Land Use Planning for Large-Scale Solar

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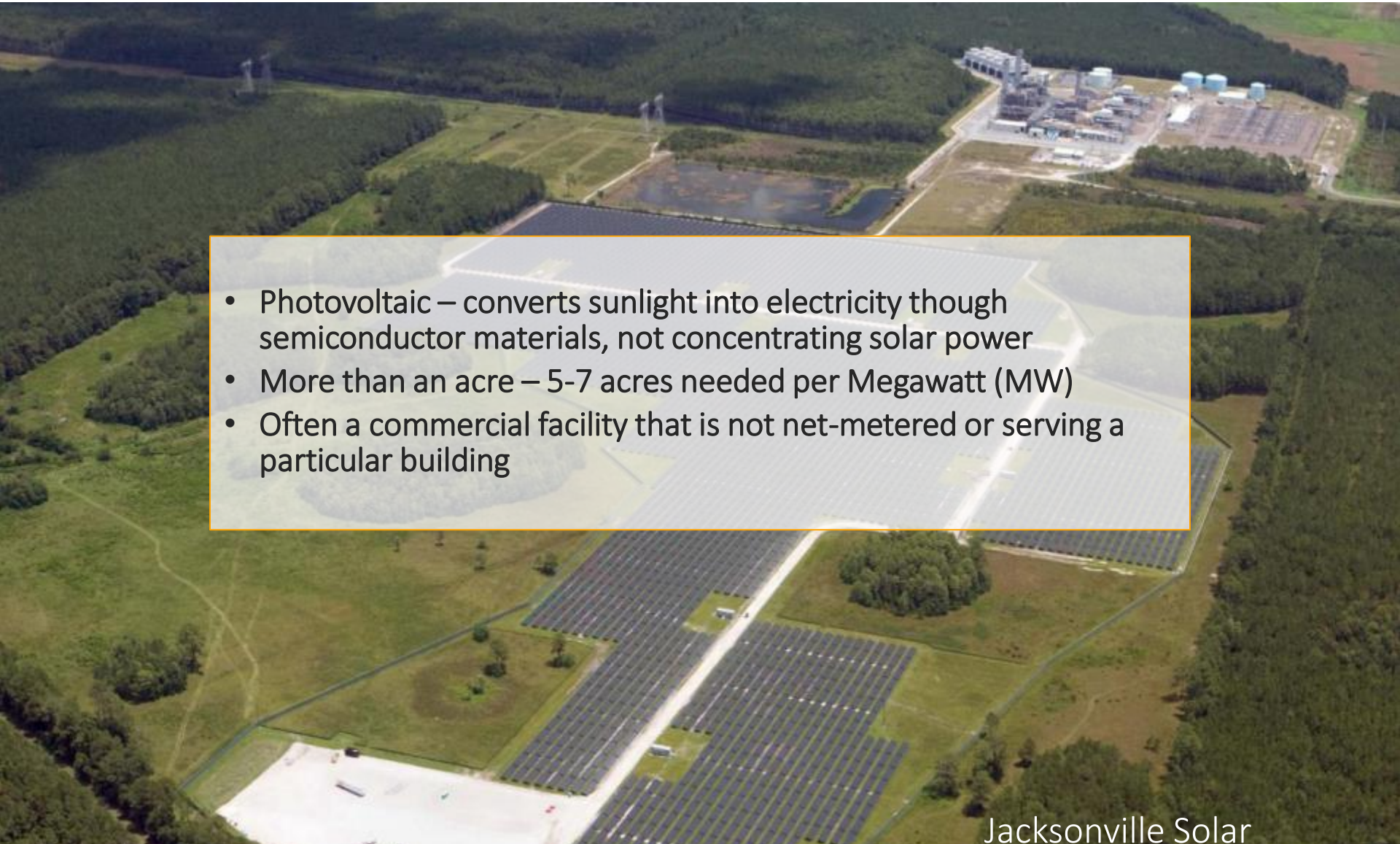
What is Large-Scale PV?



- Photovoltaic – converts sunlight into electricity though semiconductor materials, not concentrating solar power
- More than an acre – 5-7 acres needed per Megawatt (MW)
- Often a commercial facility that is not net-metered or serving a particular building

