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Land Use Planning for Large-Scale Solar

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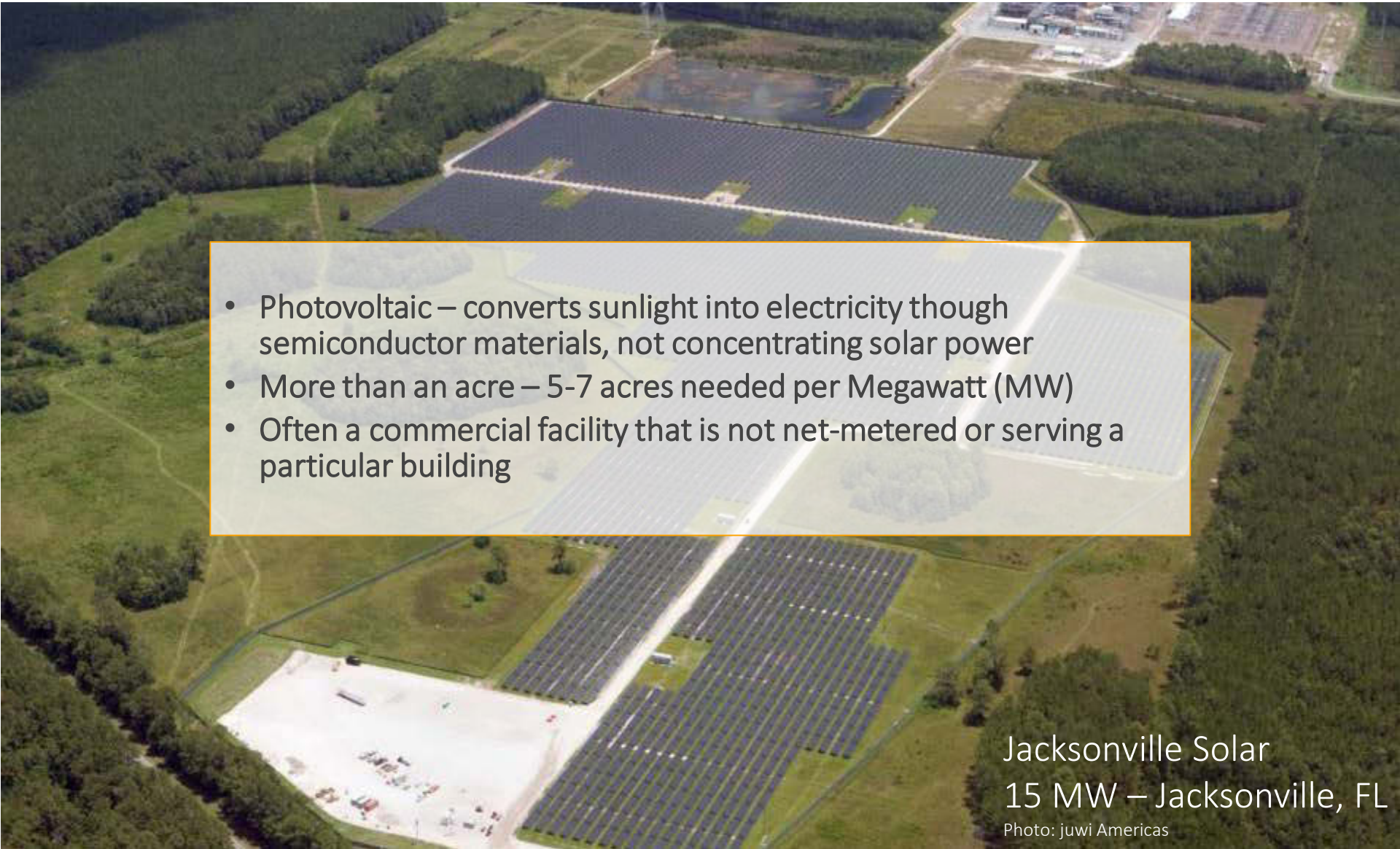
The data, results, conclusions, and interpretations presented in this document have not been reviewed by technical experts outside NREL or the Solar Energy Technologies Office.

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
15 MW – Jacksonville, FL
Photo: juwi Americas

Why Plan for Large-Scale PV?

