UMASS CLEAN ENERGY EXTENSION

Dual-Use Solar and Agriculture

Rutgers EcoComplex Clean Energy Innovation Center

Dwayne Breger, Director
UMass Clean Energy Extension

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Outline

- Who We Are
- MA Dual-Use in the SMART Solar Program
- Our Role and What We're Seeing
- UMass Research Farm Site Trials
- U.S. DOE Dual Use Research Grant
- Questions & Discussion

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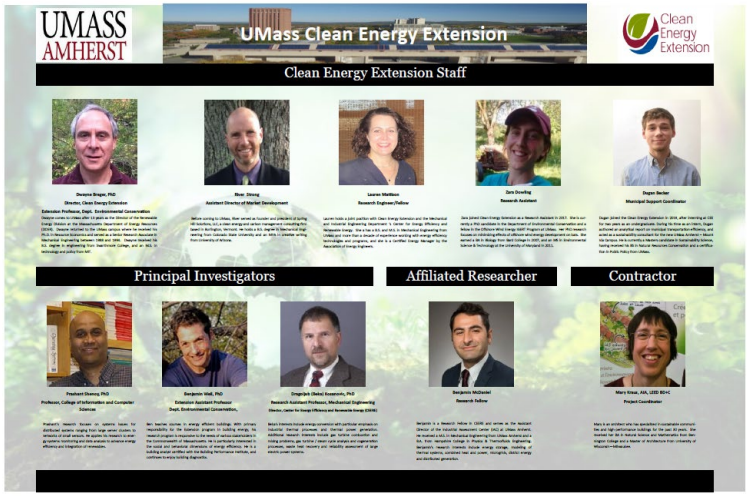
UMass Clean Energy Extension

Established in 2015, with support from MA Department of Energy Resources, to help meet the state's energy and climate goals.

Expanded UMass extension services under the Center for Agriculture, Food and the Environment (CAFE).

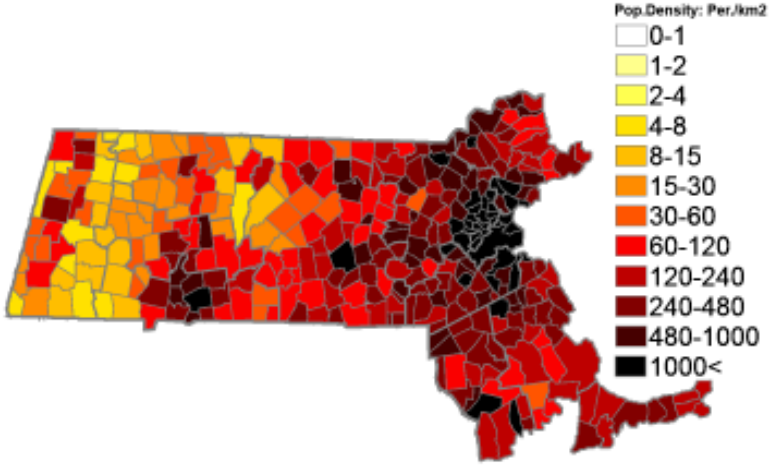
Our Activity Areas

- Technical Assistance & Advisory Services
- Market Analysis & Outreach
- Collaborative Applied Research
- Education & Workforce Development



Massachusetts – Land Use and Solar

- 3rd most densely populated state



- 62% forest cover
- ~8.5% agricultural land
- Top 10 for solar capacity and solar capacity per capita

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Solar Massachusetts Renewable Target (SMART) Program
Incentive Structure

Base Compensation Rate ($0.12 - $0.31/kWh)

- Service territory
- System size
- Capacity block

Adders (additional tariff $/kWh)

- **Energy Storage (~$0.05/kWh)**
- **Tracking Systems ($0.01/kWh)**
- **Pollinator Habitat ($0.0025/kWh)**
- **Off-taker Based (adders vary)**
- **Location Based (adders vary)**