Jacksonville Solar

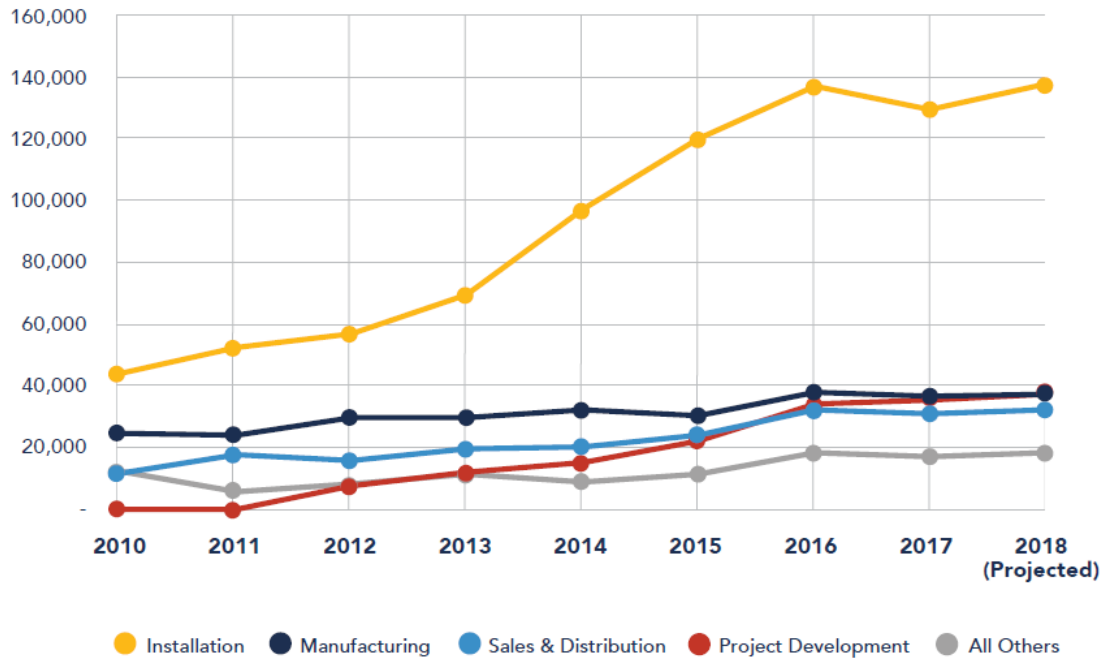
Commonly Cited Large-Scale PV Benefits

- Economic development (jobs & spending)
- Increased local property tax income without additional services
- Improves energy security – distributed assets, no fuel needs
- Local power generation – no shipping or purchasing of fuels
- Cleaner air & water → Public health improvement ($0.08/kWh in Southeast in DOE study)
- Reduces environmental risk of fossil fuels – mining, coal ash, greenhouse gases, mercury, etc.

PV array at the National Wind Technology Center *Photo by Dennis Schroeder, NREL 11249490*

Large-Scale PV Economic Benefits

Figure 1: Solar Employment Growth, 2010-2018 (Projected)

