



RUTGERS

New Jersey Agricultural
Experiment Station

Agrivoltaics (a.k.a. Dual Use Solar): A Win-Win for Agriculture?



New Jersey Agricultural Experiment Station

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NJAES Vision 2025



- Special state appropriation of \$3 million/year beginning in 2018
- Strategic investment initiative to improve NJAES farms, field stations, business incubators, centers, and programs.
- These investments will provide a platform to **build greater programmatic capacity** to address current and future needs of NJ and broader society.



Current Funding for RAP

- FY 2022 NJAES support of \$104,000 from our special state appropriation for initial activities including light and shade modeling, collecting data from mock-up installations, and literature & policy review to avoid duplication of effort
- FY 2022 NJ State Appropriation of \$2,000,000 for the construction of agrivoltaic R&D installations at three NJAES research farms



What is Agrivoltaics?

- Combines agriculture with solar power generation (≠ solar farming)
- Keeps agriculture as the main focus for land use
- Can be combined with both animal and plant production
- Any yield losses are offset by income from electricity generation
- Can contribute to the viability and resiliency of farming
- Contributes to renewable energy goals (NJ: net-zero by 2050)

- Examples of Agrivoltaics



Vertical bifacial panels: Large animal grazing and hay production (Next2Sun, Germany)



Tracking or fixed-tilt panels: Field and fruit crops (Europe)

Rutgers Agrivoltaics Program (RAP) Mission

- Formed to take a leadership role in developing science-based answers for agrivoltaics installations across NJ
- Multidisciplinary team with expertise in crop and animal production, solar energy, engineering, soil science, economics, life-cycle analysis and sociology
- Tasked to design and construct the agrivoltaic R&D sites at NJAES farms across the state
- Perform an economic analysis of the impact of agrivoltaics on farming operations

Rutgers Agrivoltaics Program (RAP) Mission

- Provide assistance for the implementation of the Dual-Use Solar Energy Pilot Program
- Conduct outreach to farmers, project developers, policy makers, and the general public
- Collaborate at the regional/national level with other universities and publish outreach materials and scientific papers on agrivoltaics
- The team is employing undergrad and grad students and is in the process of hiring a full-time staff member

- Initial work - Collecting data using mock-up solar panels

New Brunswick, NJ →

Tair
RH
PAR

Bridgeton, NJ



Solar radiation
Tsoil
Soil water content



View looking East

Fixed tilt 25°

SOUTH →



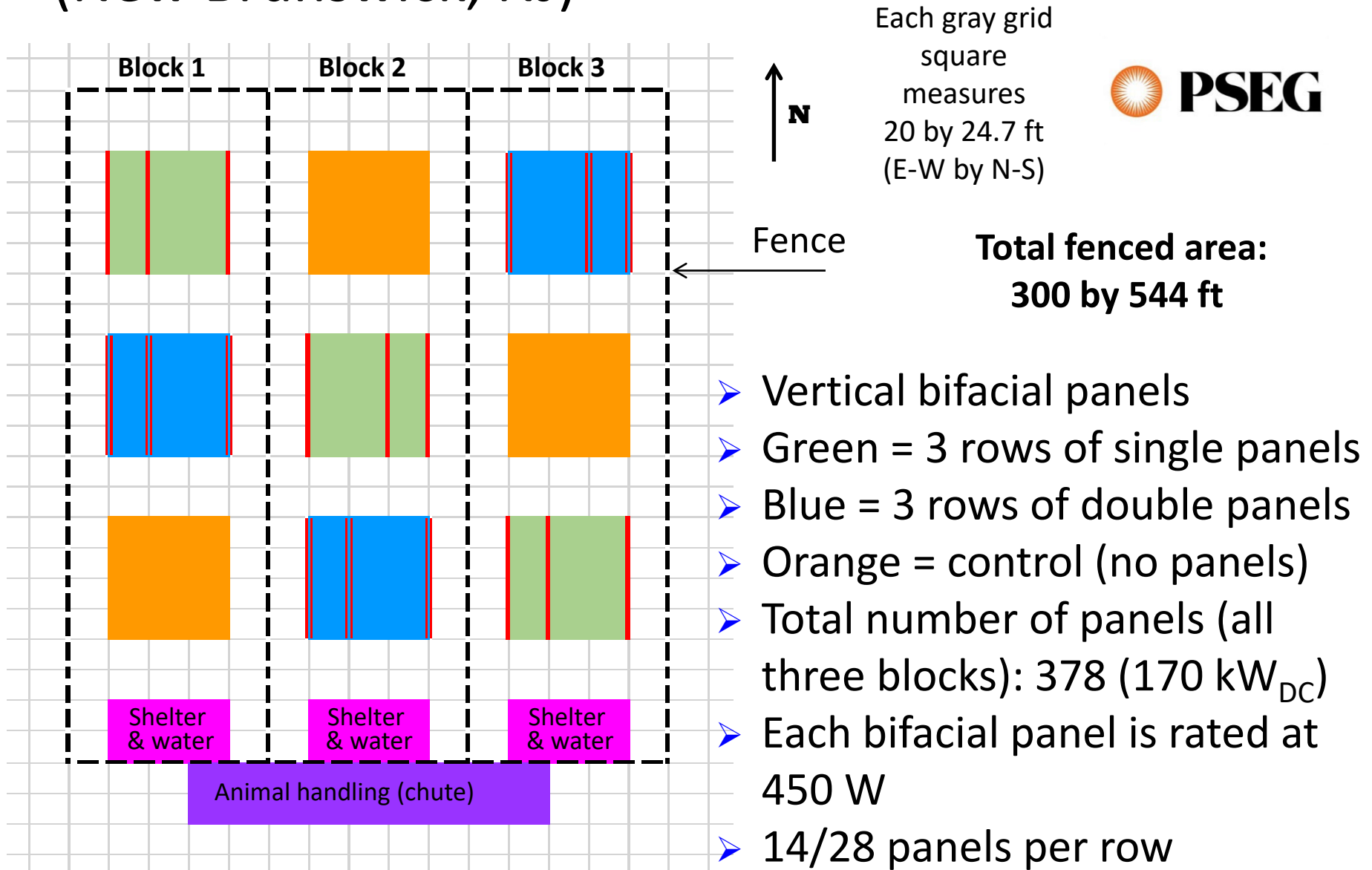
Agrivoltaic mounting (racking) systems are being installed at 3 Rutgers farms

