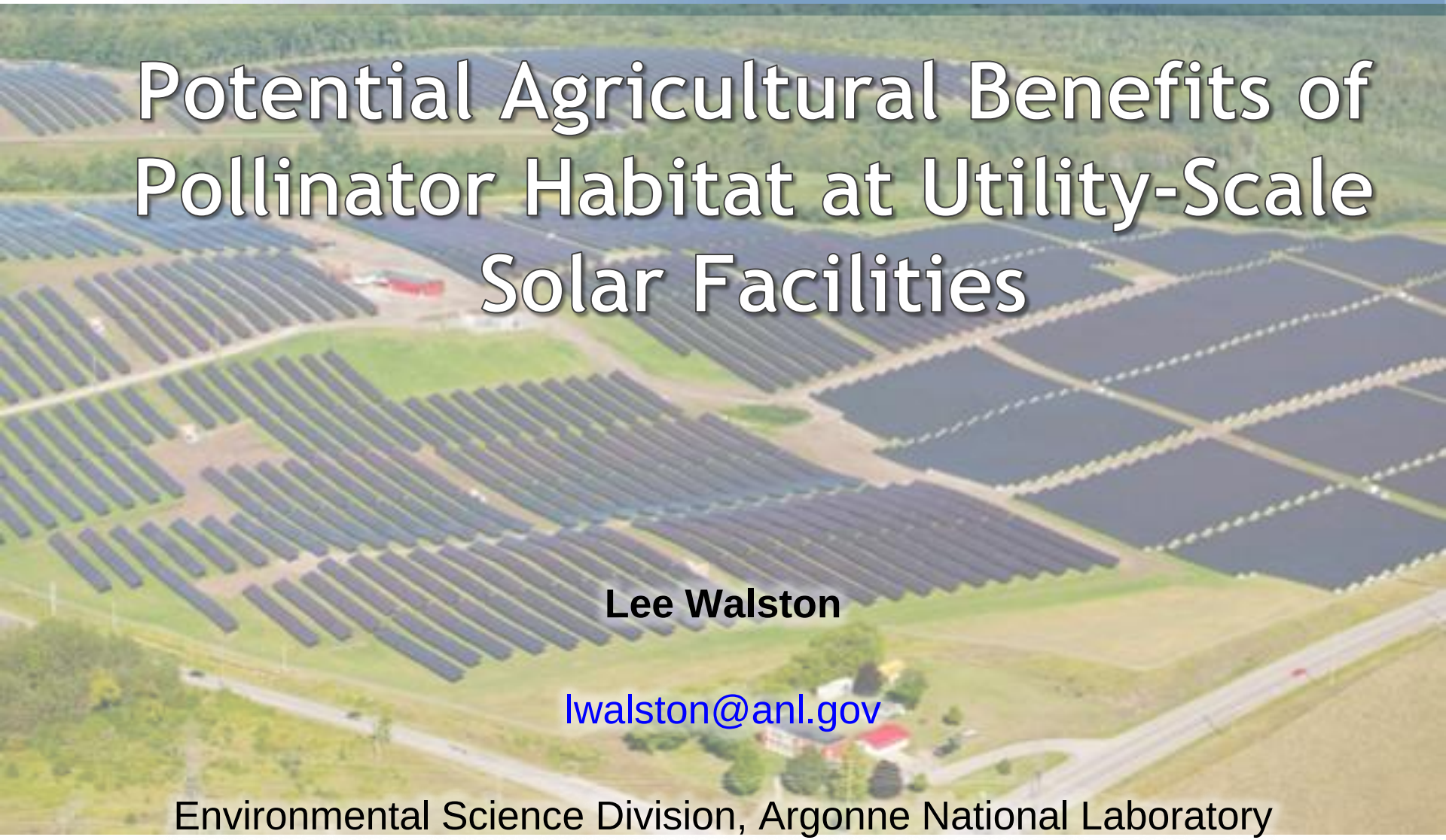
Potential Agricultural Benefits of Pollinator Habitat at Utility-Scale Solar Facilities



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Walston et al. *In Prep*. Examining the Potential Agricultural Benefits of Pollinator Habitat at Utility-Scale Solar Facilities in the U.S.

Utility-Scale Solar Development in the U.S.

- >1 MW ground-mounted installations that feed into the electricity grid
- Large spatial footprints: ~8 acres per MW
- Currently about 70 GW* (existing and planned): ~875 mi^2

