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Solar Development in Ohio

Trends, Processes, and Legal Issues with Solar Energy Development

Session 1: Solar Development Overview and Trends

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Spring Webinar Series
March 23, 2023

THE OHIO STATE UNIVERSITY EXTENSION

TEACHING EXTENSION RESEARCH

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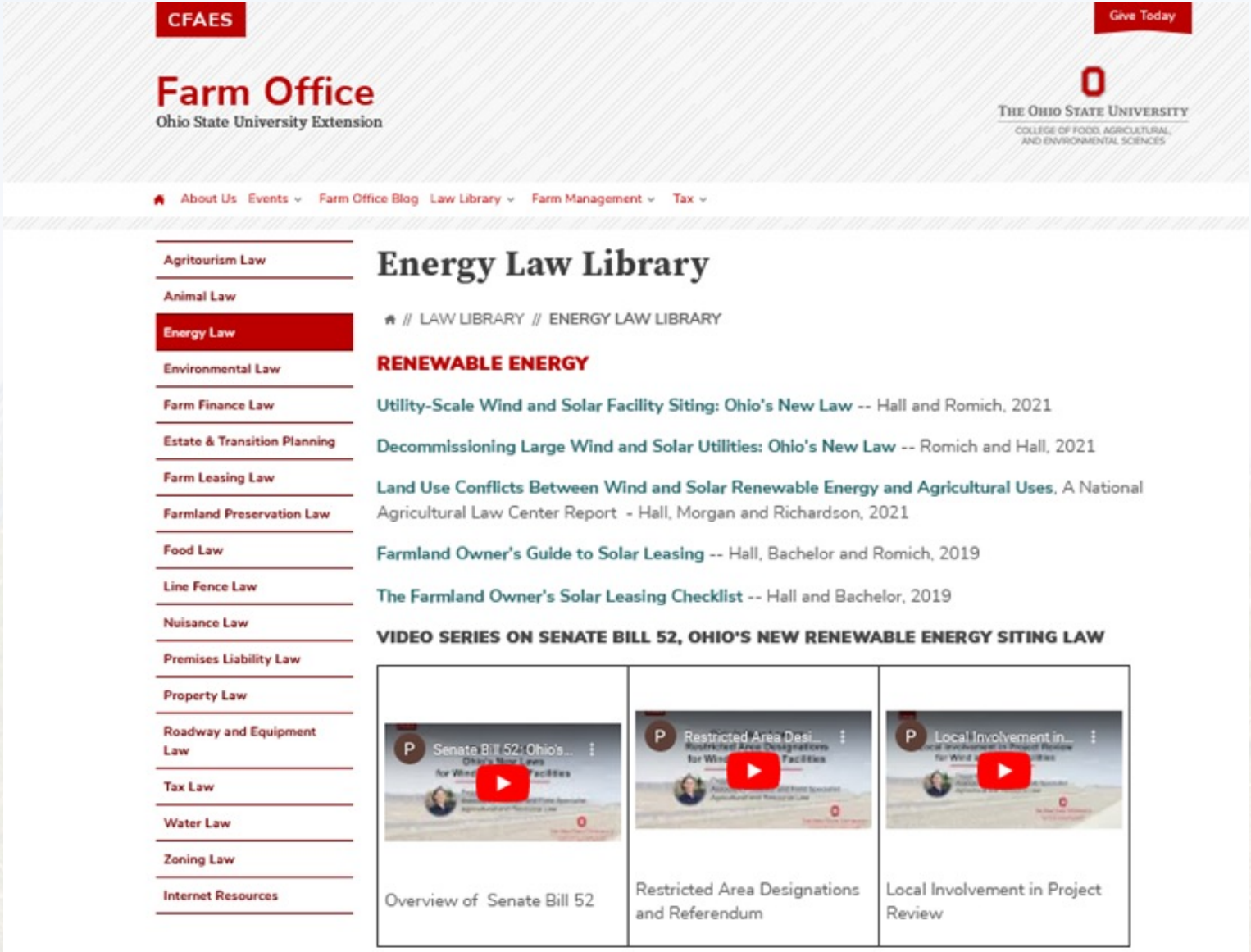

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OSU Extension Ohio Solar Development 2023 Webinar Series

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Session #1
Solar Energy Overview & Trends

Session #2
The Solar Development Lease

Session #3
Connecting to the Electric Grid

Session #4
Solar Project Approval in Ohio

Session #5
Pre & Post Construction Considerations

Overview of Ohio development, industry and technology trends, community and regulatory issues, dual use of land for solar and agricultural production.

Lease Agreement: Developer must show evidence of **site control**.

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Critical Layers of Solar Development Regulatory Oversight

1. Approval to **Interconnect** to the Power Grid
   - Public Utilities Commission of Ohio
   - PJM

2. Permit to **Construct**, Own, and Operate
   - Ohio Power Siting Board
   - County Restricted Zone
   - Local Zoning

3. Qualified Energy Facility **Tax** Exemption
   - Ohio Department of Development
   - County Commissioners

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Image Source: Adobe Stock

What is your role in this webinar today?

- Local government leader
- State government leader
- State or local government agency professional
- Interested local resident
- Landowner considering a lease
- Extension professional
- Solar industry official/worker
- Attorney
- Agricultural professional
- Other

Image Source: Adobe Stock

Session #1 : Program Objectives

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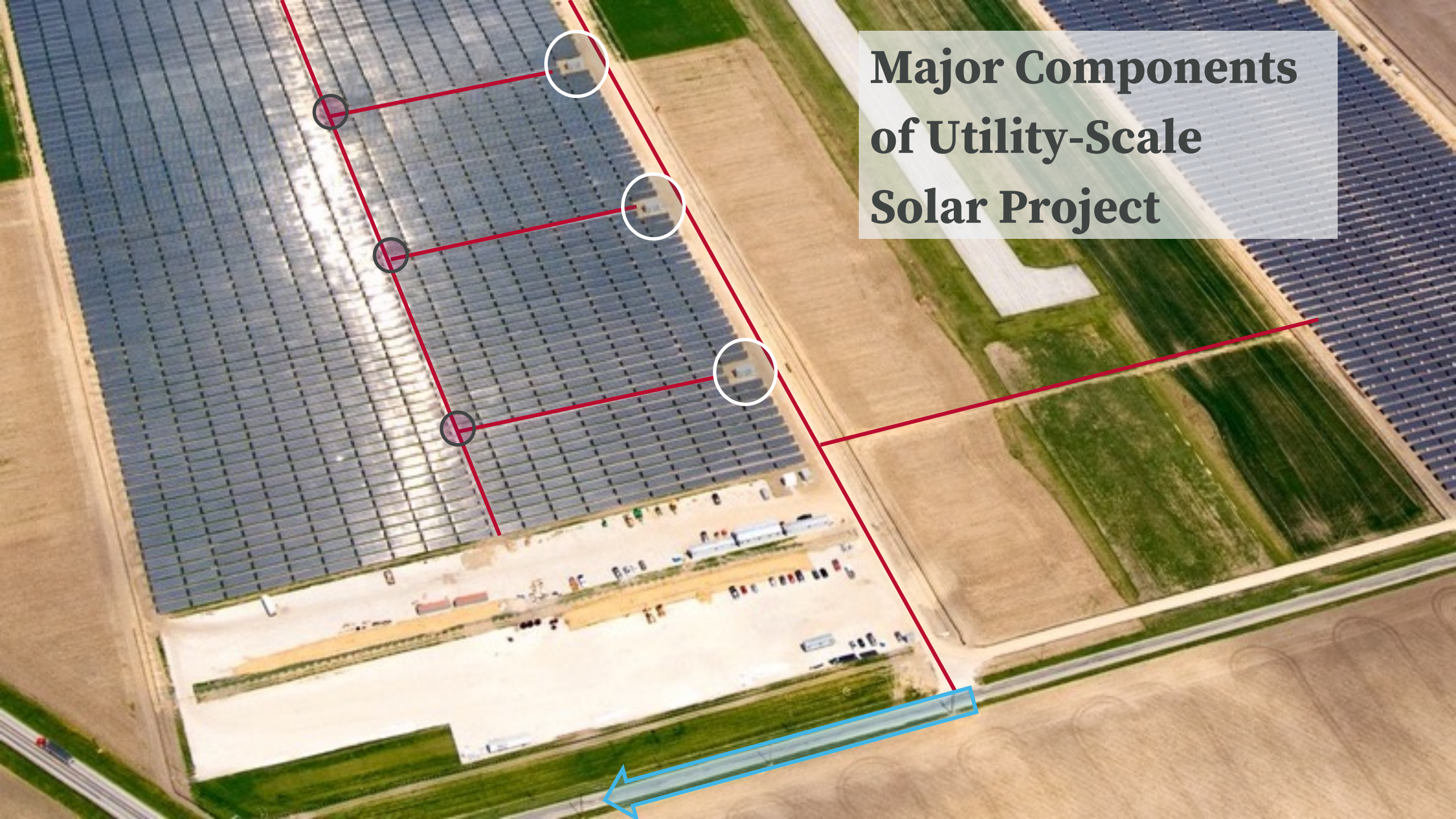
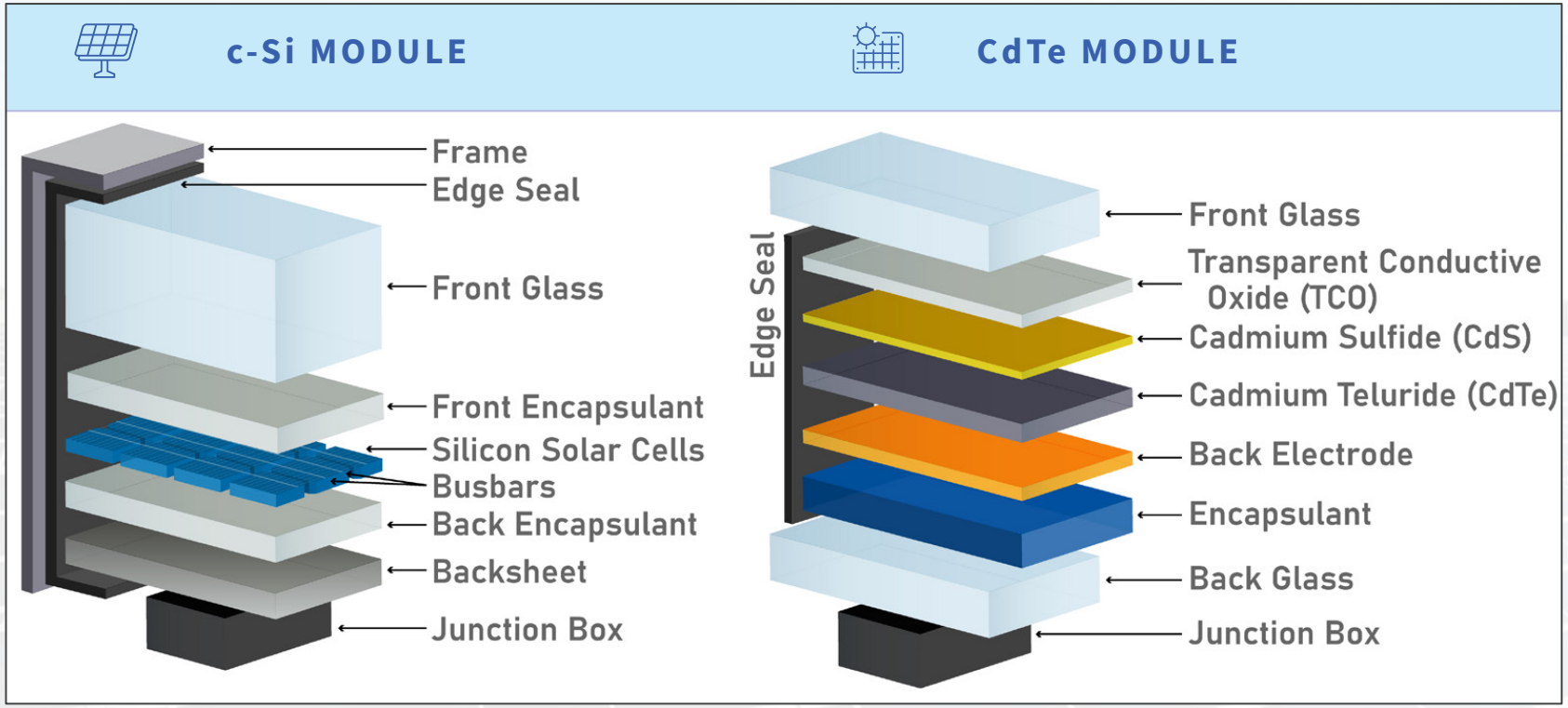
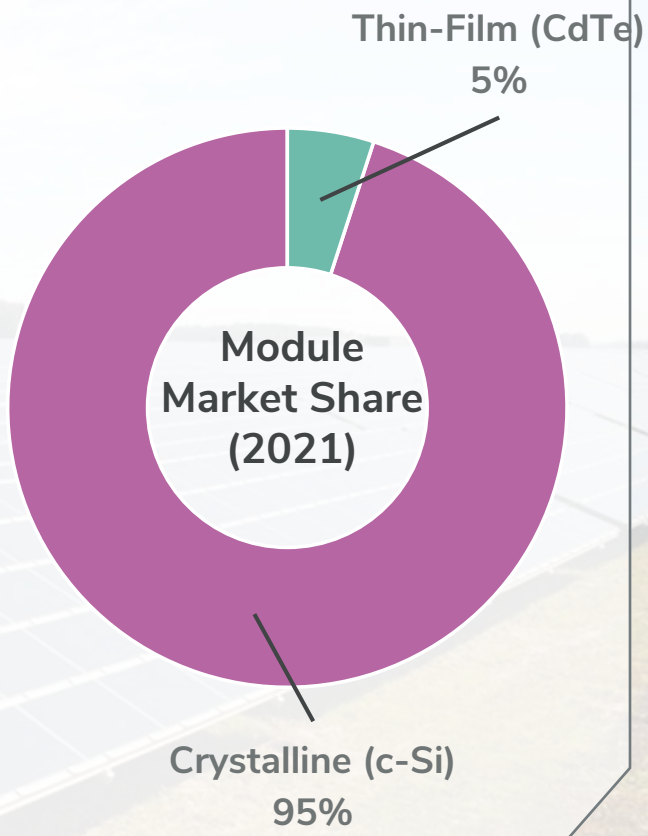
1. Photovoltaic Solar Industry Trends
2. Solar Energy Development Trends
3. Community Issues pros/cons
4. Public Comments
5. Taxation
6. Small vs Large Projects - Local Input and Regulatory Oversight
7. Dual Land Use Solar
8. Resources, Questions, and Discussion

Photovoltaic Solar Industry Trends


Major Components of Utility-Scale Solar Project

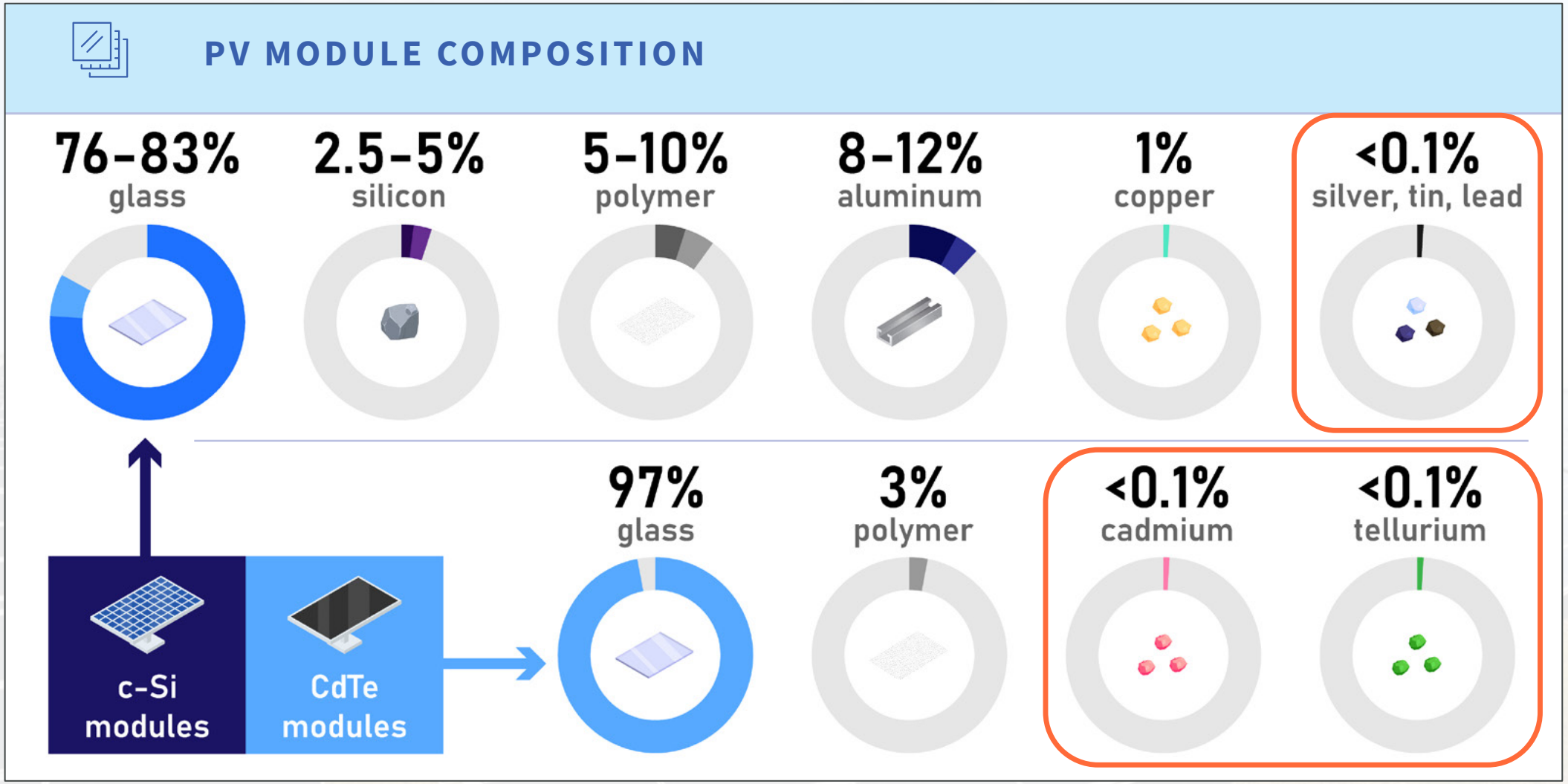
Inside a Photovoltaic Solar Module





Source: Electric Power Research Institute (EPRI), Inc. (2021). *Solar Photovoltaics End-of-Life Management Infographic*. EPRI, Palo Alto, CA. 3002021132.

