Opportunities and Challenges for Pollinator Habitat on Solar Farms

Rei Scampavia, PhD

03.26.2024

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Outline

- Background
  - The solar farm paradox
  - What is a pollinator?
  - Pollinator-friendly legislation
  - Why plant for pollinators?
- Pollinator Habitat on Solar Farms
  - Design principles
  - Unique challenges

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The Solar Farm Paradox

The Solar Farm Paradox

☺ Decreased Carbon Emissions

Blaydes et al. 2021
Walston et al. 2024
DOI 2021
Energy Information Administration 2023
Solar Power Europe 2016

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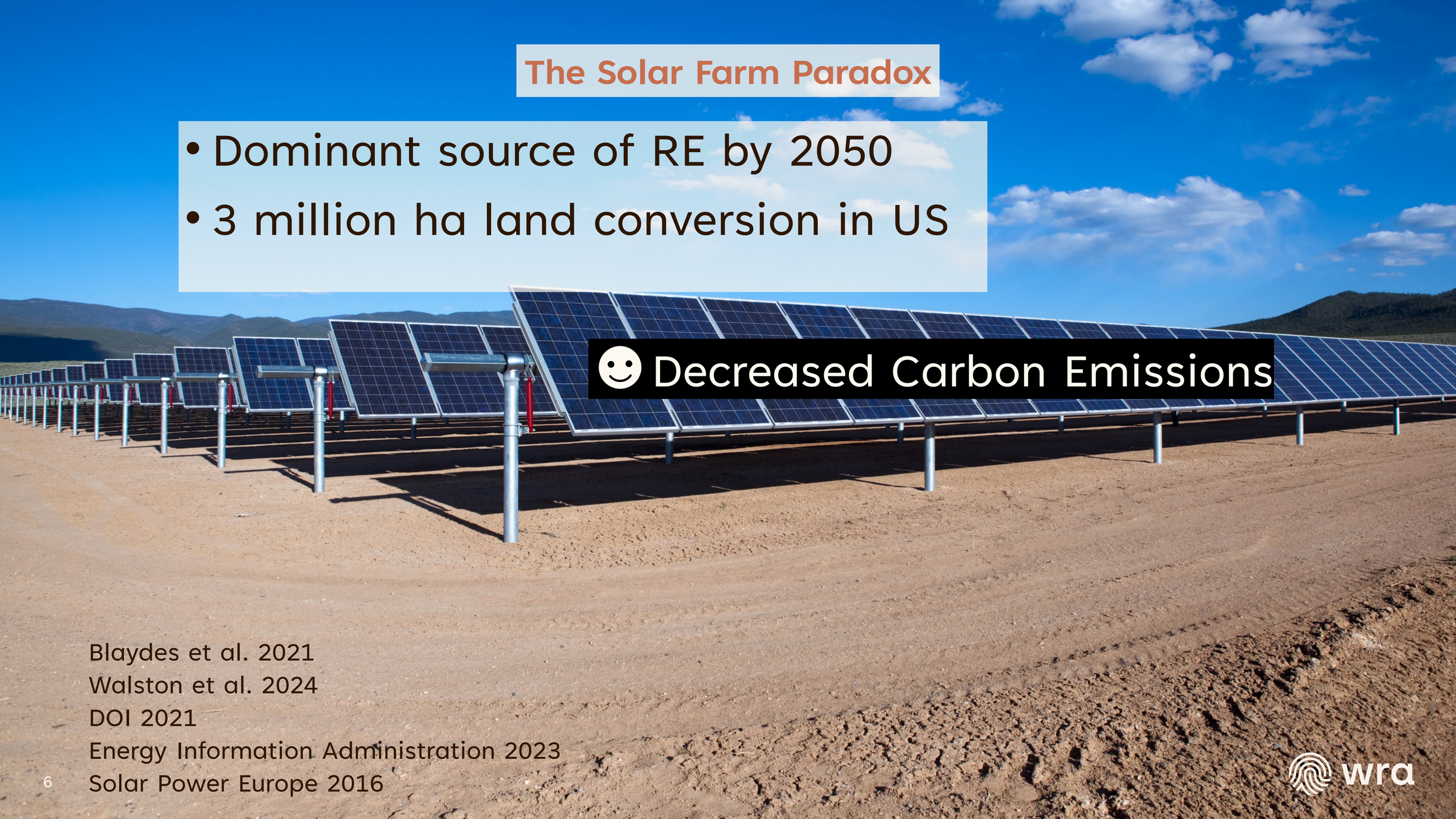