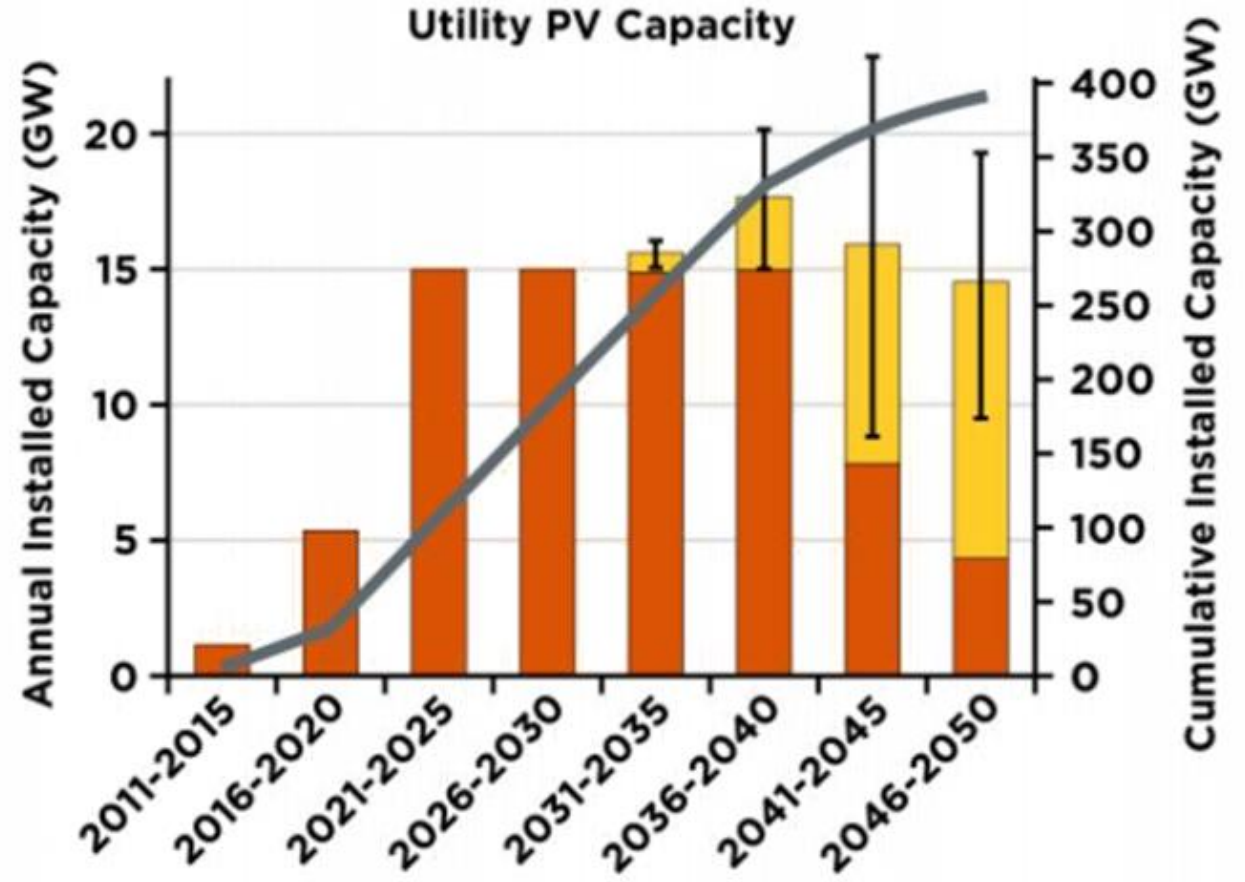
*SEIA Major Solar Projects: https://www.seia.org/research-resources/major-solar-projects-list

Desert Sunlight Solar Farm (San Bernardino County, CA)
550 MW ~4,000 acres (6.2 mi^2)

Groveland Solar Farm (Groveland, MA)
3.6 MW 30 acres

Utility-Scale Solar Development in the U.S.

- Over 2,200 existing projects (>600 planned)
- Average size: 12 MW
- Over 80% <25 MW