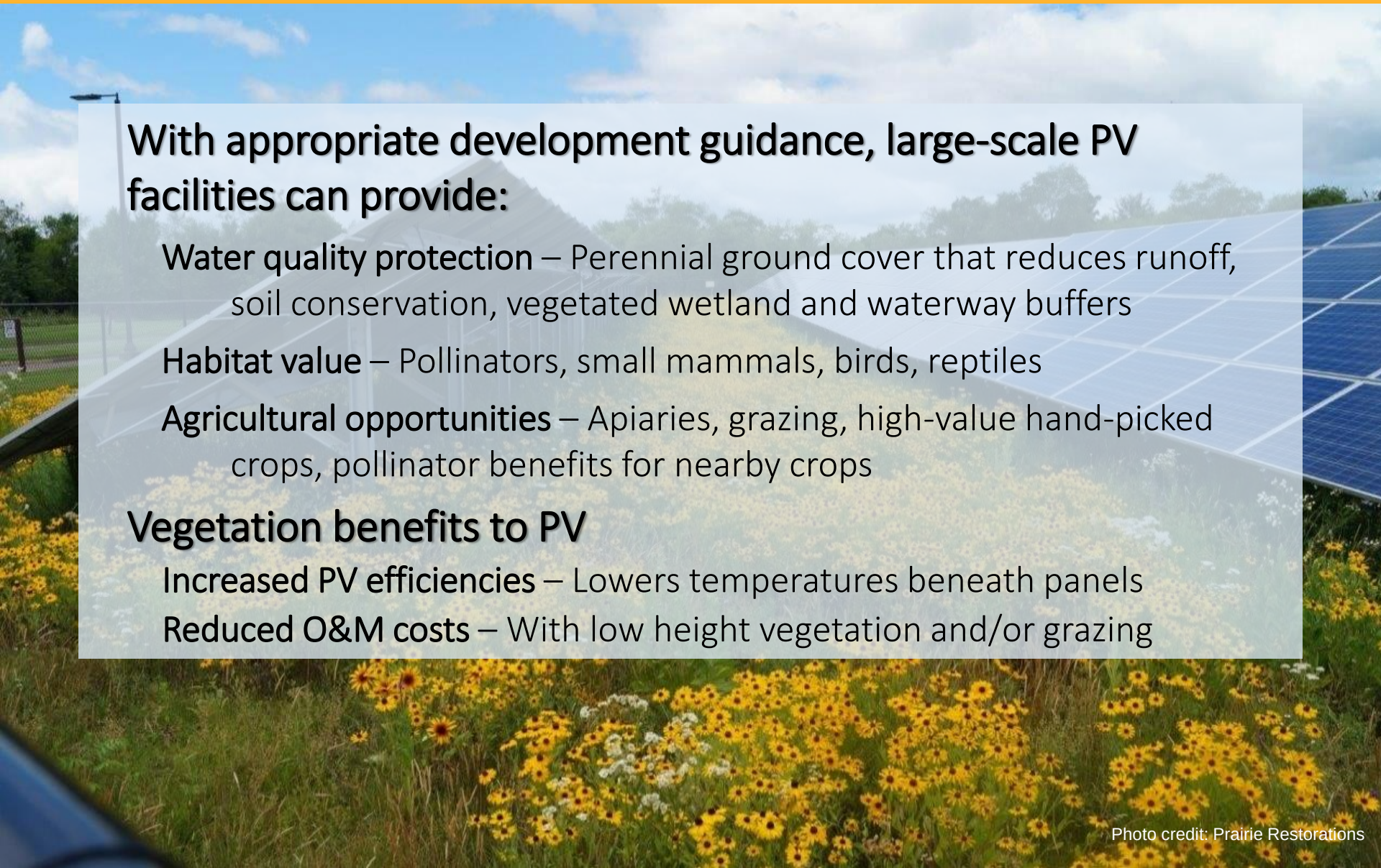


NOTE: *Projections are based on survey responses submitted prior to the trade case decision.*

Source: 2017 Solar Jobs Census, Solar Foundation

- ✓ Job creation
- ✓ New markets for local contractors
- ✓ Diversity of income to land owners
- ✓ Local resources/Import substitution

Large-Scale PV Natural Resource Benefits



With appropriate development guidance, large-scale PV facilities can provide:

Water quality protection – Perennial ground cover that reduces runoff, soil conservation, vegetated wetland and waterway buffers

Habitat value – Pollinators, small mammals, birds, reptiles

Agricultural opportunities – Apiaries, grazing, high-value hand-picked crops, pollinator benefits for nearby crops

Vegetation benefits to PV

Increased PV efficiencies – Lowers temperatures beneath panels

Reduced O&M costs – With low height vegetation and/or grazing

Photo credit: Prairie Restorations

Large-Scale PV Concerns

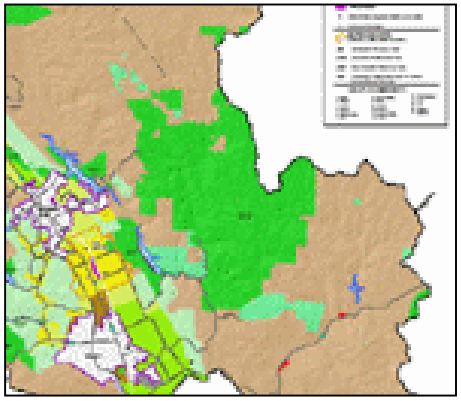
No glare	• Less reflective than water and windows and compatible with nearby residential, office, or aviation uses
Very low noise	• 45 decibels at 10 meters from the inverters, which is slightly less noise than a refrigerator makes
Safe	• Photovoltaic modules are enclosed in glass, carry a 25 year warranty, meet all applicable electrical and safety standards
Low voltage	• Far lower voltage than transmission lines – No EMF impacts

https://www.nrel.gov/tech_deployment/state_local_governments/blog/top-five-large-scale-solar-myths

Solar Farms ≠ Industrial Land Use

Industrial zoning and land use characteristics

- Access to major transportation corridors, water, sewer = EXPENSIVE
- Often urban, smaller parcels = EXPENSIVE, too small
- Employment
- Nuisances (noise, traffic, pollution)



Tonopah/Arlington Area Plan definition

- INDUSTRIAL: "major employment centers," Uses permitted in this category include warehousing, storage, distribution activities, and manufacturing

Requiring change of land use/zoning for solar amounts to spot zoning and "stranded" industrial zoned land

- PV should not be restricted to Public Utilities zoning
- PV farms ≠ traditional power plants. Do not need:
  - Massive amounts of water for cooling
  - On-site personnel
  - Fuel delivery via rail, road, or pipeline

Large-Scale PV Potential Impacts

Potential conflicts with other resources or development goals:

- Agricultural practices
  - Loss of prime agricultural soils
  - Loss of local productive capacity
  - Fragmentation of land
- Forested areas
- Historic resources
- Redevelopment and density
- Natural areas
- Habitat
- Aesthetics/viewsheds

