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Large-Scale Solar in Pennsylvania: 2025

September 30th-Mid-Atlantic Renewable Energy Association

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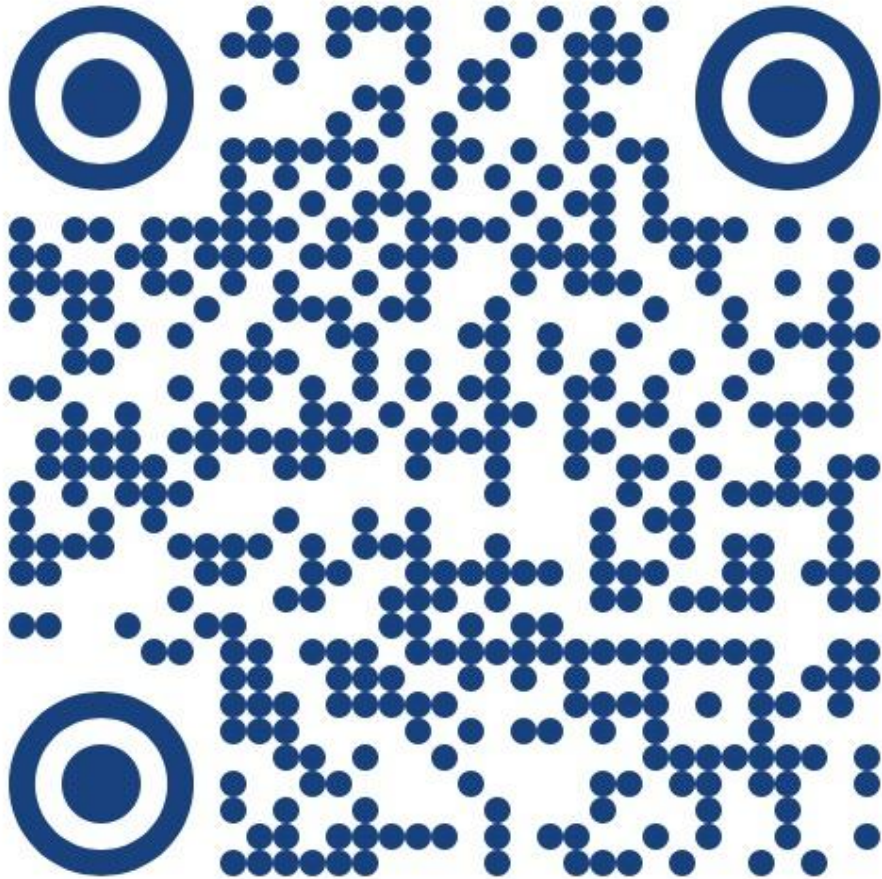
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Extension Energy Essentials Newsletter



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Extension Energy Essentials

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Large-Scale Solar in Pennsylvania

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— The Future of Energy lies within the “Energy Triangle”

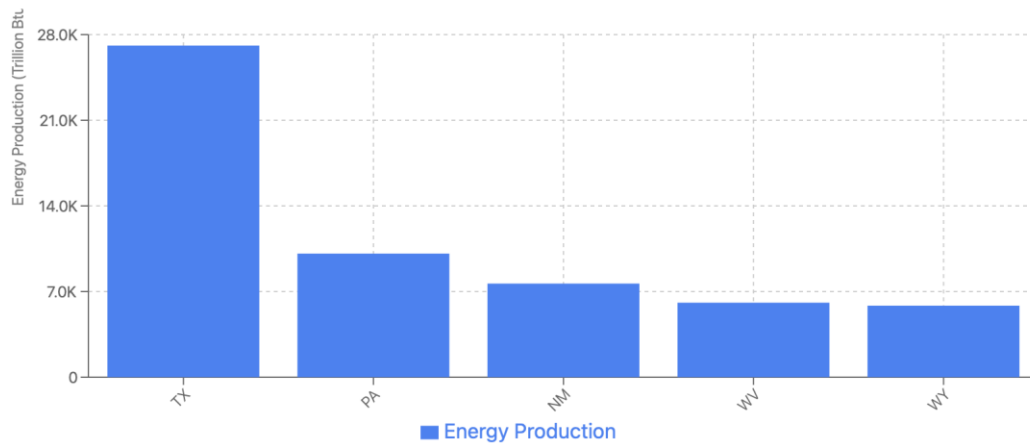
Todd Sallade, PREA/Allegheny Energy
Vice President of Power Supply & Engineering



Large-Scale Solar in Pennsylvania

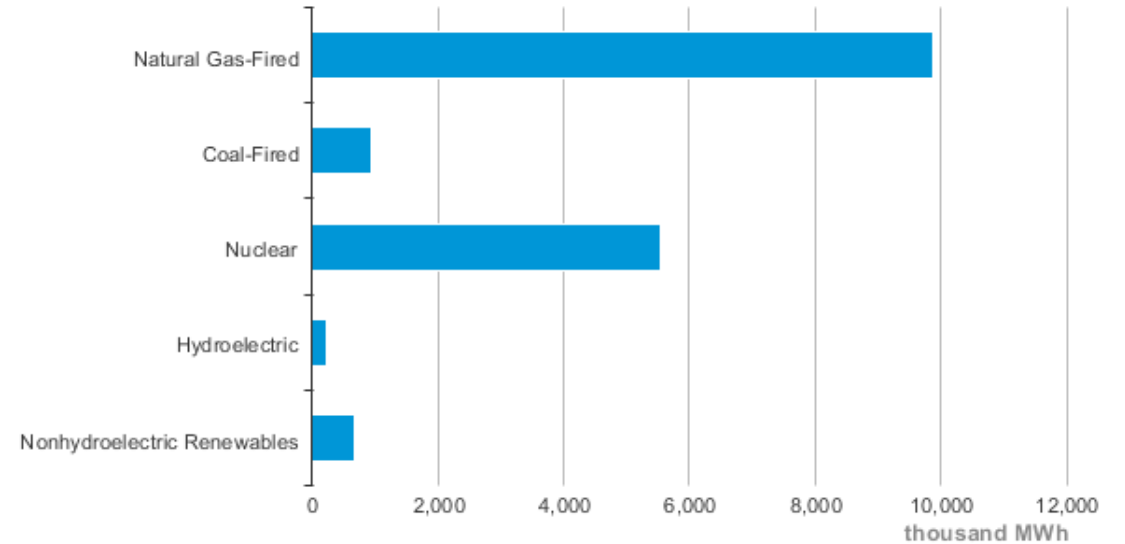
Energy Production in Pennsylvania

Top 5 US States by Total Energy Production (Trillion Btu)



Data Source: Total Energy Production-StateRankings.csv

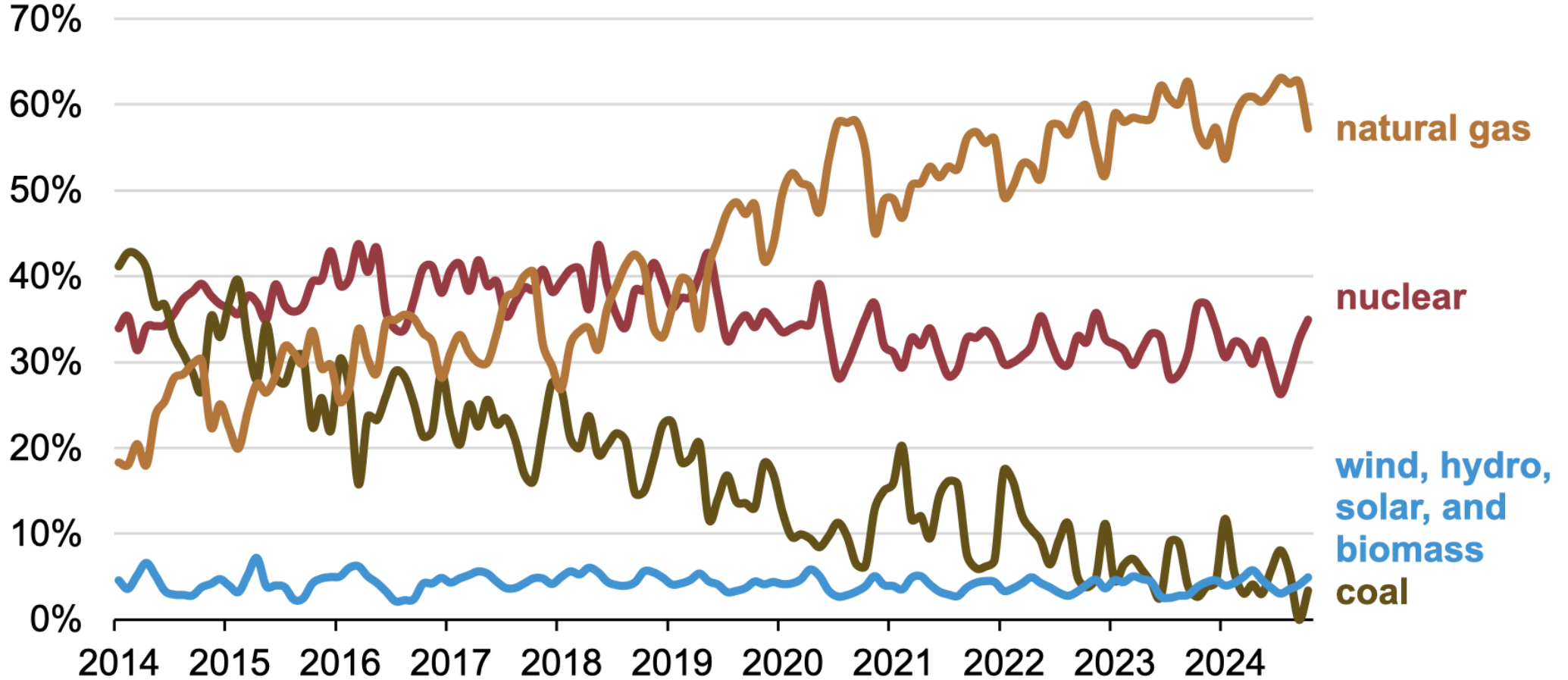
Pennsylvania Net Electricity Generation by Source, Apr. 2025



Source: Energy Information Administration, Electric Power Monthly

Monthly electricity generation by source in Pennsylvania (Jan 2014–Oct 2024)

percentage of total generation

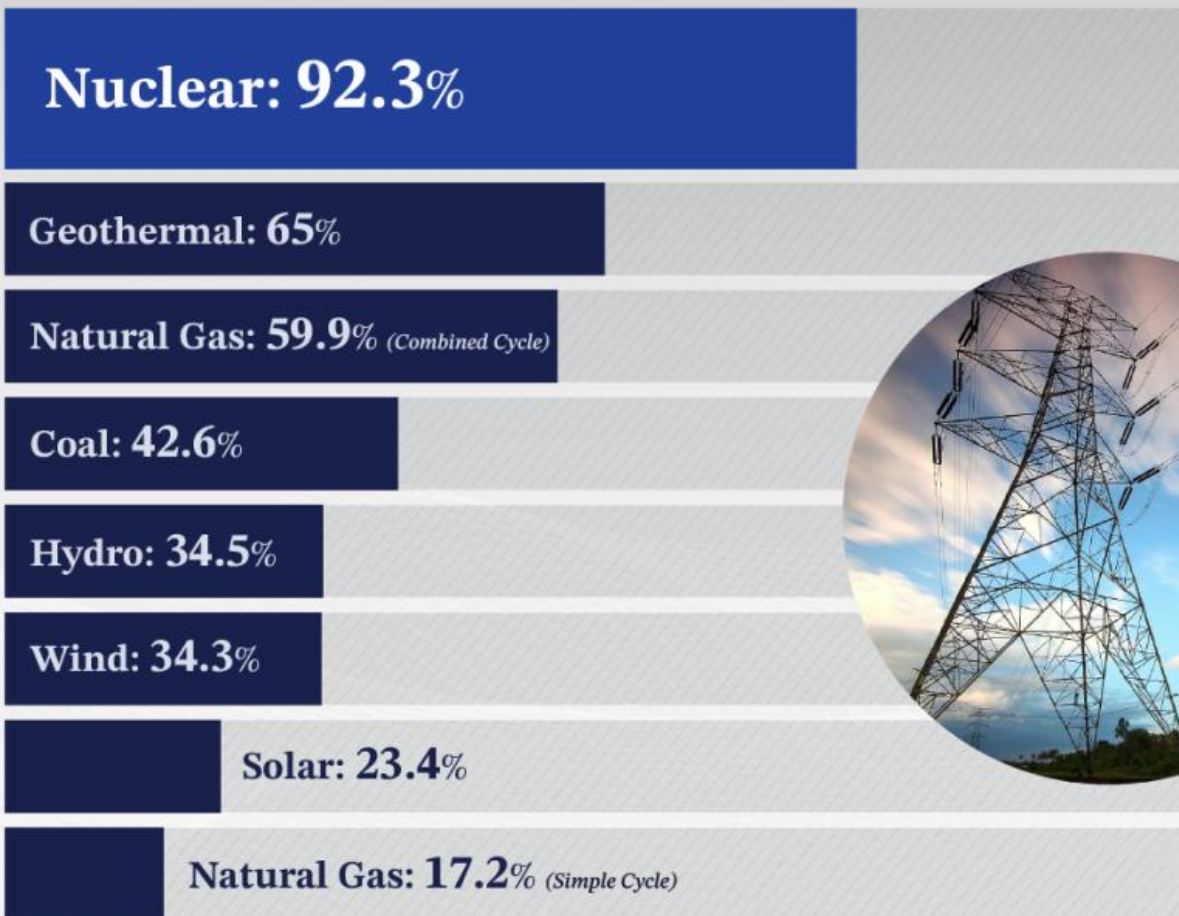


Data source: U.S. Energy Information Administration, [Form EIA-923, Power Plant Operations Report](#), Monthly Generation by State

Capacity Factor by Energy Source, 2024

Source: U.S. Energy Information Administration

Capacity factor measures a power plant's actual generation compared to the maximum amount it could generate in a given period without any interruption.