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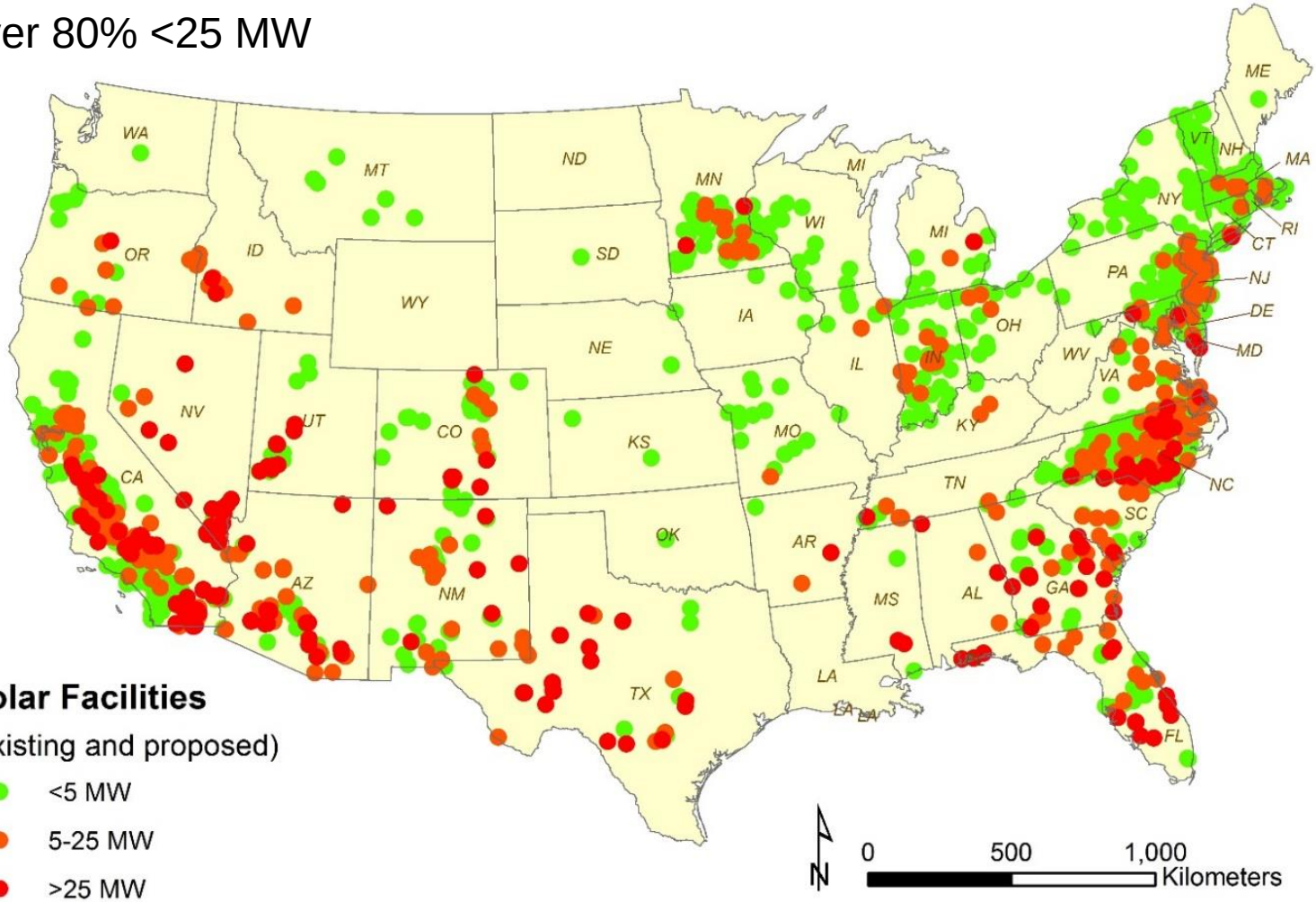


InSPIRE: Innovative Site Preparation and Impact Reductions on the Environment

- NREL-led effort to improve the landscape compatibility of large-scale solar projects through innovative siting practices
  - Focus on contaminated and previously disturbed lands
  - Co-locating solar projects on agricultural lands

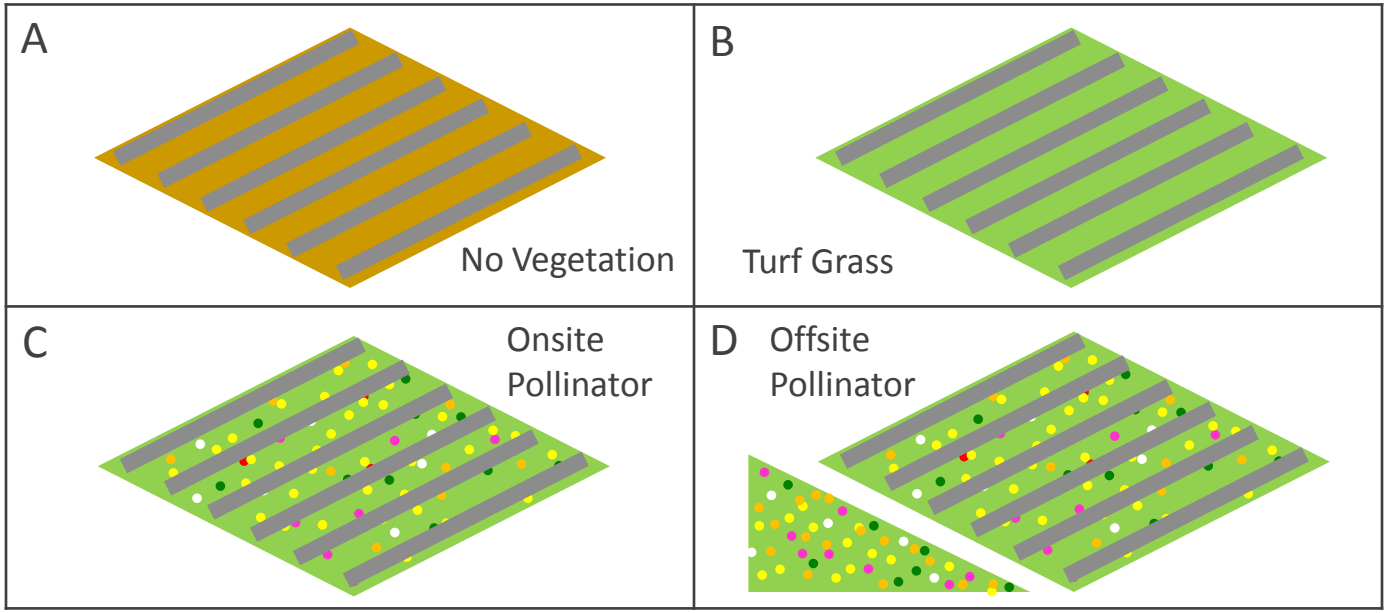
Evaluating vegetation performance under PV arrays