The Solar Farm Paradox

- Dominant source of RE by 2050
- 3 million ha land conversion in US

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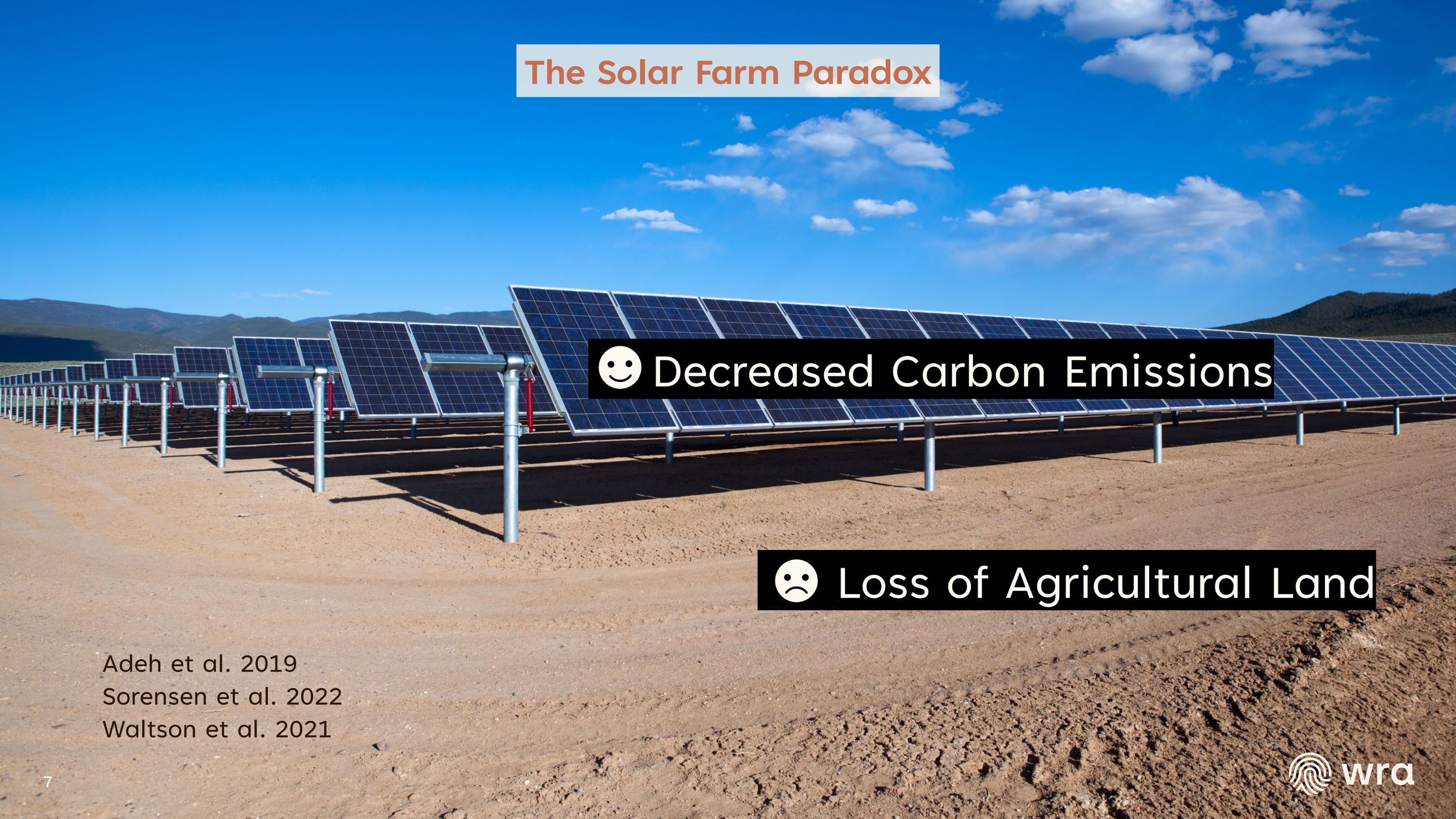