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SMART Location-Based Adders

Generation Unit Type	Adder Value ($/kWh)
Building Mounted Solar Tariff Generation Unit	$0.02
Floating Solar Tariff Generation Unit	$0.03
Solar Tariff Generation Unit on a Brownfield	$0.03
Solar Tariff Generation Unit on an Eligible Landfill	$0.04
Canopy Solar Tariff Generation Unit	$0.06
Agricultural Solar Tariff Generation Unit	$0.06

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Pollinator-Friendly Certification Program for PV Arrays

DOER SMART Program
April 2020 Regulatory Update
Solar incentive adder ($0.0025/kWh) for pollinator-friendly certification

Certification Program Components

- Certification Criteria
  - Certified, Silver, Gold, Platinum
- Certification Procedure and Fees
  - Certification Application
  - Re-Certification
- Best Management Practices Document
- Recommended Plant Species List
- Application Form
- Annual Maintenance Log
- Monitoring

Program Status

- Open for Applications – June 2020
- 7 Applications received in 2020
- 8 Applications received so far in 2021
- 10 Certificates Awarded

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Dual-Use Solar – DOER Support, Outreach and Research

SMART Program Dual-Use Pre-Application Reviews and Reporting

- Shading Analysis of array on farmland
- Farm Plan and anticipated yields
- Annual production reporting

- Evaluation and publication of dual-use farm activities
- Contribute to “best-practices” for industry
- Reviewed 26 dual-use applications and conducted 16 site visits since the 2018 program launch

Fact Sheets and Outreach

Working with UMass Extension colleagues and MDAR to provide program support to farm sector on solar adoption generally, and for dual-use solar arrays specifically per state regulations.

U.S. DOE $1.8M Award

Impacts of Dual-Use Solar on Crop Productivity and the Agricultural Economy in Massachusetts and Beyond

Public/Private/Gov’t Partnership

8 site trials, across state regions

3 solar developers and farmers committed to dual-use research

Breadth of crops (hay, row crops, cranberries) and grazing

Project builds on UMass dual-use experiments at Research Farm and Cranberry Station

UMass and AFT to conduct research. State energy and agriculture agencies are policy partners.

American Farmland Trust

DOER

MDAR

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Solar and Agriculture – Fact Sheets

Fact Sheets and Outreach

General options for solar PV on your farm:

- Solar PV Options for Your Farm: An Overview
- Location Considerations for Ground-Mounted Solar PV Arrays
- Legal and Financial Considerations for Solar PV Arrays on Farms
- Contract Negotiations for Solar PV Facility Agreements
- SMART Program Incentives for Solar Arrays on Farms

Fact sheets specific to dual-use solar PV and agriculture

- Dual-Use: Agriculture and Solar Photovoltaics
- Dual-Use: Farm Operations Considerations
- Dual-Use: Crops and Livestock Considerations

Written for the farmer, available at: https://ag.umass.edu/clean-energy/current-initiatives/solar-pv-agriculture

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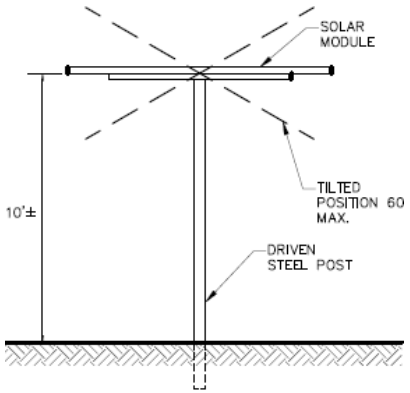
Dual-Use Solar - SMART Program Guidelines

- Panel Height
  - 8 ft fixed arrays
  - 10 ft tracking arrays
- System Size Limit – 2 MW