Inside a Photovoltaic Solar Module



Source: Electric Power Research Institute (EPRI), Inc. (2021). *Solar Photovoltaics End-of-Life Management Infographic*. EPRI, Palo Alto, CA. 3002021132.

TCLP Test Results for Lead Content [1)]

Batch 1		EPA Limit = 5 mg/L				
	Mf1M1	Mf1M2	Mf2M1	Mf2M2	Mf3M1	Mf3M2
Lab1	3.04	2.89	3.04	2.87	2.28	2.55
Lab2	2.6	1.7	3.7	16	1.9	1.9

Batch 2						
	Mf1M3	Mf1M4	Mf2M3	Mf2M4	Mf3M3	Mf3M4
Lab1	3.8	3.14	3.07	2.8	2.61	n/a/y
Lab2	3.6	3.1	2.6	3.7	1.4	n/a/y

Mf = Manufacturer *M = Module* *STDEV = Standard Deviation*

Values are lead content in mg/l *n/a/y = not available yet*

outlier

[1)] ***Note**: None of the other RCRA 8 metals were detected*

- Testing done in accordance with EPA's Toxicity Characteristic Leaching Procedure (TCLP). This includes eight (8) distinct metals – Mercury, Arsenic, Barium, Cadmium, Chromium, Lead, Selenium and Silver (Method 6010C).
- Tested 4 modules from 3 different manufactures, with analysis conducted by 2 different labs.
- **All modules tested passed the TCLP toxicity tests using the waterjet sampling method.**

Source: Electric Power Research Institute (EPRI), Inc. (2021). *Solar Photovoltaics End-of-Life Management Infographic*. EPRI, Palo Alto, CA. 3002021132.

Environmental Health and Safety Risks of CdTe

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- Elemental cadmium, which forms CdTe when reacted with tellurium (Te), is a lung carcinogen, and long-term exposures can cause detrimental effects on kidney and bone.

- **The only pathways by which people might be exposed to PV compounds from a finished module are by accidentally ingesting flakes or dust particles, or inhaling dust and fumes**.

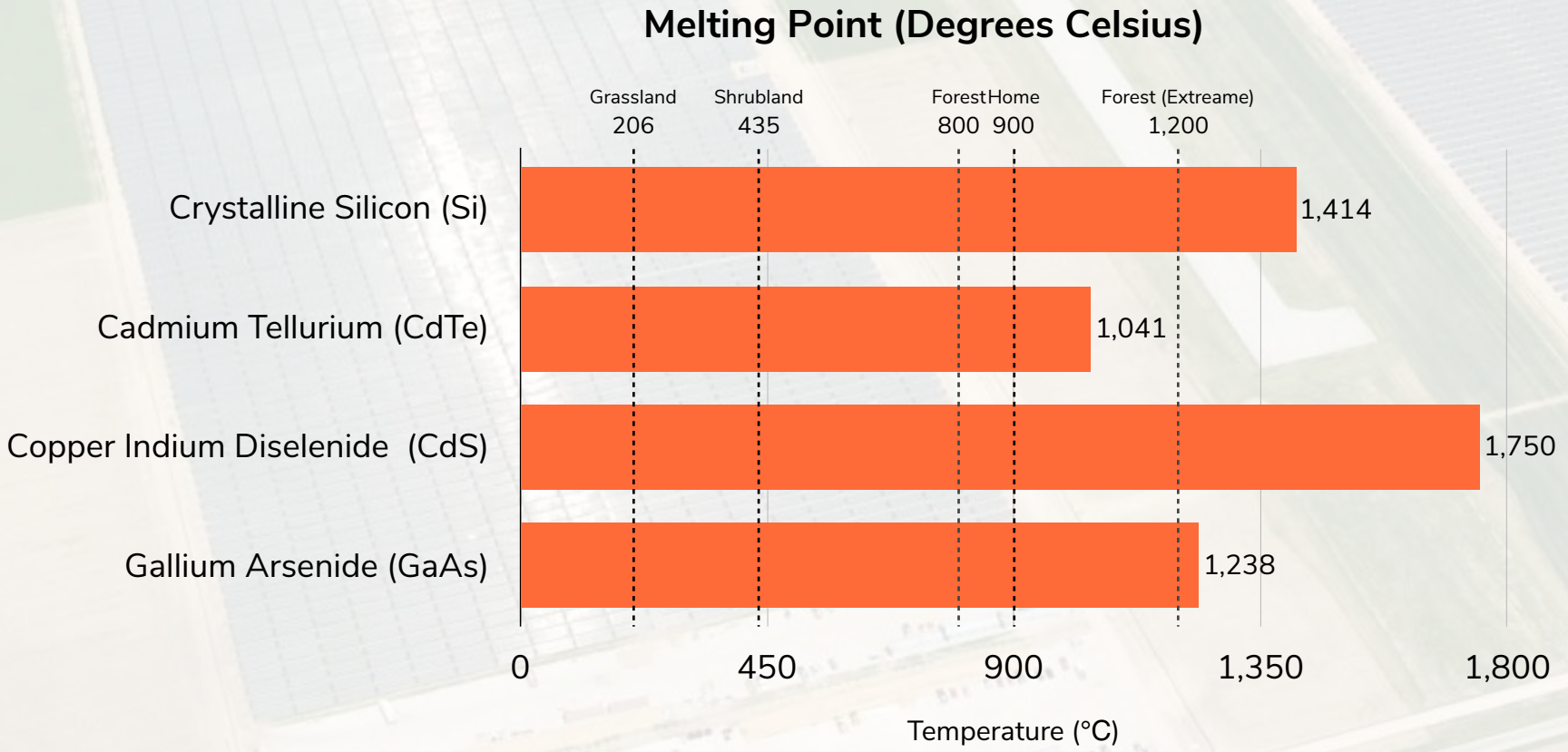
    1. The thin CdTe/CdS layers are stable and solid and are encapsulated between thick layers of glass. Unless the module is purposely ground to a fine dust, dust particles cannot be generated.

    2. The vapor pressure of CdTe at ambient conditions is zero. Therefore, it is impossible for any vapors or dust to be generated when using PV modules.

- **Thin CdTe PV end-of-life or broken modules pass Federal (TCLP-RCRA)** leaching criteria for non-hazardous waste. Therefore, according to current laws, such modules could be disposed of in landfills.

Source: U.S. Department of Energy Laboratory (NREL). (2003). *CdTe PV: Real and Perceived EHS Risks*. Contract No. DE-AC36-99-GO10337

Do Solar Modules Present Additional Health Risks during a Fire?

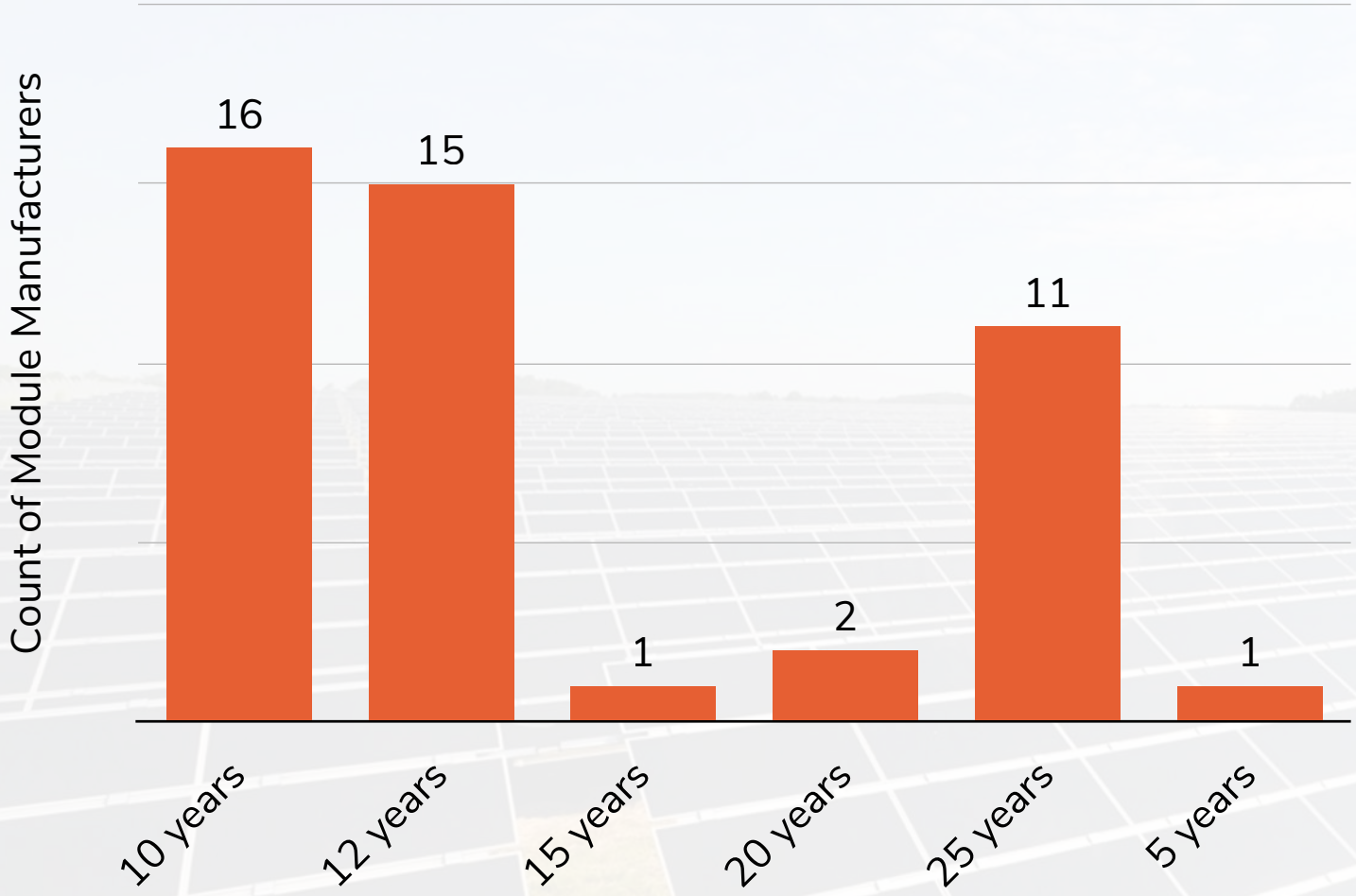


- The flame temperatures in typical U.S. residential fires are not high enough to vaporize CdTe.
- The melting point of CdTe is 1,041°C, and evaporation starts at 1,050°C.

Source: *Health and Safety Impacts of Solar Photovoltaics.* (2017). N.C. Clean Energy Technology Center at N.C. State University.

Source: U.S. Department of Energy Laboratory (NREL). (2003). *CdTe PV: Real and Perceived EHS Risks*. Contract No. DE-AC36-99-GO10337

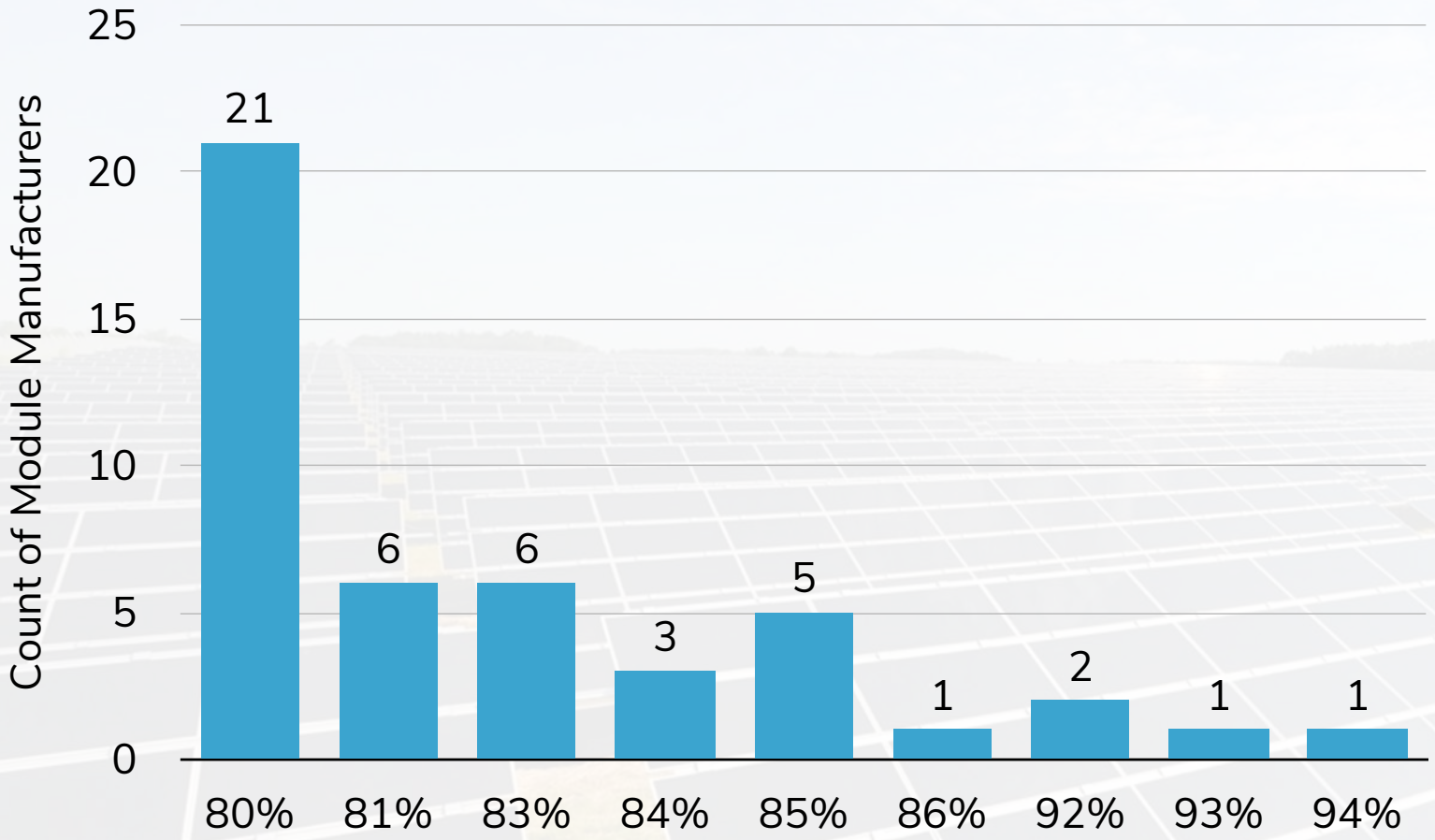
Solar Module Product Warranty



- For panel manufacturers who have varying product warranties depending on the module, the highest value is listed.
- Most manufacturers offer a **10-year product warranty** from the date of installation.

Source: National Renewable Energy Laboratory. *Winter 2023 Solar Industry Update*.