Under the Department of Energy's SunShot, low battery storage cost scenario, PV deployment is predicted to grow to an estimated 1,618 GW by 2050, requiring an estimated 6.6 million acres of land, roughly equivalent to the size of Massachusetts.

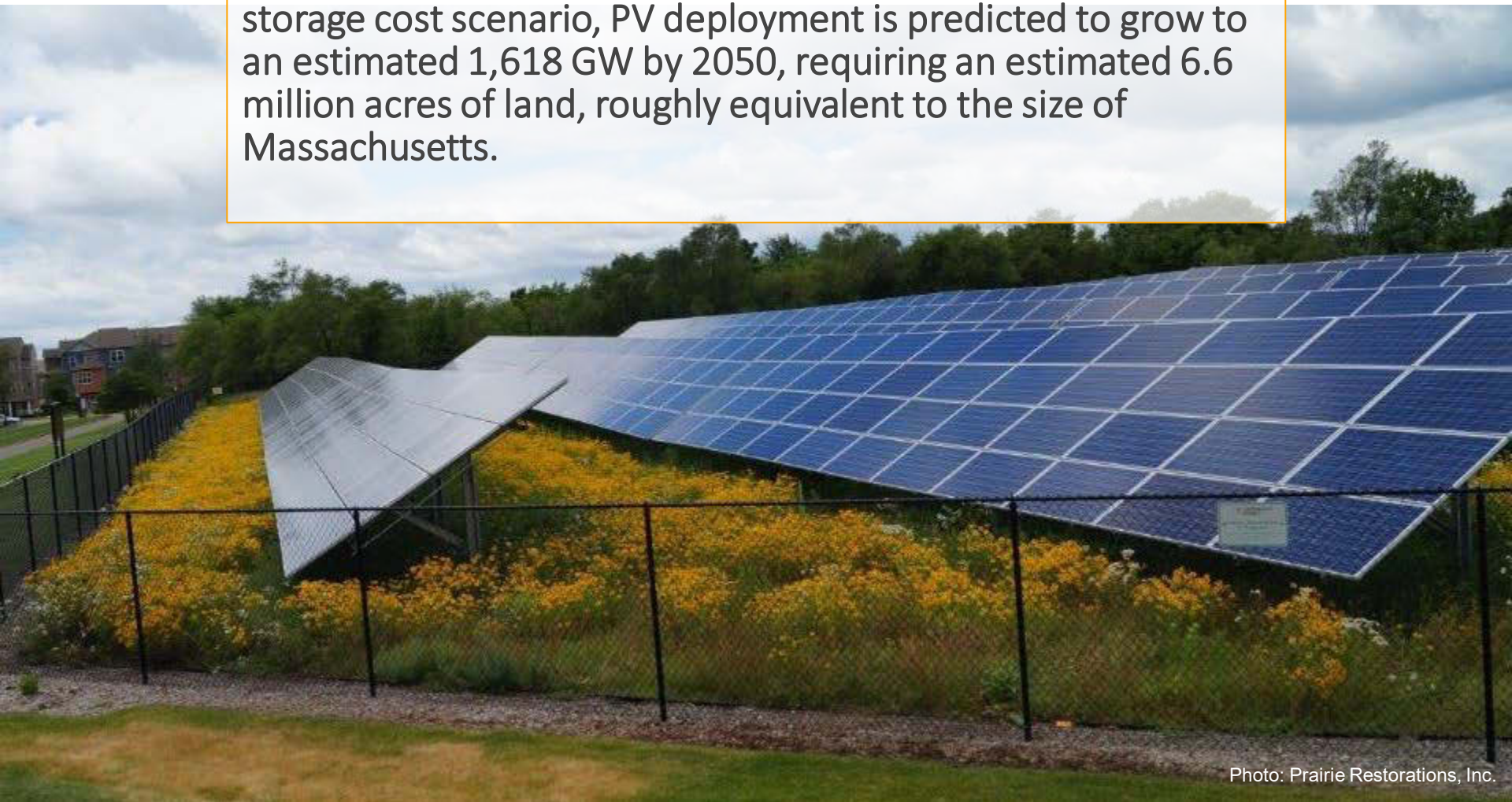


Photo: Prairie Restorations, Inc.