1 SOLAR RACKING DETAIL
NOT TO SCALE

- Maximum Direct Sunlight Reduction
  - 50% on every square foot of the project site
- Compatible Sunlight Needs
  - Not explicitly defined, but crop selection should align with the available sunlight of the project design based on best available data
  - Maintain UMass (or third party) to provide comment on sunlight needs for proposed crop(s).
- Growing Season/Time of Day
  - March through October
  - Maximum 50% sunlight reduction between 10AM and 5PM for March and October, and from 9AM to 6PM from April through September

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Pre-Determination Form Components

- **Applicant Information** – Contact information for applicant, farmer, developer, land-owner
- **Basic Farm Information** – Type of production, total acreage, annual sales, anticipated changes to farm business
- **Site Information** – Location, land status, soils, property map
- **Solar Array Design** – Capacity, type of system, design, ground penetration, site plan
- **Shading Analysis** – Using SMART shading tool
- **Agricultural Plan** – Crop or grazing narrative, farm equipment table, anticipated yield, crop rotation (if applicable)

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SMART Reviews – What We're Seeing

- **Total Projects**: 26 applications received, about 2/3^{rds} expected to complete pre-determination process
  - 10 for active cranberry bogs
  - 7 were primarily for livestock grazing (principally beef cattle, heifers, and cow-calf pairs, chickens, turkeys, sheep)
  - 5 application was for mixed hay and grazing
  - 4 applications were for squash/pumpkins or mixed vegetables
- **Farm Ownership:** Approx. 18 applications with farmer as current landowner, but of these, half are planning to retire or sell within 5 years
- Construction of first system in 2020, quite a few more expected in 2021

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SMART Reviews – What We're Seeing

- **Significant developer concern with 2 MW size limit**

- **Many unknowns regarding crop production**
  - Limited research on impact of shading on crops
  - Annual reporting process (required) will be informative but anecdotal

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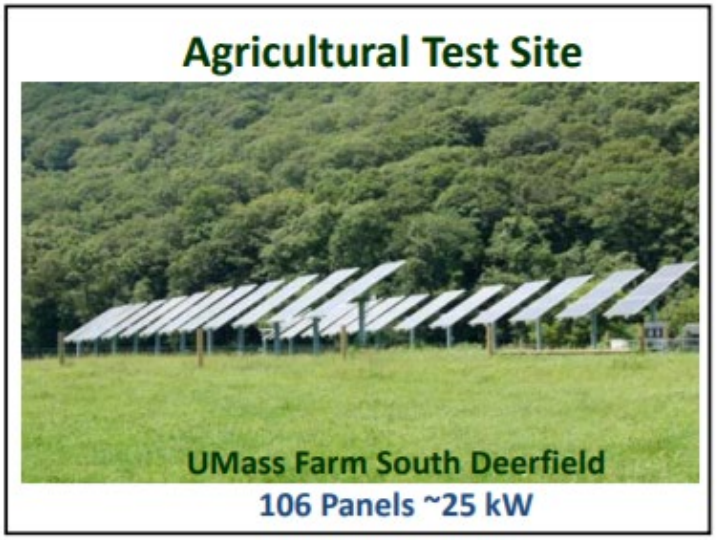
UMass Research Farm - Dual-Use Site Trial



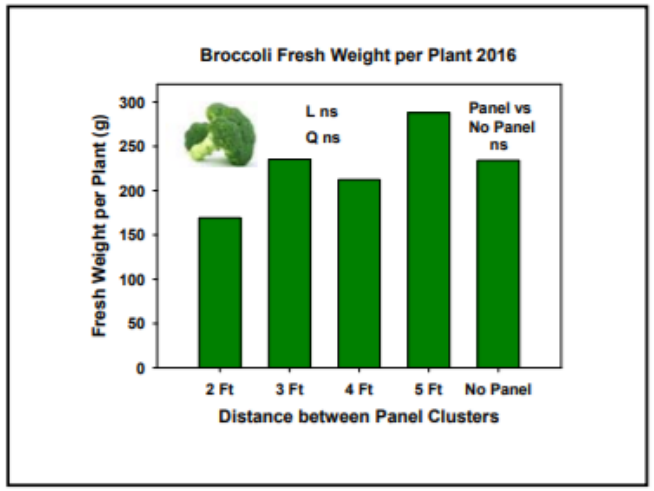
Prof. Stephen Herbert
UMass Stockbridge School of Agriculture