U.S. DEPARTMENT
of **ENERGY** | Office of
Nuclear Energy

energy.gov/ne



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Different Scales of Solar



10 kW home system



500 kW commercial system



3 MW Merchant Generator



20 MW grid-scale system

Residential & Commercial

- For on-site energy use
- Rooftop or mounted adjacent to structure
- Measured in kW
- Mature market – available guidance

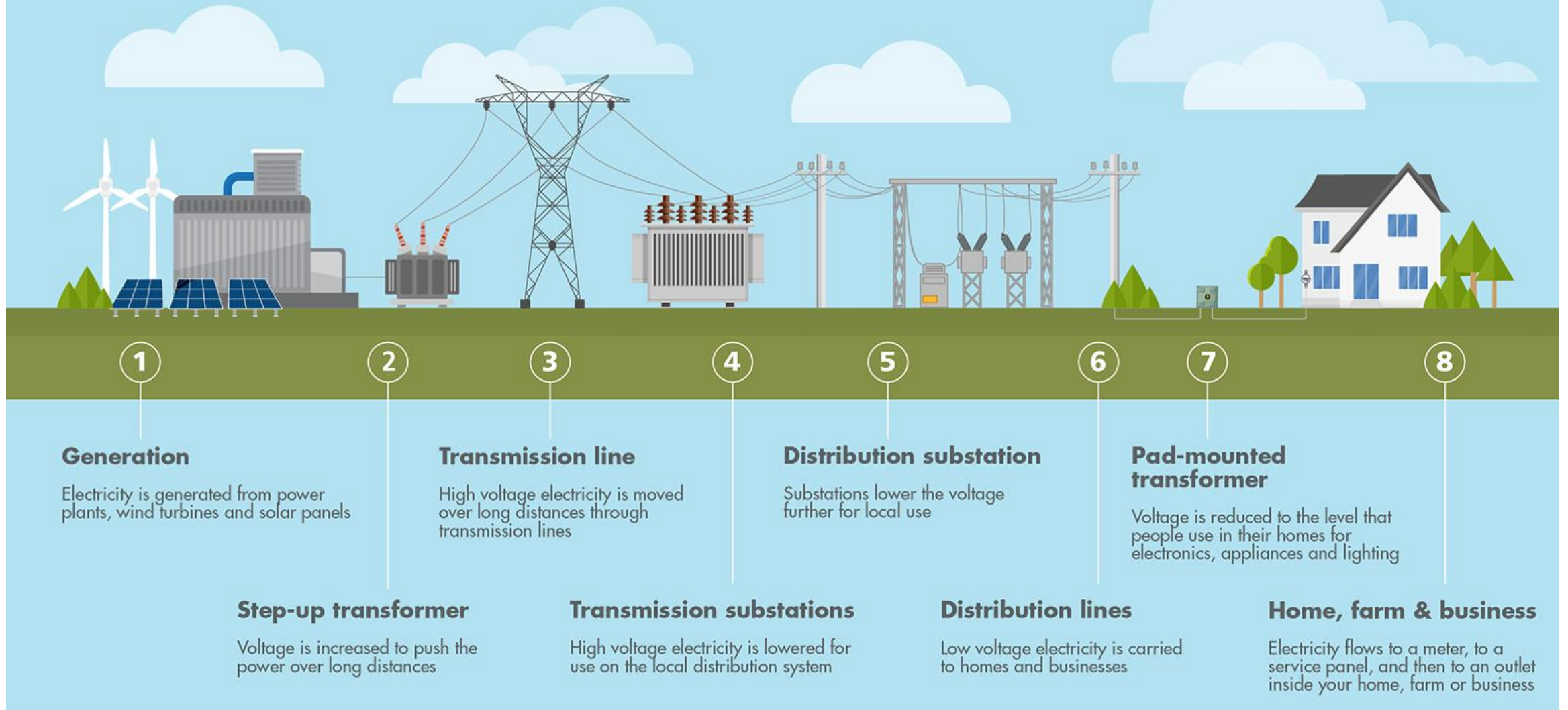
Large Net-Meter/Merchant Generator Community Solar

- For off-site energy use within community (distribution grid)
- Usually ground mounted requiring multiple acres but potential for rooftop or parking lot installations
- Measured in 100s of kW up to 3 MW
- Community Solar guidelines unclear – pending legislation

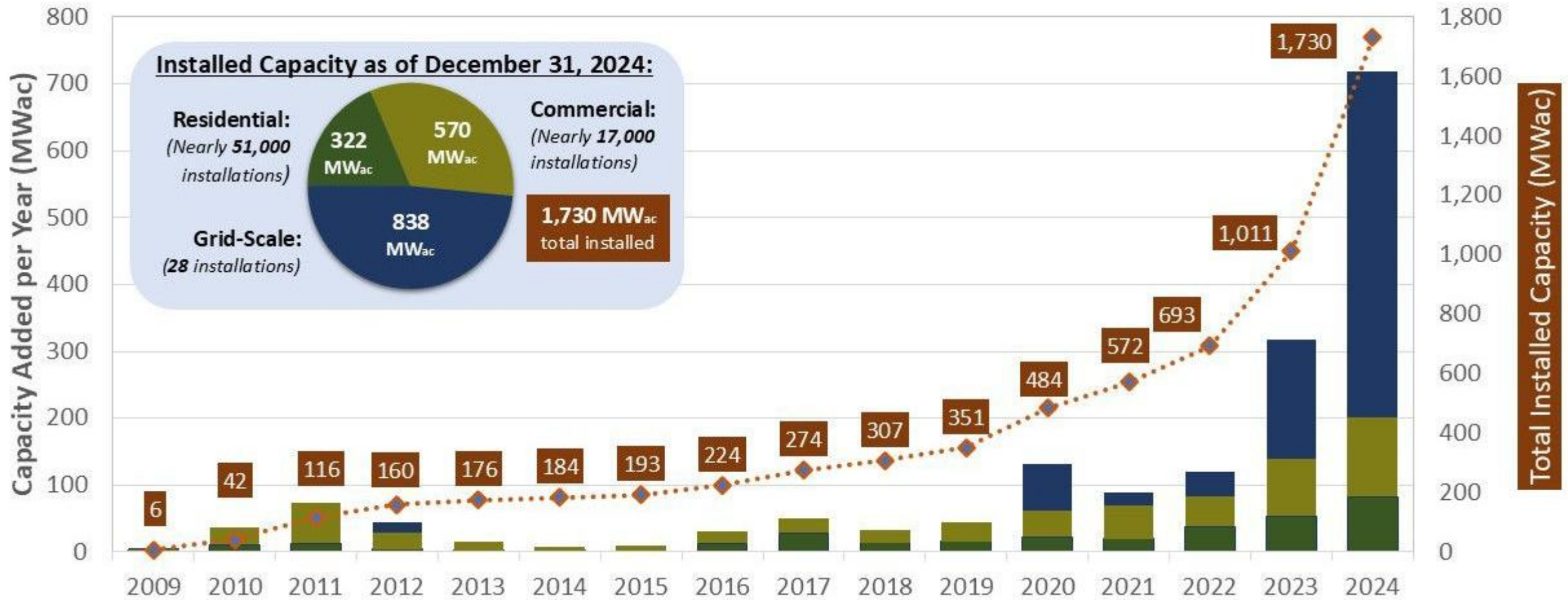
Grid-Scale Solar

- For off-site energy use distributed through transmission grid
- Ground mounted requiring significant acres to reach economies of scale
- Measured in MW

How electricity gets to you

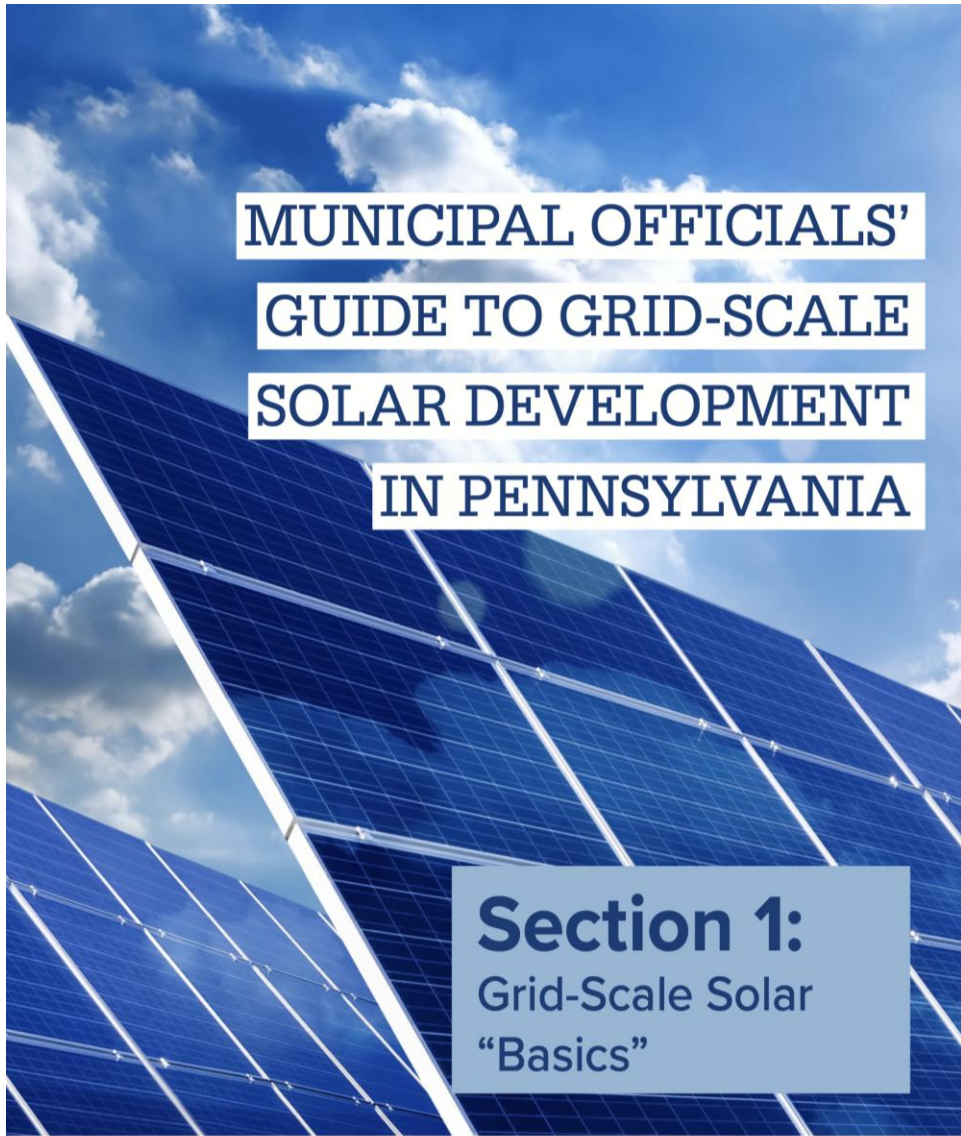


Pennsylvania Annual Solar Installations and Cumulative Capacity (MWac)



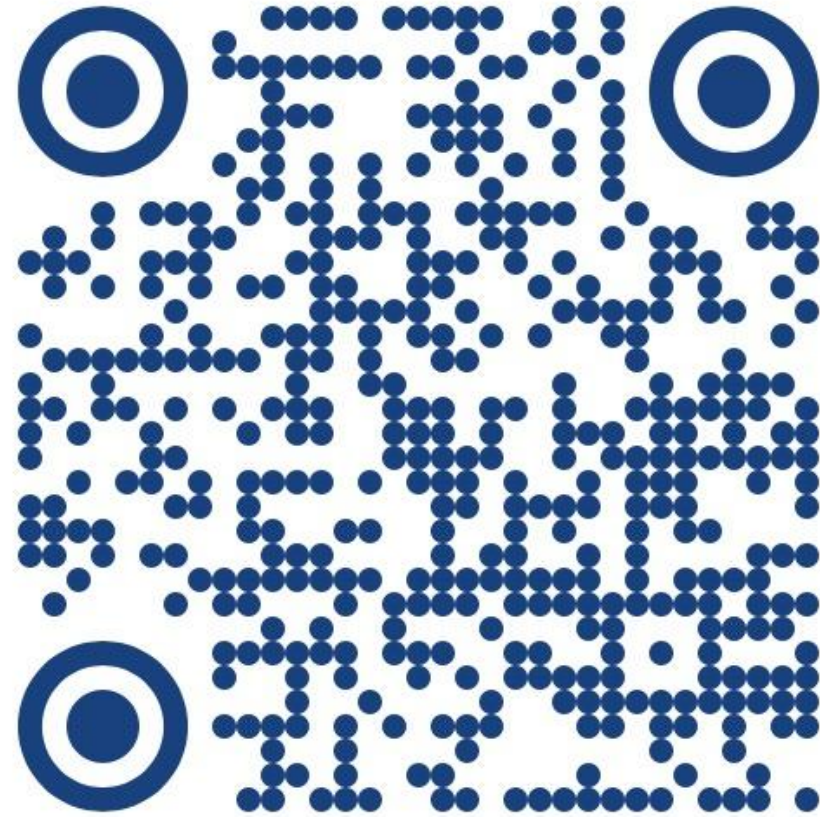
Pennsylvania Annual Solar Installations

Residential, Grid-Scale, and Commercial Solar Installations



Webinars/in-person meetings

Penn State Response



Reasons for Growth of Large-Scale Solar

There is enough sun in Pennsylvania

Large amounts of infrastructure exists

Policy (AEPS/IRA) and public pressure

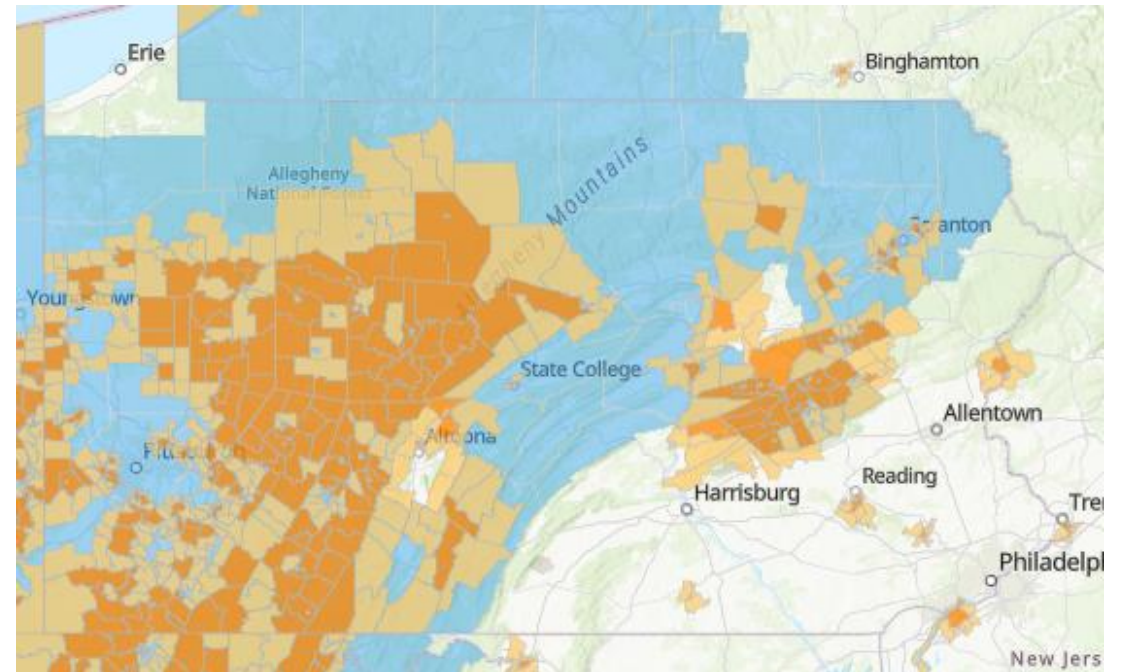
Business/Government development and investor support