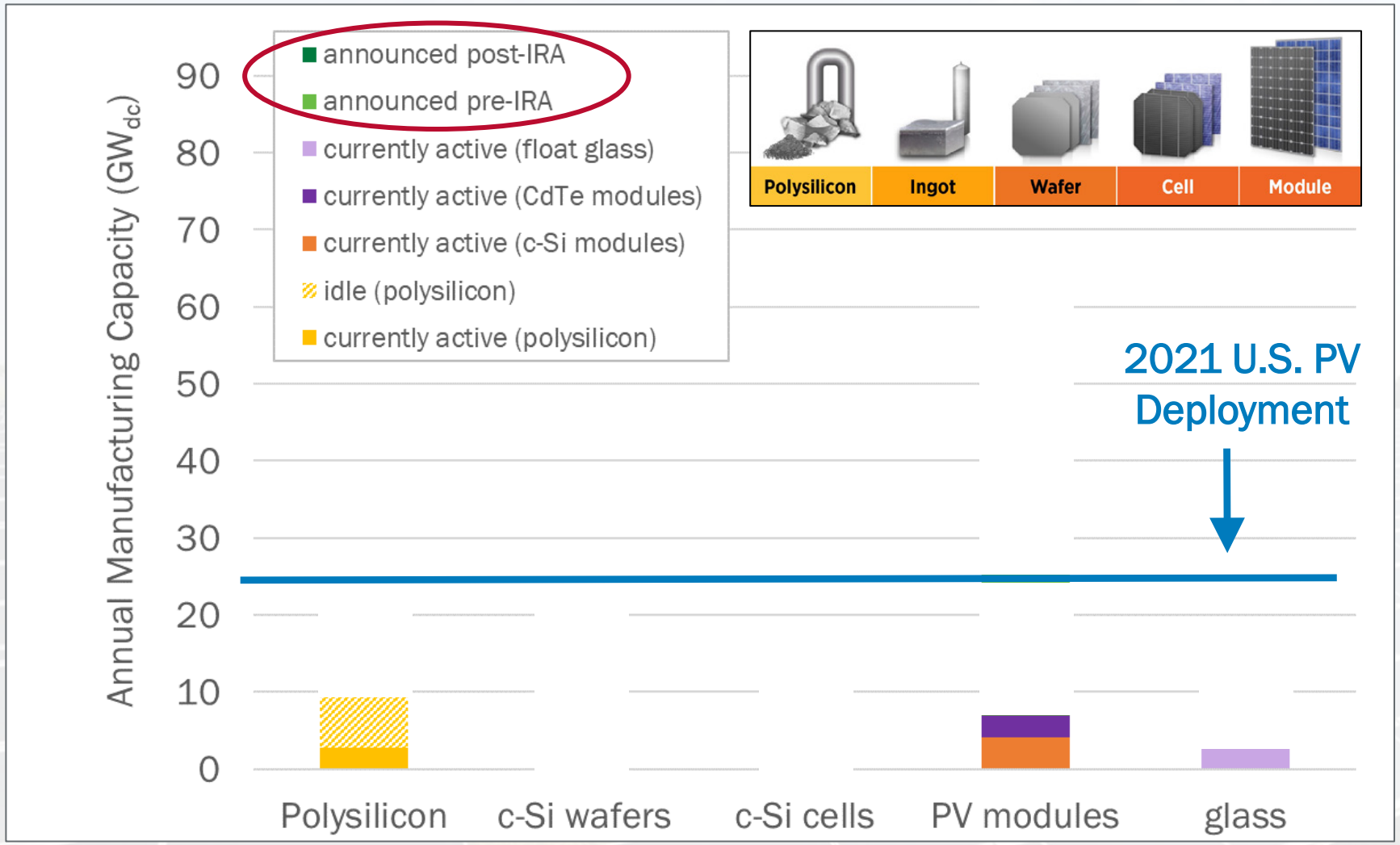
Solar Module Performance Warranty @ 25-years



- The amount of electricity a solar panel produces declines slightly every year.
- Panel manufacturers generally guarantee that their panels **will produce electricity at 80%-90% of their power output rating** at the end of 25 years.

Source: National Renewable Energy Laboratory. *Winter 2023 Solar Industry Update*.

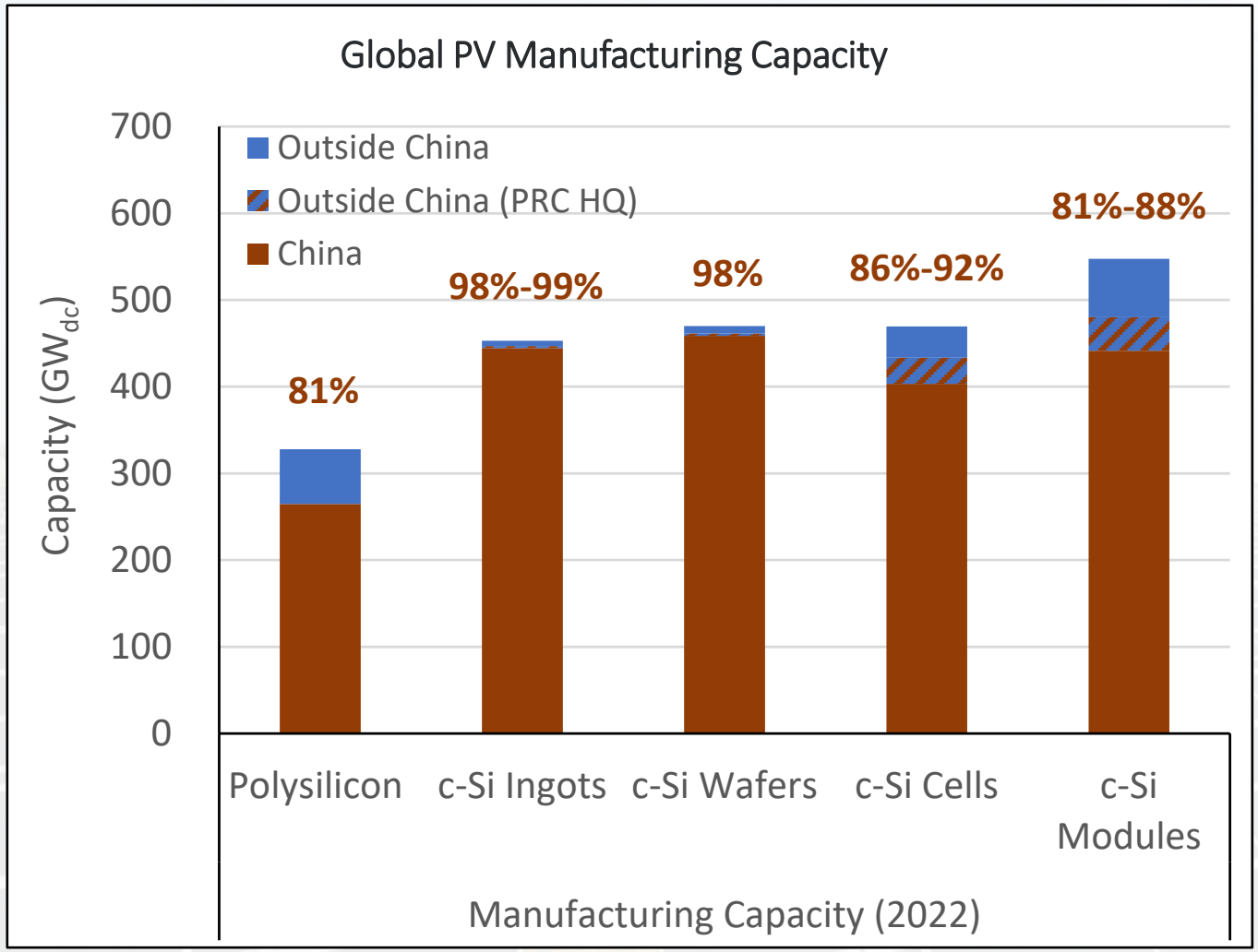
PV Solar Domestic Manufacturing



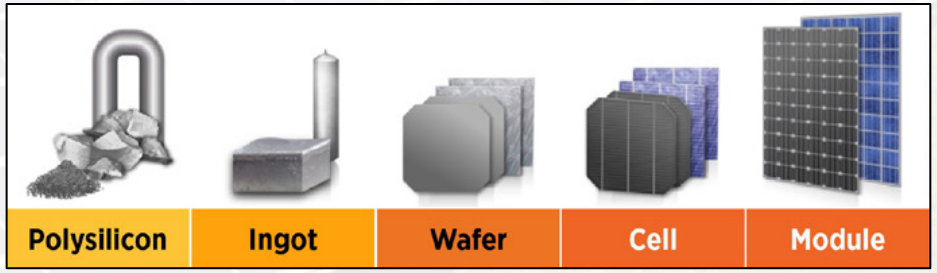
Source: National Renewable Energy Laboratory. *Winter 2023 Solar Industry Update*.

Since the IRA's passage, over **85 GW** of manufacturing capacity has been announced across the solar supply chain, including **18** separate new manufacturing plants.

Global PV Solar Supply Chain

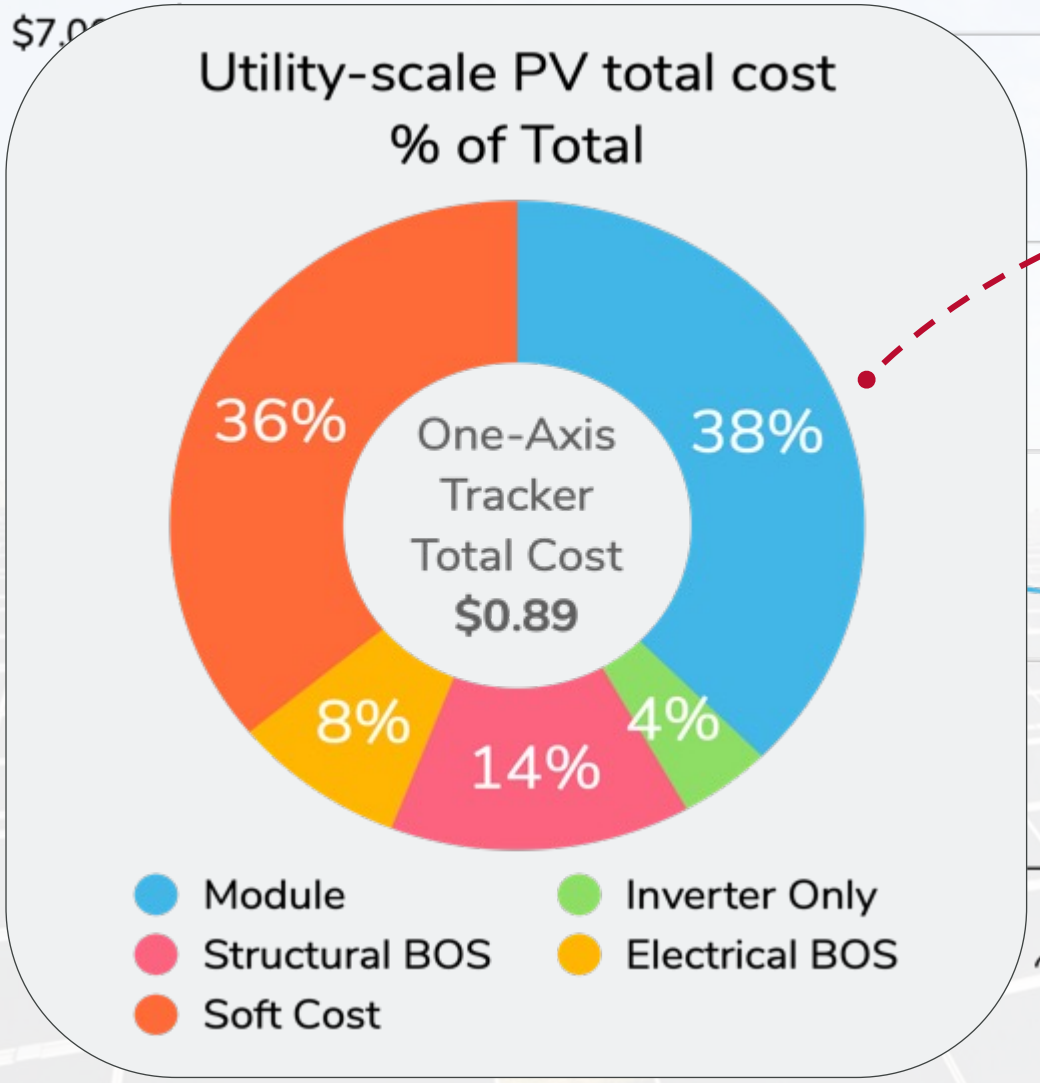


- As of December 2022, over 80% of each of the various c-Si manufacturing steps is performed in China.
- Ingot and wafer form the tightest bottleneck, at 98% of global capacity within China.
- Given the announced capacity increases within China, this imbalance is unlikely to change soon.



Source: National Renewable Energy Laboratory. *Winter 2023 Solar Industry Update*.

Cost of Utility-Scale 100-MW One-Axis Tracking System (2020 USD)



Source: National Renewable Energy Laboratory. 2022. *U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022*.