Co-location of solar and agriculture

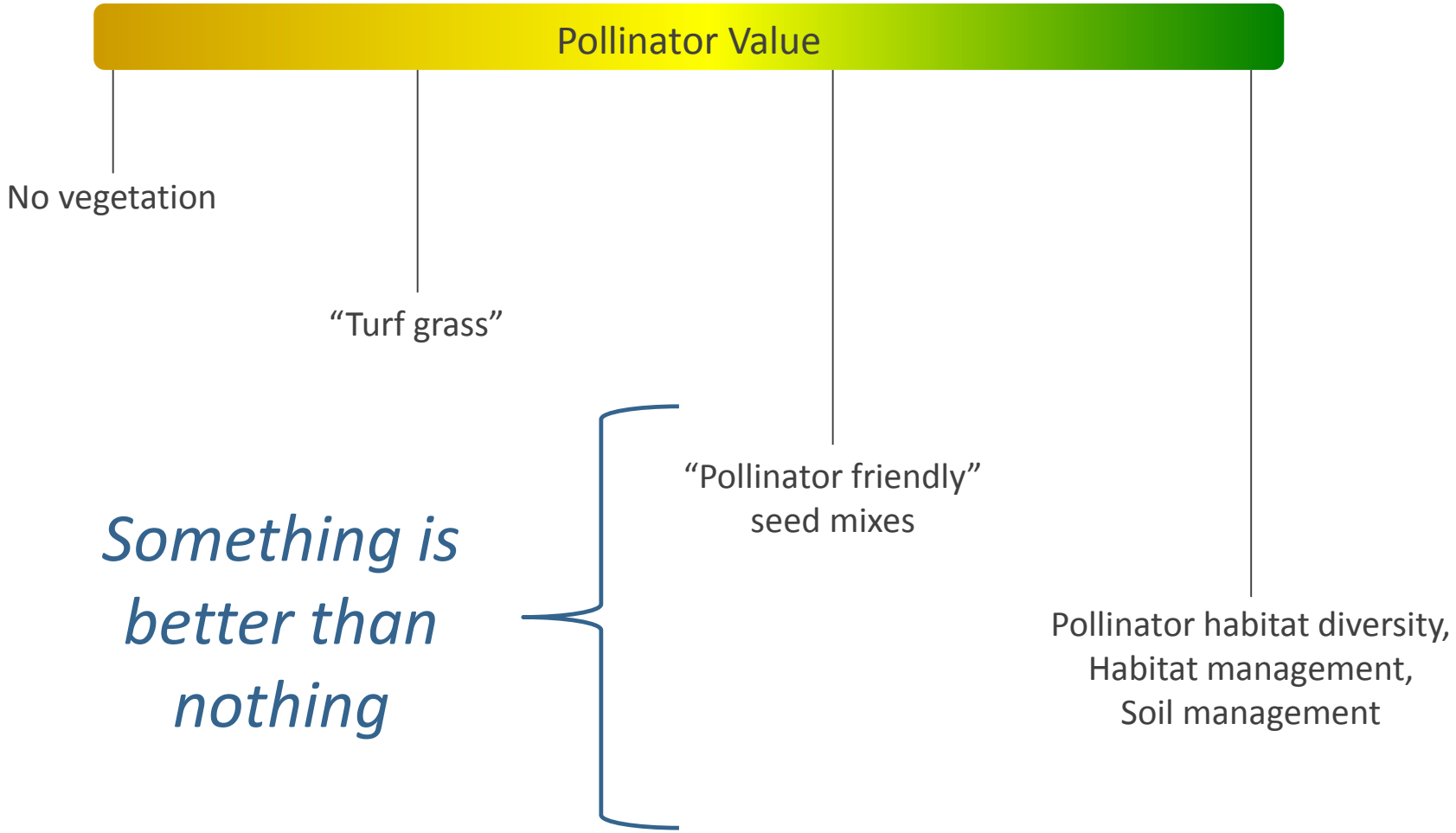
InSPIRE: Innovative Site Preparation and Impact Reductions on the Environment

- Interest in restoration of ecosystem services of solar sites
- What about pollinator services through maintenance of solar-pollinator habitat?

The establishment of regional flowering plants such as milkweed and other wildflowers, and soil preparation methods, either within the solar facility footprint area (e.g., beneath PV panels) and/or in offsite areas adjacent to the solar facility, that attract and support insect pollinators by providing nesting areas and a source of food.



What is Solar-Pollinator Habitat?