Declining costs and the Inflation Reduction Act (IRA)

Investment Tax Credit (ITC)

		2006 to 2019	2020 to 2021	2022	2023 to 2033	
ITC	Full rate (if project meets labor requirements ^b)	Base Credit	30%	26%	30%	30%
		Domestic Content Bonus				10%
		Energy Community Bonus				10%
	Base rate (if project does not meet labor requirements ^b)	Base Credit	30%	26%	6%	6%
		Domestic Content Bonus				2%
		Energy Community Bonus				2%
	Low-income bonus (1.8 GW/yr cap)	<5 MW projects in LMI communities or Indian land				10%
		Qualified low-income residential building project / Qualified low-income economic benefit project				20%

Energy Communities



Chart/Map: U.S. DOE



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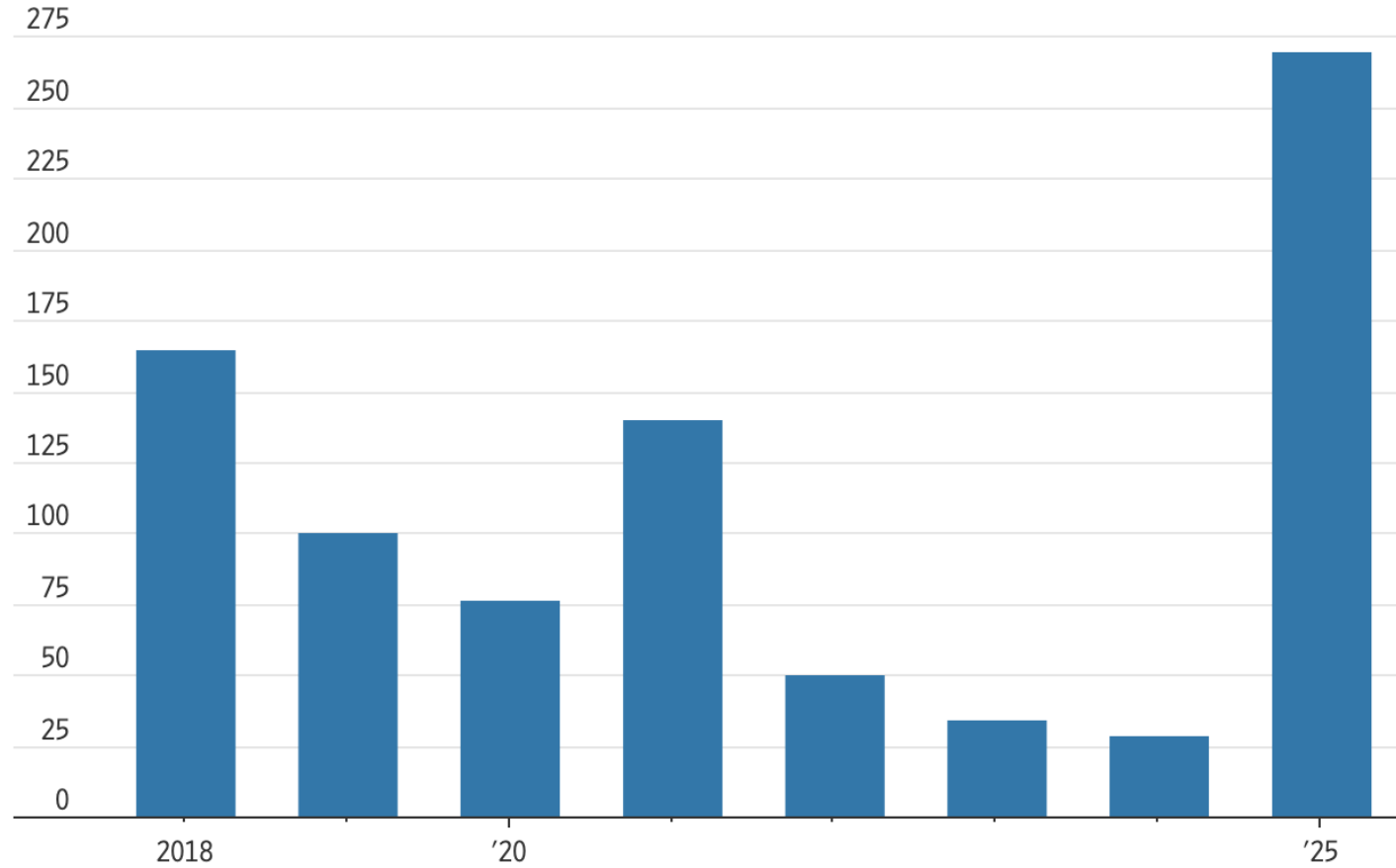
What is driving demand?

Electric demand projected to rise sharply

Electric Shock

PJM Interconnection's capacity prices for the majority of its footprint

\$300/ Megawatt-day

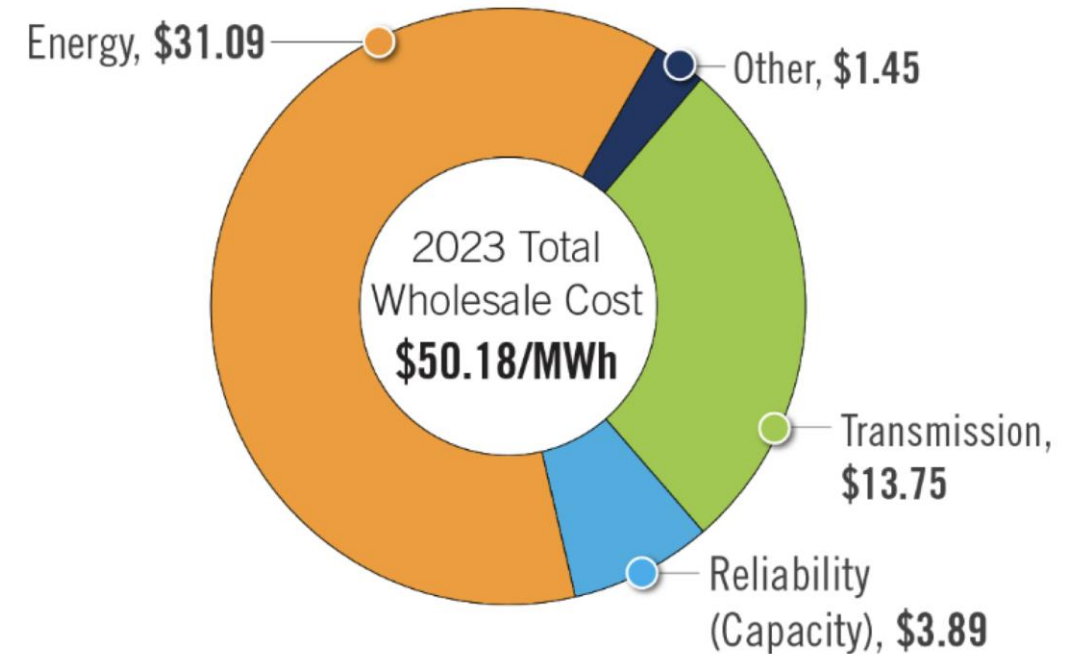


Source: PJM Interconnection

PJM Capacity Auction

- The PJM capacity auction, called the Base Residual Auction, procures power supply resources in advance of the delivery year to meet electricity needs in the PJM service area
- Auctions are usually held three years in advance of the delivery year. The next auction, for the 2026/2027 Delivery Year, is currently scheduled for December 2024
- The portion of wholesale electricity cost determined by the capacity market was 8% in 2023

Relative Size of Components of Wholesale Cost (2023)

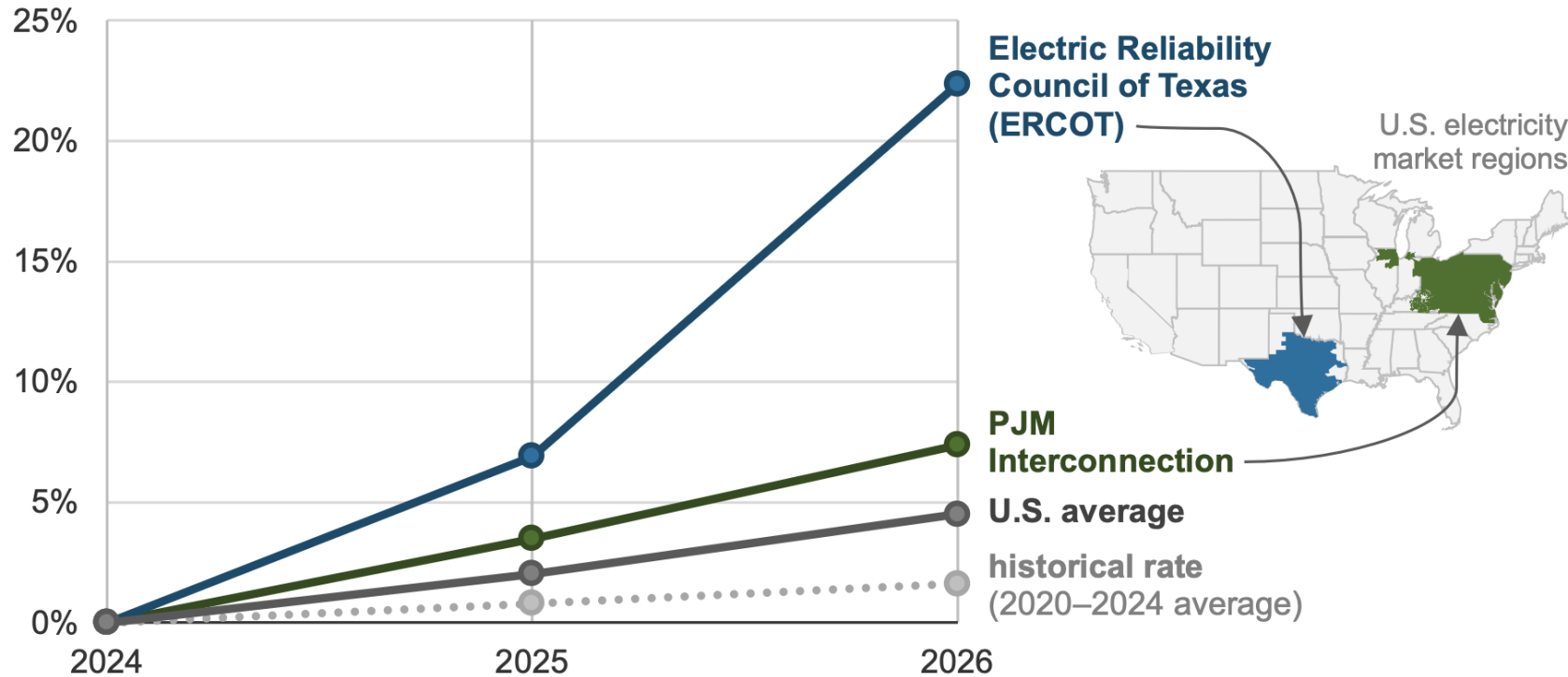


<https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/understanding-the-difference-among-pjms-markets.ashx#:~:text=PJM%27s%20capacity%20market%20secures%20enough,at%20the%20lowest%20reasonable%20price.>

What is Driving Electricity Demand?

Rapid Electricity Demand Growth TX & Mid-Atlantic

Forecast change in U.S. electricity sales to ultimate customers (2024–2026)
percentage change since 2024



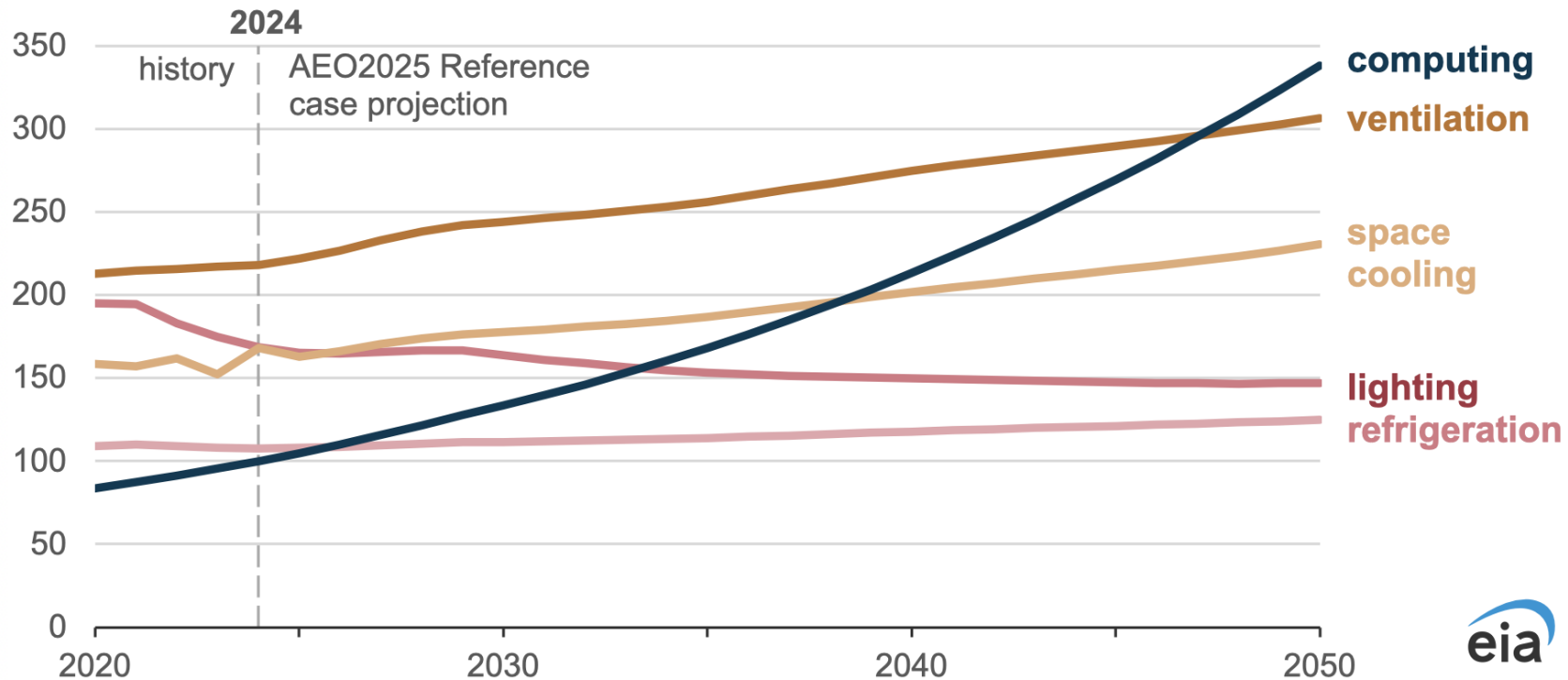
Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, July 2025

Data values: U.S. Regional Electricity Sales to Ultimate Customers and U.S. Regional Electricity Generation, Electric Power Sector

What is Driving Electricity Demand?