Monocrystalline Silicon PV Supply Chain Spot Price Trends

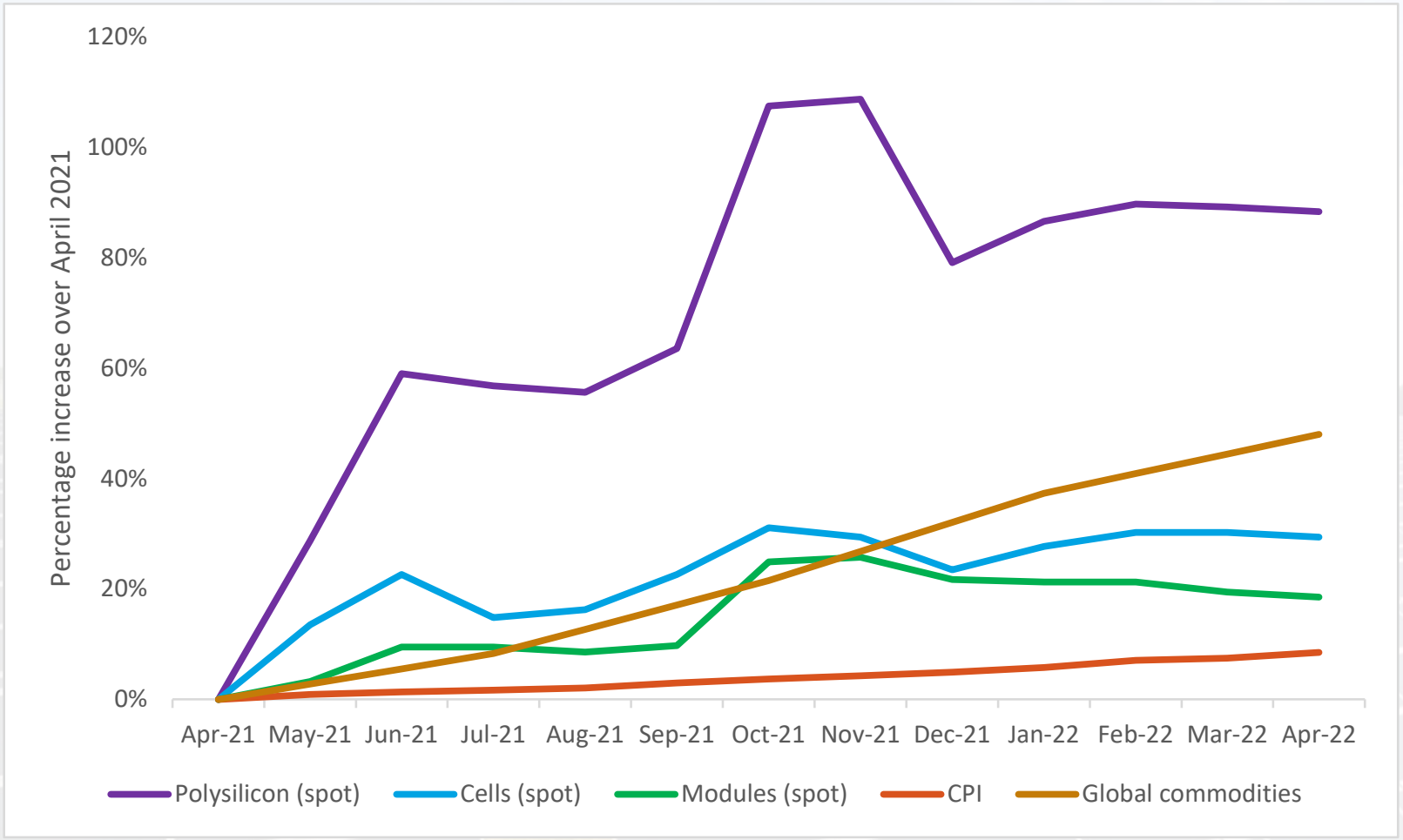


Figure 1. Select price increase indicators, April 2021–April 2022

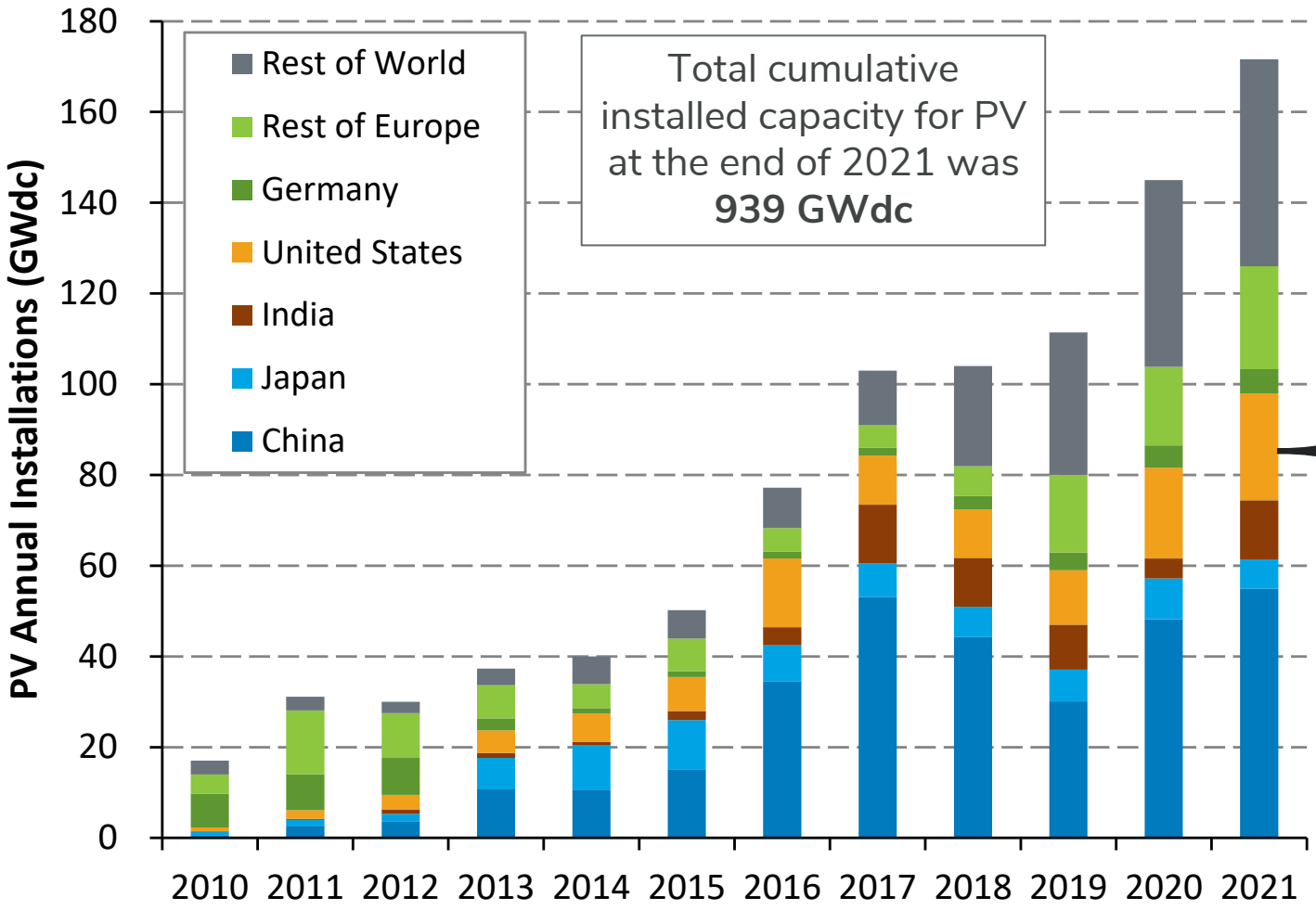
Sources: BNEF (2022), FRED (2022a, 2022b)

- Spot prices rose across the monocrystalline silicon PV supply chain between April 2021 and April 2022:
- 88% for polysilicon
- 29% for cells
- 19% for modules

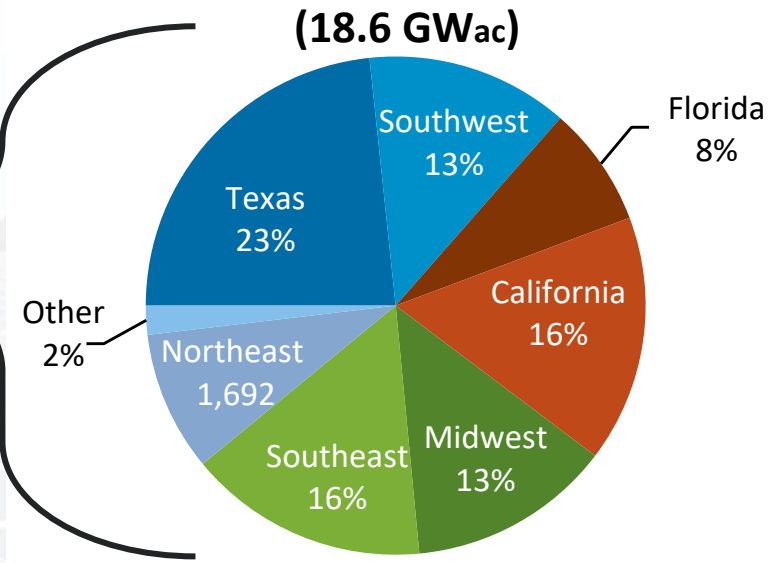
Source: National Renewable Energy Laboratory. 2022. *U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022.*

Solar Energy Development Trends

PV Capacity Additions by Country

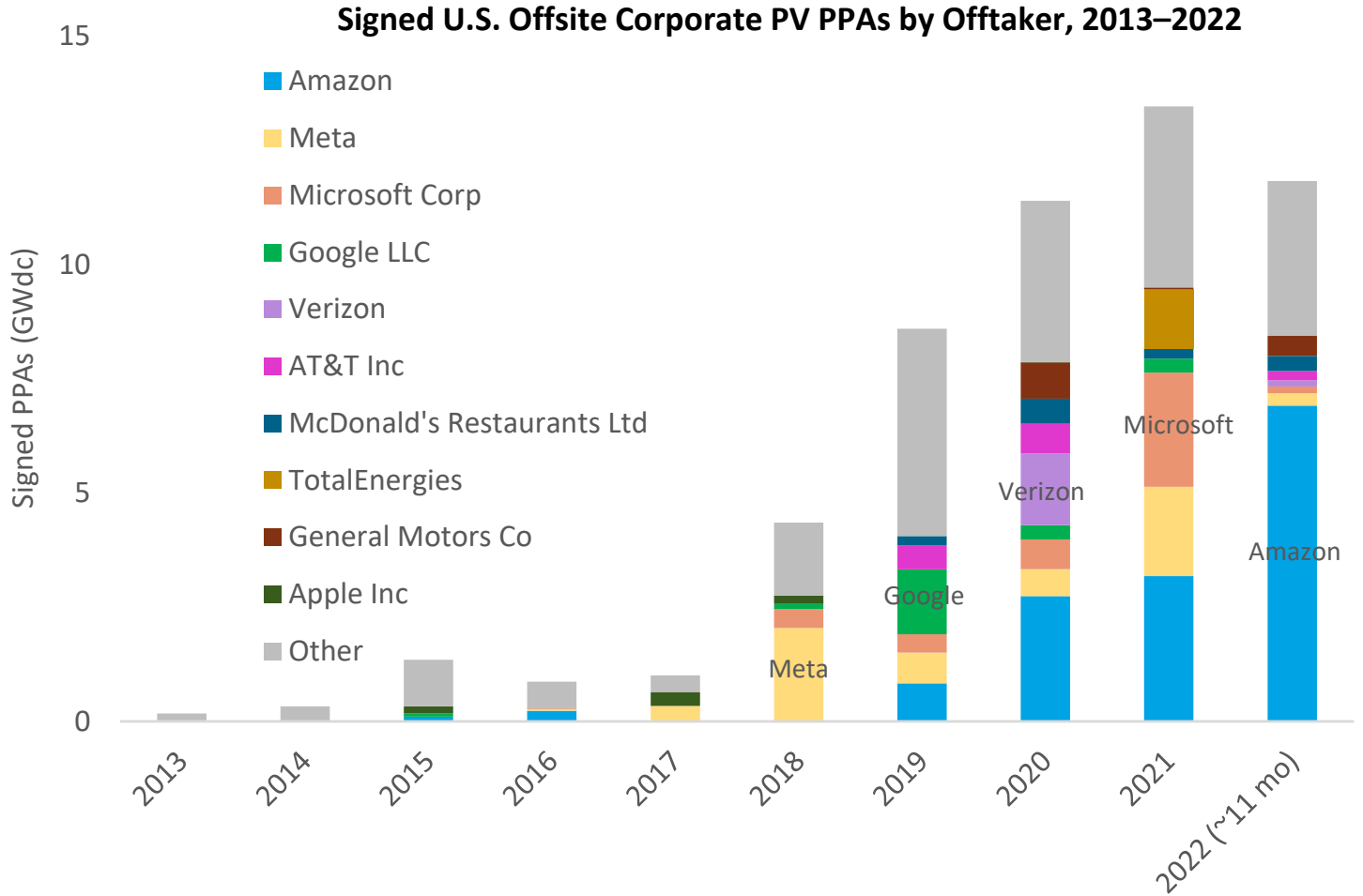


United States PV Capacity Additions (2021)



Source: National Renewable Energy Laboratory. *Spring 2022 Solar Industry Update.*

Off-Site Corporate Power Purchase Agreements



- Offsite corporate PPAs signed in the past several years eclipse all PV currently installed to support U.S. commercial activities.
- Completion of all projects signed in 2018 through most of 2022 would **represent 50 GWdc** of PV capacity

Source: National Renewable Energy Laboratory. *Winter 2023 Solar Industry Update*.

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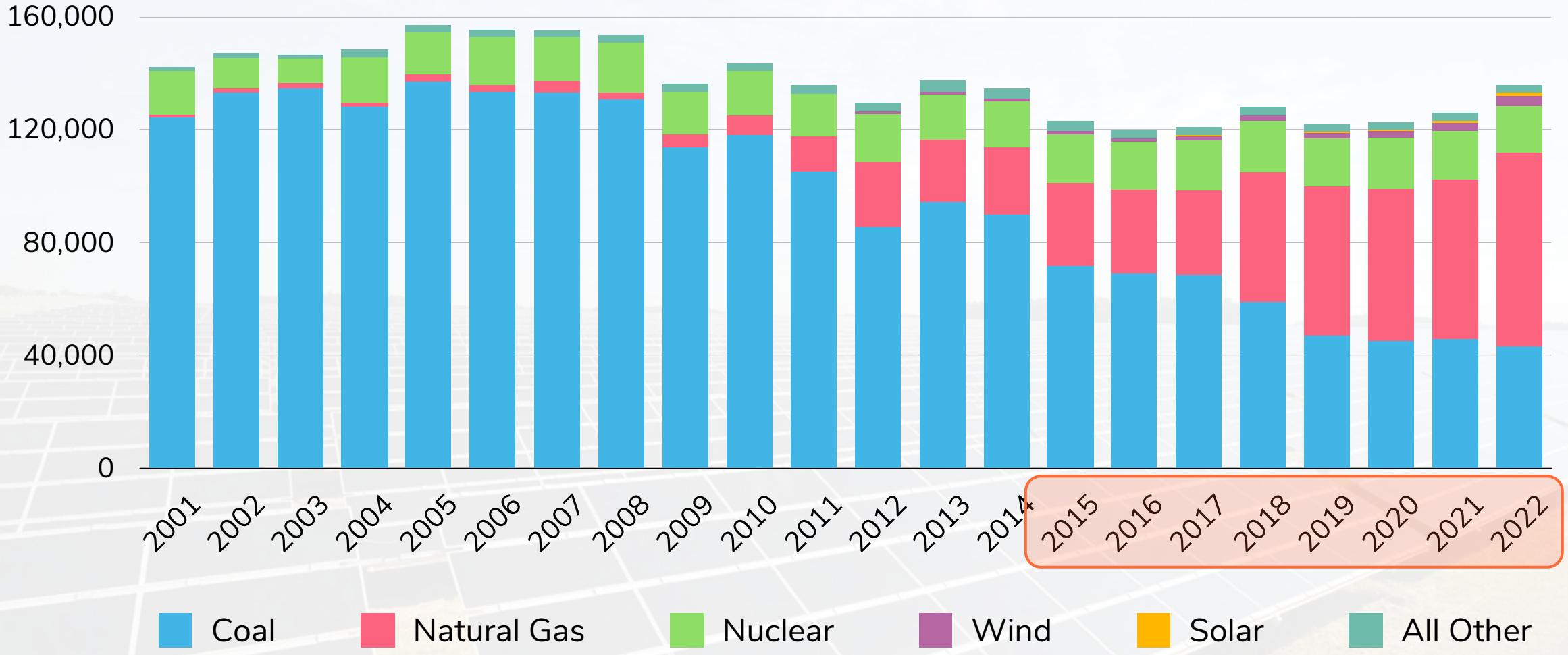
Ohio Net Electric Generation (Thousand-Megawatt-Hours)



Data source: U.S. Energy Information Administration

Source: Ohio Power Siting Board. Available at: www.opsb.ohio.gov

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Summary of Utility-Scale Solar Under OPSB Review (≤ 50 MW)

Status	Projects	Capacity MW	Acres
Operational	3	450	4,312
Under construction	13	3,104	30,198
Pre-construction	22	3,071	33,800
Pending	12	2,590	23,236
Pre-application	1	152	1,200
Total	**51**	**9,367**	**92,746**

9.9 Acres per MW

PJM Interconnection Queue: Project Count

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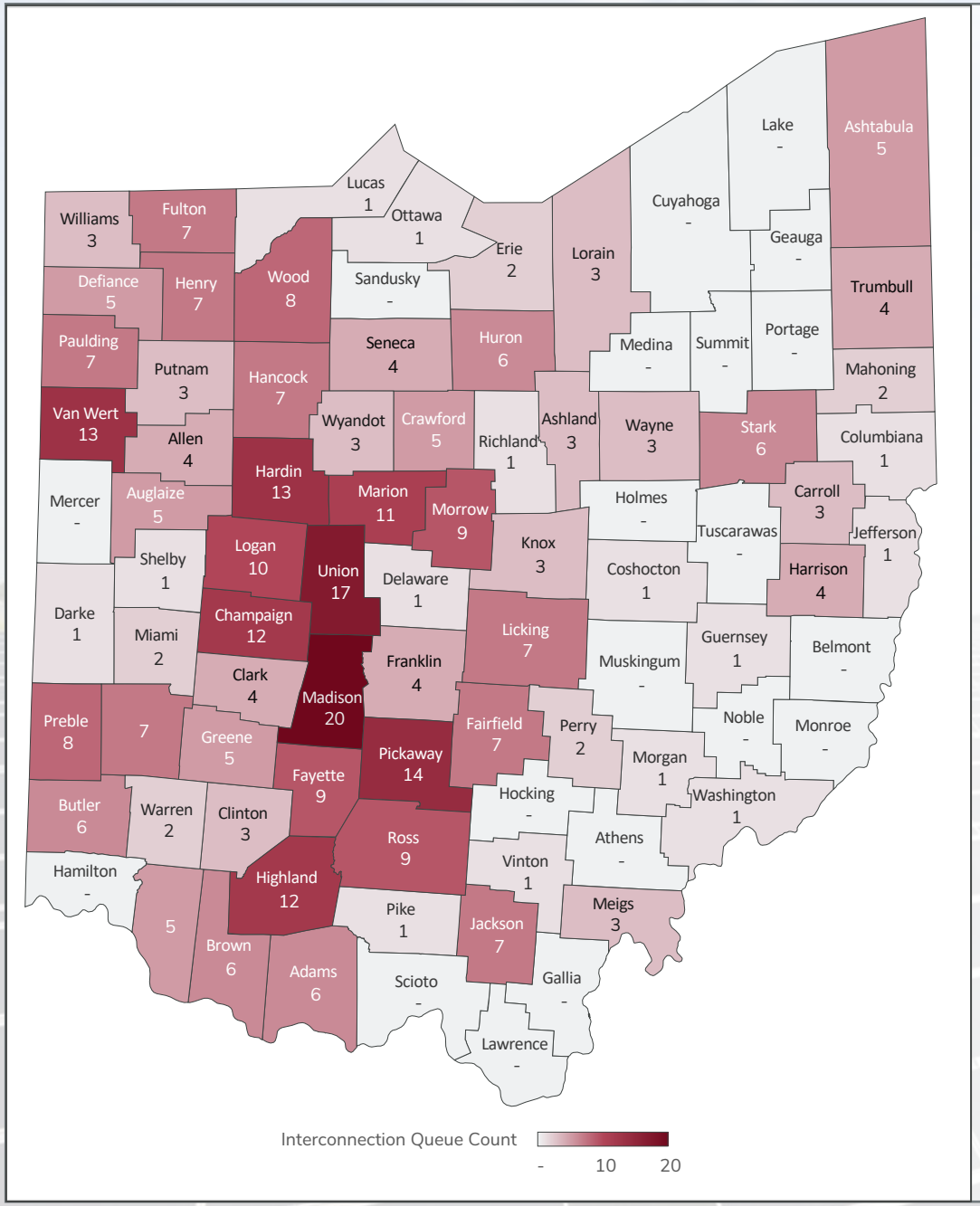

