking East

*95 kW<sub>DC</sub> installed, 82.4 kW<sub>DC</sub> grid-connected, single-axis trackers with a pivot point 2.4 m (8 feet) above ground level): hay production. Two treatment blocks, each with a control area and five rows with single rows of panels. Row spacing: 9.8 m (32 feet).*



# Key lessons learned/challenges encountered

- Every utility has its own procedures/timelines
- The local grid capacity may not be large enough
- Grid capacity information is not always easy to obtain
- Grid upgrades are very expensive and time-consuming
- Price per watt for each system (For our VBF  $> \$4/W_{DC}$ )
- Consider trackers that can rotate  $\pm 90^\circ$  from horizontal
- East or West orientation of VBF panels?
- Need for contingency funds (be aware of rocky fields)
- Design-build projects require good communication and trust between developer and customer
- Operating large agricultural equipment near an agrivoltaic system can be tricky and will likely slow the process down



# Key design and construction challenges

- Few design tools available for agrivoltaics
- Hiring an experienced developer/contractor
- Keeping the developer/contractor focused on agriculture
- Time required to get permits/approvals
- Dealing with delays in the supply chain
- Planning for future replacement/decommissioning
- Design-build projects can be time consuming (better outcome?)





# Highlighted construction challenges



**Soil compaction during construction**  
**Recommendation: Use tracked vehicles only,**  
**and let soil dry before driving on it**





**When backfilling trenches,  
put topsoil back on top**





**Rocky soils:  
Refusals had to be remediated**





**Remediated refusal**



Unprotected conduit risers

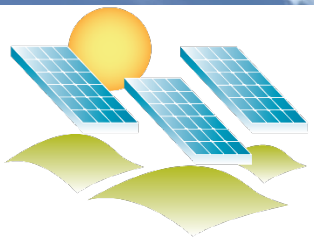






**Incorrect placement of in-ground conduit boxes:  
Obstruction for farming equipment**





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**Thank you!!**  
**Questions?**

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