Making the Case for Solar-Pollinator Habitat

- Business case
  - Potential reductions in O&M costs with pollinator habitat (e.g., less mowing, risks)

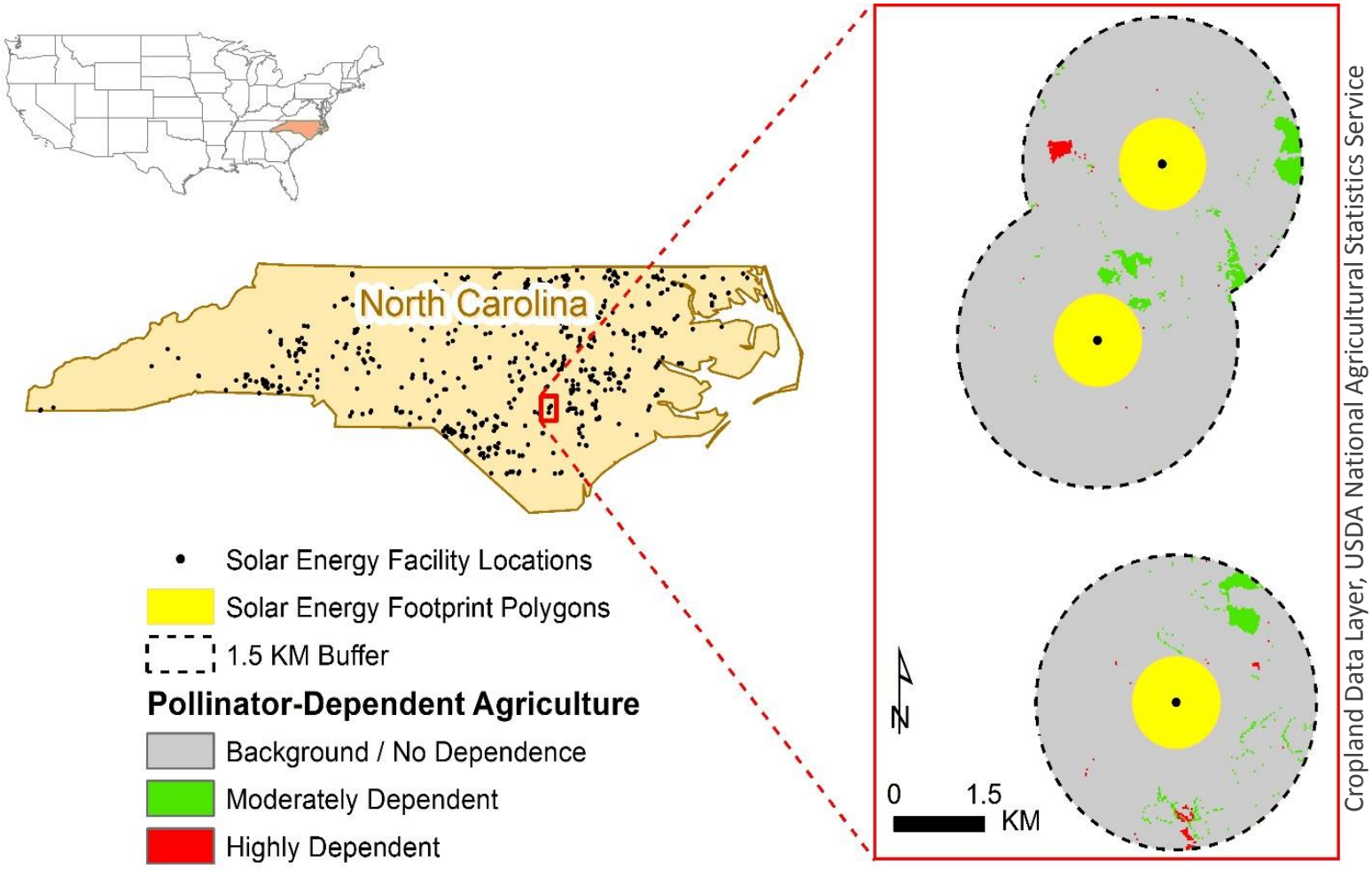
- Ecosystem benefits
  - Increased biodiversity
  - Storm water & erosion control
  - Carbon storage
  - **Agricultural benefits (e.g., pollination services)**

Despite the potential ecosystem service benefits of solar-pollinator habitat, little has been done to quantify these benefits.

The first step towards quantifying the pollination service benefits of solar-pollinator habitat is to identify the areas of co-location where solar-pollinator habitat may be most beneficial to crop production.

Quantifying *Potential* Solar-Pollinator Agricultural Interactions

What if *something* was done at solar facilities?



Quantifying *Potential* Solar-Pollinator Agricultural Interactions

Ten States with the greatest area within 1.5 km of existing and planned solar facilities.