Top 10 Counties by Project Count

1. Madison - 20
2. Union - 17
3. Pickaway - 14
4. Hardin - 13
5. Van Wert - 13
6. Highland - 12
7. Champaign - 12
8. Marion - 11
9. Logan - 10
10. Ross - 9

PJM Queue Total: 387 Active Projects

Source: PJM - https://pjm.com/planning/services-requests.aspx

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PJM Interconnection Queue: Capacity (MW)

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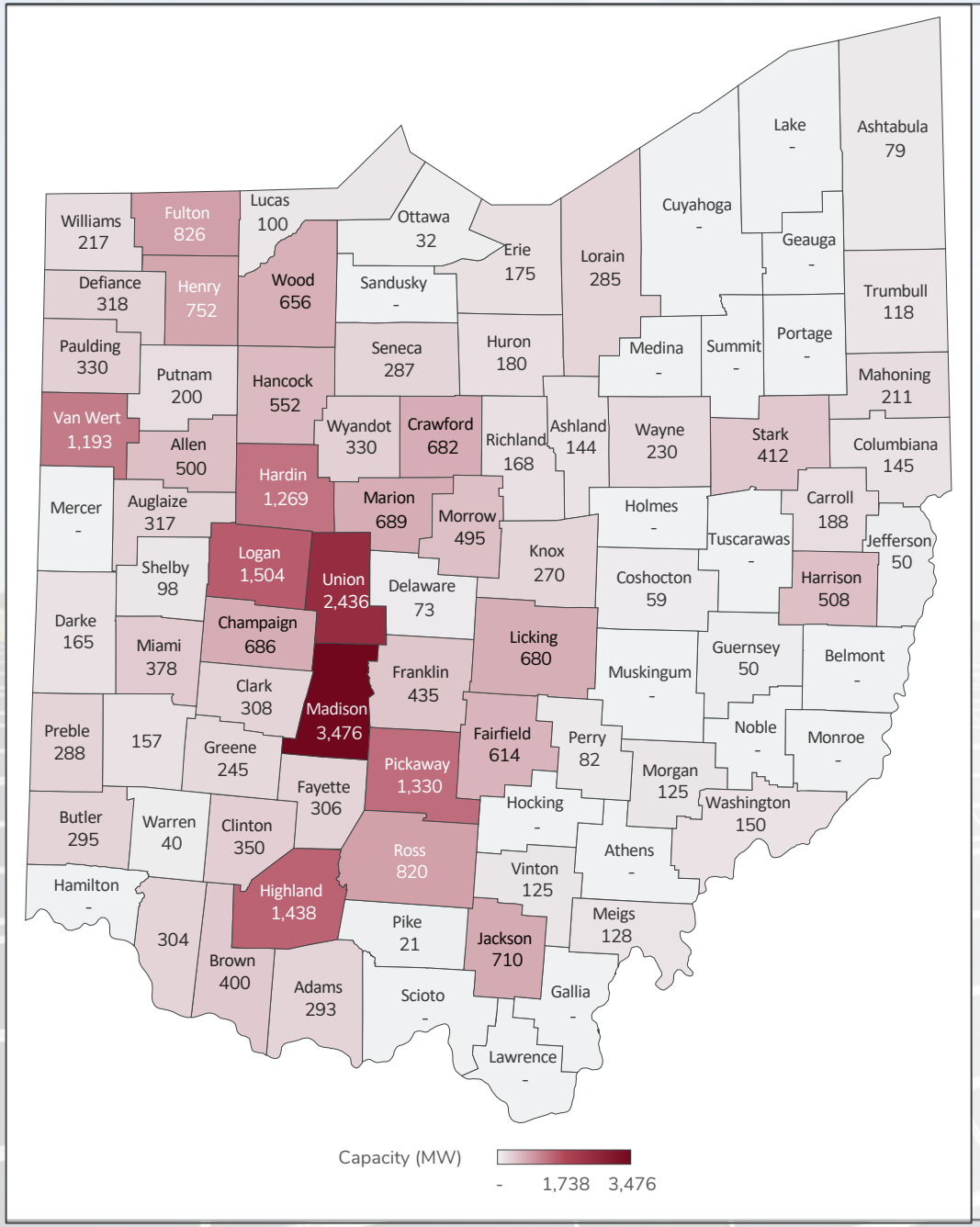


Top 10 Counties by Capacity

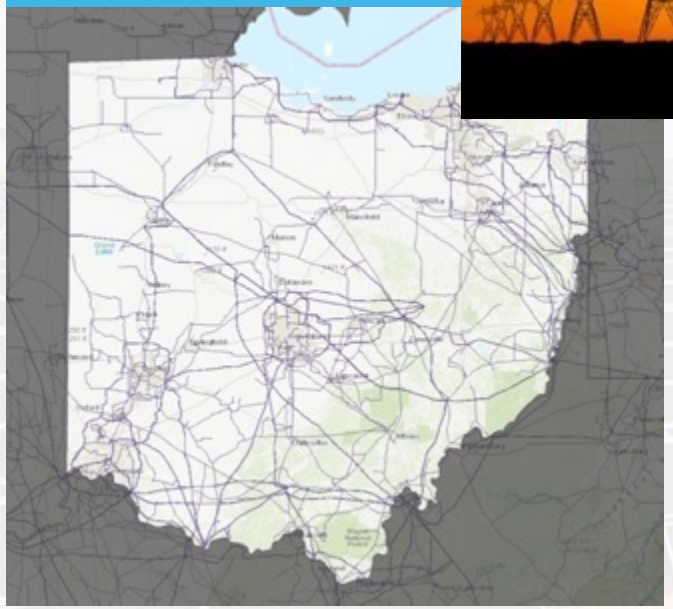
1. Madison - 3,476
2. Union - 2,436
3. Logan - 1,504
4. Highland -1,438
5. Pickaway -1,330
6. Hardin -1,269
7. Van Wert – 1,193
8. Fulton - 826
9. Ross - 820
10. Henry - 752

PJM Queue Capacity Total: 31,484 (MW)

Source: PJM - https://pjm.com/planning/services-requests.aspx

Why is There so Much Development Activity in Ohio?

PJM includes over **85,103** miles of high-voltage transmission lines.



41,222 sq. mile Ohio land area.

60% Agriculture & 33% Forestland

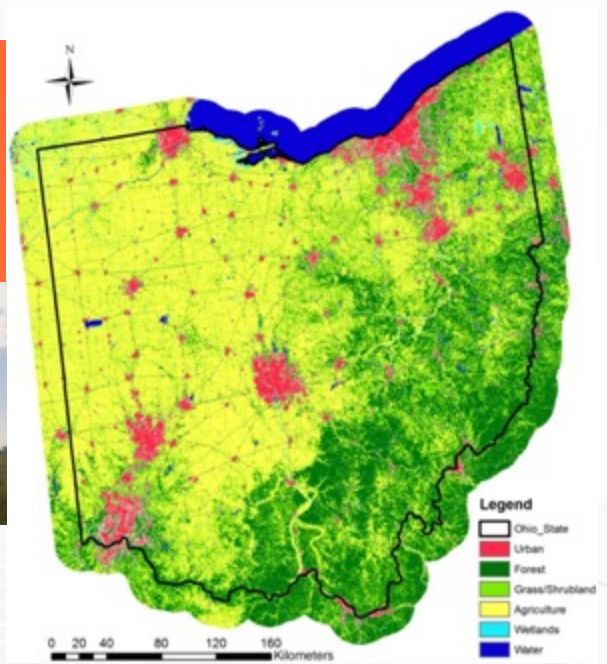
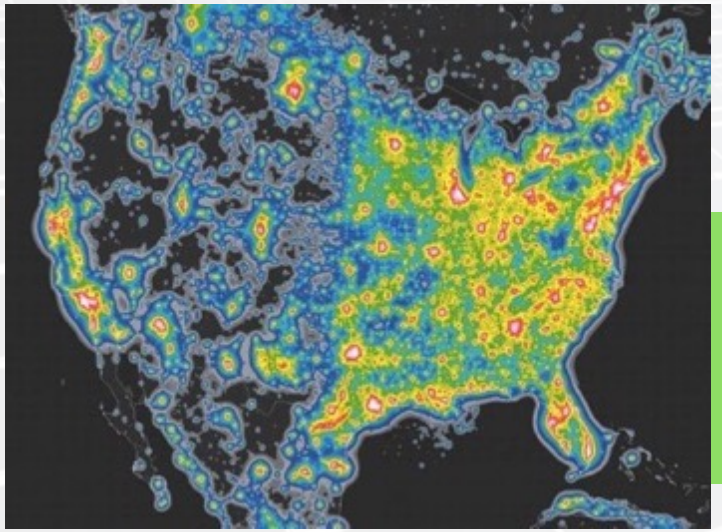


Image Source: Batdorf, K. E. 2012. Environmental Science



PJM Services 65 Million Electric Consumers

20% of U.S. Population

Community Impacts:

Benefits and Challenges

Why is Utility-Scale Solar Such a Polarizing Community Topic?

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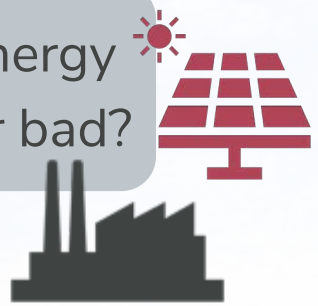
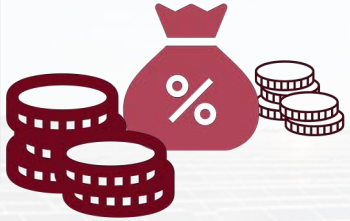
Renewable Energy Policy: good or bad?



How will the CONVERSION of farmland impact agriculture, neighbors, and communities?

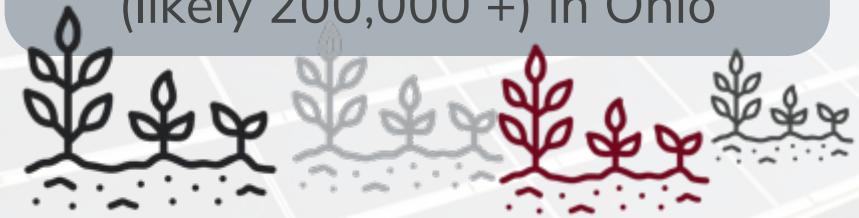
Possible development projects in 76 **Ohio counties**?

Contribution of **SIGNIFICANT** local tax revenue!



Landowner Rights: New lease income for farmland owners **$800 to $1,200 per acre**

The leasing and purchase of **over 100,000 acres** (likely 200,000 +) in Ohio



Could **complex lease agreements** expose farmers to additional risk?

Power Density and Land Requirements

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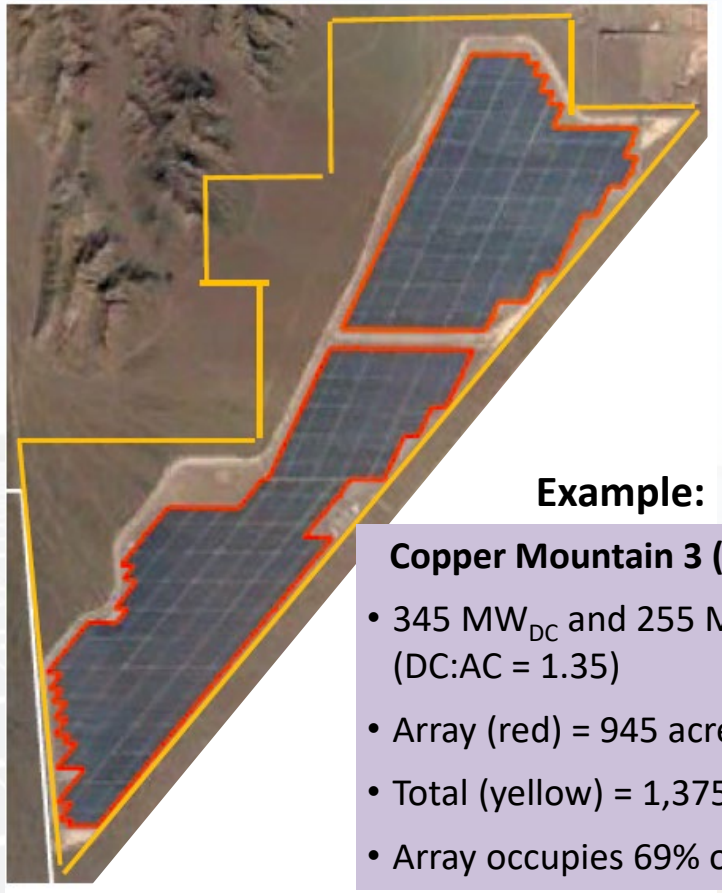
- Increasing utility-scale PV's power density (MW/acre) can help reduce land costs and land-use impacts.
- The relationship between the direct/array area and the total leased/owned area may vary considerably from site to site, depending on local site conditions.

Low Case Scenario (array area) - NREL 4.2 acres/MWDC

- 4.2 acres x 31,484 MW = 132,233 acres

High Case Scenario (total area) - OPSB 9.9 acres/MWDC

- 9.9 acres x 31,484 MW = 311,692 acres



Example:

Copper Mountain 3 (Nevada)

- 345 MW_{DC} and 255 MW_{AC} (DC:AC = 1.35)
- Array (red) = 945 acres
- Total (yellow) = 1,375 acres
- Array occupies 69% of the site

Source: Bolinger, M. and G. Bolinger. 2022. "Land Requirements for Utility-Scale PV: An Empirical Update on Power and Energy Density." Lawrence Berkeley National Laboratory.

Power Density and Land Requirements

311,692 Acres = 487 Sq Miles

Utility Scale Solar: Benefits and Challenges

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Benefits

- Emission free electric generation
- Renewable “free” fuel source
- High landowner lease rates
- Short term construction jobs
- Local tax revenue

Challenges

- Intermittent electric generation
- Low power density / land competition
- Subsurface drainage
- Vegetation management and weed control
- Long term impact to sub-soil and topsoil
- Planning for decommissioning and remediation
- Family and community conflict

OPSB Solar Certificates Recently Denied

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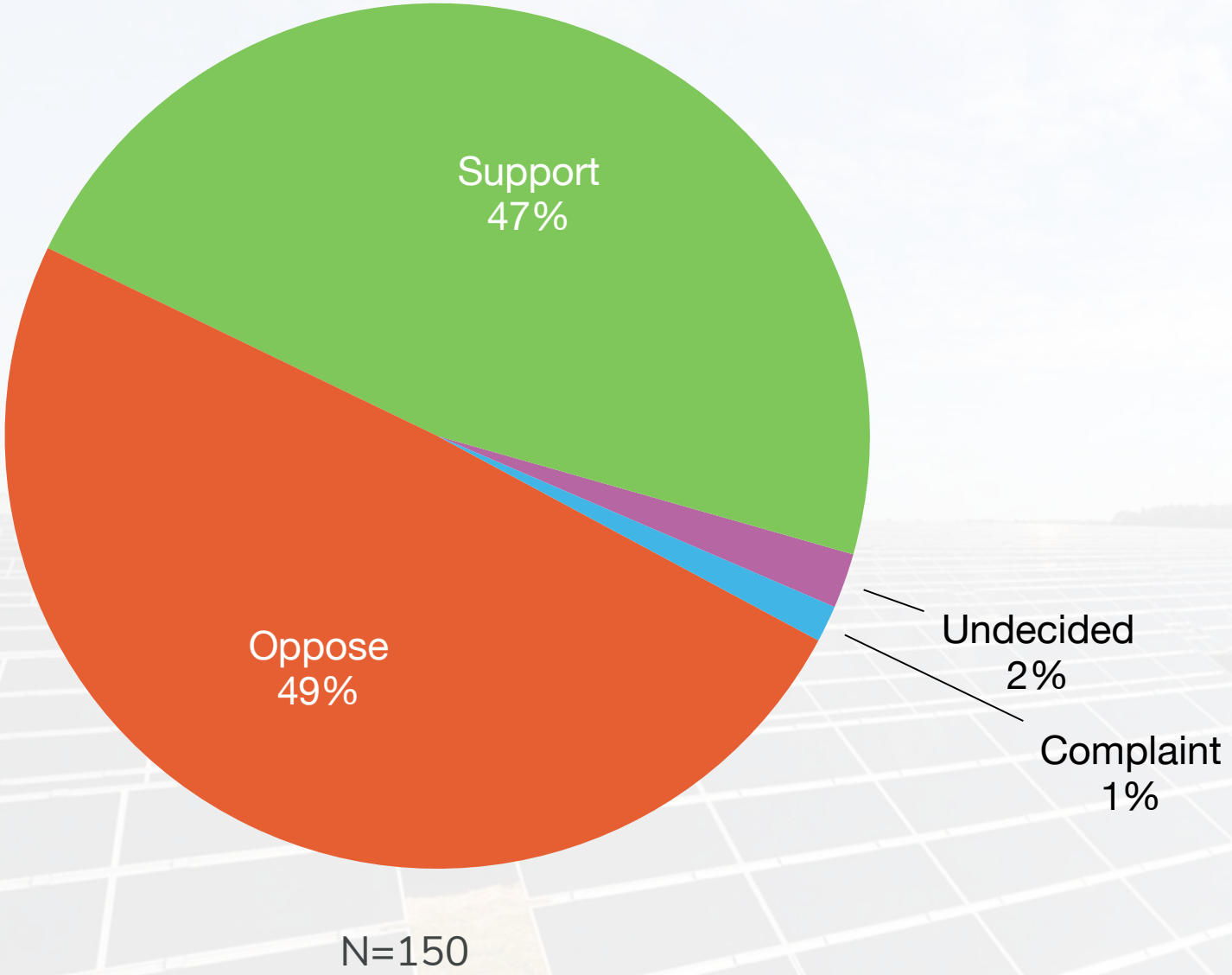
1. **Birch Solar 1 LLC** - 300 MW facility on 1,410 acres in Allen and Auglaize counties.
2. **Kingwood Solar LLC** - 175 MW facility on 1,200 acres in Greene County.
3. **Cepheus LLC** - 68 MW facility on 649 acres in Defiance County.

