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Office of the Assistant Secretary for Civil Rights
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fax:
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Dual Use Practices for Solar Energy Systems

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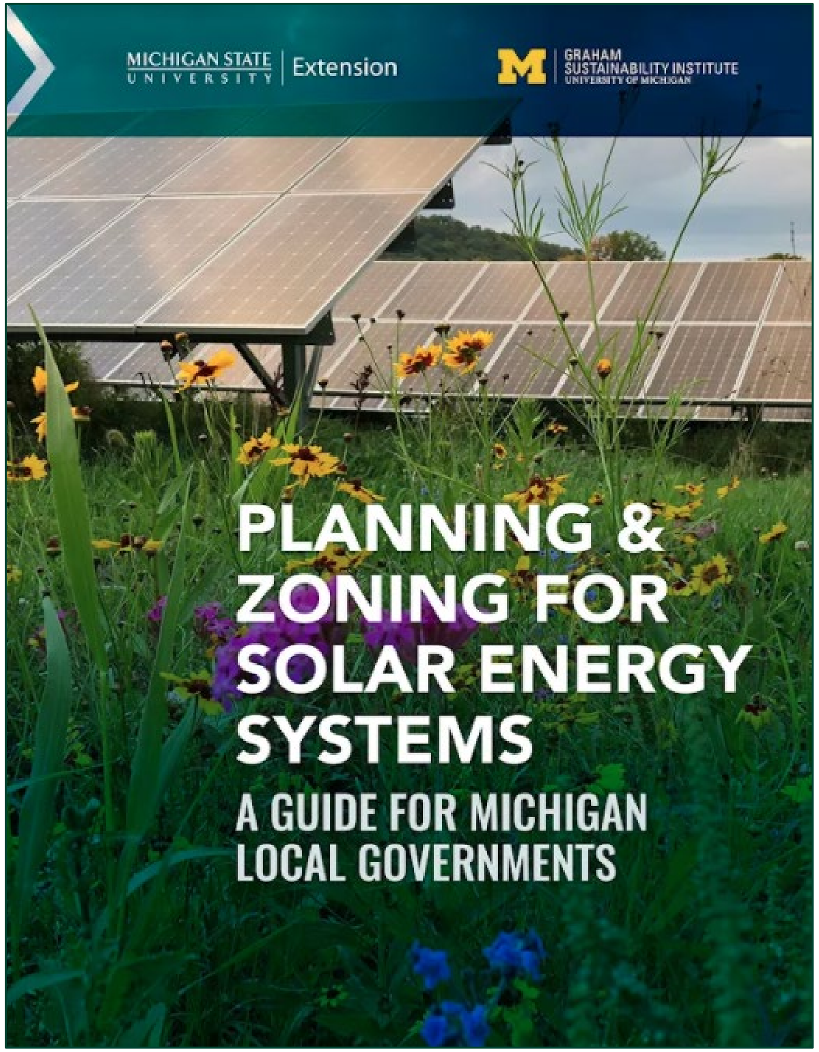
extension.msu.edu/solarzoning



Dual Use

Land should never be used exclusively for solar power production.