Skyrocketing Electricity Use for Commercial Computing

Electricity consumption of selected end uses in the U.S. commercial sector (2020–2050)
billion kilowatthours



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2025* Reference case
Data values: [Commercial Sector Key Indicators and Consumption](#)

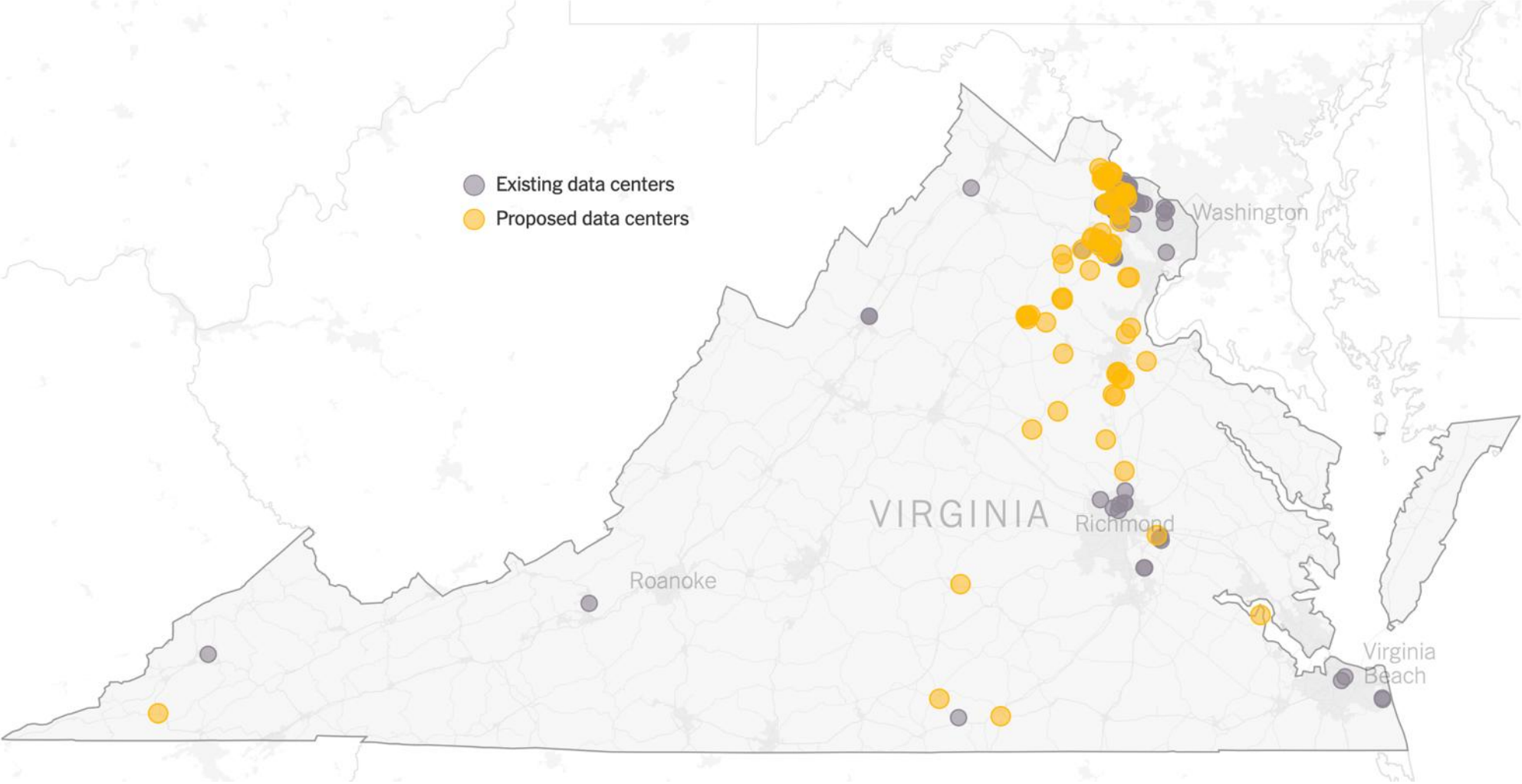
What is driving demand?

Data centers and industrial facilities driving growth

- Shockingly large increases in 5-year load growth expectations
- Other growth drivers, including building (heat pumps, water heaters) and transportation electrification (EV charging), tend to be less volatile and more impactful in the 2030s

	Data Centers	Industrial Facilities	Hydrogen Plants	Electrification
ERCOT	●	●		
PJM	●			
Duke Energy	●	●		
Georgia Power	●	●		
NYISO	●	●	●	●
Arizona Public Service	●	●		
CAISO				●
Portland General Electric	●	●		

In Virginia, power-hungry data centers are being approved at breakneck pace.





Article: A New Surge in Power Use Is Threatening U.S. Climate Goals

PJM Interconnection, which oversees the nation's largest regional grid, stretching from Illinois to New Jersey, is now expecting an additional 10,000 megawatts of demand by 2030 that wasn't forecast last year.

That's akin to adding another New York City to the system.

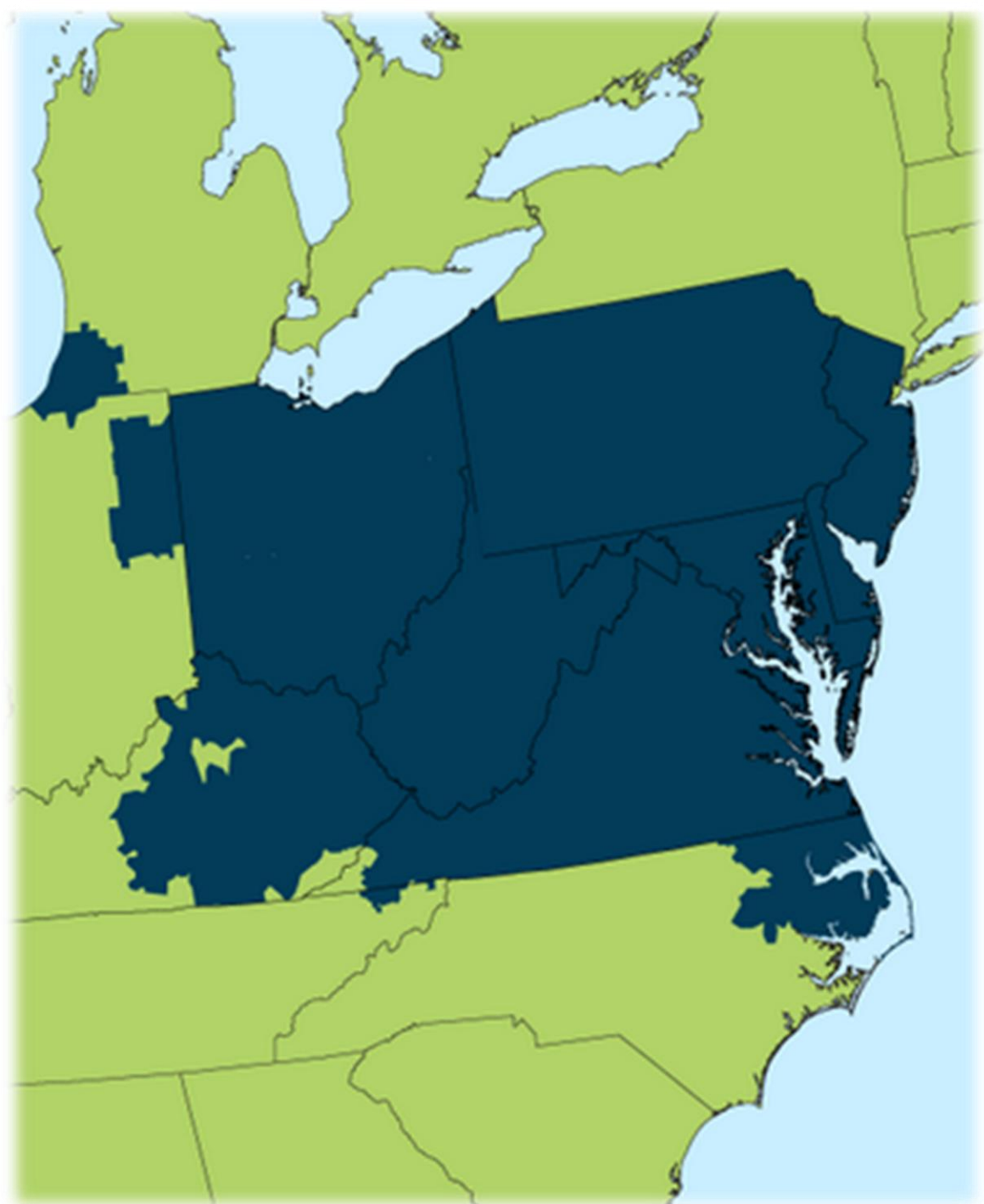
New York Times March 2024



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Utility-Scale & Net-Metering

Joseph Conklin- juc50@psu.edu



PJM

PJM is a regional transmission organization that coordinates wholesale energy movement in this region. As such, they look at energy development projects through feasibility, capacity, impact, facilities, interconnection, and market participation.

Status of PJM

PJM is the largest system operator in the United States

Inundation of projects led to Federal Energy Regulatory Commission intervention

Allow time for verifying projects in the interconnection queue

Projects have been delayed

Created opportunities for projects connected at the distribution level

Generation Interconnection Requests by Fuel Type

As of 3:01 p.m. EPT

All Fuels | Renewables

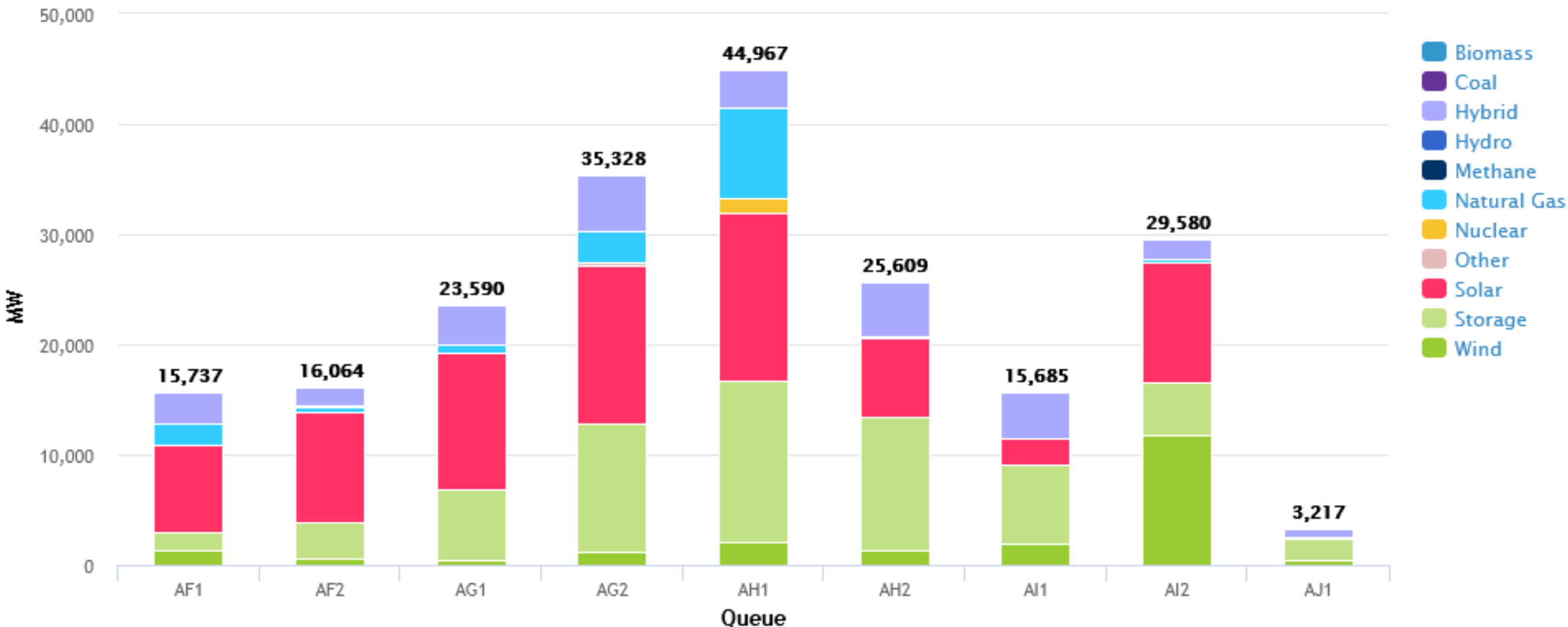


Chart: PJM– Aug. 2025

PJM Queues Timeline- August 2025

Cycle Timeline

As of 7.22.2025 9:36 a.m. EPT

Interconnection Cycle Study Timeline									
Phase	Transition Cycle 1			Transition Cycle 2			Cycle 01		
	Start Date	End Date	Duration	Start Date	End Date	Duration	Start Date	End Date	Duration
Fast Lane End Date <i>executed by Developer & TO OR filed unexecuted</i>	12/15/2023	4/18/2025							
Application Deadline	N/A	N/A	N/A	12/17/2024	12/17/2024	0	4/24/2026	4/24/2026	0
Application Review	N/A	N/A	N/A	12/18/2024	7/6/2025	201	4/27/2026	7/25/2026	90
Model Posting	2/1/2024	2/1/2024	0	6/6/2025	6/6/2025	0	6/27/2026	6/27/2026	0
Phase I	1/22/2024	5/21/2024	120	7/7/2025	9/24/2025	80	7/27/2026	11/23/2026	120
Decision Point I	5/22/2024	6/20/2024	30	9/25/2025	10/24/2025	30	11/24/2026	12/23/2026	30
Phase II	6/21/2024	12/20/2024	182	10/27/2025	4/24/2026	180	12/24/2026	6/21/2027	180
Decision Point II	12/23/2024	1/21/2025	30	4/27/2026	5/26/2026	30	6/22/2027	7/21/2027	30
Phase III	4/21/2025	9/19/2025	152	5/27/2026	11/22/2026	180	7/22/2027	1/17/2028	180
Decision Point III	9/22/2025	10/21/2025	30	11/23/2026	12/22/2026	30	1/18/2028	2/16/2028	30
Final Agreement	9/22/2025	11/20/2025	60	11/23/2026	1/21/2027	60	1/18/2028	3/17/2028	60