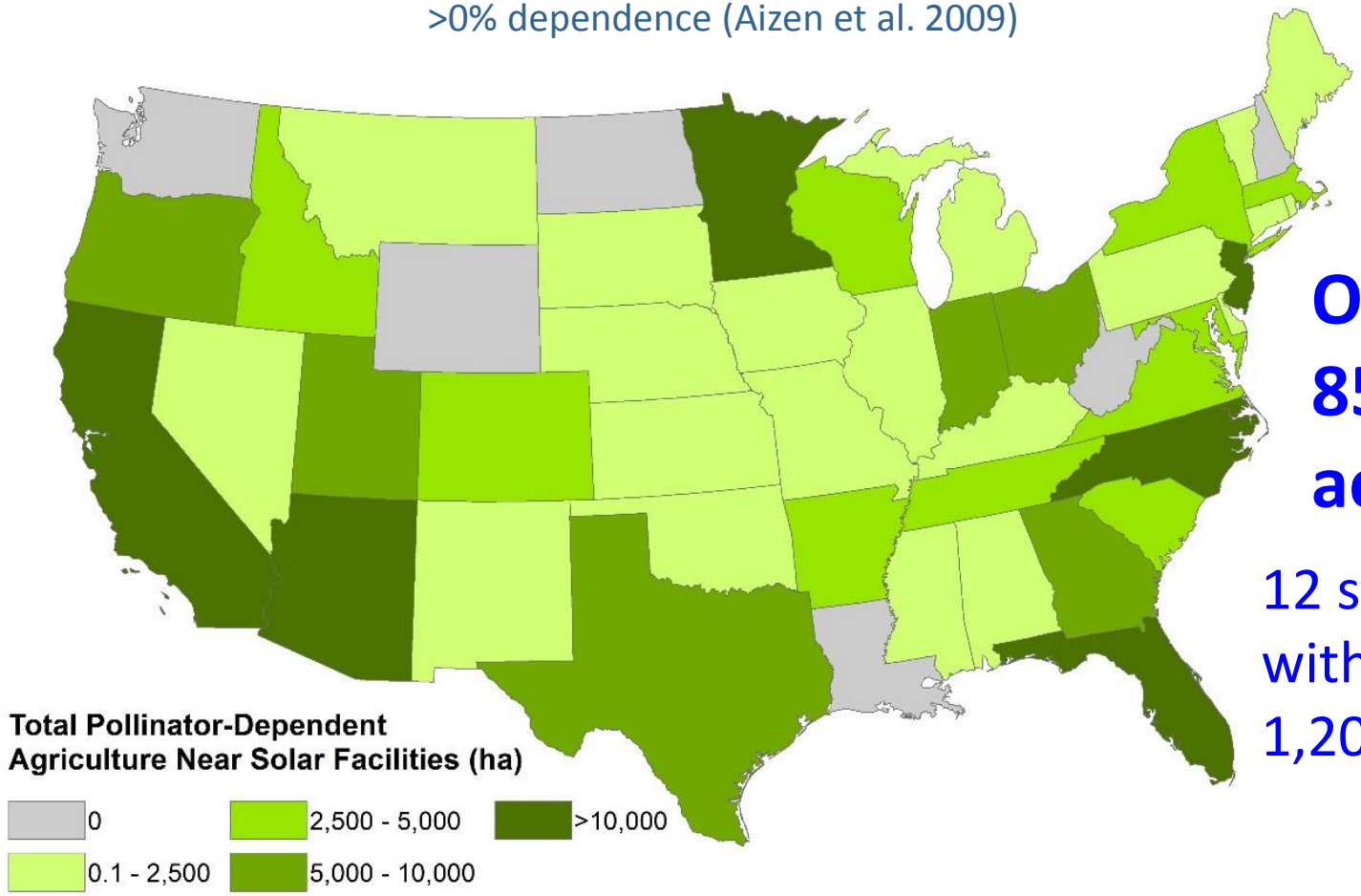
State Name	Total Number of USSE Projects	Total USSE Electric Capacity (MW)	Total Area within 1.5 km of USSE Facilities (km^2)
California	776	14,562	8,059
North Carolina	591	4,027	7,572
Massachusetts	220	569	2,238
New Jersey	218	666	2,031
Arizona	111	2,528	1,647
Texas	42	2,701	1,456
Nevada	61	2,458	1,301
Florida	40	1,105	1,070
Minnesota	168	489	1,059
Georgia	39	1,030	965
Total	**2,266**	**30,135**	**27,298**

(6.7 million acres)

Quantifying *Potential* Solar-Pollinator Agricultural Interactions

Total Amount of Pollinator-Dependent Agriculture Near Solar Facilities

>0% dependence (Aizen et al. 2009)