☺ Decreased Carbon Emissions

☹ Loss of Agricultural Land

Adeh et al. 2019
Sorensen et al. 2022
Waltson et al. 2021

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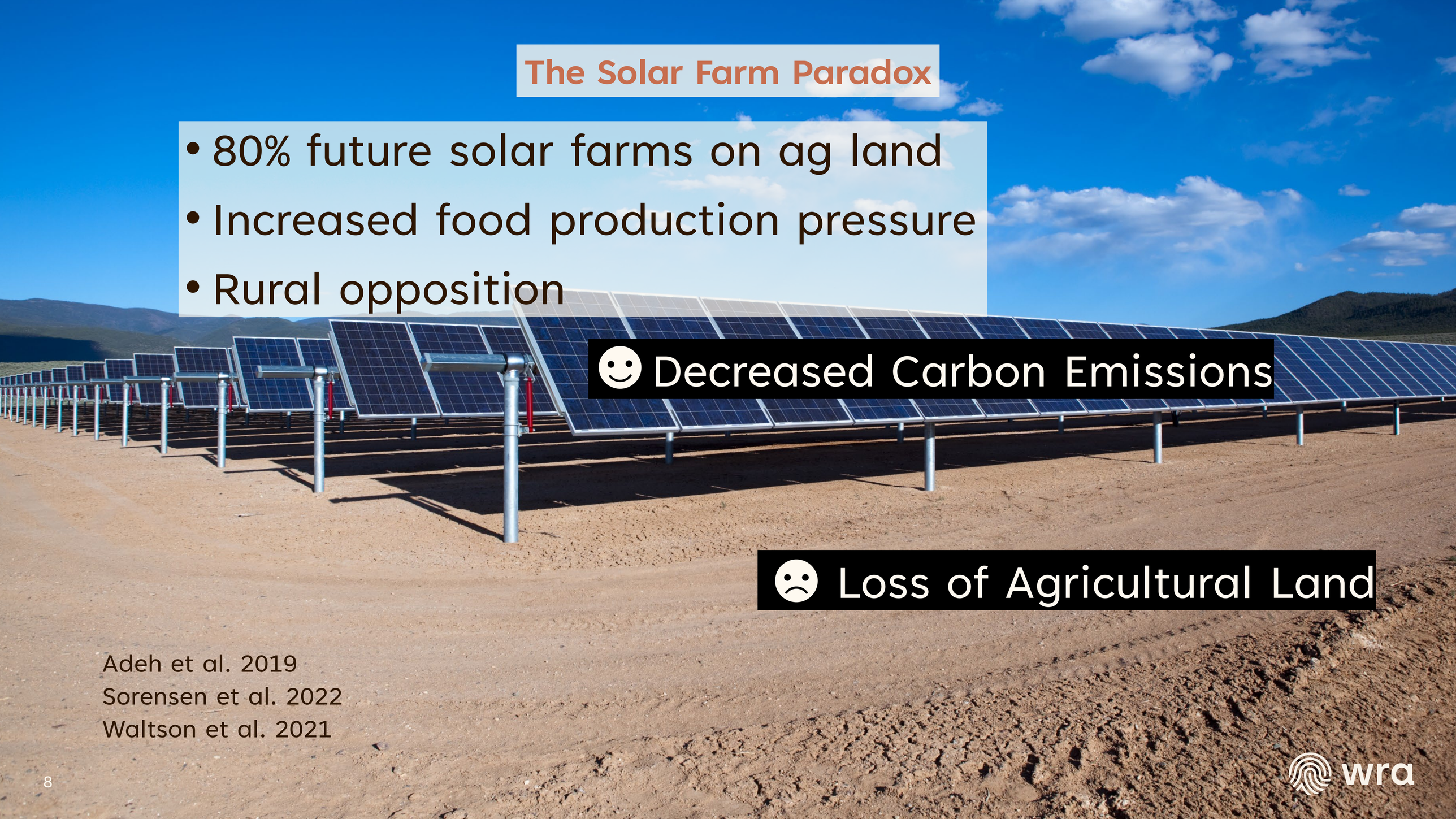

The Solar Farm Paradox

- 80% future solar farms on ag land
- Increased food production pressure
- Rural opposition

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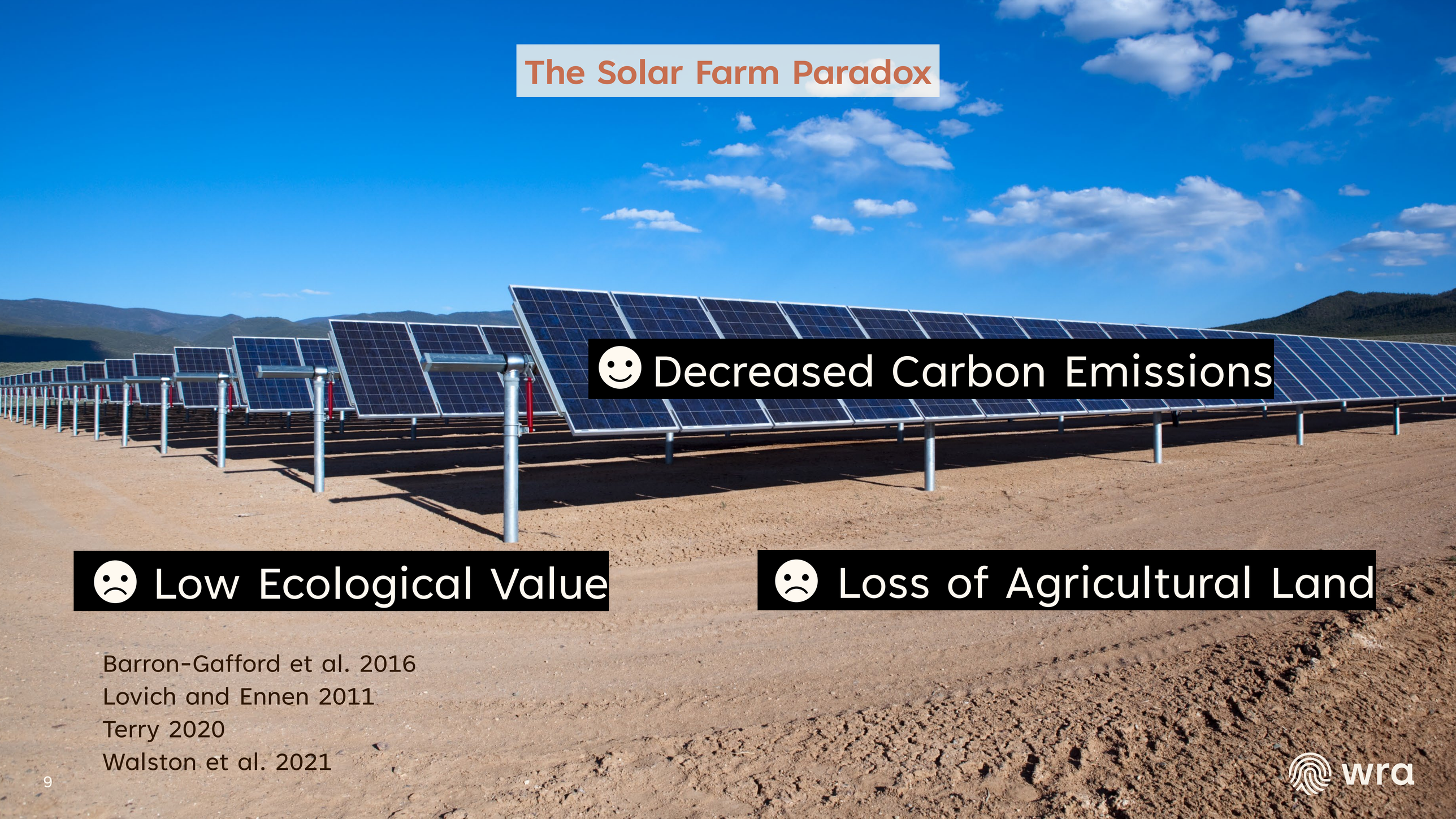