Notes:

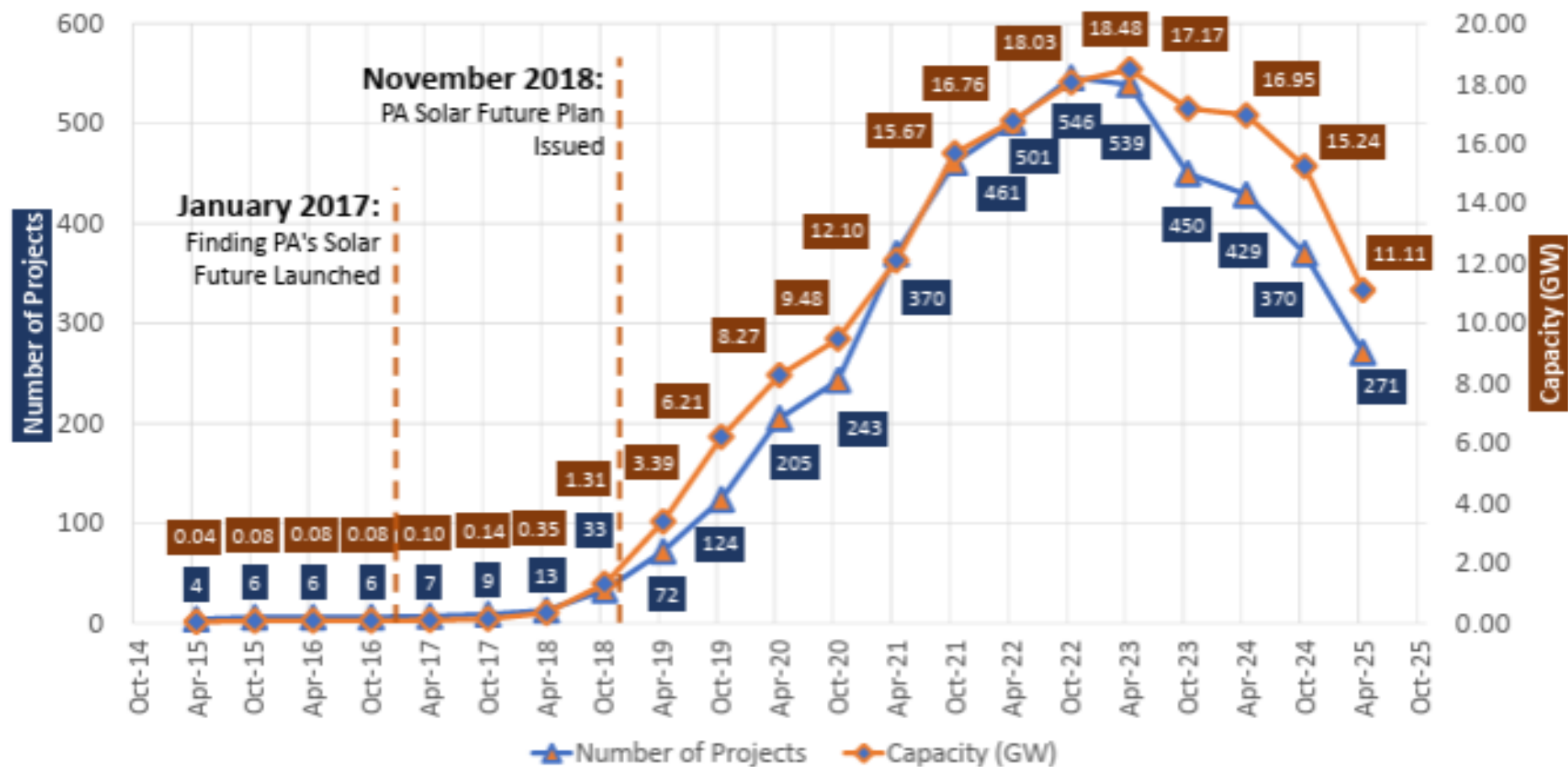
- **Transition Cycle #1 Phase 3** cannot formally start until Fast Lane is officially closed out. PJM will begin preparatory work activities for Phase 3 SIS in March 2025.
- **Transition Cycle #2 Phase 1** start date is dependent on Transition Cycle #1 DP2 close, Transition Cycle #2 Review completion and Transition Cycle #2 Model being posted for 30 days
- **Transition Cycle #2 Phase 2** start date is dependent on Transition Cycle #1 DP3 close
- **Transition Cycle #2 Phase 3** start date is dependent on Transition Cycle #1 GIAs executed or filed unexecuted
- **Cycle #1 Phase 1** start date is dependent on Transition Cycle #2 DP2 close, Cycle #1 Review completion and Cycle #1 Model being posted for 30 days
- **Cycle #1 Phase 2** start date is dependent on Transition Cycle #2 DP3 close
- **Cycle #1 Phase 3** start date is dependent on Transition Cycle #2 GIAs executed or filed unexecuted

Legend

Actual date

Projected date

Active Projects in PJM New Services Queue in Pennsylvania



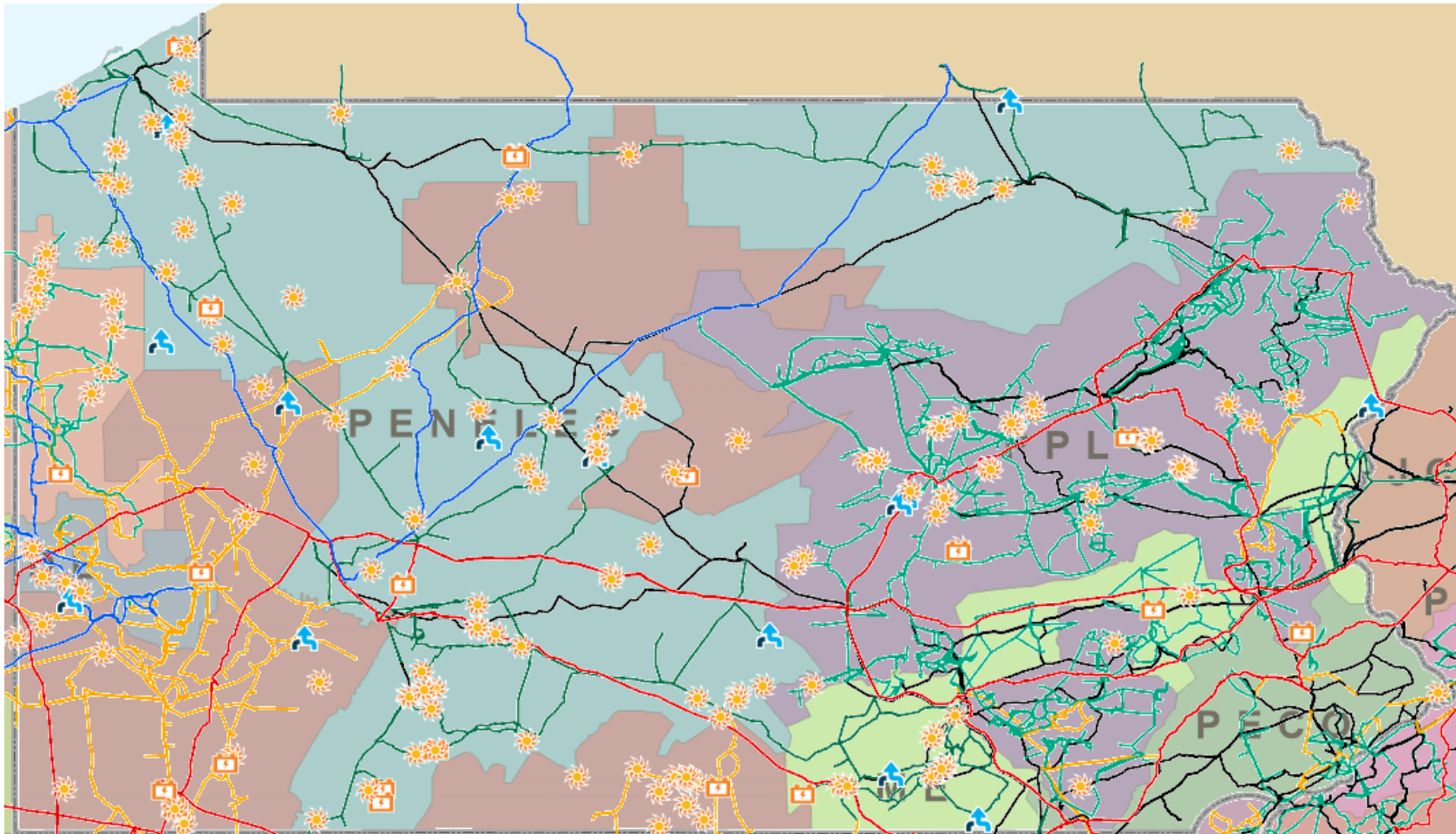
Data from PJM New Services Queue (03/21/2025)

with additional DEP analysis

<https://www.pjm.com/planning/service-requests/serial-service-request-status>



PJM Solar/Storage Interconnection Requests



Map/Chart: PJM August 2025

Large Net Metering--Public Utility Commission (PUC)

Allows for net-metering projects up to 3 MW

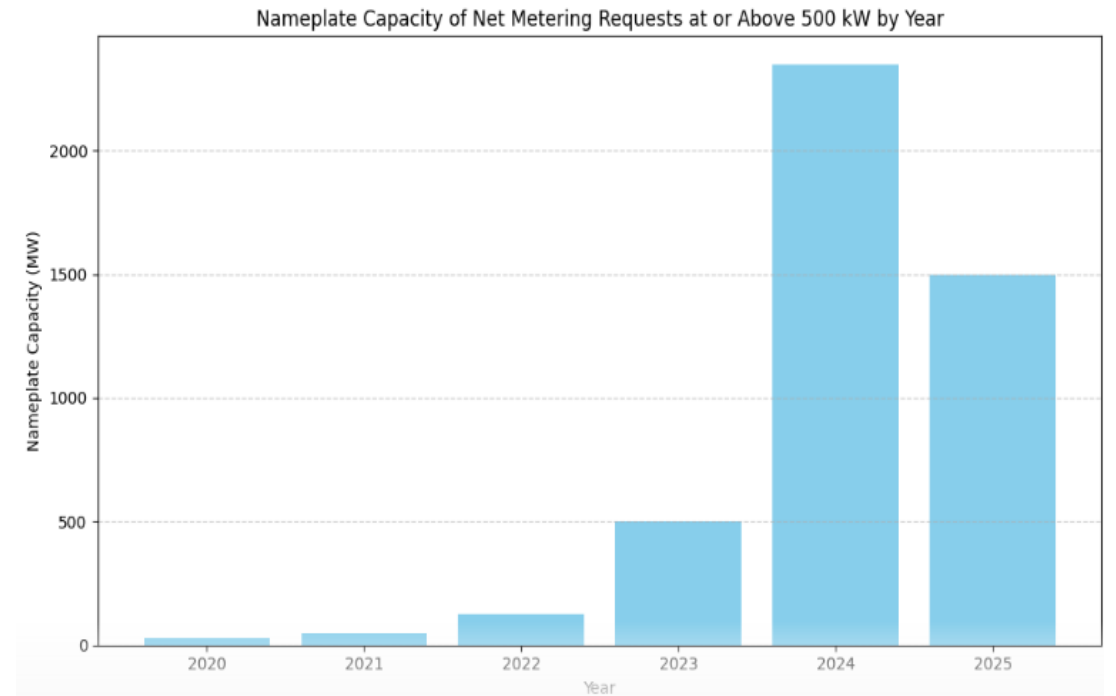
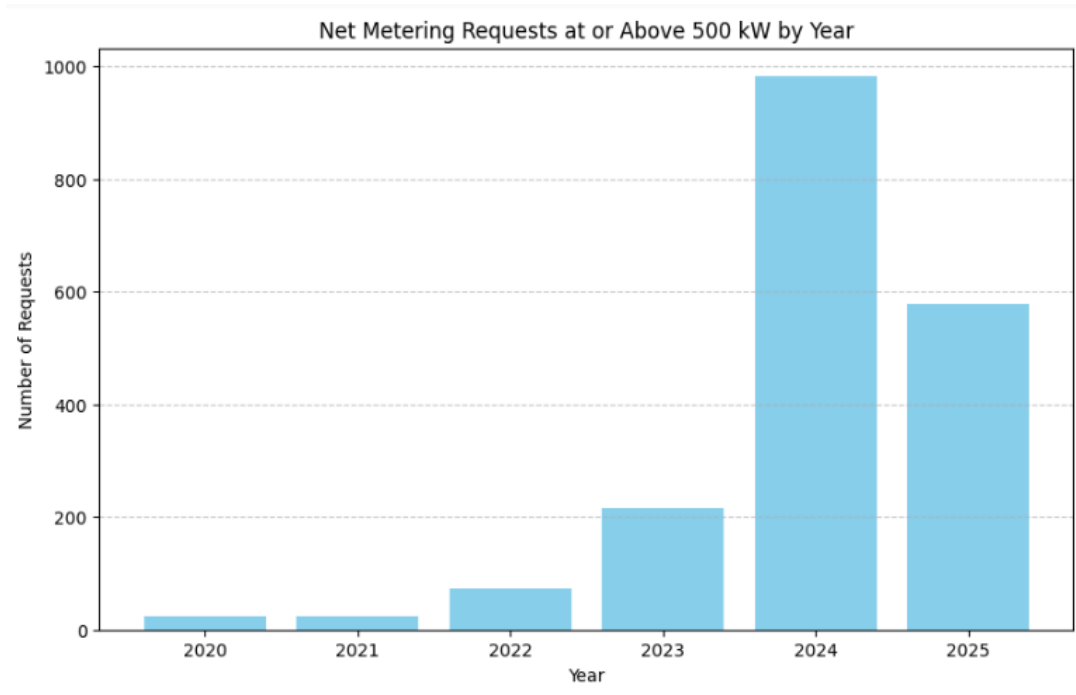
Projects are not required to have an onsite load- Merchant Requests

Projects can be adjacent to one another with separate meters

Substantial increase in Merchant Requests

Reviewed by PUC and local utility not PJM

Large Net-Metering in Pennsylvania



Large Net Metering in Pennsylvania

Status of Large Net Metering Projects Through 5/31/24				
Status	Projects		kW	
Approved; Not Yet Online	128	20%	319,172	20%
Cancelled by Customer	64	10%	163,685	10%
Online	4	1%	3,620	0%
Under Review	459	70%	1,089,811	69%
Total	655	100%	1,576,288	100%

- Some projects leaving PJM then appearing on PUC side
- Typically 2 years from approval to online
- Delays or increased revenues?