1. Single-axis tracking – rows of panels that run North-South; panels track the sun from East to West (mounted on rotating beam)
2. Stationary vertical bifacial – rows of panels that run North-South; panels are mounted vertically and able to generate power on both sides that face either East or West

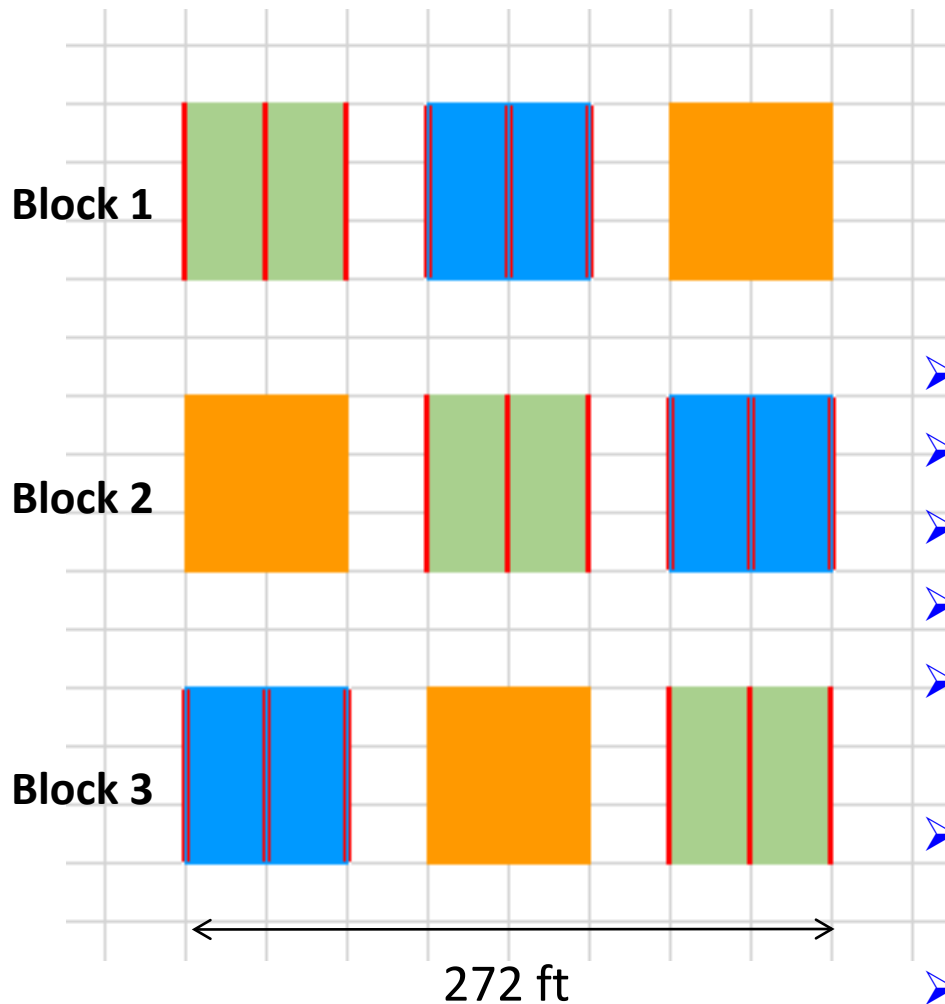
Elevated systems were not included in the R&D blocks at Rutgers due to the high capital costs.