☺ Decreased Carbon Emissions

☹ Low Ecological Value

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Barron-Gafford et al. 2016
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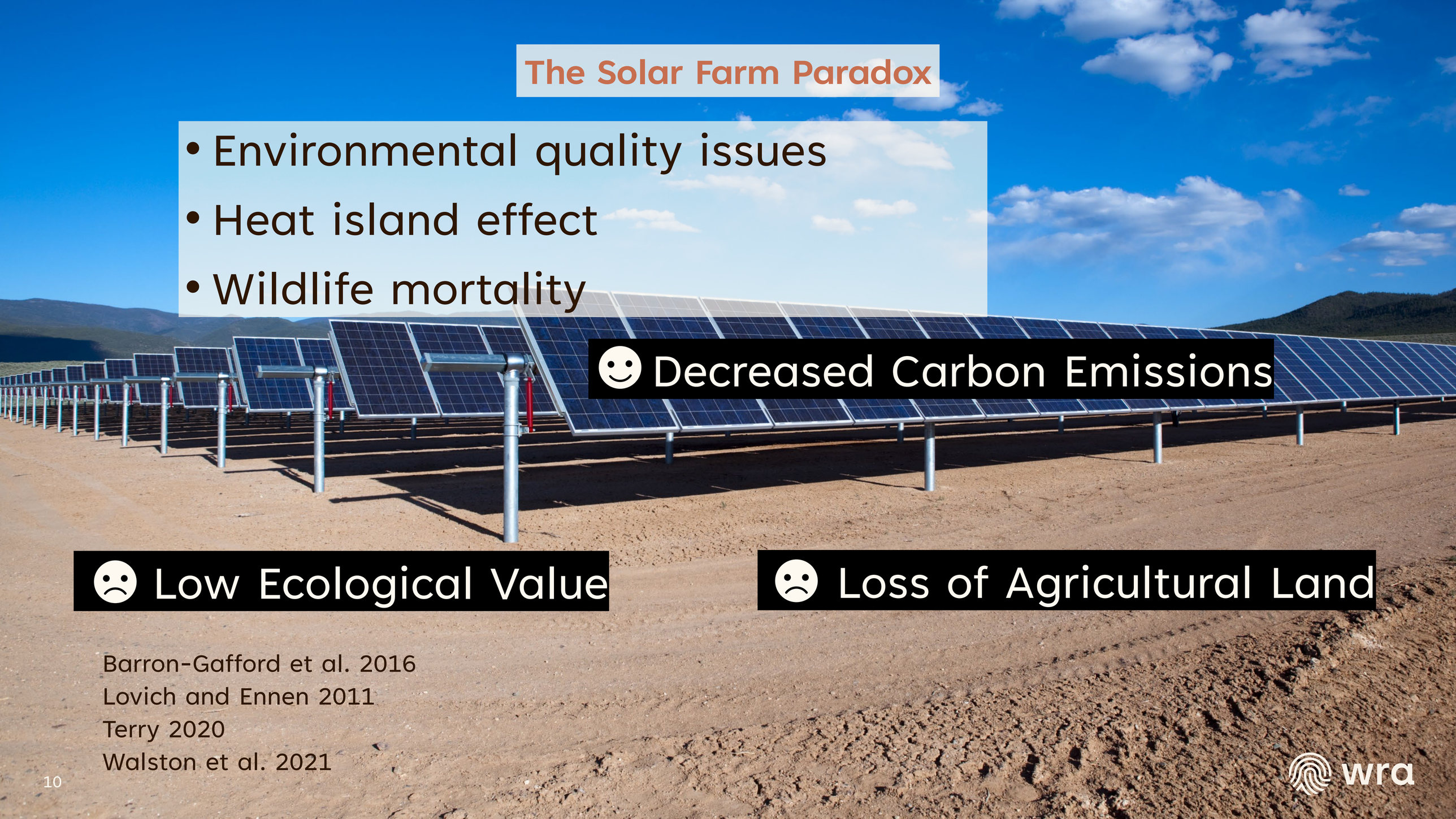