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Understanding H.R. 1 and Solar Energy

The *One Big Beautiful Bill Act* (H.R. 1), signed July 4, 2025, impacts solar energy projects

Tax credits existed before but were bolstered by the Inflation Reduction Act (IRA)



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Key Solar Energy Changes in H.R. 1

Accelerated Phase-Out of Solar Tax Credits

- H.R. 1 ends 45Y (Production Tax Credit) and 48E (Investment Tax Credit) for solar projects not in service before December 31, 2027.
- Projects starting construction before July 5, 2026, are exempt from this termination date—safe harbor.
- 25D Residential Clean Energy Credit ends 30% credit December 31, 2025.



Foreign Entity Restrictions

Restrictions on Foreign Components

H.R. 1 adds “Foreign Entity of Concern” (FEOC) rules for solar projects

Projects starting after December 31, 2025, must prove components (e.g., panels) are not from a Prohibited Foreign Entity (PFE)

At least 40% of manufactured products not from a PFE starting in 2026 then increasing to 60% by 2030.

Lightning Plan



Photo: Pennsylvania Capital-Star

- **RESET**-Reliable Energy Siting and Electric Transition Board(25 MW)
- **PRESS**-Pennsylvania Reliable Energy Sustainability Standard increase Tier 1 to 35% by 2035.
- **Community Energy Act (504)**- Expanded beyond solar to include digesters and geothermal
 - Operate and bill subscribers
 - Interconnection stipulations
- RGGI?

Other Legislative Themes

Decommissioning

Require detailed decommissioning plans and financial assurances to cover the cost of removal and restoring the site

Net-Metering

Concerns have been expressed about allowing retail rate for the Merchant Generator projects.

Data Centers

Flurry of legislative activity including expediting permitting and standardizing zoning.

Siting Board?

- **Governor Shapiro has proposed the RESET Energy Facility Siting Board:** The Governor is proposing the Pennsylvania Reliable Energy Siting and Electric Transition (RESET) Board to speed up permitting, reduce red tape, and support the next generation of energy projects in the state.
 - "...to handle siting decisions for key energy projects"
 - Presumably needs legislative support in order to have decision-making power?

The Future of Merchant Generator solar in PA?

- Investor-Owned Utilities don't like it
- PUC does not appear to like it
- It would take legislative action to change this
 - We're not seeing much legislative action on energy (yet)
- Governor may not sign off on this if legislative is taken – unless there is a compromise (like community solar)

Other Legislation that may be introduced:

- Community Solar
 - What is it, how is it different from Merchant Generator solar
- Decommissioning
 - Performance Bonds...



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Siting & Zoning Considerations for Solar

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Large-Scale Solar Land Use

5-8 acres per MW

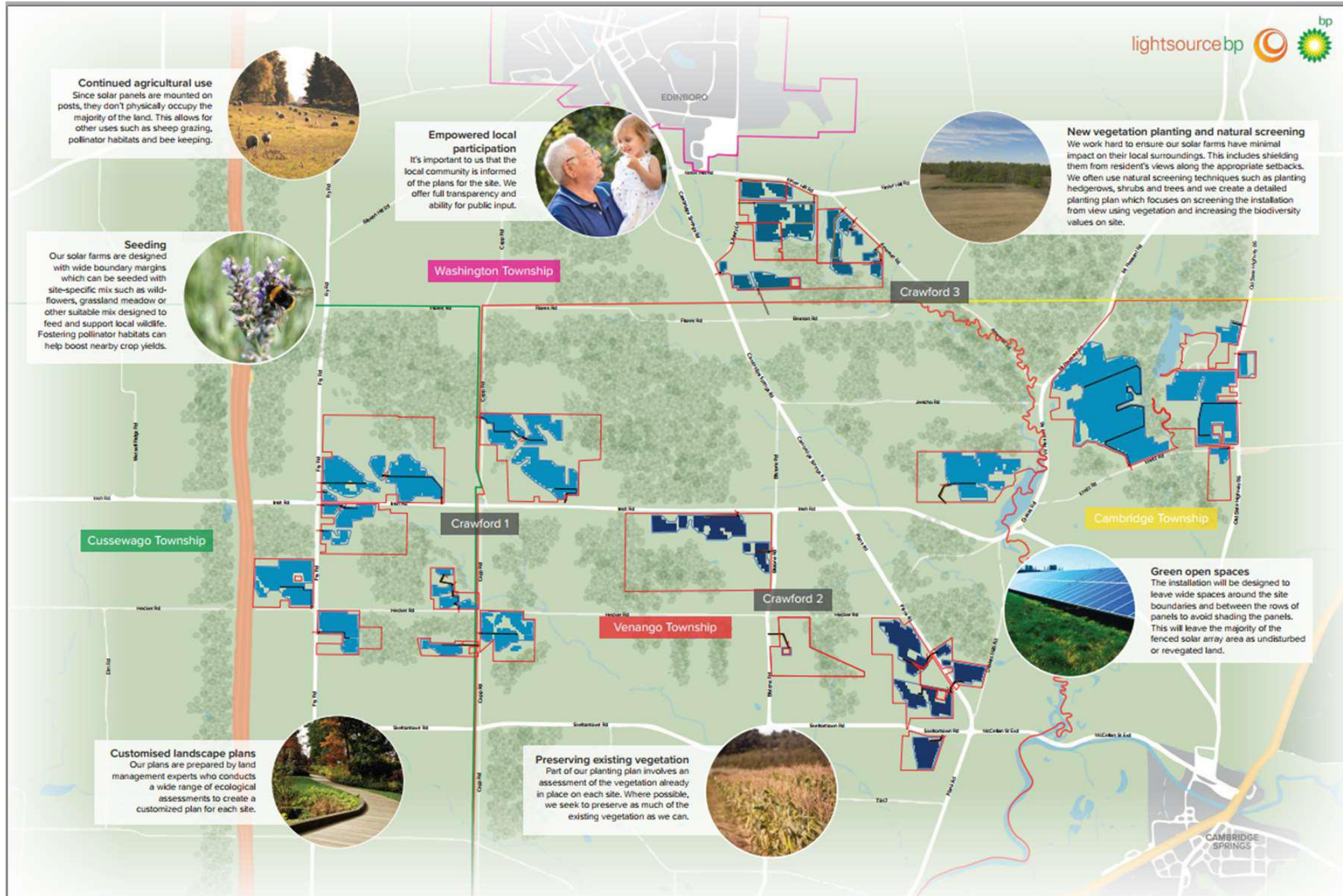
Utility-Scale Solar—20 MW

Net Metering 0.5-3 MW

Community Solar ? MW

Landowner Choice for Distributed Scale

Example Project: Shorebird Solar



Continued agricultural use
Since solar panels are mounted on posts, they don't physically occupy the majority of the land. This allows for other uses such as sheep grazing, pollinator habitats and bee keeping.



Empowered local participation
It's important to us that the local community is informed of the plans for the site. We offer full transparency and ability for public input.



New vegetation planting and natural screening
We work hard to ensure our solar farms have minimal impact on their local surroundings. This includes shielding them from resident's views along the appropriate setbacks. We often use natural screening techniques such as planting hedgerows, shrubs and trees and we create a detailed planting plan which focuses on screening the installation from view using vegetation and increasing the biodiversity values on site.



Seeding
Our solar farms are designed with wide boundary margins which can be seeded with site-specific mix such as wildflowers, grassland meadow or other suitable mix designed to feed and support local wildlife. Fostering pollinator habitats can help boost nearby crop yields.



Cussewago Township

Washington Township

Crawford 3

Crawford 1

Cambridge Township

Crawford 2

Venango Township

Green open spaces
The installation will be designed to leave wide spaces around the site boundaries and between the rows of panels to avoid shading the panels. This will leave the majority of the fenced solar array area as undisturbed or revegetated land.



Customised landscape plans
Our plans are prepared by land management experts who conducts a wide range of ecological assessments to create a customized plan for each site.



Preserving existing vegetation
Part of our planting plan involves an assessment of the vegetation already in place on each site. Where possible, we seek to preserve as much of the existing vegetation as we can.



CAMBRIDGE SPRINGS

- Crawford / Erie Counties
- 3 Phases
- 2 Counties / 4 Townships
- 156 MW total capacity
- 900-1,000 acres developed

Sources:

Venango Township Meeting Presentation (11/20/21) <https://venangotwp.org/crawford-solar-project-by-lightsource-bp/>
GoErie.com Article (10/5/21): <https://www.goerie.com/story/news/local/2021/10/05/solar-energy-project-planned-former-seminary-property-girard-erie-county/5987887001/>

Example of 3 MW projects being proposed adjacent to each other

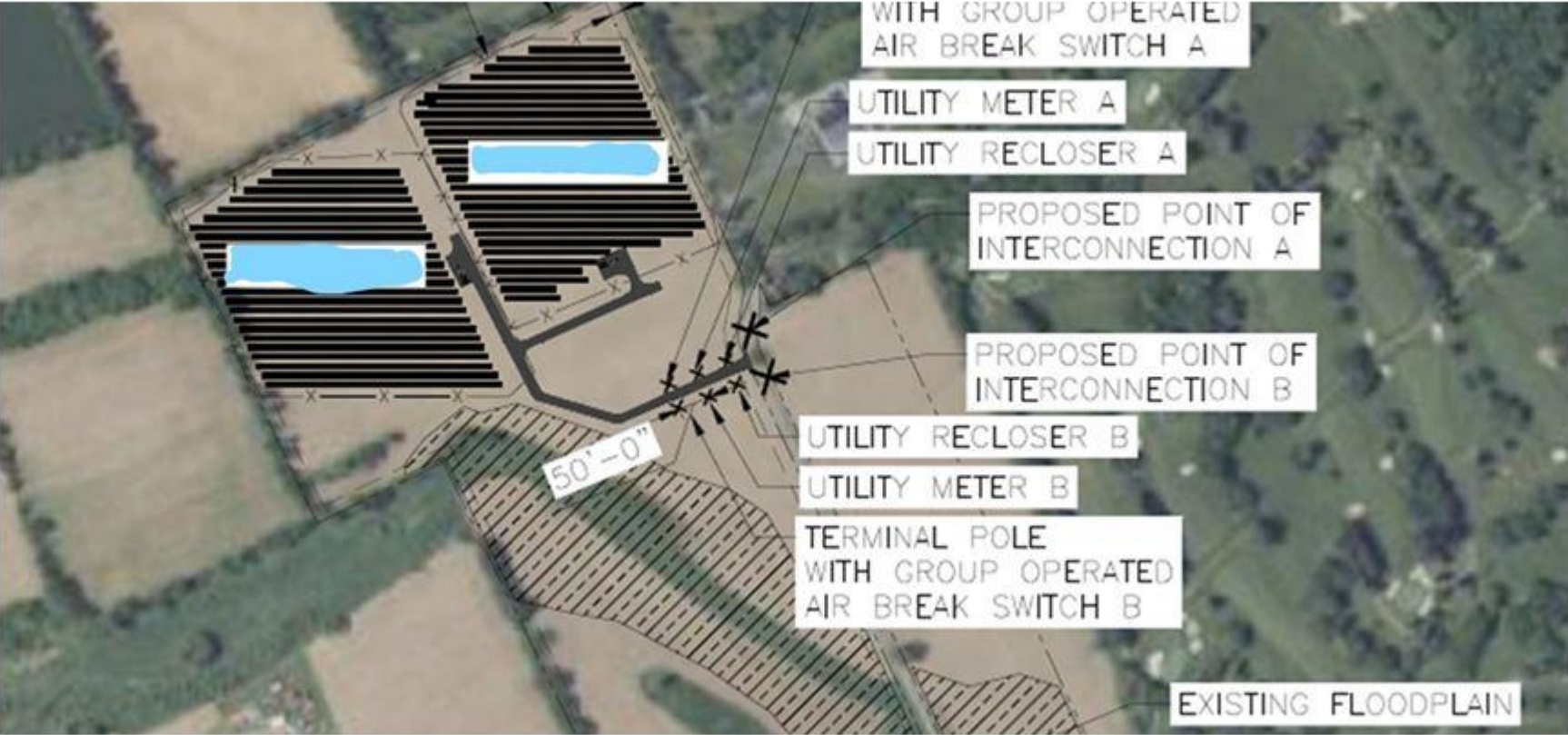
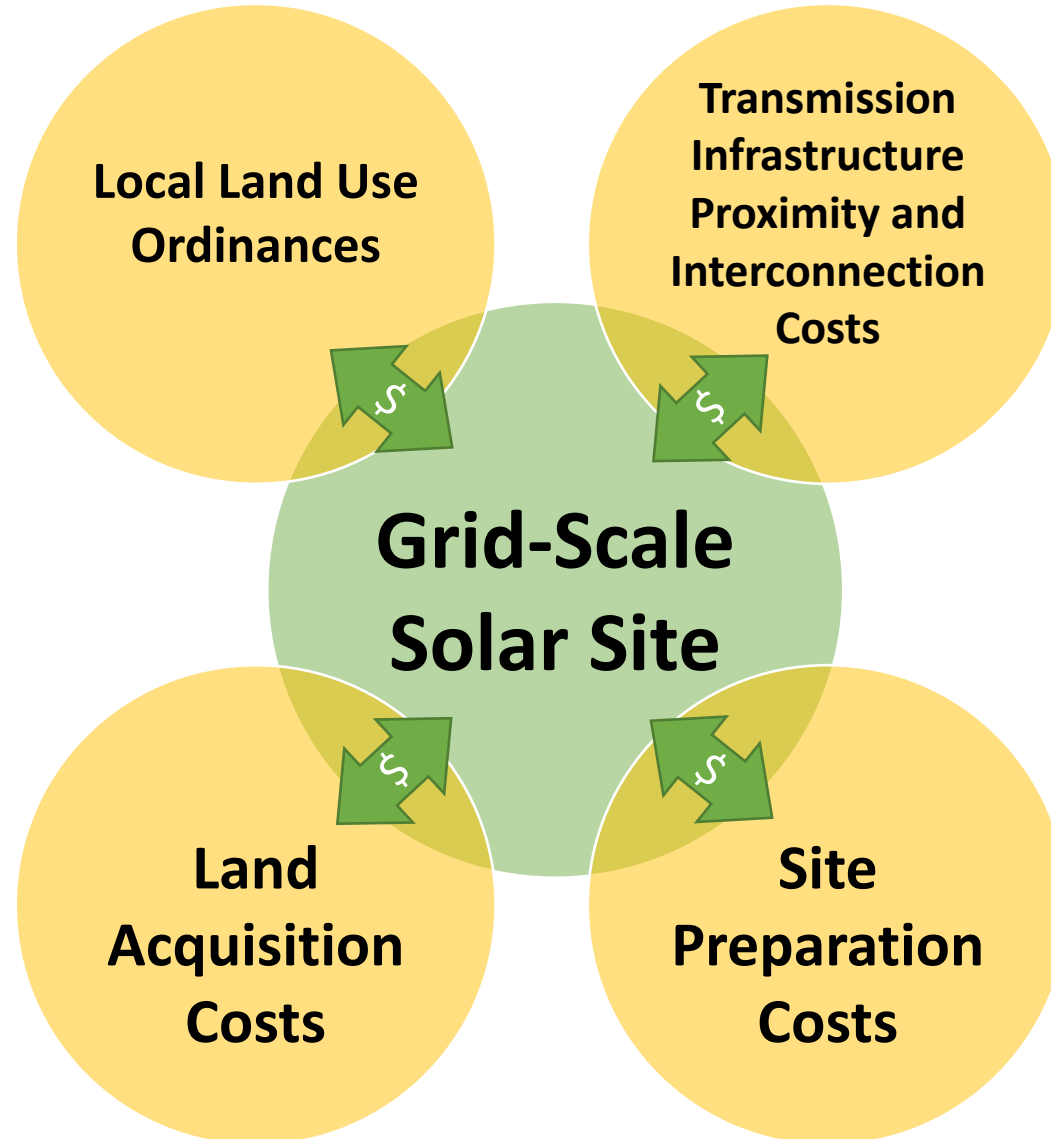