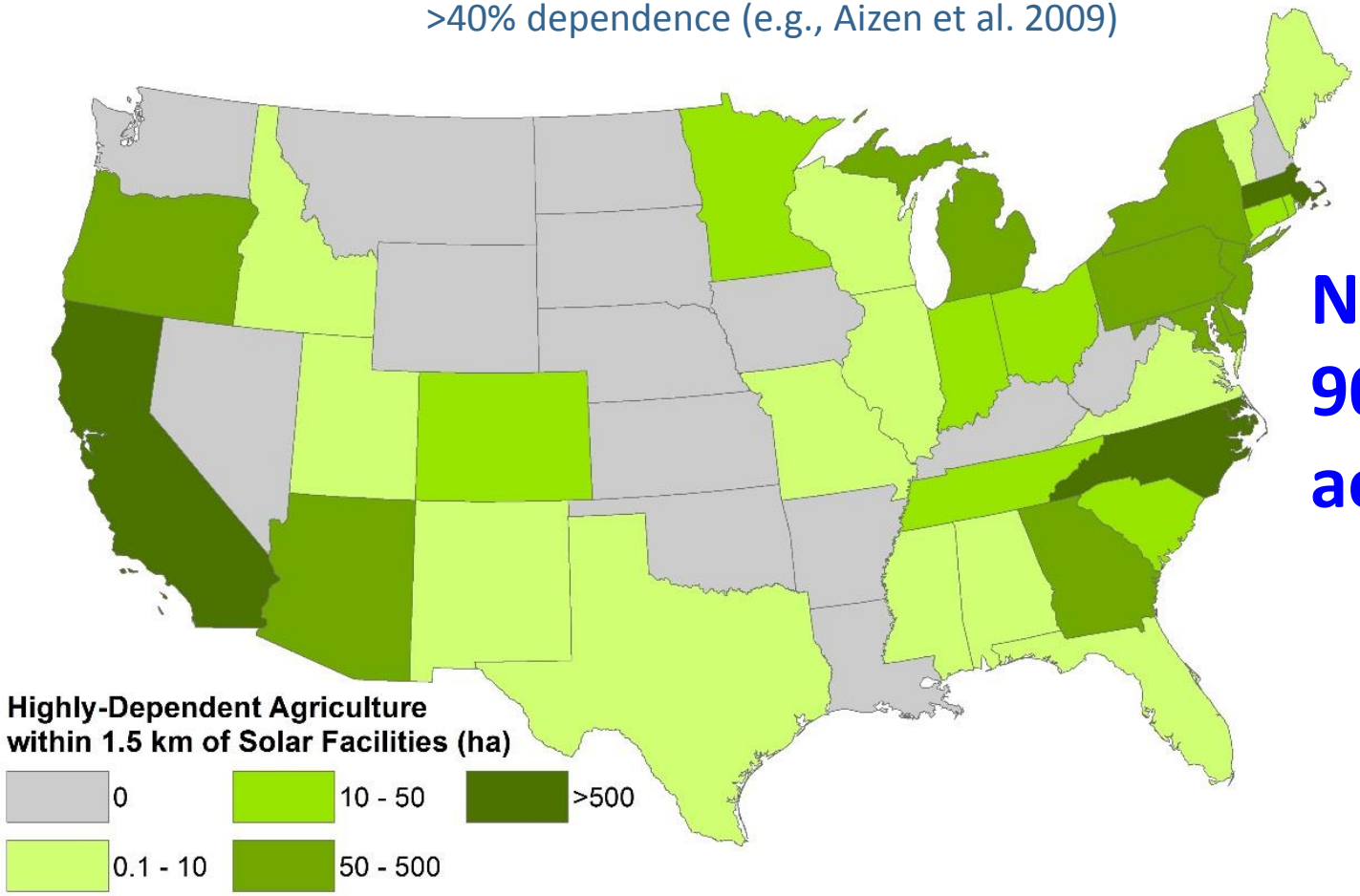
Over 850,000 acres

12 states with at least 1,200 acres

Quantifying *Potential* Solar-Pollinator Agricultural Interactions

Total Amount of Highly Pollinator-Dependent Agriculture Near Solar Facilities

>40% dependence (e.g., Aizen et al. 2009)



Nearly 90,000 acres

Quantifying *Potential* Solar-Pollinator Agricultural Interactions

Summary of Low & Moderately-Dependent Crop Types Near Solar Facilities

These crop types near solar facilities have 1%-40% benefit from insect pollination (e.g., Aizen et al. 2009)

Over 775,000 acres of these 10 crop types near solar facilities

Crop Type	Total Hectares of USSE Foraging Zones Planted, All States	States with Greatest Crop Area Near USSE Facilities
Soybeans	149,364	North Carolina (75,883 ha), Minnesota (21,040 ha), New Jersey (9,747 ha)
Alfalfa	78,326	California (27,592 ha), Arizona (15,450 ha), Utah (7,744 ha), Oregon (4,782 ha)
Cotton	41,204	North Carolina (18,911 ha), California (6,081 ha), Texas (5,506 ha), Georgia (5,188 ha)
Citrus	20,781	Florida (13,400 ha), California (7,377 ha)
Tomatoes	10,202	California (10,067 ha)
Peanuts	8,573	Georgia (4,022 ha), North Carolina (3,589 ha), South Carolina (717 ha)
Onions	3,001	California (1,788 ha), Oregon (1,092 ha), Idaho (81 ha)
Beans	1,770	California (460 ha), Oregon (429 ha), Minnesota (238 ha), Idaho (169 ha)
Sunflower	340	California (219 ha), Colorado (63 ha)
Strawberries	292	California (186 ha), Florida (93 ha)

Quantifying *Potential* Solar-Pollinator Agricultural Interactions

Summary of Highly-Dependent Crop Types Near Solar Facilities

These crop types near solar facilities have >40% benefit from insect pollination (e.g., Aizen et al. 2009)

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

Quantifying *Potential* Pollination Service Benefits

Examples…

1. California Almonds

Almond orchards are largely dependent upon managed honeybees for pollination. However, improved pollinator habitat near almond orchards may increase pollination by wild insects and improve the pollination efficiency of both managed and wild pollinators.