Basis for denials: Due to general opposition by local governmental bodies and citizens, applicants did not satisfy Ohio Revised Code 4906.10(A)(6), which requires showing that a facility "will serve the public interest, convenience, and necessity."

Appeals. All applicants have requested re-hearings on their applications, and the Kingwood application is on appeal to the Ohio Supreme Court.

Source: Ohio Power Siting Board.

OPSB Solar Project Public Comments



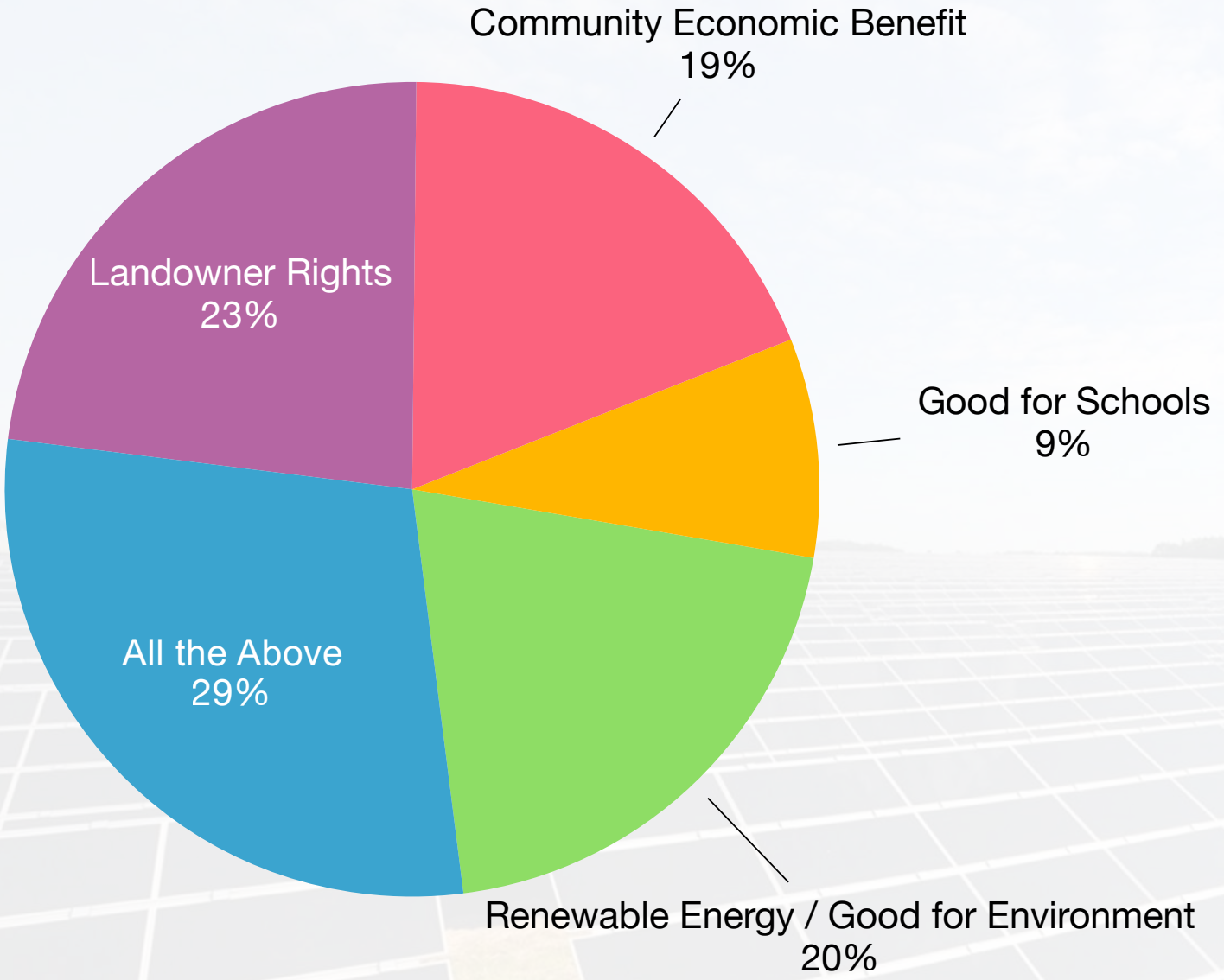
OPSB Solar Certificate:
Random Sample of 150 Public Comments from 1,345

General Opinion

Support or Oppose

Utility-Scale Solar

Source: Ohio Power Siting Board.

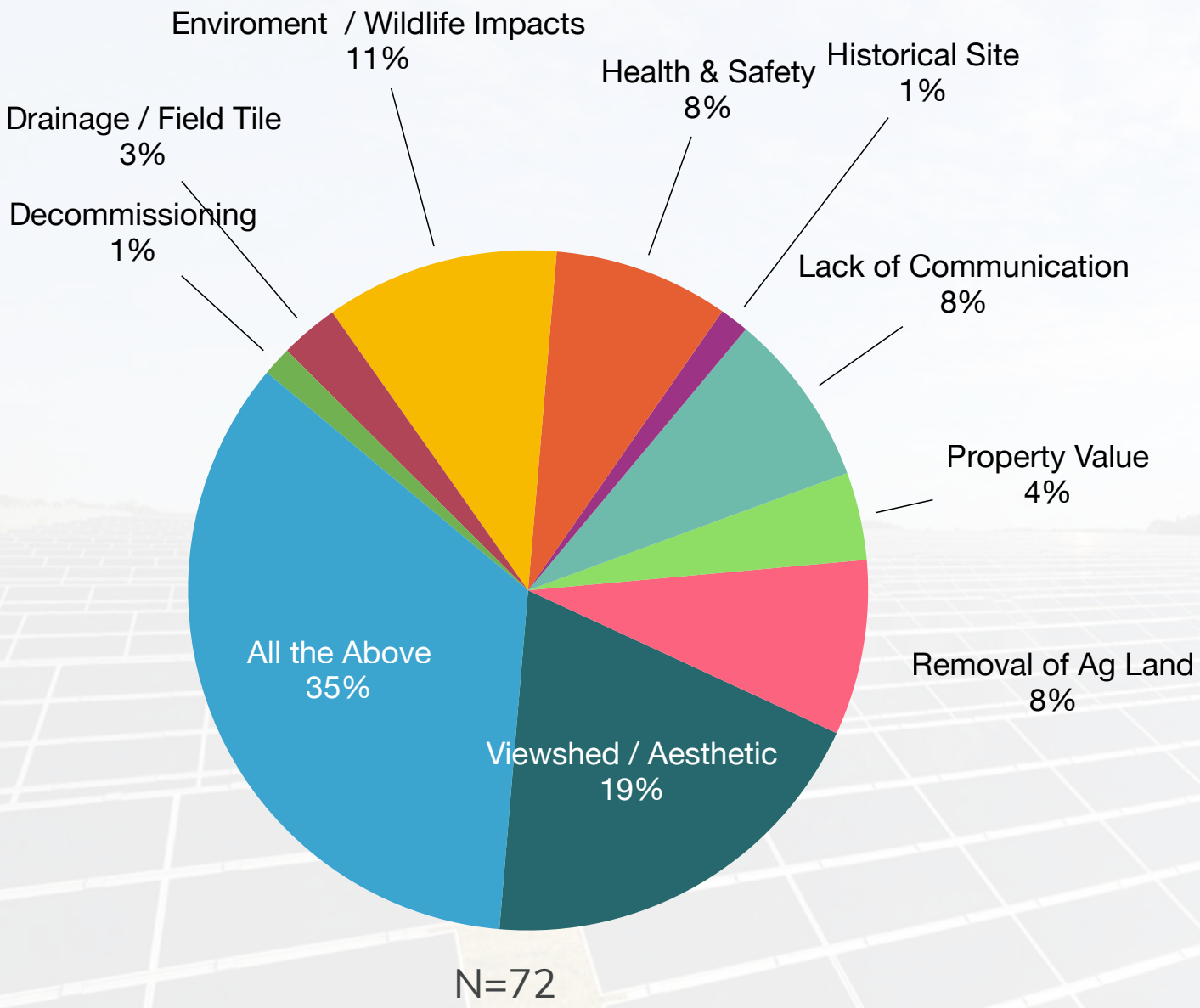


N=69

Source: Ohio Power Siting Board.

OPSB Solar Certificate:
Random Sample of 150 Public Comments from 1,345

General Theme of Comments **Supporting** Utility-Scale Solar

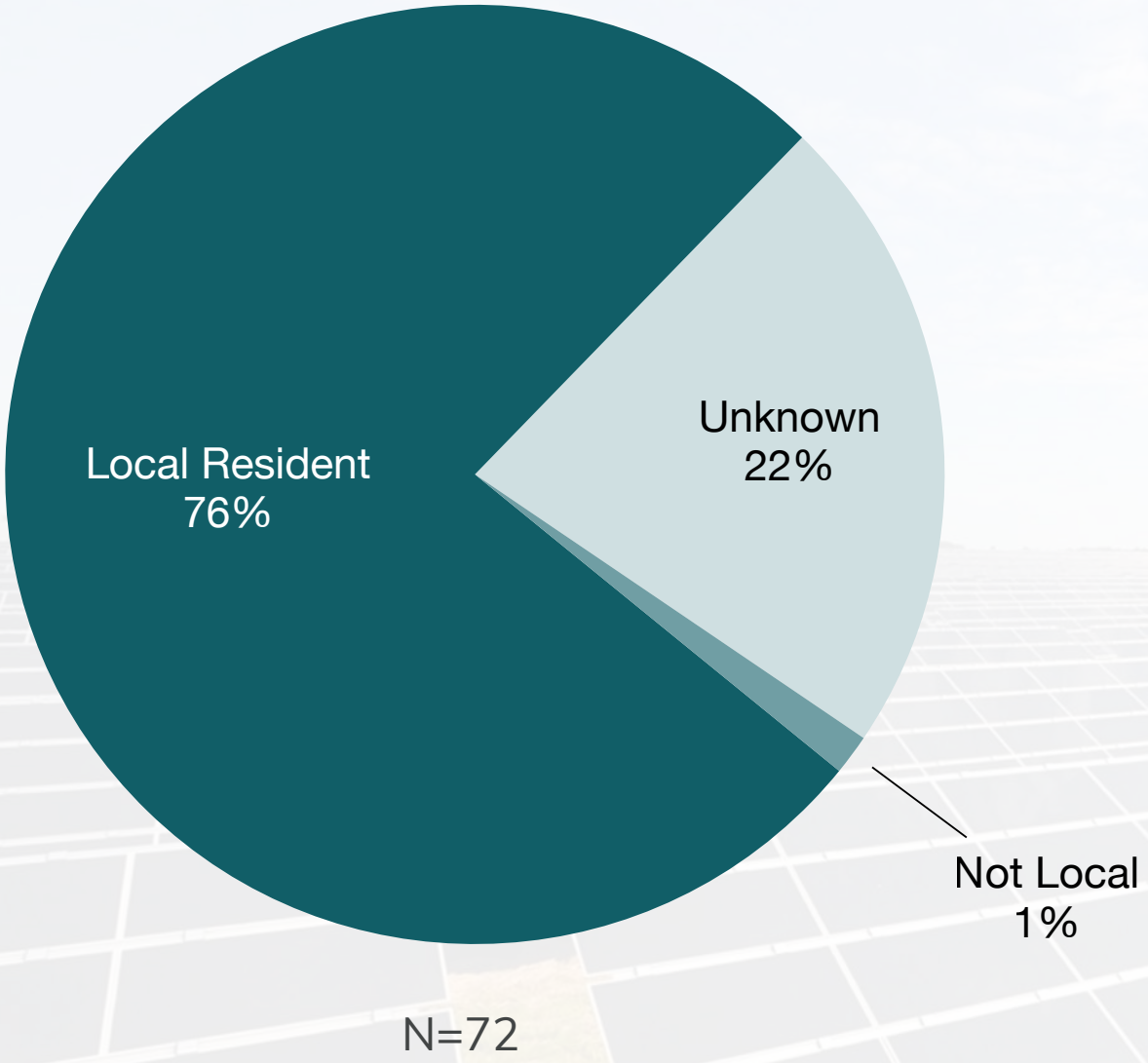


N=72

Source: Ohio Power Siting Board.

OPSB Solar Certificate:
Random Sample of 150 Public Comments from 1,345

General Theme of Comments **Opposing** Utility-Scale Solar



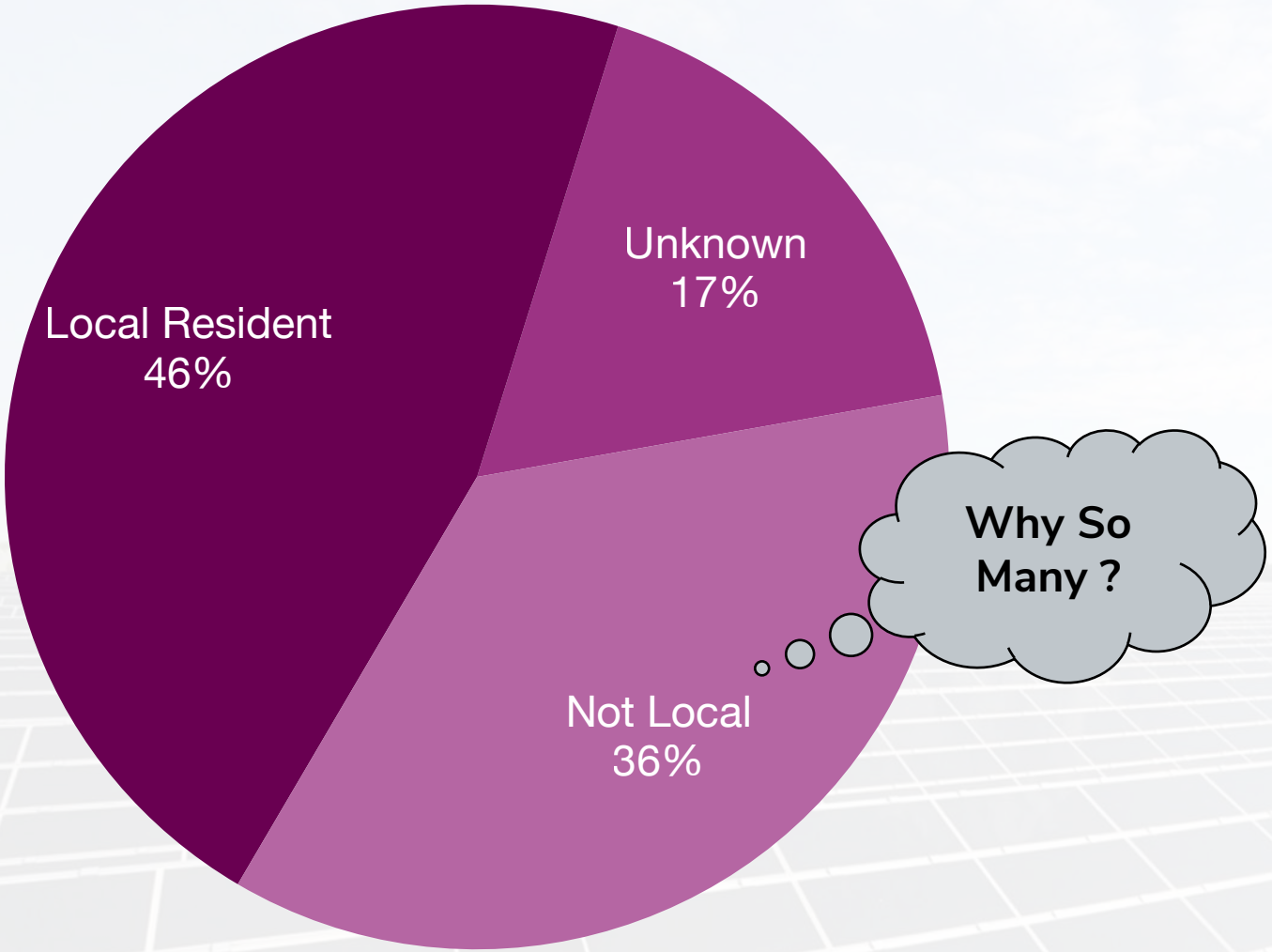
OPSB Solar Certificate:
Random Sample of 150 Public Comments from 1,345

Location of Comments

Opposing

Utility-Scale Solar

Source: Ohio Power Siting Board.