Photo: PA PUC

Grid-Scale Solar Site Selection Considerations

- Where does the community stand on grid-scale solar development?
- Final siting authority rests at local government level



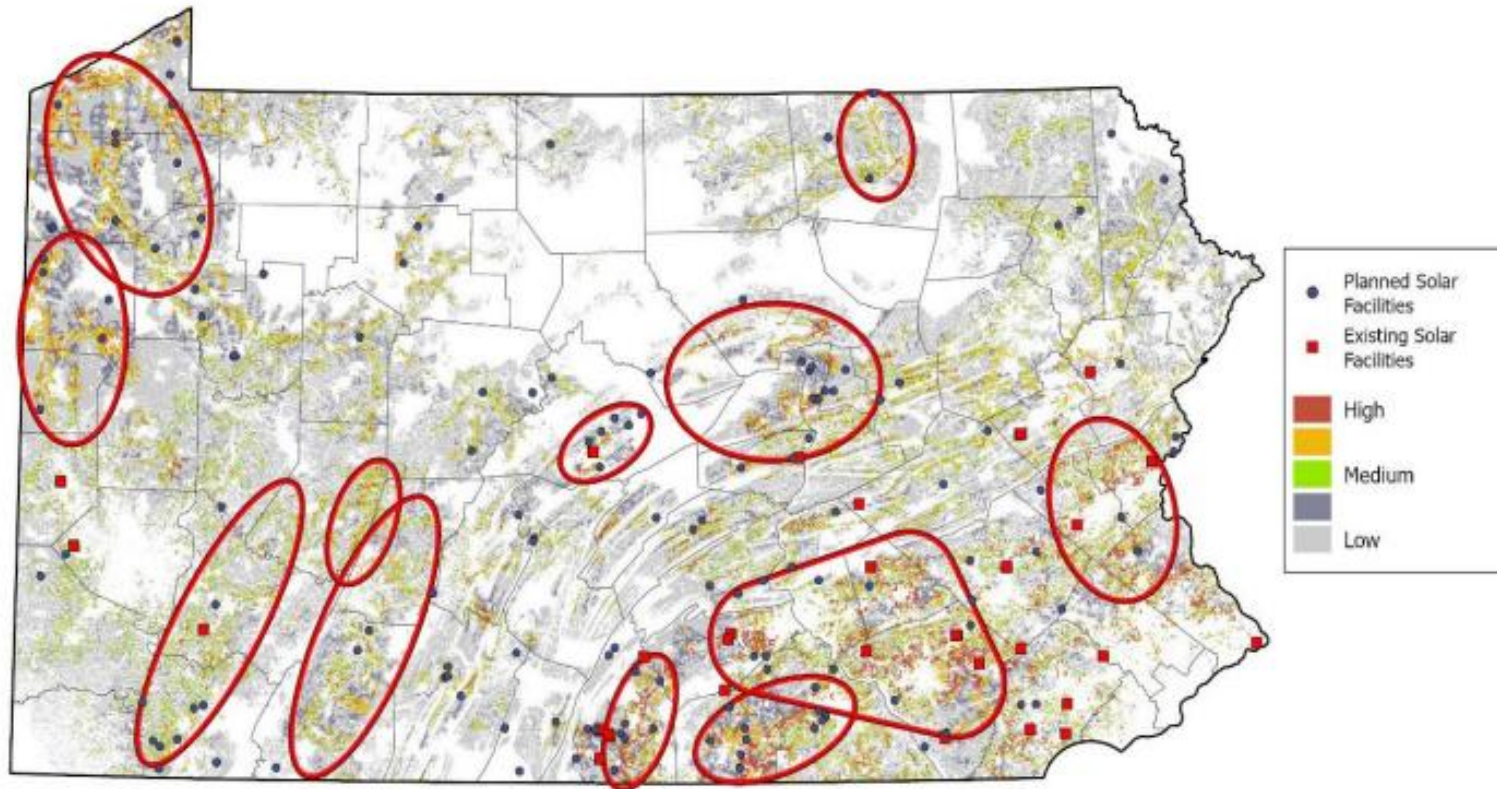
- Developer responsible for costs to tie into transmission system as well as any upgrades to lines, substations, etc.

- Productive agricultural land vs. previously impacted sites with lower economic value

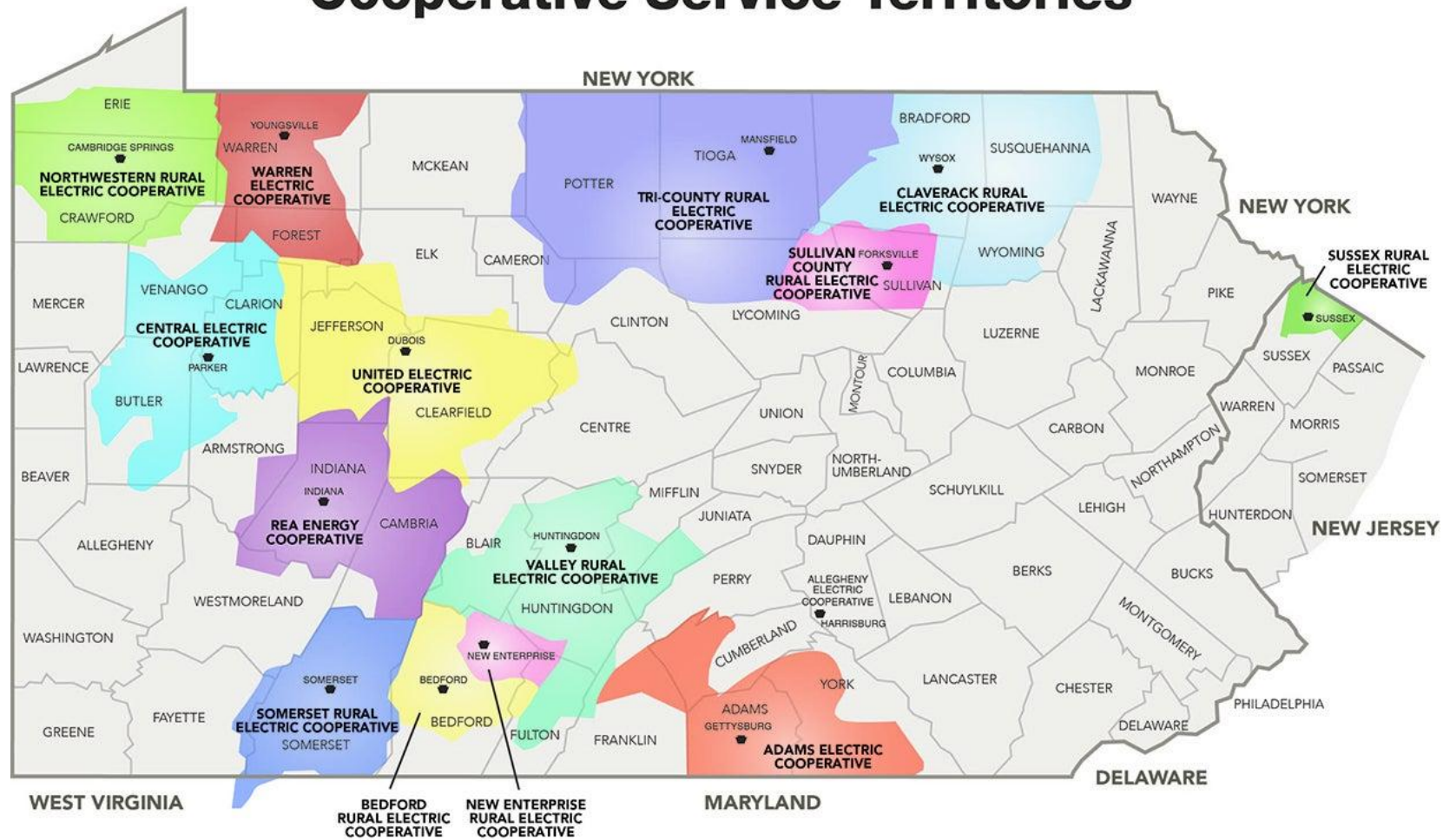
- “Shovel-ready” greenfield site vs. land requiring significant reclamation and/or grading activities

Center for Rural PA's Most Likely Areas for Utility Scale Solar

Figure 9: Regions Most Likely to Experience Utility-Scale Solar Development Pressure



Pennsylvania/New Jersey Electric Cooperative Service Territories



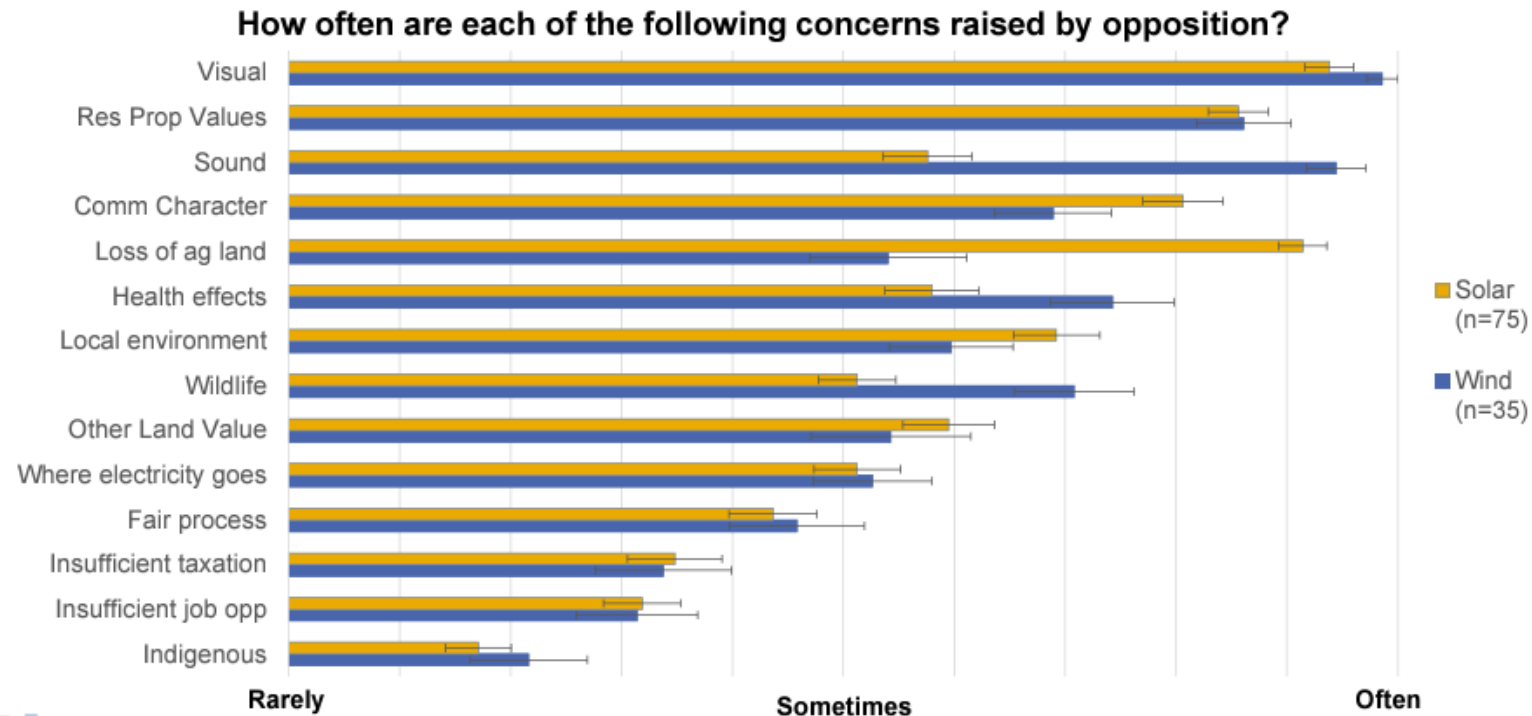
• Source: <https://www.prea.com/member-cooperatives>