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
- 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 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

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 electro magnetic field (EMF) impacts

https://www.nrel.gov/tech_deployment/state_local_governments/blog/top-five-large-scale-solar-myths
https://www.nrel.gov/technical-assistance/blog/posts/research-and-analysis-demonstrate-the-lack-of-impacts-of-glare-from-photovoltaic-modules.html

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.

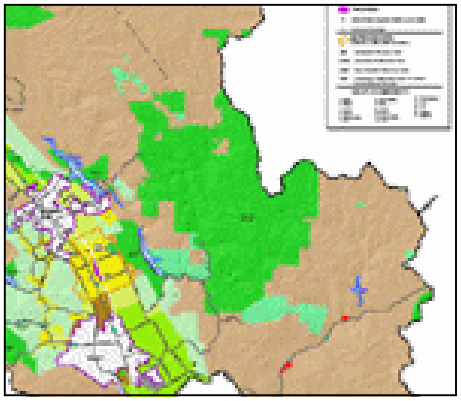
Further distinguish between rooftop and ground-mounted.

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

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)



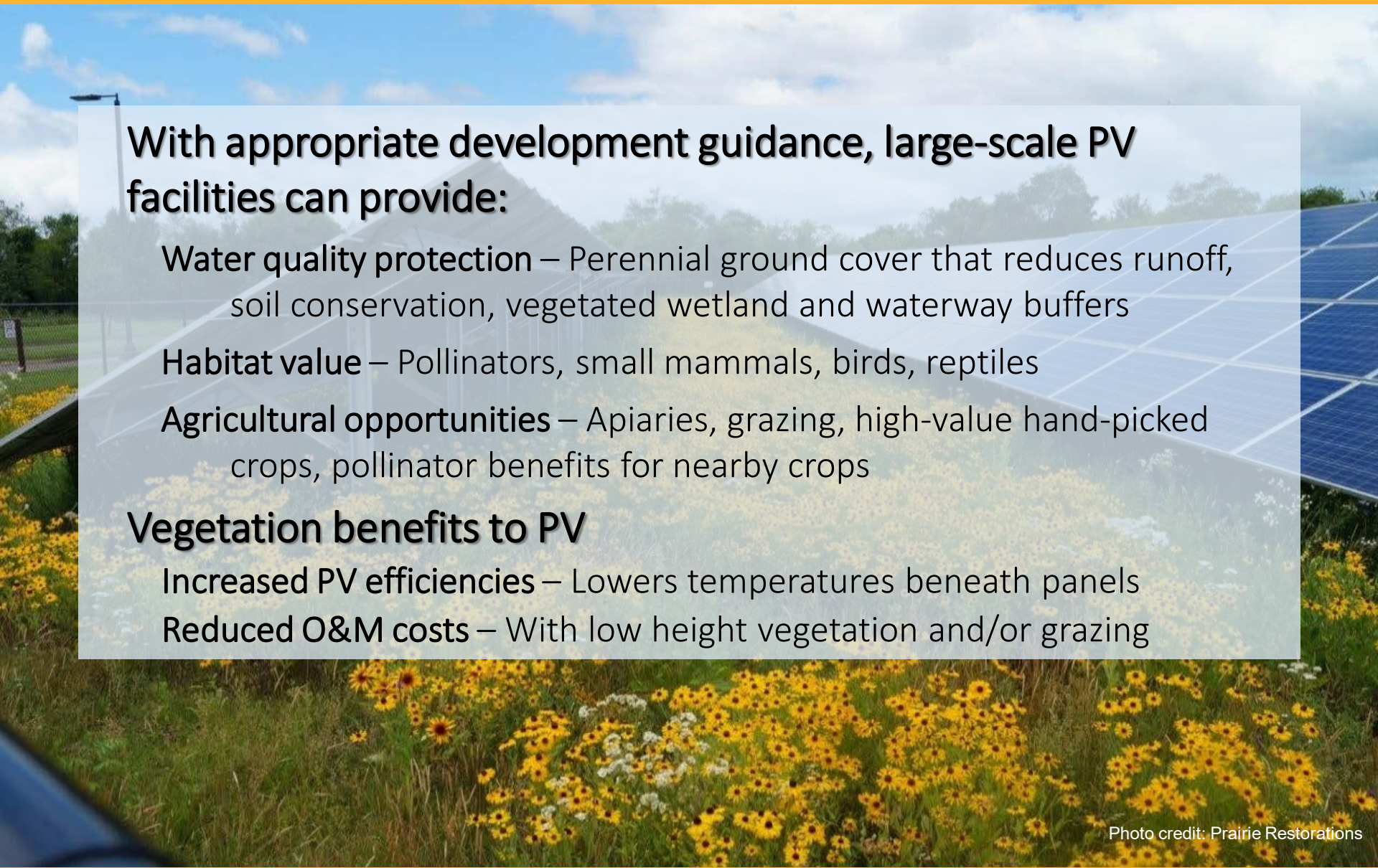
Tonopah/Arlington Area Plan definition

- 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

Low-Impact PV Development 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

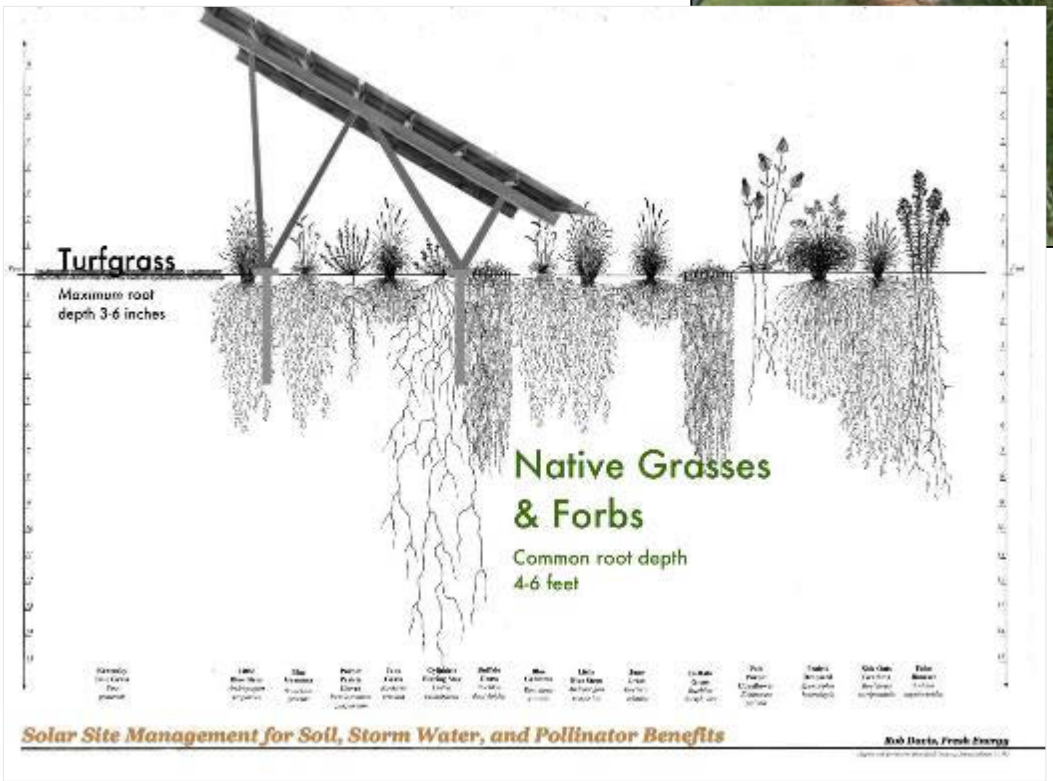
Increased PV efficiencies – Lowers temperatures beneath panels

