Co-Location of Agriculture and Solar: Opportunities to Improve Energy, Food, and Water Resources

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InSPIRE Project Overview

Low-impact site preparation
Pollinator and native vegetation solar
Solar-agricultural co-location

Department of Energy Funded (2015-2021)
Extensive Industry Partnerships
Field and Analytical Modeling Work

- **Energy**
  - Improved solar PV efficiencies due to cooler microclimate underneath panels
  - Reduced O&M costs
  - Reduced construction and acquisition/permitting costs

- **Water**
  - Reduced evaporation
  - Reduced runoff
  - Improved water use efficiency of crops and pollinator habitat

- **Agriculture**
  - Compatibility with crop production and livestock
  - Pollinator habitat can improve local agricultural yields
  - Improved soil health
Field-based research across multiple sites is driven by key scientific questions to provide foundational insights that will support economic, environmental, and agricultural evaluations of solar-agriculture co-location. Research topics include:

1. Economic viability of solar-agriculture co-location configurations. (University of Massachusetts-Amherst and Minnesota)
2. Increasing agricultural yields in arid environments. (University of Arizona Biosphere 2 and Colorado State University)
3. Energy, water, and food security in remote, off-grid areas. (Puerto Rico and Indonesia)
4. Pollinator habitat and ecological services. (Cornell University, Illinois, and Minnesota)
Specific research activities for field studies

- Study Design
- Crop Planting
- Harvesting
- Data Collection and Analysis

- Temperature Probe
- Soil Carbon
- Relative Humidity Probe
- Rain Gauge
- Datalogger
- Soil Heat Flux Plate
- Wind Anemometer
- Soil Thermocouple
- Pyranometer
- Soil Moisture Reflectometer
- PV Panel Thermocouple

Armstrong et al., 2016
Key Highlight: Co-Location can lead to Higher Crop Yields with Less Water

Arizona co-location facility: higher yields, less water, longer growing season
Massachusetts co-location facility: higher yields in hot, dry years
New sites planted or under development in Colorado, Oregon, Puerto Rico, United Arab Emirates, and Indonesia
Higher soil moisture in solar array area than in non-shaded (non-solar) control area
Significant variation in soil moisture levels depending location within array (directly underneath panels, in between rows, etc.)
Improved soil moisture retention for vegetated groundcover PV than for non-vegetated groundcover PV

Key Highlight: Vegetation under PV can Improve Soil Moisture Retention
Chervil: *annual herb related to parsley with a delicate anise-like flavor*

Plants that received the altered light spectrum of LUMO in the late afternoon performed significantly better than chervil grown under a greenhouse with clear covering.

**Key Highlight: Solar-Integrated Greenhouses can Improve Yields**

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- **Key Highlight:** Solar-Integrated Greenhouses can Improve Yields
- **Chervil:** *annual herb related to parsley with a delicate anise-like flavor*
- **Plants** that received the altered light spectrum of LUMO in the late afternoon performed significantly better than chervil grown under a greenhouse with clear covering.
Over 860,000 acres of agricultural land would benefit if existing solar facilities had pollinator-friendly vegetation.

Key Highlight: Pollinator-Friendly Solar
Key Highlight: Solar-Powered Honey Production

Hives can be located in or outside of project fence
Innovative branding and marketing opportunities
Ongoing work evaluating honeybee and native bee preferences
Sustainable grazing practices can improve soils
Cost reductions from standard mowing practices
Ongoing work evaluating pastureland performance
Key Highlight: Floating Solar on Agricultural Reservoirs

Siting on reservoirs can reduce evaporation and algae growth
Avoid conflicts with land used for agriculture
Recent NREL study identified over 25,000 man-made reservoirs that could supply 10% of U.S. power

Key Highlight: Education through field research

Educational benefits through internships, field trips, work experience, tours
Elementary school through PhD students
State agency, academic, and professional training
Key Highlight: Broad Stakeholder Impacts

Pollinator-Friendly solar standards and scorecards
State Agency partnerships and technical assistance
Direct partnerships with solar and agricultural industry
University initiatives
Closing Thoughts

• There are many opportunities for synergies between agriculture and solar energy development

• Solar projects can be designed and constructed in ways that improve energy, water, and agricultural resources

• Low-impact designs can lead to reductions in some upfront and O&M costs for solar developers, while also increasing solar energy output

• There are many innovative configurations that can be employed and that still have not been tested
Thank you

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https://openei.org/wiki/InSPIRE

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