Photo credit: Charles Gould

Photo credit: Charles Gould

Photo credit: Rob Davis

Photo credit: Charles Gould

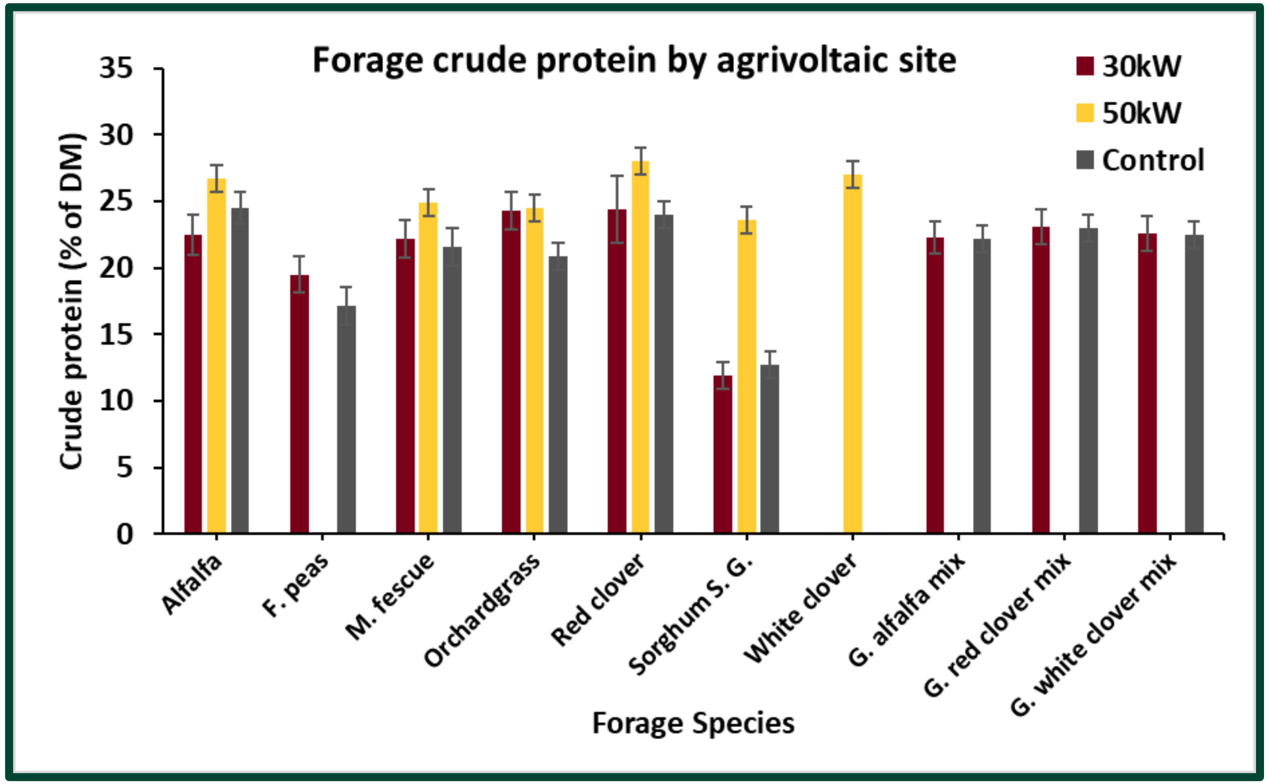
Grazing and Forage Production

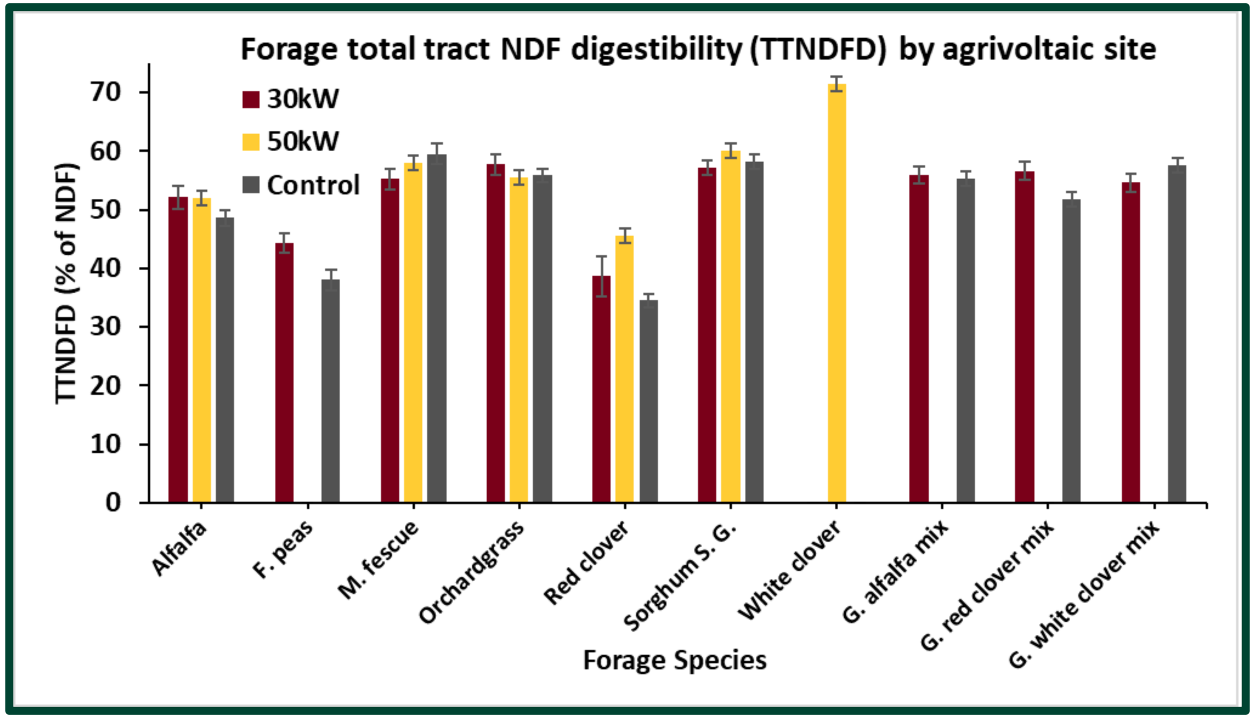
- Solar sites that incorporate rotational livestock grazing and forage production as part of an overall vegetative maintenance plan.