Vegetable Site Trials 2016-2018

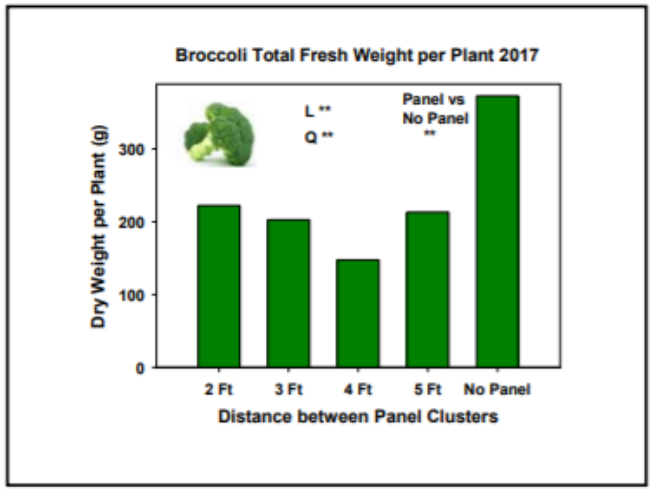
Broccoli, Swiss Chard, Kale, Pepper under shade and unshaded plots transplanted June 7, 2016.

Future crops: Common Bean and Cabbage were planted as second summer crops. Cabbage failed because of the heat and drought in 2016.

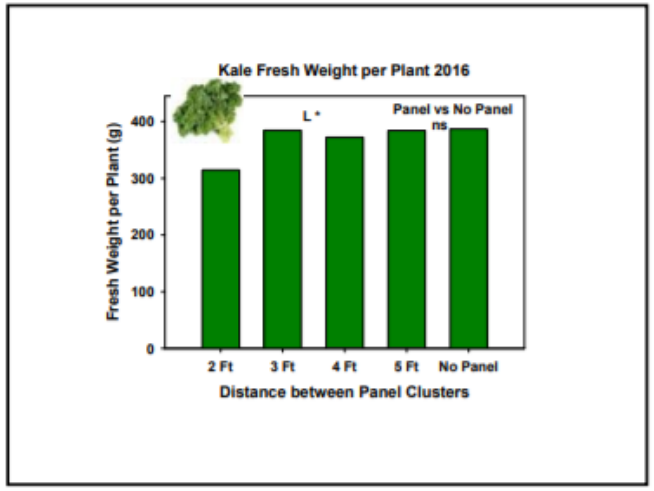
UMass Research Farm - Dual-Use Sample Results



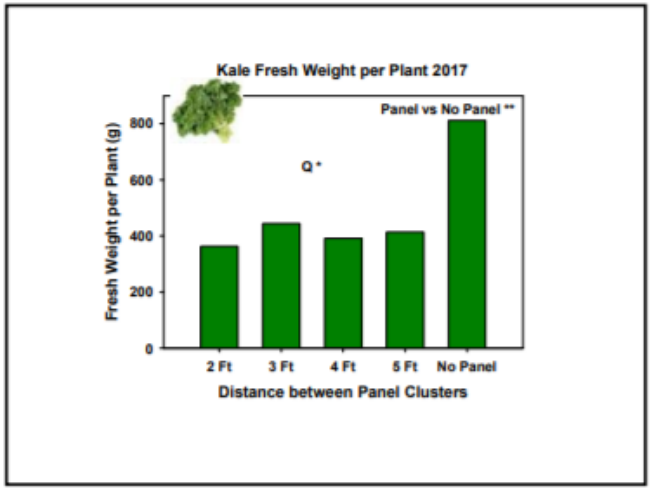
Broccoli



2016 (Severe Drought) **2017**



Kale



Key Outcomes

1. Yield of crops under shade from panel clusters were less than the yields from the control (no panels)
2. During a severe drought year (2016), shading resulted in similar yields across shaded and unshaded crops.