N=69

Source: Ohio Power Siting Board.

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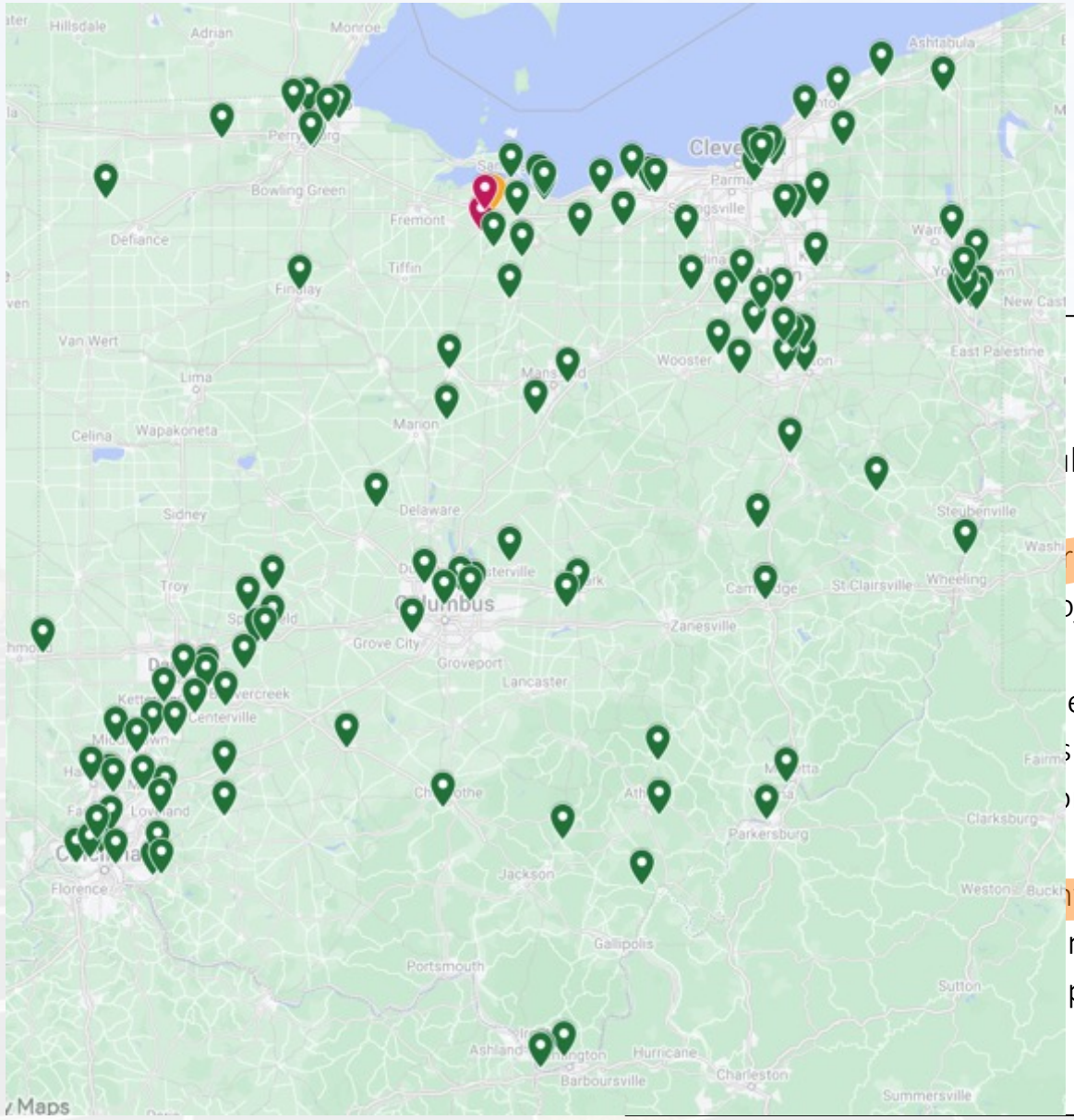
Location of Comments

Supporting

Utility-Scale Solar



OPSB Solar Case 20-1529-EL-BGN: Public Comments

ublic hearing on July 7. Please accept this as my written testimony.

r of property rights, and clean energy, I urge you to award a permit to oject (Docket No. 20-1529-EL-BGN, Wheatsborough Solar).

eatsborough are an important part of the future of Ohio's economy. supplies many of the components for these projects in other states, and omponents to work in projects in our own state.

nfrastructure, and health benefits that would result from this project are n the community's interest for this project to move forward. For these permit to Wheatsborough Solar.

Source: Ohio Power Siting Board Case: 20-1529-EL-BGN.

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Project Taxation:

Ohio SB 232 Legislation Tax Exemption and PILOT Payments

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Public Utility Tangible Personal Property Tax:

The tangible personal property of public utilities, such as energy companies, remains taxable. (R.C. § 5727.06). **Solar projects**, generally fall within the definition of an "energy company." which is classified as public utilities for Ohio tax purposes under R.C. § 5727.01.

Personal Property Tax:

Projects that are not exempt from taxation will be taxed. (24% for generation equipment and 85% on transmission & distribution equipment)

Real Estate Tax:

If the project is not certified as a qualified energy project (or loses this certification), the project's real property is subject to taxation. See R.C. §5709.01(A).

Ohio SB232: Qualified Energy Project Tax Exemption

Small Projects (≤250 kW)	Large Projects (>250 kW)	
Small projects 250 kW or less **are automatically exempt.** (Revised Code Section 5709.53)	In order to qualify, the owner or lessee **must apply** to the Ohio Department of Development	Large projects (> 20 MW) require County Commissioners approval

Ohio S.B. 232 Qualified Energy Project Tax Exemption

- Program provides owners of alternative energy projects with an **exemption for the public utility tangible personal property tax (personal and real)** and consolidates tax liabilities into one flat fee.
- The recipient pays an annual per-megawatt **Payment in Lieu of Taxes (PILOT)** based on the facilities' total nameplate capacity for power production.

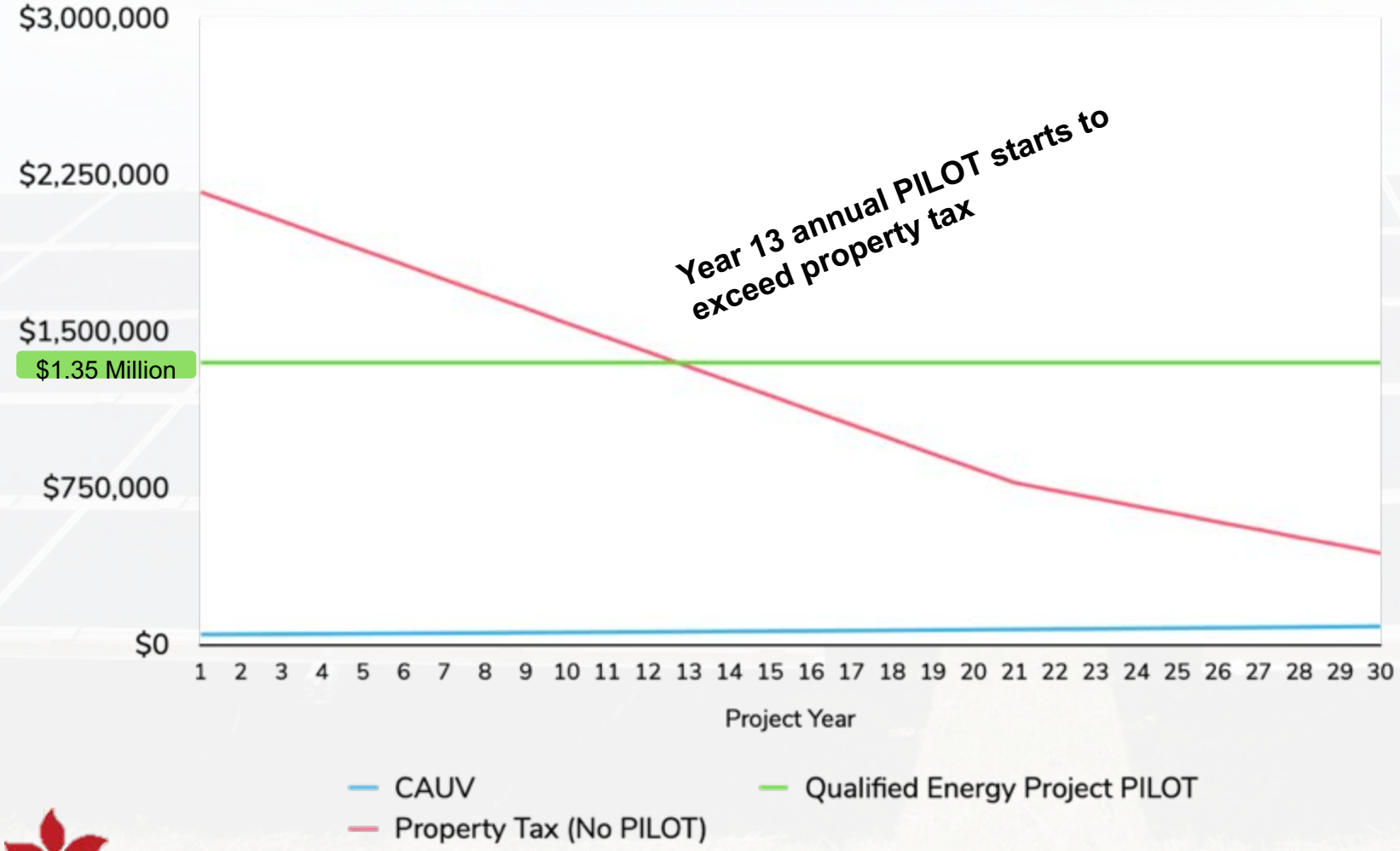
- ORC Section 5727.75(F) outlines requirements qualified energy projects must comply with to keep their designation and property tax exemption:
  - **Construction Progress Report**
  - **Construction Employment Report**
  - **Infrastructure Repair**
  - **Public Safety Training**
  - **Ohio Resident Percentage**
  - **University Partnership**
  - **Energy Credit Offer**
- In addition, timely payment of their PILOT is required to maintain their designation and property tax exemption.

Payment in Lieu of Taxes (PILOT) Program

- Require PILOTs of **$7,000 per MW** for qualified **solar projects**
- $6,000 to $8,000 per MW for all other renewable energy projects
- County commissioners may negotiate additional service payments, **not to exceed $9,000** per MW when combined with the PILOT payment.

- The mandatory PILOT is to be allocated just as tangible personal property tax is allocated — to local governments and school districts. Any additional service payment required by the county is to be deposited in the county general fund. § 5727.75(E)(1)(b).

Annual Revenue from Qualified Energy Project $9,000 PILOT Payment Hypothetical Scenario (150 MW / 900 Acres)



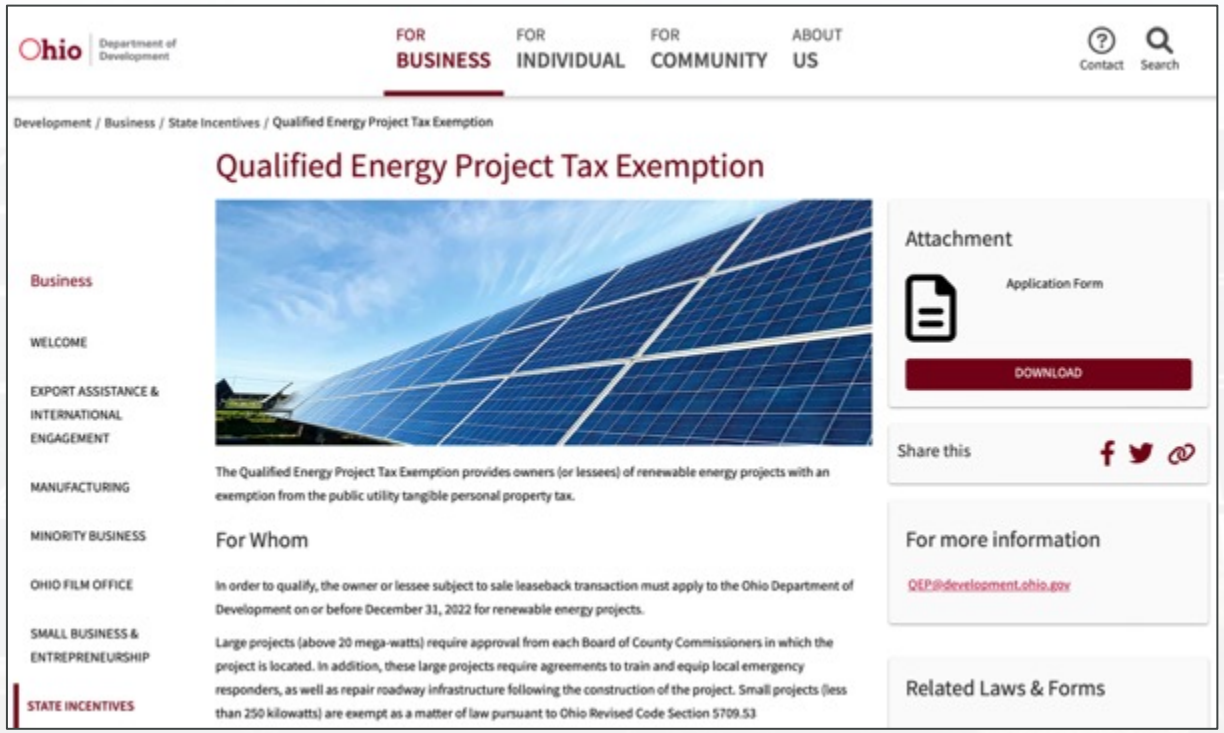
PILOT 30 Yr. Total = $40.5 Million

Property Tax 30 Yr. Total = $36.2 Million

CAUV 30 Yr. Total = $1.9 Million

Source: Commissioners' Manual for Renewable Energy Generation Facilities: Siting And Taxation of Certain Wind and Solar Projects

Additional Resources for the SB232: Qualified Energy Project Tax Exemption Program



John Werkman
Ohio Development Services Agency
Tax Incentives Manager
(614) 466-6791
John.Werkman@development.ohio.gov

https://development.ohio.gov/business/state-incentives/qualified-energy-project-tax-exemption

Utility-Scale Solar Dual Land Use

Dual use of land for ag and solar

(also known as co-location and agrivoltaics)

LIMITATIONS

FEASIBILITY RESEARCH

INFRASTRUCTURE CHANGES

Dual use: what's needed?

1. Research results
2. Willing parties
3. Lease negotiations
4. Policies, incentives, or regulations?

Dual-Use or (Agrivoltaic) Solar Installations

What is Dual-Use?

- Dual use is the integration of agricultural production with a photovoltaic (PV) system. It allows for solar energy production while maintaining agricultural activities.
- Typically it is considered the installation of a solar array that partially obstructs solar penetration to crop production (either forage land or crops).
- Solar mounted on barns, greenhouses, or floating on agricultural ponds may also be considered dual-use operations.

Benefits of Dual-Use

- Landowners diversify their incomes streams while continuing to produce agricultural products.
- Protects against loss of productive farmland due to permanent solar development.
- Provides a marketing opportunity to a sustainability-minded audience.
- Required security fencing doubles as an extra secure enclosure for livestock.
- Shaded soils may retain more moisture and reduce water consumption for some species of crops.
- Provides relief for workers and animals beneath the array.

Potential Drawbacks

- Loss of tax benefits for the conversion of land into solar production for landowners enrolled in the State's Farmland, Open Space, and/or Tree Growth Tax Programs.
- Although well established in some countries, experimentation in the Northeast is just beginning.
- Potential for reduced crop yields, and limitations on mechanical harvesting equipment access beneath the solar array.

Crop production around a solar array
Source: Grist / National Renewable Energy Lab

Updated December2020

Page 1 of 2

Considerations for Dual Land Use Solar Projects

- Turfgrass – high maintenance cost, limited environmental benefit
- Pollinators – high establishment and maintenance cost, weed control
- Specialty crops – labor intensive
- Advanced Agrivoltaic solutions add additional racking cost
- Grazing – heard size, internal fencing and rotation
- **Solutions must be scalable!**
- OSU CFAES research is focused on forage production which could provide both economic and environmental benefits

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Project Size:

Utility-Scale Solar vs. Small-Scale Solar

Defining Utility-Scale & Small-Scale Solar

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Utility-Scale Solar - O.R.C. 4906.01 / Power siting definitions

- (B)(1) "Major utility facility" means:
  - (a) Electric generating plant and associated facilities designed for, or capable of, operation at a capacity of **fifty megawatts or more**
- (G) "Large solar facility" means an electric generating plant that consists of solar panels and associated facilities with a single interconnection to the electrical grid that is a major utility facility.

Small-Scale Solar - O.R.C. 303.213, 519.213, & 713.081 / Zoning Regulations

- (2) "Small solar facility" means solar panels and associated facilities with a single interconnection to the electrical grid and designed for, or capable of, operation at an aggregate capacity of **less than fifty megawatts**.