Wyandot County Airport, OH – Photo credit: juwi Americas

Land Use Planning for Large-Scale PV

Good plans enable good development

- Solar energy is an economically valuable local resource
- Valuable resources should benefit the owner and the community
- Local plans lay the policy foundation for development regulation and programs that enable capture of benefits, while minimizing risks

Solar Ready Communities Comprehensive Plans

- Identify and define solar resources
- Acknowledge solar development benefits and desired co-benefits
- Identify solar development opportunities and conflicts in the community
- Set development targets or goals

Photo credit: Fresh Energy/Giving Tree

Table 15: Median Installer Wages

	INSTALLATION	PROJECT DEVELOPMENT	INSTALLATION AND PROJECT DEVELOPMENT
Entry-Level Wage	$15.00	$16.22	$15.00
Mid-Level Wage	$20.00	$25.00	$21.00
Senior/Supervisor Wage	$30.00	$38.00	$30.00

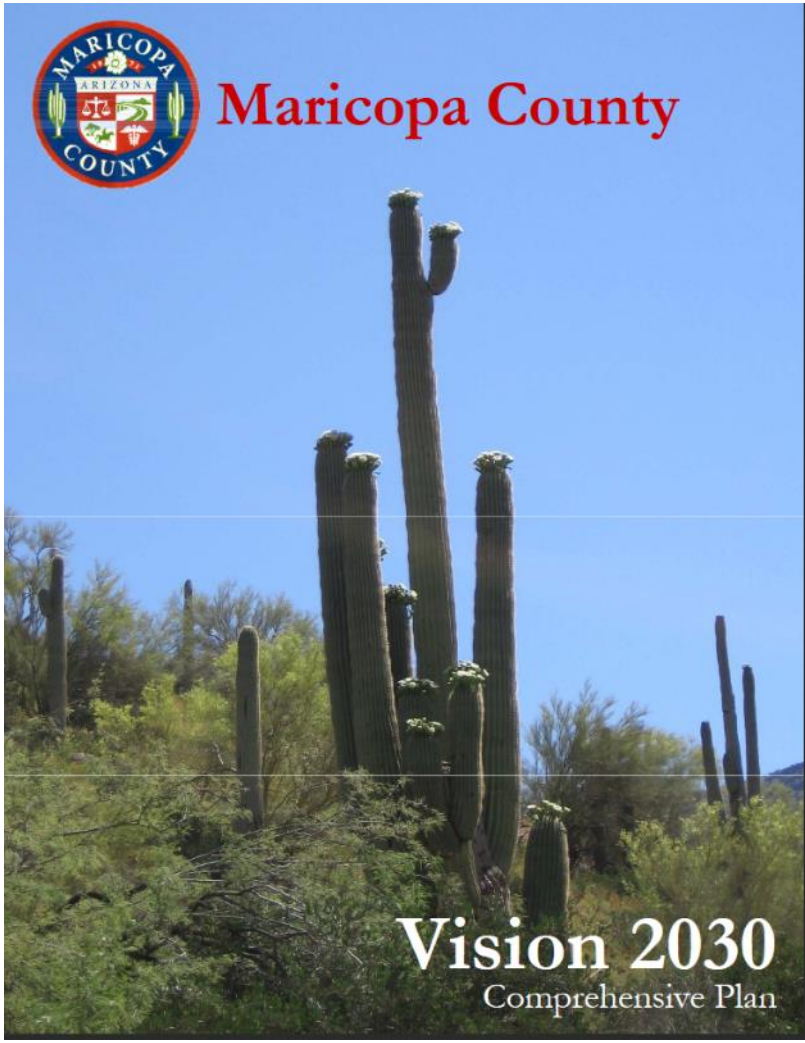
Source: 2017 Solar Jobs Census, Solar Foundation

Solar Ready Counties

Maricopa County, AZ (SolSmart Bronze)

Economic Growth Policy #10

"Maricopa County supports leveraging its solar resource potential to attract solar-related industries and alternative energy research and development."



Solar Ready Counties

Stearns County, MN (SolSmart Silver)

Environment and Natural Resources

Goal 2. Assure the reasonable and responsible use of natural resources . . .

Objective 4. Encourage use of renewable energy systems, including wind energy and solar energy, which reduce the footprint of development on local and global natural systems.

Goal 3. Protect agricultural natural resources.

Objective 1. Protect agricultural soils and other agricultural resources by regulating non-agricultural land uses in areas with agricultural soils.

Photo credits: Great Plains Institute

Large-Scale Solar in Zoning Codes

Solar Energy System. A **device or** structural **design feature**, a substantial purpose of which is **to provide daylight** for interior lighting or provide for the **collection, storage, and distribution of solar energy for space heating or cooling, electricity generation, or water heating**.