Photo credit: Charles Gould

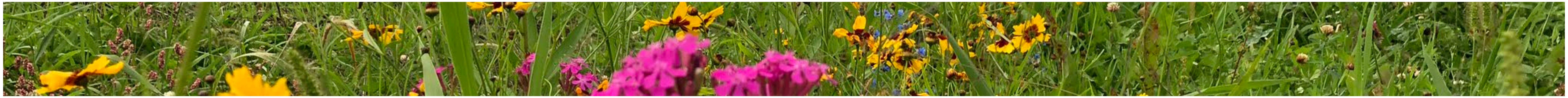
Photo credit: Charles Gould

Forage Crude Protein and Digestibility Comparison





Source: S.L. Portner, B.J. Heins, E.S. Buchanan, M.H. Reese. 2022. Agrivoltaics site effects on forage biomass and nutritive value, University of Minnesota.



Pollinator Habitat

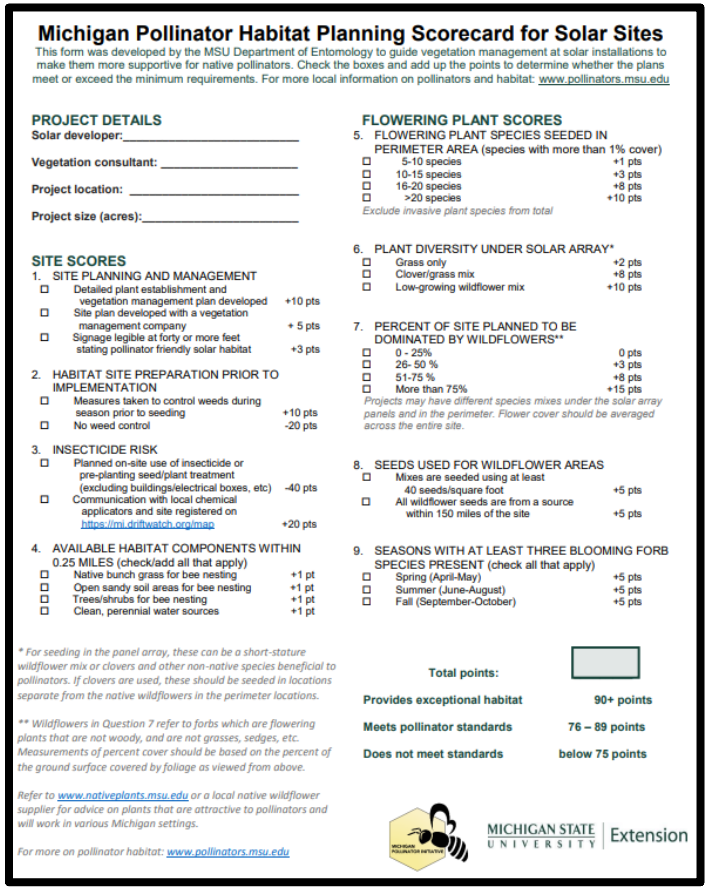
The site should be designed and planted to achieve a score of at least 76 on the Michigan Pollinator Habitat Planning Scorecard for Solar Sites.