Utility Solar or Small Solar?

Utility Solar or Small Solar?

PSEG Wyandot Solar

- **Capacity:** 10 Megawatt (ac)
- **Footprint:** 85 Acres
- **Point of Interconnection:** Distribution System Operator (AEP Ohio)
- **Interconnection Approval:** State (PUCO)
- **Construction Approval:** N/A

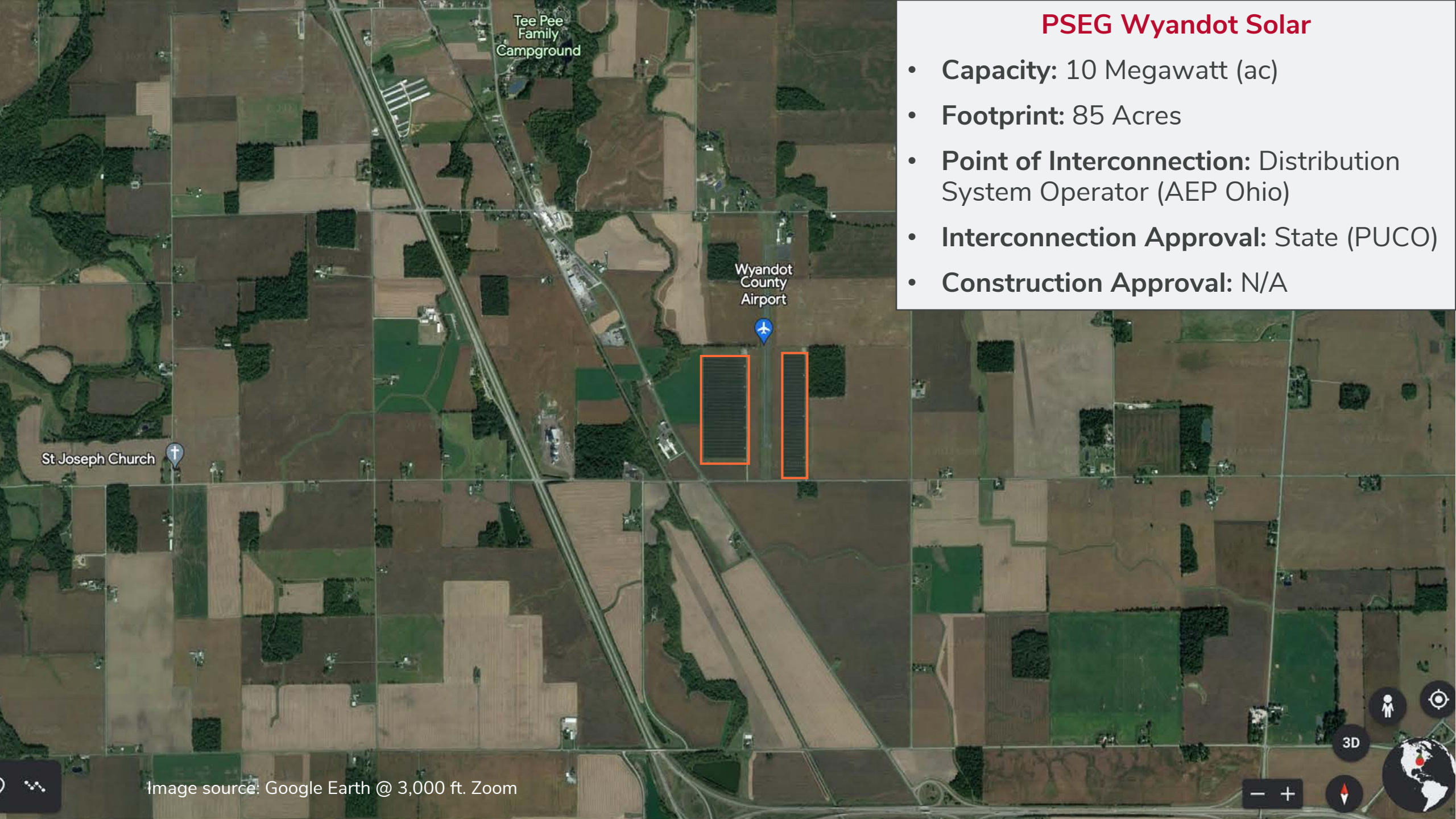

Image source: Google Earth @ 3,000 ft. Zoom

Hardin Solar Energy I

- **Capacity:** 150 Megawatt (ac)
- **Footprint:** 1,115 Acres
- **Point of Interconnection:** 345 kV Transmission Line (American Electric Power)
- **Interconnection Approval:** Federal (PJM)
- **Construction Approval:** Ohio Power Siting Board

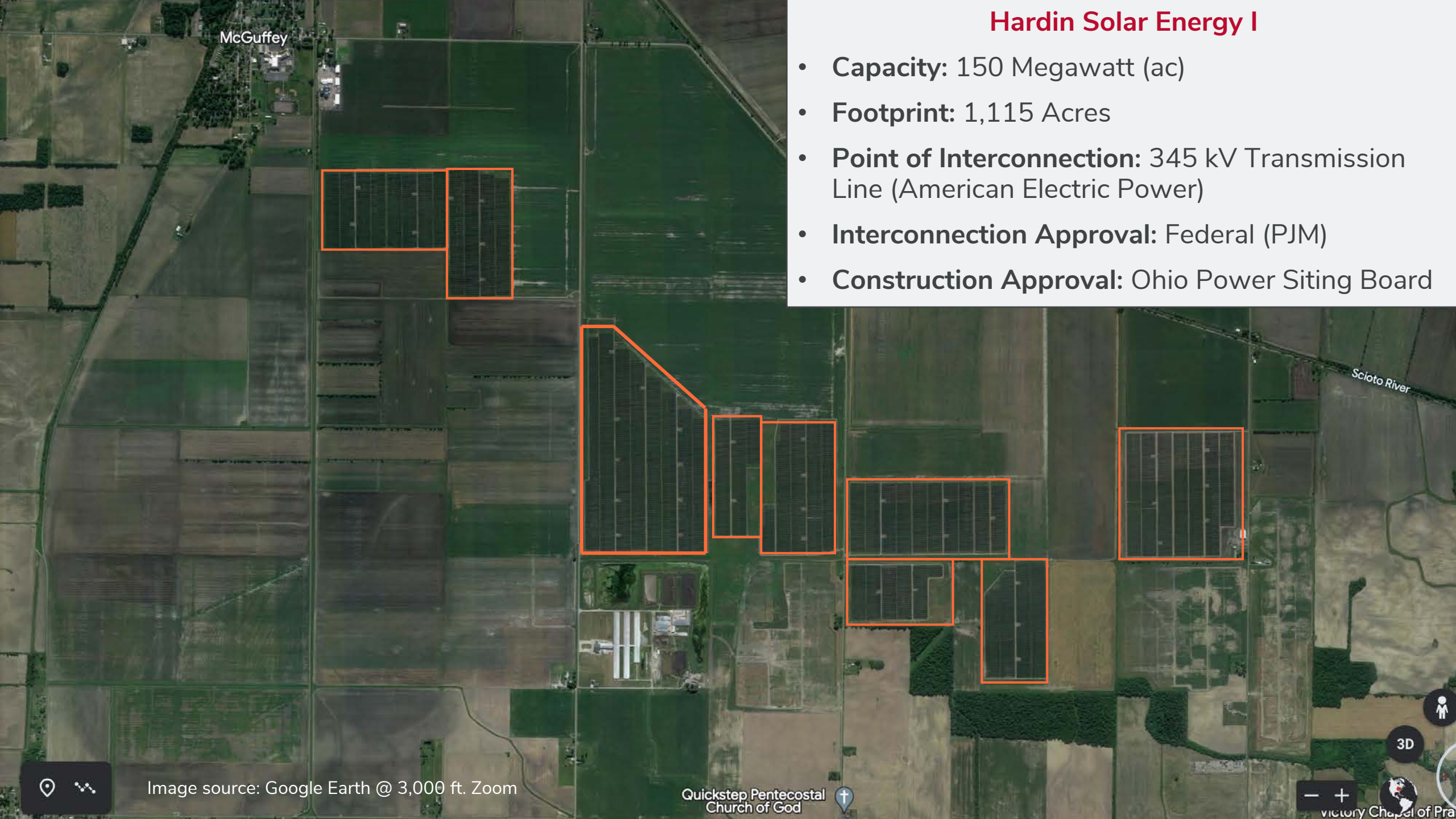

Image source: Google Earth @ 3,000 ft. Zoom

Side-by-Side Comparison:

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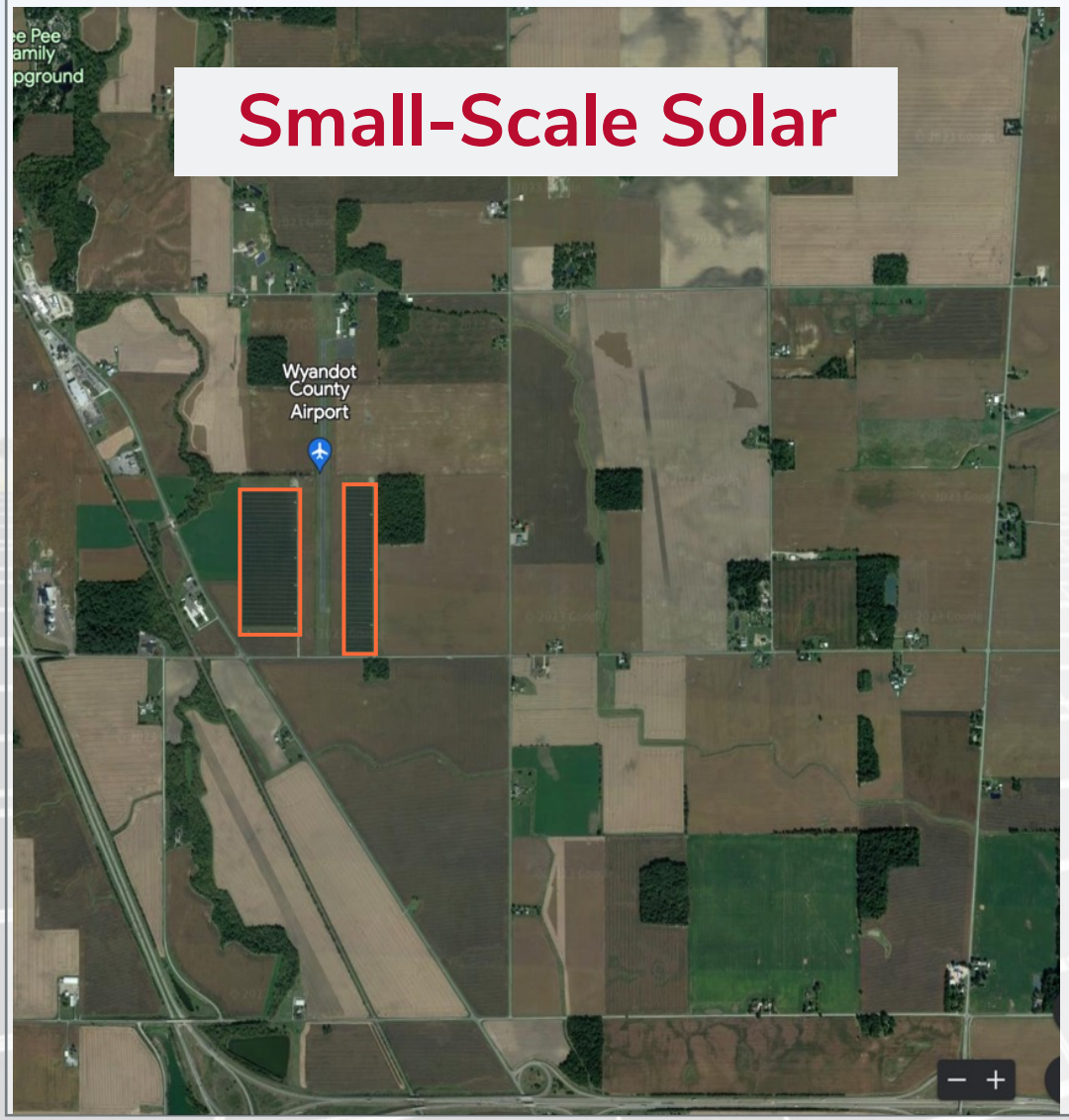

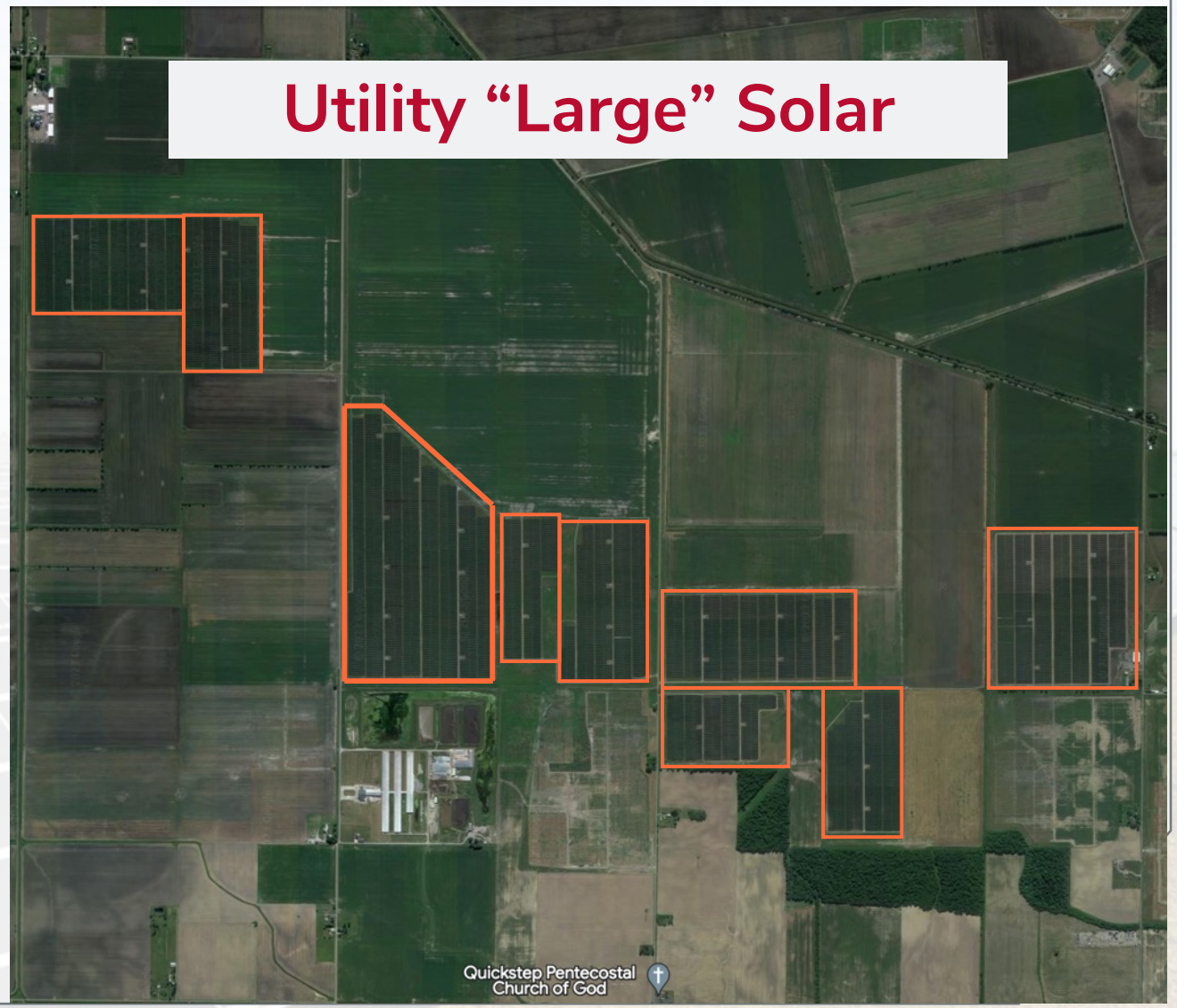

Image source: Google Earth @ 3,000 ft. Zoom

Remember……..in some cases both utility-scale and small-scale solar can have similar construction practices and impacts.

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Additional Resources, Questions, & Discussion

THE OHIO STATE UNIVERSITY
EXTENSION

TEACHING
EXTENSION RESEARCH

Law bulletins and videos are available at:

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OSU Farm Office Energy Law Library

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SCAN ME

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OHIO STATE UNIVERSITY EXTENSION

OSU Extension Ohio Solar Development 2023 Webinar Series

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Session #1
Solar Energy Overview & Trends

Session #2
The Solar Development Lease

Session #3
Connecting to the Electric Grid

Session #4
Solar Project Approval in Ohio

Session #5
Pre & Post Construction Considerations

This session targets landowners considering a solar lease. We'll cover pre-leasing issues, solar lease phases, common legal terms, and best management practices for leasing.

Questions and Discussion

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