See more results available at

https://ag.umass.edu/clean-energy/current-initiatives/solar-pv-agriculture

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U.S. DOE Research Grant

Impacts of Dual-Use Solar on Crop Productivity and the Agricultural Economy in Massachusetts and Beyond

UMass CEE selected for 2020 award from U.S. DOE Solar Energy Technology Office

3-Year Program; $1.8M federal award; est. start May 2021

Key Outcomes

1. Detailed designs for dual-use site trials with protocols for solar/PAR, and soil and agricultural monitoring.
2. Generate pioneering data on crop viability under shading and farming conditions of dual-use solar arrays.
3. Integrate site trail data to evaluate economic impacts of dual-use at the farm and regional levels.

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U.S. DOE Research Grant

Integrated with commercial Dual-Use projects with 3 solar developers and 8 farms

Crops: Cranberry, vegetables, squash, hay, grazing

First site trials expected next growing season

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Public/Private/Gov't Partnership

Academic, Public, Private Collaboration

UMass

- Clean Energy Extension
- Center for Food, Agriculture and the Environment (CAFE)
- UMass Extension
- Cranberry Station
- Department of Resource Economics

American Farmland Trust (AFT)

Solar Developers & Farm Manager

- BlueWave Solar
- Pine Gate Renewables
- Hyperion Systems LLC
- Iain Ward (Farm Manager)

State Agencies

- MA Department of Agricultural Resources (MDAR)
- MA Department of Energy Resources (DOER)

Project builds on UMass dual-use experiments at Research Farm and Cranberry Station

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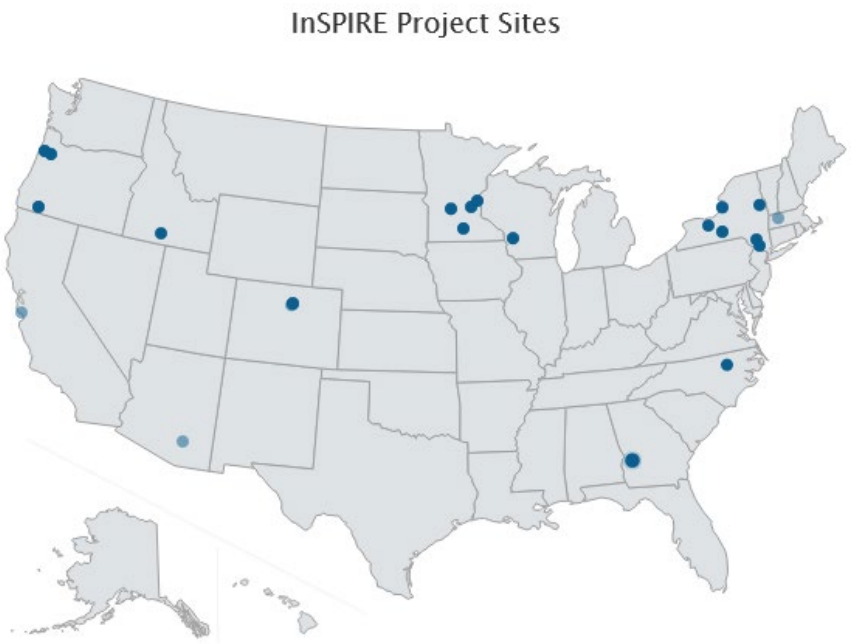
Dual-Use – Selected Resources

- **CEE's dual-use resource page:** https://tinyurl.com/y5gc4gjx
- **NREL's InSPIRE Program:** https://tinyurl.com/y3mkd5re



Thank You. Questions?

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