Developed by the MSU Department of Entomology to guide vegetation management decisions at solar installations to be more supportive of native pollinators.

Check the boxes and add up the points to determine if the plan meets or exceeds pollinator habitat establishment standards.

Use during initial planning stages to ensure the desired outcome is achieved.

For more local information on pollinators and habitat visit www.pollinators.msu.edu.



Michigan Pollinator Habitat Planning Scorecard for Solar Sites

This form was developed by the MSU Department of Entomology to guide vegetation management at solar installations to make them more supportive for native pollinators. Check the boxes and add up the points to determine whether the plans meet or exceed the minimum requirements. For more local information on pollinators and habitat: www.pollinators.msu.edu

PROJECT DETAILS

Solar developer:___________________________

Vegetation consultant: ______________________

Project location: ___________________________

Project size (acres):_________________________

SITE SCORES

1. SITE PLANNING AND MANAGEMENT
   - ☐ Detailed plant establishment and vegetation management plan developed +10 pts
   - ☐ Site plan developed with a vegetation management company + 5 pts
   - ☐ Signage legible at forty or more feet stating pollinator friendly solar habitat +3 pts
2. HABITAT SITE PREPARATION PRIOR TO IMPLEMENTATION
   - ☐ Measures taken to control weeds during season prior to seeding +10 pts
   - ☐ No weed control -20 pts
3. INSECTICIDE RISK
   - ☐ Planned on-site use of insecticide or pre-planting seed/plant treatment (excluding buildings/electrical boxes, etc) -40 pts
   - ☐ Communication with local chemical applicators and site registered on https://mi.driftwatch.org/map +20 pts
4. AVAILABLE HABITAT COMPONENTS WITHIN 0.25 MILES (check/add all that apply)
   - ☐ Native bunch grass for bee nesting +1 pt
   - ☐ Open sandy soil areas for bee nesting +1 pt
   - ☐ Trees/shrubs for bee nesting +1 pt
   - ☐ Clean, perennial water sources +1 pt

FLOWERING PLANT SCORES

5. FLOWERING PLANT SPECIES SEEDED IN PERIMETER AREA (species with more than 1% cover)
   - ☐ 5-10 species +1 pts
   - ☐ 10-15 species +3 pts
   - ☐ 16-20 species +8 pts
   - ☐ >20 species +10 pts

   Exclude invasive plant species from total
6. PLANT DIVERSITY UNDER SOLAR ARRAY*
   - ☐ Grass only +2 pts
   - ☐ Clover/grass mix +8 pts
   - ☐ Low-growing wildflower mix +10 pts
7. PERCENT OF SITE PLANNED TO BE DOMINATED BY WILDFLOWERS**
   - ☐ 0 - 25% 0 pts
   - ☐ 26- 50 % +3 pts
   - ☐ 51-75 % +8 pts
   - ☐ More than 75% +15 pts

   Projects may have different species mixes under the solar array panels and in the perimeter. Flower cover should be averaged across the entire site.
8. SEEDS USED FOR WILDFLOWER AREAS
   - ☐ Mixes are seeded using at least 40 seeds/square foot +5 pts
   - ☐ All wildflower seeds are from a source within 150 miles of the site +5 pts
9. SEASONS WITH AT LEAST THREE BLOOMING FORB SPECIES PRESENT (check all that apply)
   - ☐ Spring (April-May) +5 pts
   - ☐ Summer (June-August) +5 pts
   - ☐ Fall (September-October) +5 pts

** For seeding in the panel array, these can be a short-stature wildflower mix or clovers and other non-native species beneficial to pollinators. If clovers are used, these should be seeded in locations separate from the native wildflowers in the perimeter locations.*

*** Wildflowers in Question 7 refer to forbs which are flowering plants that are not woody, and are not grasses, sedges, etc. Measurements of percent cover should be based on the percent of the ground surface covered by foliage as viewed from above.*

Refer to www.nativeplants.msu.edu or a local native wildflower supplier for advice on plants that are attractive to pollinators and will work in various Michigan settings.