Solar Energy System, Large-Scale: Active Solar Energy System that occupies more than 40,000 square feet of surface area.

Solar Energy System, Medium-Scale: Active Solar Energy System that occupies more than 1,750 but less than 40,000 square feet of surface area.

Solar Energy System, Small-Scale: An Active Solar Energy System that occupies 1,750 square feet of surface area or less.

Further distinguish between rooftop and ground-mounted.

Photo credit: https://www.sunraisedfarms.com/

Brownfield Redevelopment Opportunity

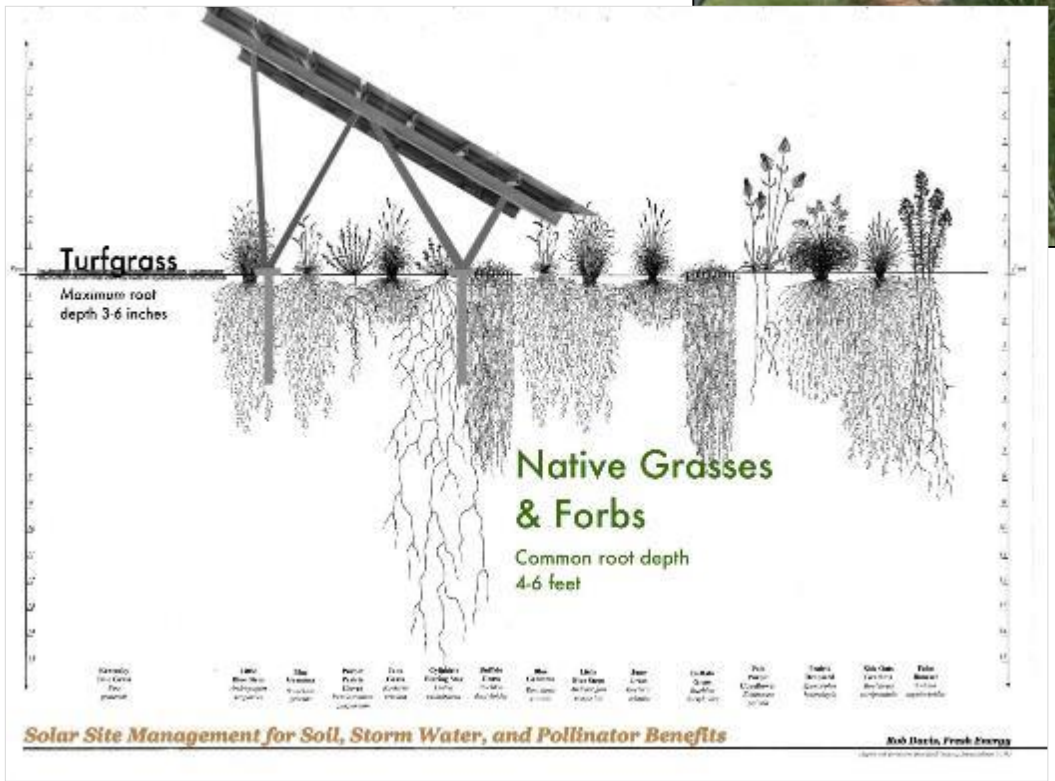
Shaffer Landfill, Billerica, MA, Urban Green Technologies
https://www.high-profile.com/wp-content/uploads/2015/04/Shaffer-Landfill_PV-aerial.jpg

Opportunity to generate revenue from otherwise undevelopable land

SolSmart criteria: Encourage or incentivize solar PV development on parking lots, vacant lots, landfills, buffer lands, brownfields, airport safety zones, and non-building structures