Honey bees pollinating almonds. (Photo by UC-Davis, Kathy Keatley Garvey)

The **29,718 ha** (73,434 acres) of almond orchards near solar facilities in California represents nearly **8%** of the total almond production in California, which is an industry valued at over **$5 billion USD**.

Therefore, a **1%** yield increase resulting from improved insect pollination efficiency associated with the maintenance of solar-pollinator habitat could be valued at over **$4 million**.

Possible additional economic tradeoffs in relation to reduced honeybee rental fees ($300-$400 per acre).

Quantifying *Potential* Pollination Service Benefits

Examples…

2. Massachusetts Cranberries

Bumblebee pollinating cranberry. (Photo credit: University of Maine – Cooperative Research Extension)

The **1,904 ha** (4,705 acres) of cranberry bogs near solar facilities in Massachusetts represents approximately **one-third** of the total cranberry production in the state, which is valued at about **$80 million USD** (farm production value).

Therefore, a **1%** yield increase resulting from improved insect pollination efficiency associated with the maintenance of solar-pollinator habitat could be valued at over **$266,000**.

Possible additional economic tradeoffs in relation to reduced honeybee rental fees ($200-$300 per acre).

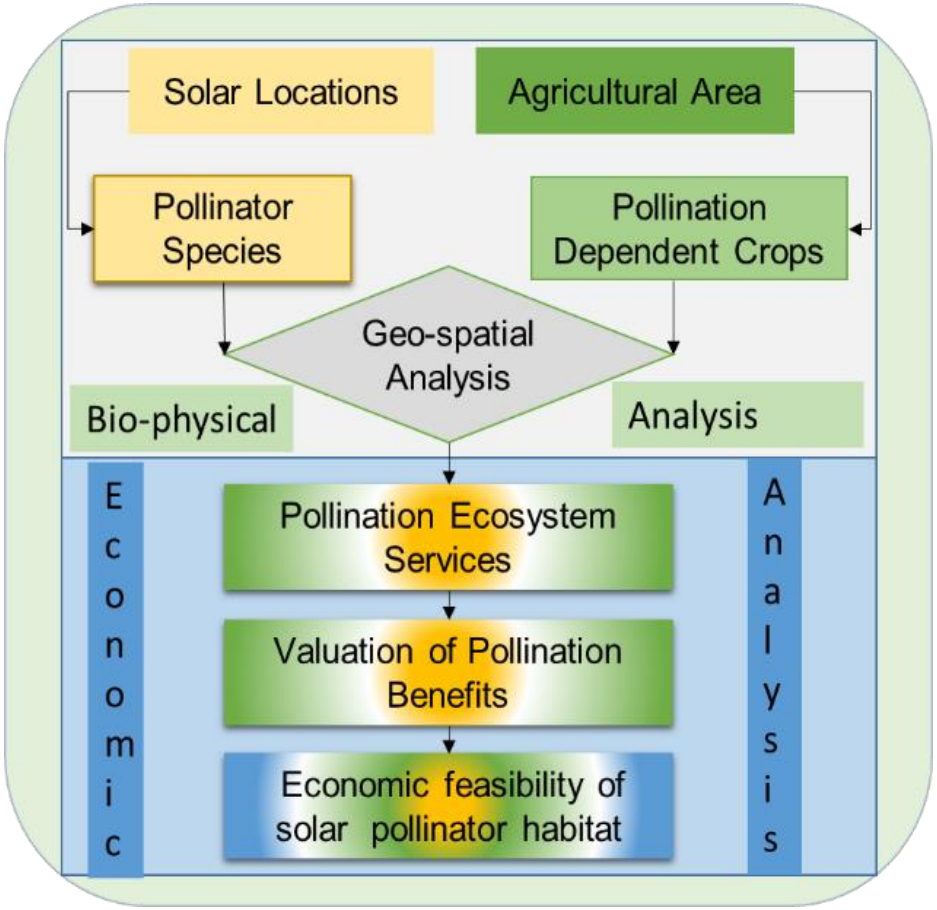
Quantifying *Potential* Pollination Service Benefits

Next Steps…

Economic analysis of solar-pollinator habitat benefits to agricultural production:

- Biophysical characteristics
- Pollinator communities
- Crop value

Field work to collect baseline data and measure pollinator service response to solar-pollinator habitat




Questions?