For more on pollinator habitat: www.pollinators.msu.edu

Total points: ☐

Provides exceptional habitat	**90+ points**
Meets pollinator standards	**76 – 89 points**
Does not meet standards	**below 75 points**

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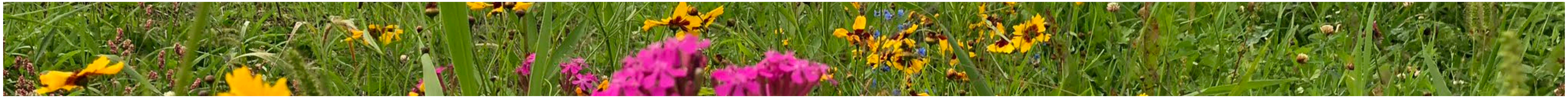
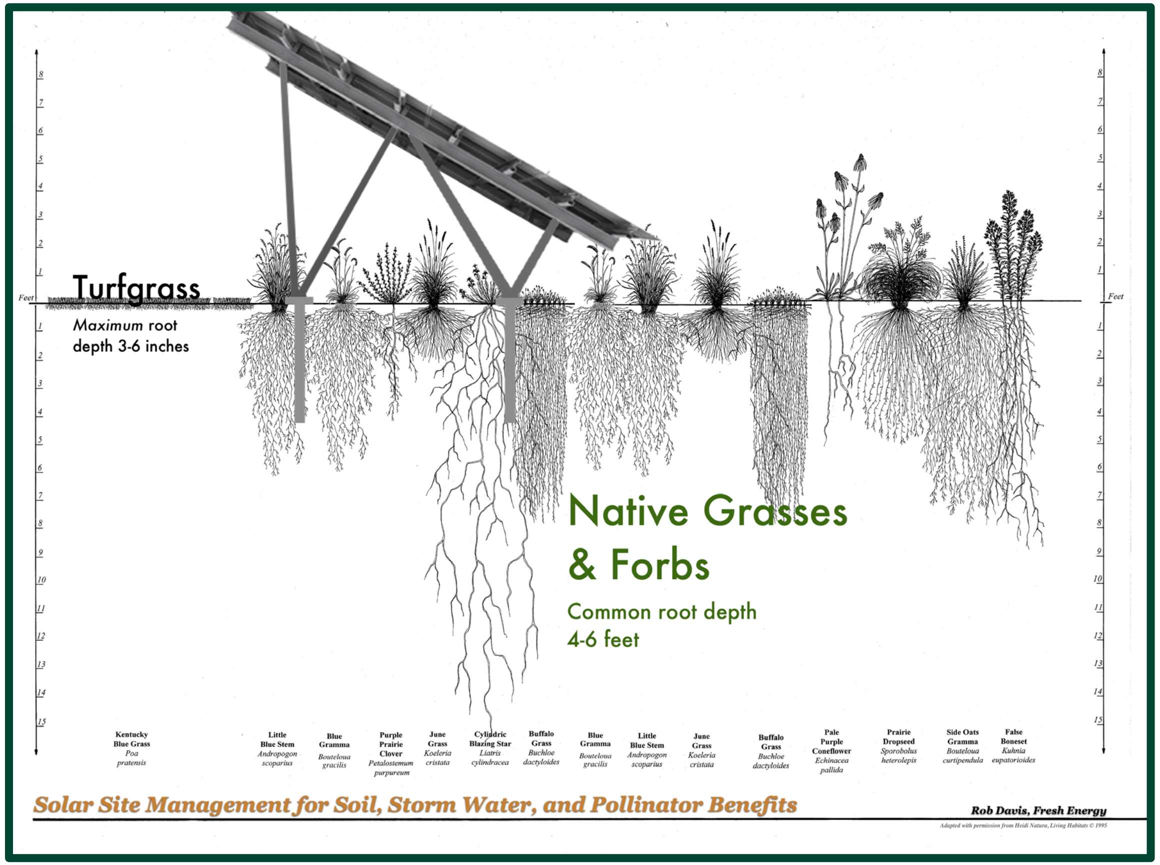


Reasons for Establishing Pollinator Habitat

- Deep roots improve water infiltration, recharge groundwater, sequester carbon, and reduce soil compaction.
- Contributes to local biodiversity and other ecological benefits like soil health.
- Stem the decline of pollinators.
- Provides nesting and feeding habitat, which supports healthy populations of native pollinators.
- Enhancing crop pollination leads to improved crop yield.