Low-Impact Solar Development

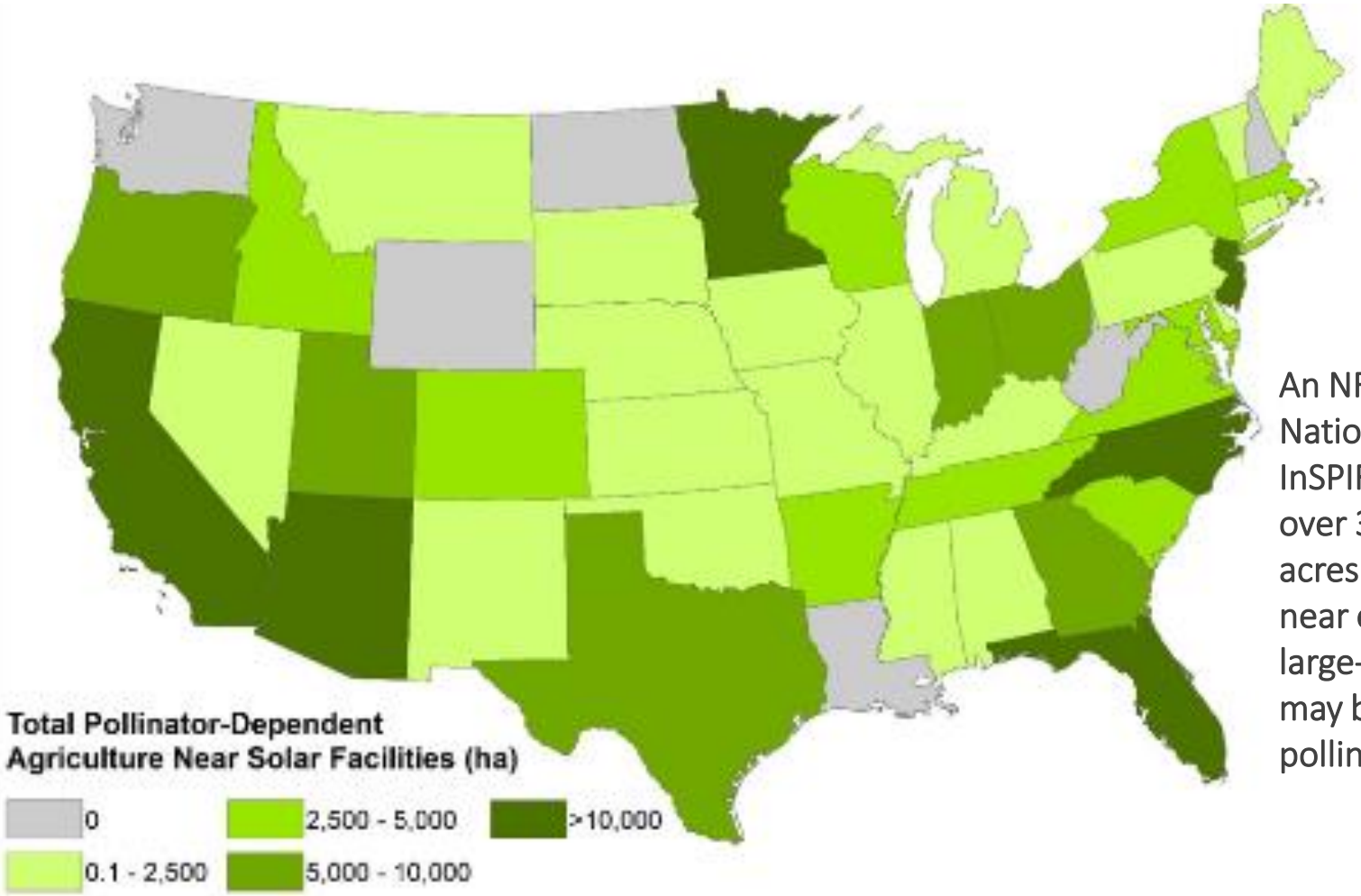
- Minimizing grading
- Minimizing soil compaction
- Planting native vegetation



NREL's National Wind Technology Center's solar installation where native grasses and revegetation techniques were tested.

https://www.nrel.gov/docs/fy17osti/66218.pdf

Potential Ag Benefits of PV Pollinator Habitat



An NREL and Argonne National Laboratory InSPIRE study identified over 3,500 km^2 (800,000 acres) of agricultural land near existing and planned large-scale PV facilities that may benefit from insect pollinators.

Examining the Potential for Agricultural Benefits from Pollinator Habitat at Solar Facilities in the United States
Leroy J. Walston, Shruti K. Mishra, Heidi M. Hartmann, Ihor Hlohowskyj, James McCall, and Jordan Macknick
Environmental Science & Technology, https://pubs.acs.org/action/showCitFormats?doi=10.1021%2Facs.est.8b00020

Potential Ag Benefits of PV Pollinator Habitat

Possible agro-economic benefits of solar-pollinator habitat where there is overlap between solar development and high-value pollinator-dependent crops, especially in areas where pollination is essential for production (e.g., >40% dependence on insect pollination).

Planting and maintaining native pollinator-friendly vegetation at solar energy developments could offset local impacts to agricultural production through benefits provided by increased pollination services, insect pest management, and storm water and erosion control.