The Solar Farm Paradox

- Environmental quality issues
- Heat island effect
- Wildlife mortality

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The Solar Farm Paradox

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The Solar Farm Paradox

Pollinator-Friendly Solar Initiatives:

- Decrease carbon emissions
- Offset costs to agriculture
- Increase ecological value

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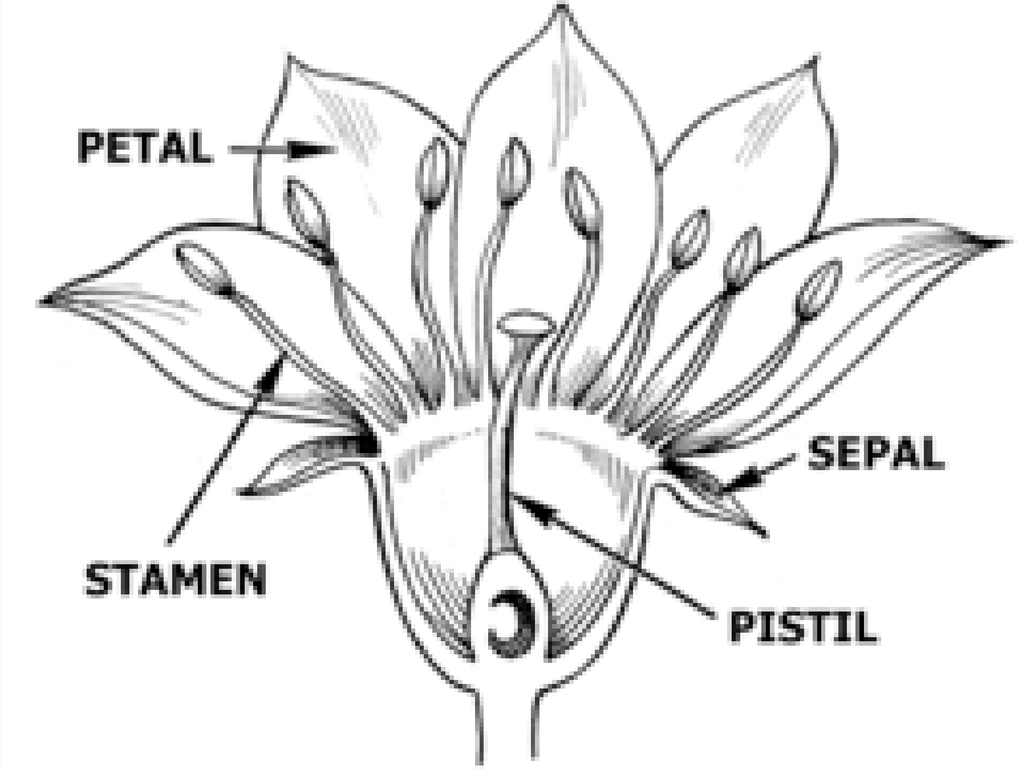
What is a Pollinator?

What is Pollination?



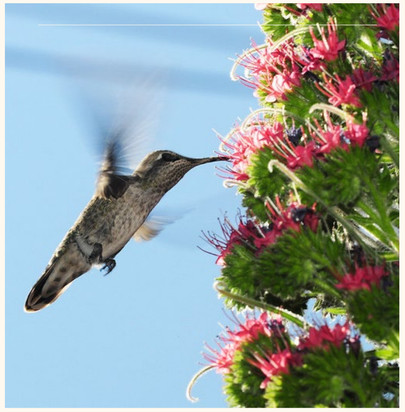
What is Pollination?