Source: Rob Davis, Center for Pollinators in Energy, Fresh Energy

Evaluating the impact of increased pollinator habitat on bee visitation and yield metrics in soybean crops

- How does the presence of the habitat, and resulting pollinator community, impact soybean yield?
  - Heavier seeds and more seed per plant.

Source: Hannah K. Levenson, April E. Sharp, David R. Tarpy, Evaluating the impact of increased pollinator habitat on bee visitation and yield metrics in soybean crops, Agriculture, Ecosystems & Environment, Volume 331, 2022, 107901, ISSN 0167-8809,

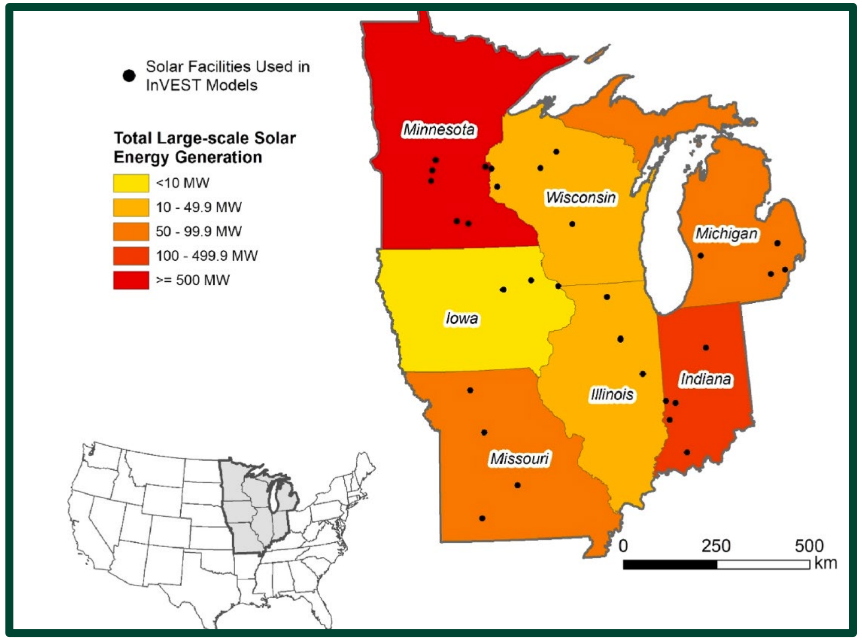
Conservation Cover

- Solar sites designed in consultation with conservation organizations that focus on restoring native plants, grasses, and prairie with the aim of protecting specific species (e.g., bird habitat) or providing specific ecosystem services (e.g., carbon sequestration, soil health).

Photo courtesy of Charles Gould

Conservation Cover: Ecosystem services

- Walston et al. examined the potential response of four ecosystem services (carbon storage, pollinator supply, sediment retention, and water retention) to native grassland habitat restoration at 30 solar facilities across the Midwest United States.
- Results
  - Compared to presolar agricultural land uses, solar-native grassland habitat produced:
    - A 3-fold increase in pollinator supply.
    - A 65% increase in carbon storage potential.
    - Increases in sediment and water retention of over 95% and 19%, respectively.



Source: Walston, L.J. et al. (2021). Modeling the ecosystem services of native vegetation management practices at solar energy facilities in the Midwestern United States, Ecosystem Services, Volume 47, February 2021.