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

Photo credit: Prairie Restorations

Low-Impact Solar Development

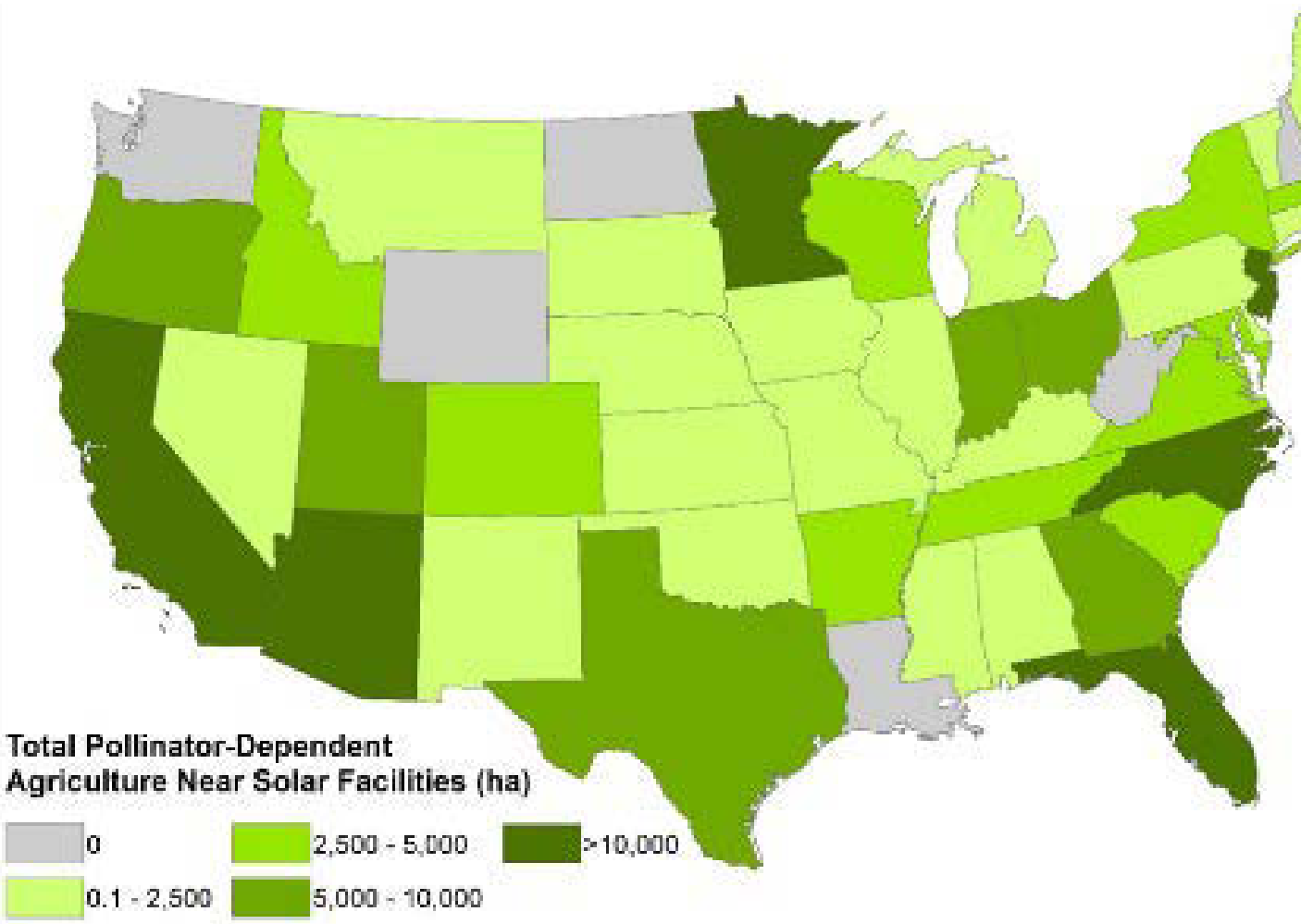
- Minimizing grading
- Minimizing soil compaction
- Planting native vegetation



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.

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.

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

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

Pollinator Friendly/Ag Preservation Policies

State Policy

Minnesota standards for pollinator-friendly solar legislation – Statute 216B.1642

Maryland Department of Natural Resources – Solar Generation Facilities – Pollinator–Friendly Designation

South Carolina – Solar Habitat Act – Voluntary solar best-management practices to establish native vegetation and pollinator habitat

Oregon Land Conservation and Development regulations aim to limit large-scale solar development on high-value farmland and arable land and address soil compaction, erosion, and noxious weeds.

County Policy

Linn County, IA – Amended the Development Code to require solar farms be planted with native grasses and wildflowers and prohibits application of insecticides.

Stearns County, MN – Land Use and Zoning Ordinance requires solar farm ground cover meet above state statute.

Photo: Prairie Restorations, Inc.

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

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*

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- To make it **faster**, **easier**, and more **affordable** for more Americans to choose solar energy, SolSmart will **recognize at least 300 U.S. local governments** with a nationally prestigious solar designation.

Designation

- Earn Bronze, Silver, or Gold designation based on solar-related actions.
- 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**