Types of Pollination

Types of Pollination: Self-Pollination

Types of Pollination: Cross-Pollination

Types of Animal Pollinators



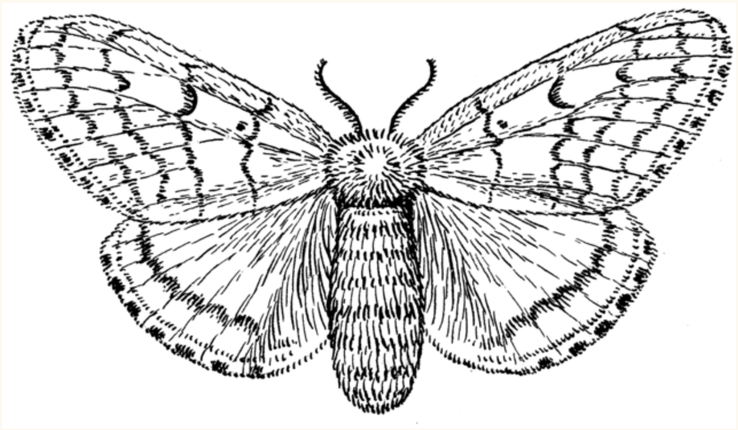
Birds

Bats

Wasps

Flies

Butterflies



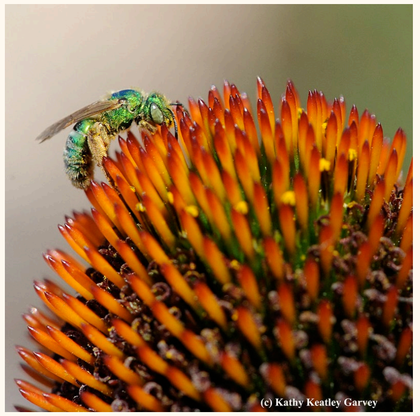
Moths

Beetles

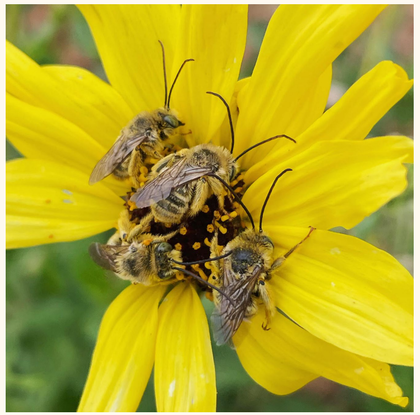
Flies (again!)

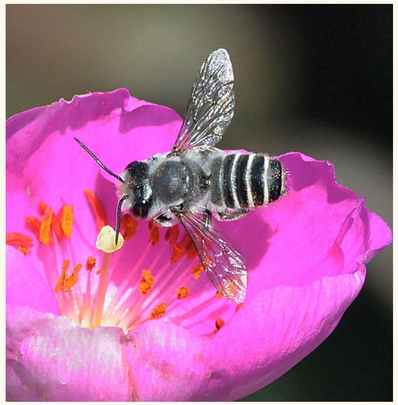
Bees: The Ultimate Pollinators

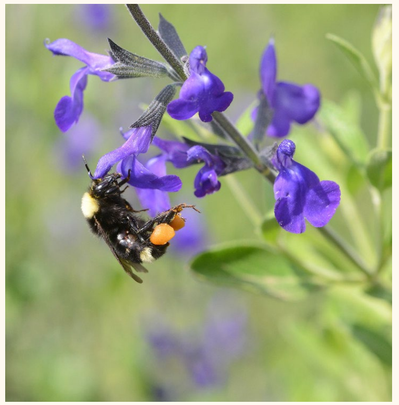








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Bee Diversity

- Size
- Shape
- Color
- Behavior
- Pollen Transport Structures
- Flight Season

Bees and Flowers Throughout the Ages

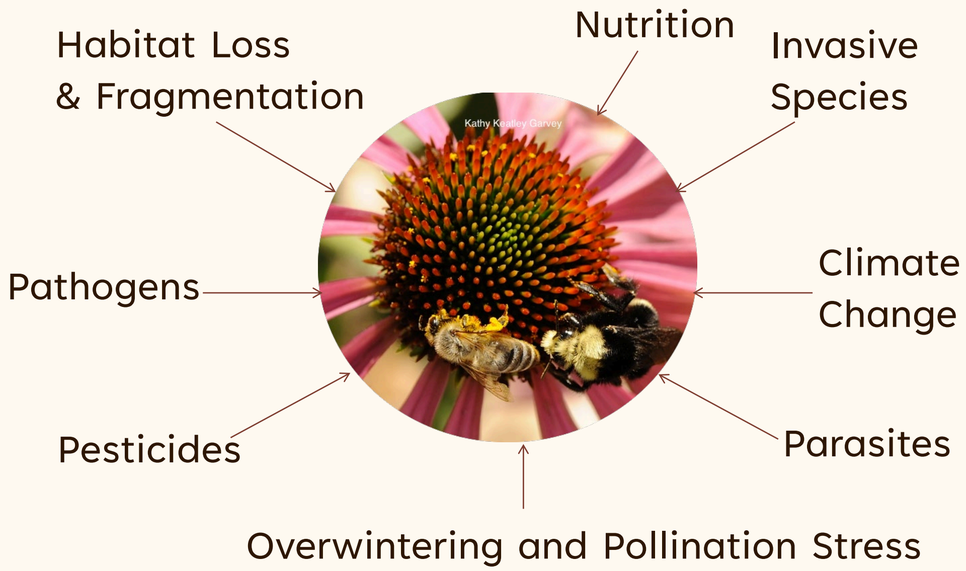
Pollination: A Vital Ecosystem Service

- 70% of world's major crops benefit from animal-mediated pollination
  - 1/3 bites of food
  - 90% of vitamin C
  - Majority of plant-based lipids, vitamin A, Calcium, fluoride, folic acid
- Dairy/Cow Products (alfalfa seed production)
- Pollination valued at ~$186 billion worldwide/year (Gallai 2009)