Agrivoltaics

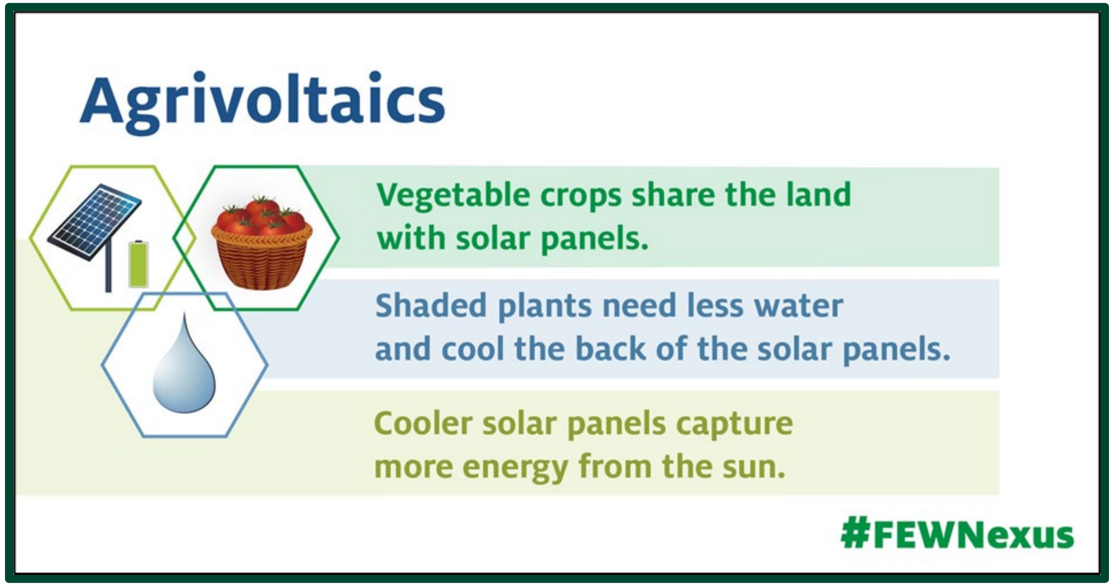


Photo credit: Charles Gould

Agrivoltaics

Photo credit: Charles Gould

Crops that can be grown under solar arrays

- Greens (lettuce, spinach, kale, Swiss chard, mustard)
- Brassicas (broccoli, cauliflower, cabbage, Brussel sprouts)
- Root crops (carrots, rutabaga, beets, radishes, potatoes, garlic)
- Herbs (parsley, mint, coriander, basil, cilantro)
- Berries (strawberries, blueberries, gooseberries)
- Peas, bush beans, peppers, tomatoes, leeks, onions

Agrivoltaic influence on soil moisture, micrometeorology and water-use efficiency

- The goal of this study was to show that the impacts of microclimatology, soil moisture, water usage, and biomass productivity should be considered in designing solar energy systems to take advantage of potential net gains in agricultural and power production.
- Significant differences in mean air temperature, relative humidity, wind speed, wind direction, and soil moisture were observed.
- A significant increase in late season biomass was observed for areas under the PV panels (90% more biomass).
- Areas under PV panels were significantly more water efficient (328% more efficient).

Source: Hassanpour Adeh E, Selker JS, Higgins CW (2018) Remarkable agrivoltaic influence on soil moisture, micrometeorology and water-use efficiency. PLoS ONE 13(11): e0203256. https://doi.org/10.1371/journal.pone.0203256

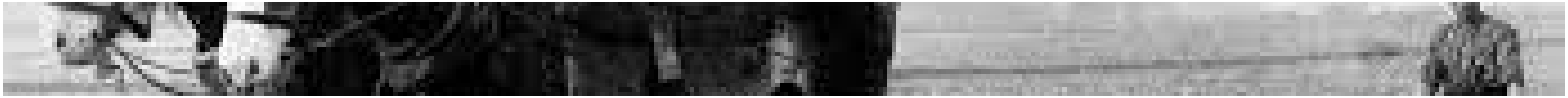
Vertical Bifacial Solar Arrays

Vertical bifacial panel reduces snow and dust accumulation.

Provides two output peaks during the day, with the second peak aligned to peak electricity demand.

Photo credit: Jean-Philippe Delacre

Khan, M., Hanna, A., Sun, X., and Alam, M. (2017). Vertical Bifacial Solar Farms: Physics, Design, and Global Optimization. Applied Energy. 206. 10.1016/j.apenergy.2017.08.042.



Some things to consider

- Agriculture has evolved over time.
- Land use resources comparison
  - 2022 Ford F-150 V8 4WD using E85 at 13 mpg => 200 bu corn per acre => 7,280 miles per year
  - 2023 Ford Lightning takes 49 kWh per 100 miles => 553,000 miles per year
- Climate change.

Keys to implementing dual use practices

- To implement dual use practices successfully, rigorous planning with all the parties is needed.
- Conversation and clear communication of expectations and outcomes before construction or engaging in a partnership ensures a greater chance of long-term productive partnerships.

Photo credit: Harvest Solar

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