Summary of highly pollinator-dependent agriculture (where insect pollination is essential for production) within solar energy pollinator foraging zones (1.5 km)

Crop	Insect Pollinator Dependence Rank[b]	Total Hectares of USSE Foraging Zones Planted, All States	States with Greatest Crop Area within USSE Foraging Zones[c]
Almonds[d]	3	29,718	California (29,718 ha)
Cranberries	3	1,904	Massachusetts (1,885 ha), New Jersey (11 ha)
Melons (Cantaloupes, Honeydew, Watermelon)	4	1,287	California (1,013 ha), Maryland (106 ha), Arizona (61 ha), North Carolina (36 ha)
Apples	3	867	North Carolina (397 ha), Massachusetts (157 ha), New York (126 ha)
Blueberries	3	521	New Jersey (202 ha), Michigan (93 ha), North Carolina (77 ha), Georgia (44 ha)
Plums	3	477	California (473 ha), New York (2 ha)
Cherries	3	418	California (408 ha), Oregon (5 ha), Michigan (3 ha)
Pumpkins / Squash / Gourds	4	351	New Jersey (115 ha), Massachusetts (106 ha), North Carolina (24 ha)
Peaches	3	189	California (53 ha), Georgia (40 ha), New Jersey (27 ha), North Carolina (22 ha)
Cucumbers	3	100	North Carolina (35 ha), New Jersey (30 ha), Michigan (10 ha)

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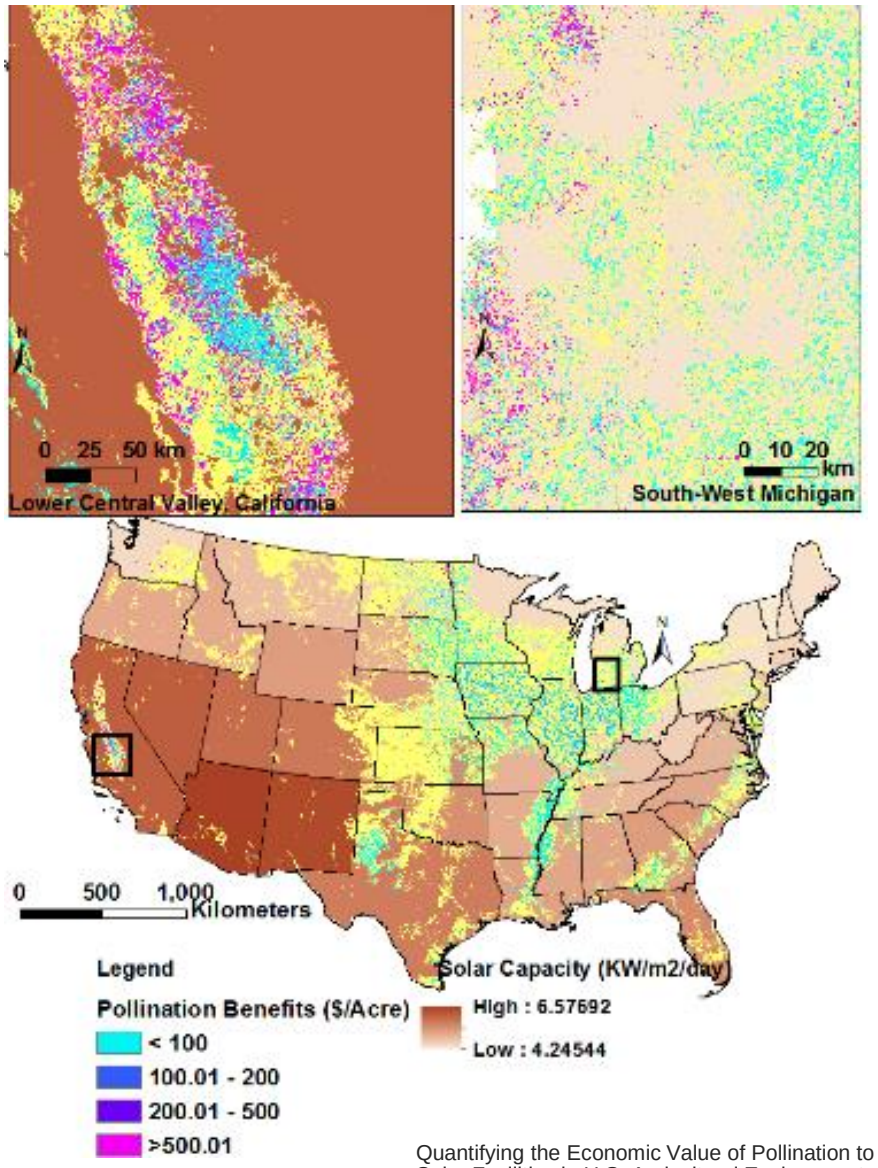
Economic Value of PV Pollinator Habitat to Ag

Integrating national-scale data on crops, pollinators, and solar facilities revealed an estimated value of pollination across the conterminous U.S. of $43 billion.

If 10% to 50% of existing and planned solar facilities were used for pollinator habitat, they would produce $1.9 to $5.7 billion in pollination benefit annually.