Pollinator Population Declines

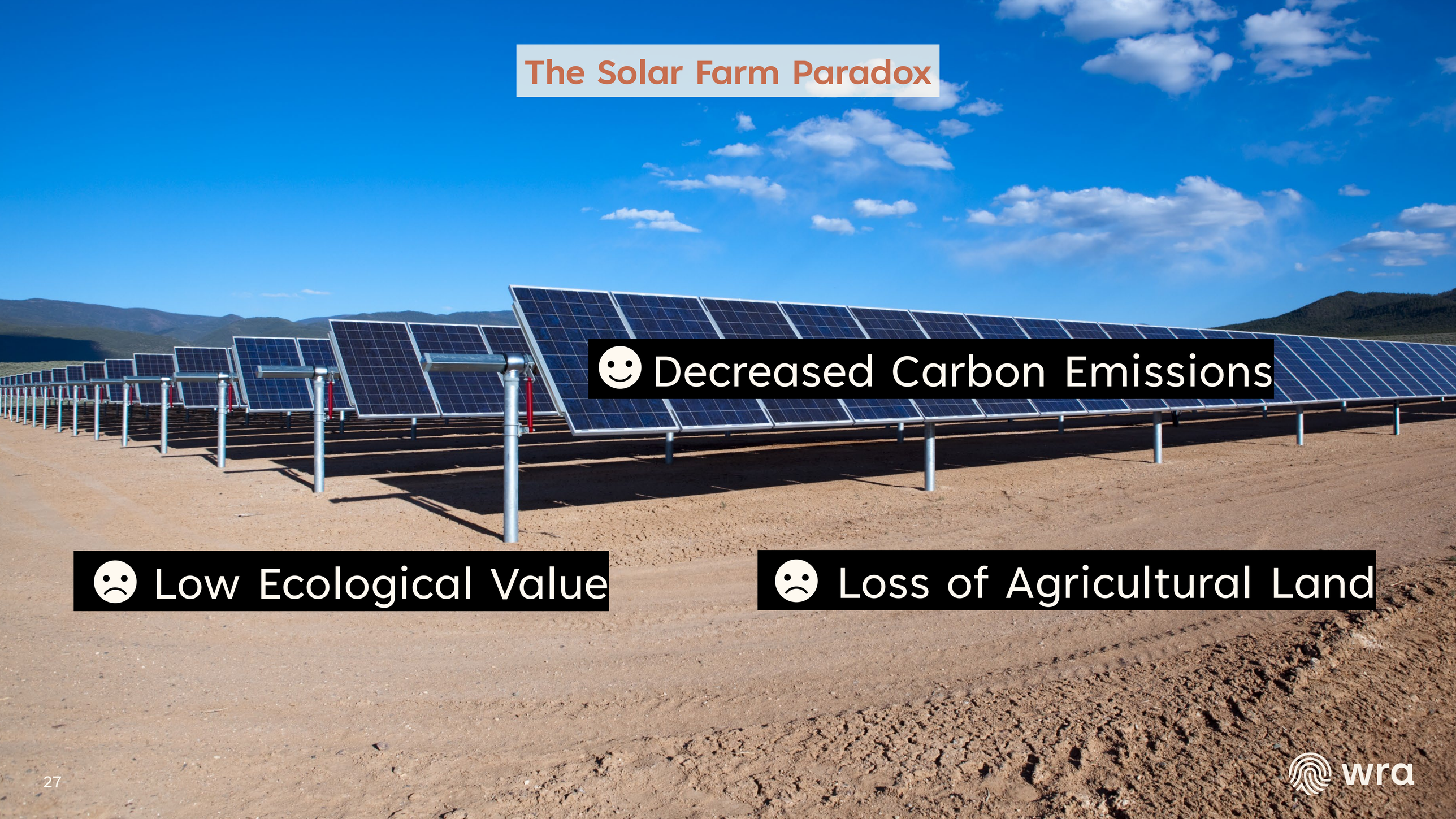
- Insect abundance decreasing by 1-2%/year (Wagner 2021)
- 29% butterfly species in U.S. and Canada are at risk of extinction (NatureServe 2022)
- 28% of North American bumble bee species are threatened (Hatfield et al. 2015)
- Degradation of pollinator network structure and function (Burkle et al. 2013)

Causes of Pollinator Decline



Pollinator-Friendly Solar Initiatives

The Solar Farm Paradox



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Pollinator-Friendly Solar Initiatives