- Experiments are planned with statistical rigor in mind
- Completion of construction target - April 2023
- 520 kW total installed capacity

- Proposed design 1: Cook Campus Animal Farm (New Brunswick, NJ)



- Proposed design 2: Rutgers Agricultural Research and Extension Center (Bridgeton, NJ)

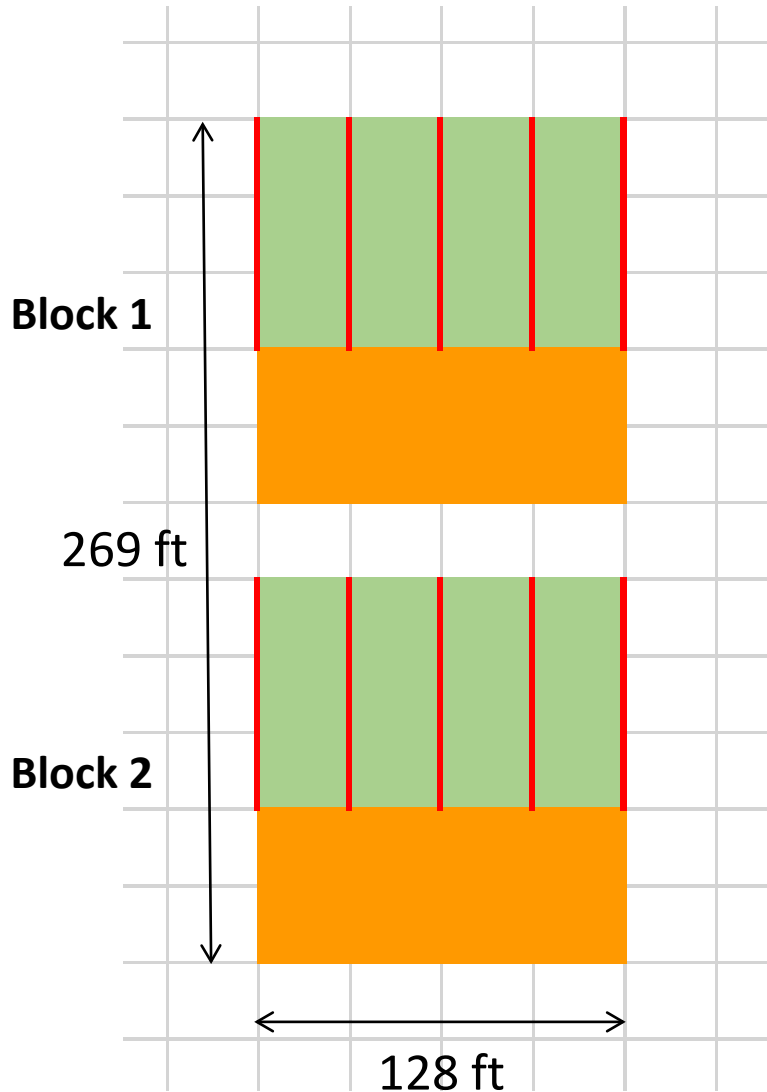


↑ **N**
 Each gray grid square measures 34 by 24.4 ft (E-W by N-S)



- Single axis trackers
- Green = 3 rows of single panels
- Blue = 3 rows of double panels
- Orange = control (no panels)
- Total number of panels (all three blocks): 567 ($255.2 \text{ kW}_{\text{DC}}$)
- Each bifacial panel is rated at 450 W
- 21/42 panels per row

- Proposed design 3: Clifford E. & Melda C. Snyder Research & Extension Farm (Pittstown, NJ)



Each gray grid square measures 32 by 24.4 ft (E-W by N-S)



- Single axis trackers
- Green = 5 rows of single panels
- Orange = control (no panels)
- Total number of panels: 210 (94.5 kW_{DC})
- Each bifacial panel is rated at 450 W
- 21 panels per row

Potential Funding for RAP

- The newly enacted Dual-Use Solar Energy Pilot Program requires any agrivoltaic system installed in an Ag Development Area (ADA) be done in association with a research study undertaken in coordination with a New Jersey public research institution of higher education
- Pending Grant Proposal for the DOE FARMS Program (Foundational Agrivoltaic Research for Megawatt Scale)
 1. Conduct agricultural, soil, energy, and socioeconomic research on agrivoltaic installations to be installed on NJAES research farms;
 2. Technical assistance and training component, partnered with American Farmland Trust;
 3. Outreach component, partner is Delaware State University.
 4. Additional team member is the National Renewable Energy Laboratory.

Challenges encountered to date

- Power grids in rural areas often are not designed to accommodate additional generating capacity, especially when considering larger systems (> 1 MW)
- Getting interconnect approvals from local utilities varies greatly from one provider to another
- Most solar developers have limited knowledge of farming practices and how to properly design agrivoltaic systems
- Some key agrivoltaic equipment is manufactured outside the US, causing longer delivery times and additional costs
- Large-scale (grid-scale) projects have a long wait time, of over two years, to get regional interconnect approvals (PJM in our case)

In summary

- The project has been challenging, yet rewarding
- Multidisciplinary approach is key
- Farmer and community acceptance to be determined
- Push-back anticipated (already encountered)
- Agrivoltaics could be a real boon for agriculture, but sound research is needed
- Real benefit to doing research at a regional level

For project details, please contact the Rutgers Agrivoltaics Program
Lead: Dave Specca (specca@njaes.rutgers.edu)

Thank You!!!



The types
of systems
we plan to
install