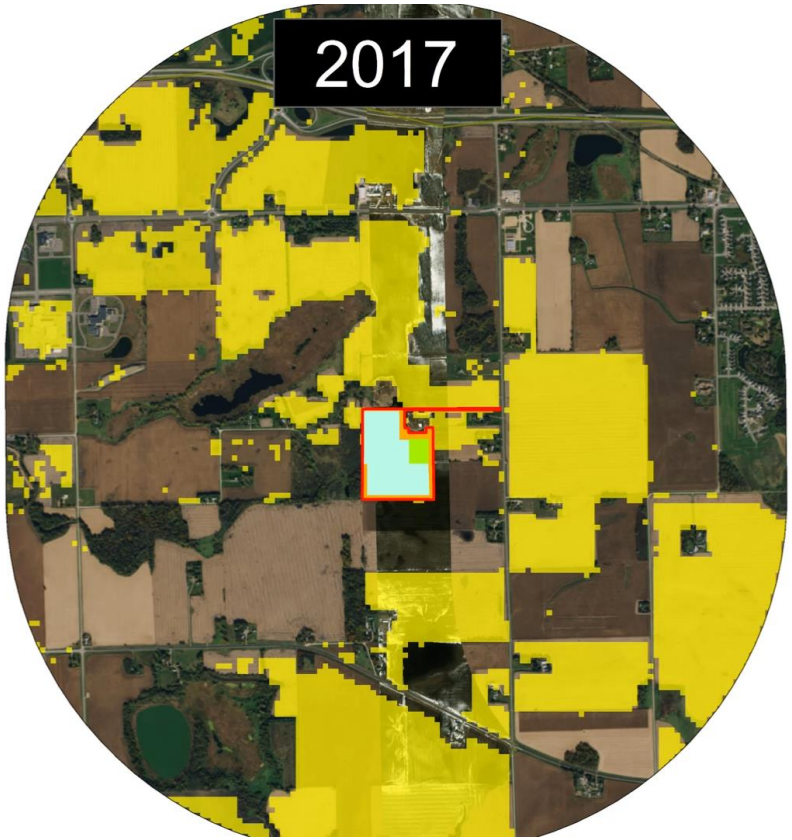
Estimated pollination benefits across the croplands of the United States



Quantifying the Economic Value of Pollination to Improve Adoption of Solar Facilities in U.S. Agricultural Environments, NREL and Argonne National Laboratory, 2018, publication pending

Economic Value of PV Pollinator Habitat to Ag

Case Study



Eastwood Solar Facility (Minnesota)
5.5 MW

Eastwood Solar Facility	
Estimated 2017 soybean production within1 km	532 acres (25,000 bushels)
Estimated 2017 soybean production within 2 km	1,425 acres (66,975 bushels)
Soybean production value	$9.15/bushel
Hypothetical 1% pollinator service increase benefit	$2,250 - $6,150

Intersection of Solar Facilities with Pollinator-Dependent Croplands, NREL and Argonne National Laboratory, 2018, publication pending

Putting the ‘farm’ back in solar farms: Study to test ag potential at PV sites

WRITTEN BY

Frank Jossi
January 22, 2018

PHOTO BY

Matthew Gorrie / Bolton Bees

Minnesota will be included in a study to help federal researchers test the potential of pollinator-friendly habitat and fruit and vegetable crops around solar arrays.

The National Renewable Energy Laboratory (NREL) will plant vegetation this year at three Minnesota solar installations owned by Enel Green Power. The sites are among 15 around the country that will be part of the research project.

Midwest Energy News: http://midwestenergynews.com/2018/01/22/putting-the-farm-back-in-solar-farms-study-to-test-crop-potential-at-pv-sites/

Solar Farms and Apiaries

Solar farms provide opportunities for honey production.

Solar Farms and Agriculture

PV at the perimeter of a field of sunflowers grown for oil production in Wisconsin

Solar Farms and Agriculture

Sheep grazing is an increasingly common vegetation management practice.

Webinar on NREL's InSPIRE project: Co-locating Agriculture and Solar https://fresh-energy.org/nrelwebinar/

Planning for Large-Scale PV -- Summary

Comprehensive plan

- Recognize your solar resource
- Establish solar goals and objectives

Zoning for large-scale PV

- Differentiate between rooftop and ground mounted
- Differentiate between small- and large-scale PV
- Establish development standards that achieve solar goals and objectives

Options for attracting beneficial solar development

- Offer expedited permitting review if projects meet established development standards
- Base permitting fees on plan review time and expense rather than a percentage of construction costs
- Offer property tax or sales tax exemptions or reductions
- Provide clarity from County Assessor on how development will be taxed
- Consider ground cover standards and PV and agriculture co-benefits

PV array at the National Wind Technology Center *Photo by Dennis Schroeder, NREL 11249490*

Thank you!

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- Demonstrate that the community is "**open for solar business**," making it more attractive to solar industries.

Technical Assistance

- Communities can receive no-cost technical assistance on:
  - Siting
  - Permitting
  - Inspection
  - **Planning and Zoning**