- Legislation
  - 2016: MN
  - Followed by MD, SC, VT, NY, IL, MI

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- Guidelines for voluntary designation as “pollinator-friendly”
- Scorecard to assess habitat quality

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- Legislation
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- Guidelines for voluntary designation as “pollinator-friendly”
- Scorecard to assess habitat quality
- State/University/Developer/Nonprofit Partnerships- OH, PA, VA

Pollinator-Friendly Solar Initiatives

2022: MCE 1st CA power provider to announce pollinator program requirement

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5. Planned percent of native species used in revegetation across the entire site (arrays, parameters, buffers). *Select one.*

☐	26-50%	+ 5 points
☐	51-99%	+ 10 points
☐	100%	+ 15 points
	Total Points	

6. Planned seasons with at least three blooming species present across the entire site. *Check all that apply.*

☐	Spring (March-May)	+ 5 points
☐	Summer (June-August)	+ 5 points
☐	Fall (September-November)	+ 5 points
☐	Winter (December-February)	+ 5 points
	Total Points	

Pollinator-Friendly Solar Initiatives

2023: Bee Better Certified Electric (EPRI)

- Nationally consistent
- 3rd party verifiable
- Balancing inputs from industry and scientists
- Currently in pilot phase

Benefits of Pollinator-Friendly Solar Farms

Solar Industry

- Generate positive press
- Decrease public opposition
- Streamline permitting process
- Ambient temperature reduction increases solar panel efficiency (e.g. Adeh et al. 2018)

Agriculture

- Increase crop pollination- economic benefit (e.g. Morandin et al. 2016)
- Pollinator-friendly solar farm tripled beneficial insect abundance, increased bee visitation to soybean fields (Walston et al. 2024)

Environment

- Increase carbon sequestration and water retention, reduce sediment export (Walston et al. 2021)

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- Improve biodiversity
- Create wildlife refuges/dispersal corridors

Basic Design Principles

Diverse Mix Native Flowering Plants

- Size, shape, color
- Local seed, if possible
- Shade and partial shade (Graham et al. 2021)
- Invasive weed treatment

Staggered Blooms Across Seasons

Staggered Blooms Across Seasons

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Layia platyglossa		■	■	■	■							
Phacelia californica			■	■	■	■	■	■				
Ceanothus thyrsiflorus			■	■	■							
Eschscholzia californica		■	■	■	■	■	■	■	■			
Grindelia camporum				■	■	■	■	■	■	■		
Epilobium canum								■	■	■		

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Create Vegetated Buffer

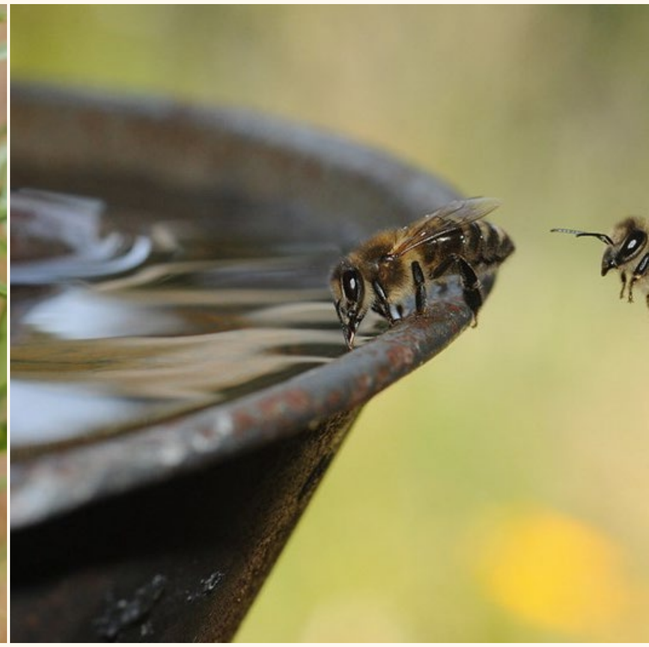
- Woody and perennial species
- Vary vegetation structure
- Provide additional resources, microclimates

Provide Nesting and Reproductive Resources

Native Bunch Grasses

Bee Boxes

Milkweed (inland)



Clean Water

Avoid Agrochemicals

- No pesticides
- Use herbicides strategically
- Communicate with local growers

Challenges of Solar Farms

Fire Risk/Shading of Panels

- Heat island effect
- Vegetation 6” tall or less
- Utilize vegetated buffers to increase plant diversity/heterogeneity of structure

Weed Management

- Large seed bank
- Increased nutrients/disturbed soil profile
- Limitations to equipment access

Availability/Cost of Native Seed

- Widely commercially available vs. locally adapted native seed
- Search for seed collection opportunities

Looking Ahead

- Majority of studies focus on Midwest and Europe
- More longitudinal studies on environmental effects
- California-specific guidelines for habitat design and management

Thank You!

Contact Info:

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