LEGEND

■ Cooperative Headquarters

Concerns About Solar

Developers report visual concerns to be the most common for both wind and solar, followed by sound for wind and loss of farm land for solar



American Farmland Trust

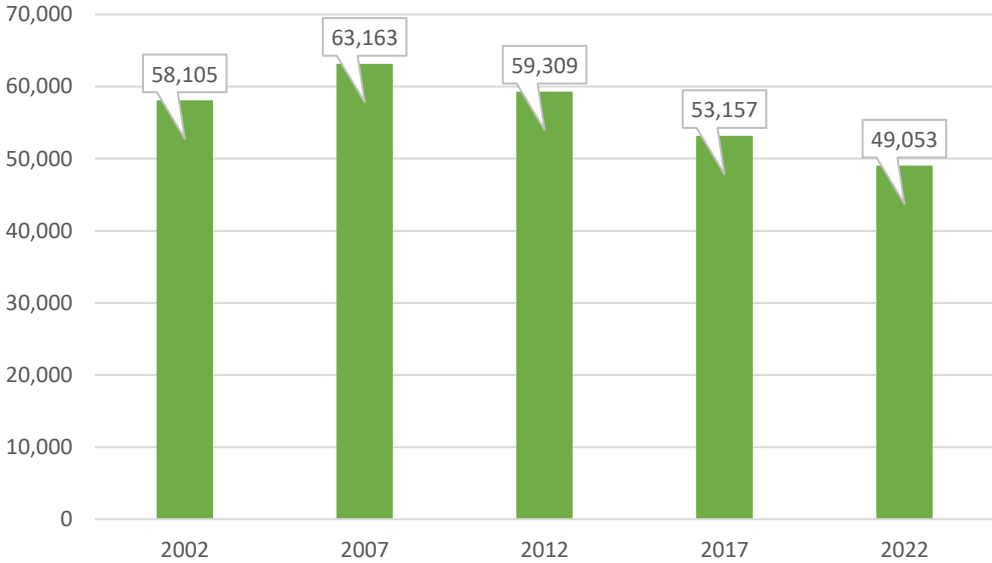
Census of Agriculture

Table 3. Acres of state agricultural land projected to be under solar installations or converted to development (UHD and LDR) by 2040.

State	Acres to Solar	Acres to UHD and LDR (BAU)
Pennsylvania	11,800	543,800
Maryland	28,200	178,200
Virginia	45,900	594,100
Delaware	5,400	65,100
Texas	345,200	2,192,700
California	311,200	797,400

Chart: Data from American Farmland Trust

Number of Farms 2002-2022



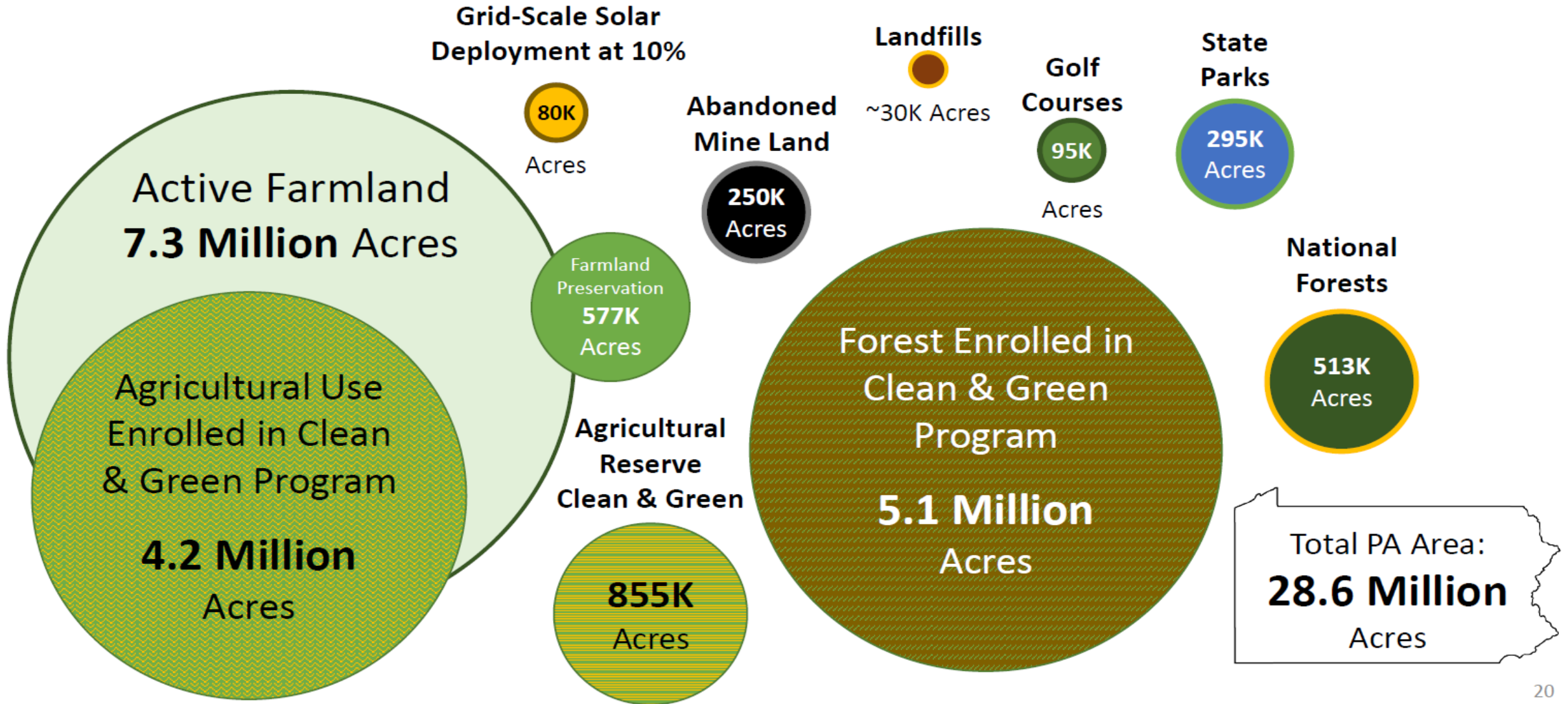
2017	2022
53157 Farms	49053 Farms
7,2786,68 ACRES	7,058,325 Acres

Graph/Data- USDA 2022 Ag Census

Examples of Social Perspective on Solar

- Size of the projects and their compatibility with current farming operations are important
- Local benefits beyond the landowner are considered
- Property rights and opportunities for diversified income are important to farmers
- Concerns exist for tenant farmers or those in the agritourism industry

Land Use Comparison



Zoning in Pennsylvania

Controls the land uses in a community and may be used to restrict uses.

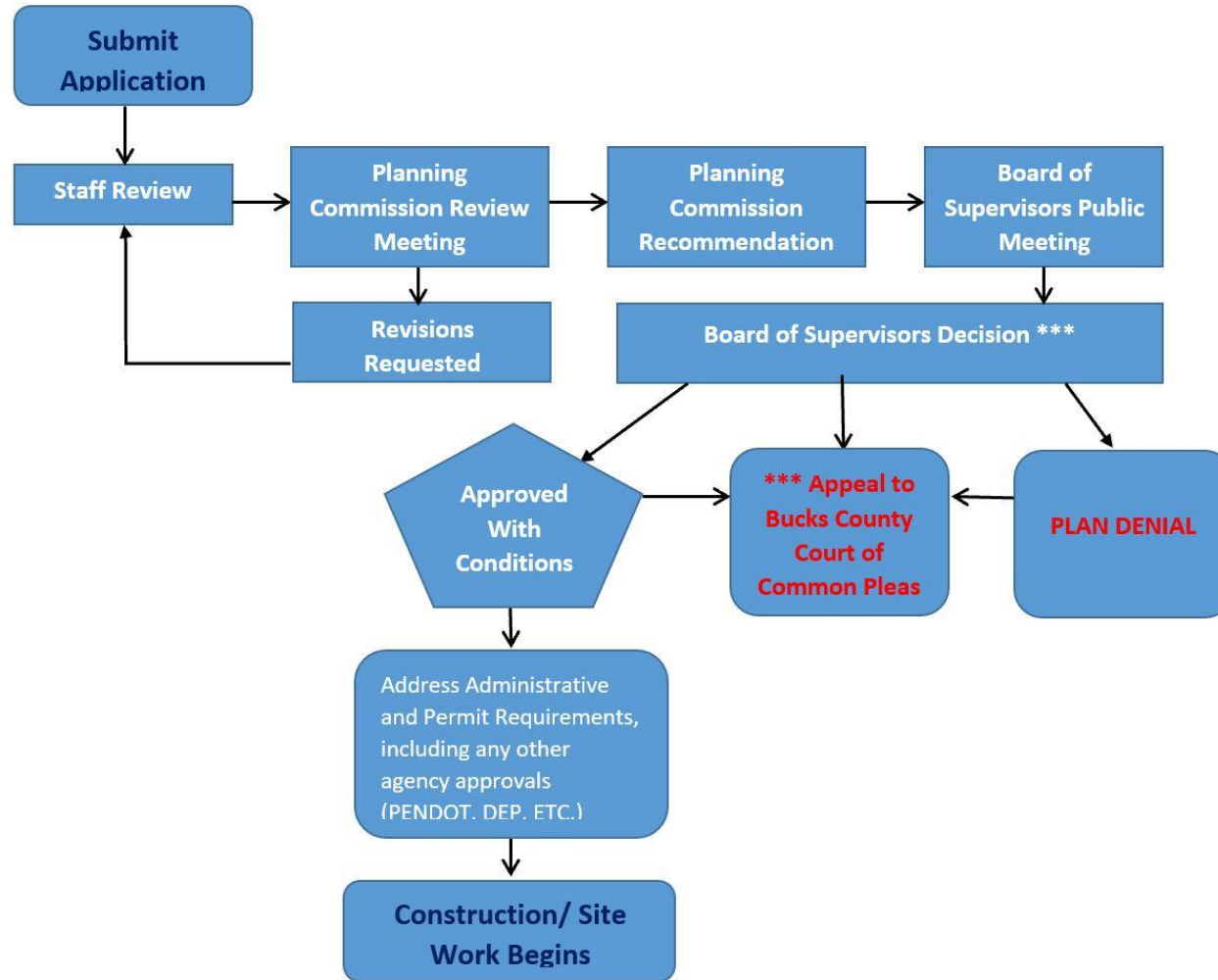
Most zoning enacted at the municipal level (2560).

Must allow use somewhere.

Primary Use-Permitted by Right/Accessory Use.

Special Exception/Conditional Use.

LAND DEVELOPMENT FINAL PLAN APPROVAL FLOW CHART





Setbacks

- May have the same requirements as other commercial development within the zoning area or there might be special conditions.



Screening

- Use of plants earth berms and fencing (5-8 feet)
- Prescriptive vs performance approach.
- Give zoning officer leeway to modify requirements.

Receptor	Green Glare (minutes / year)	Yellow Glare (minutes / year)	Red Glare (minutes / year)
Runway 17	0	0	0
Runway 35	0	0	0
Runway 3	0	0	0
Runway 21	0	0	0
Residences Single Story	0	0	0
Residences Two Story	0	0	0
Route Cars	0	0	0
Route Trucks	0	0	0

Glint and Glare

- Solar panels are made to absorb light.
- Most glare analysis find little to no risk of glare.
- Panels can be adjusted to reduce glare.



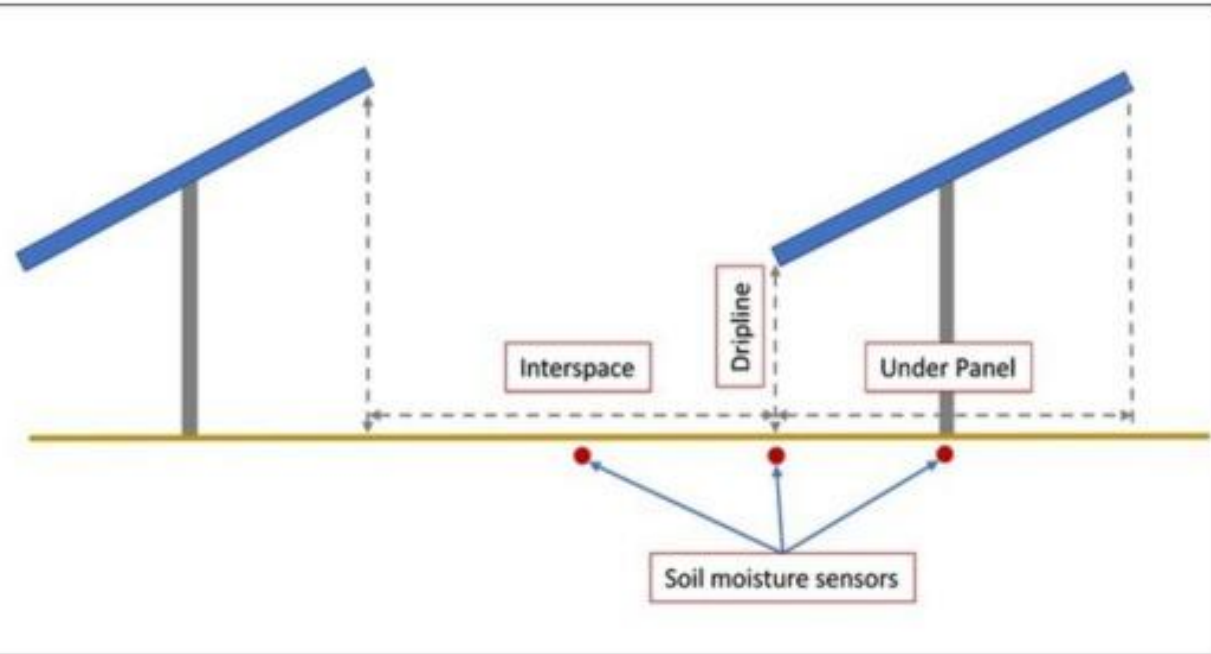
(a)

(b)

(c)

Stormwater Management

- Projects need Erosion & Sediment Control and NPDES Permits.
- Stormwater can be managed on solar arrays with best practices.



(d)

Rouhangiz Yavari Bajehbaj, Raj Cibin, Jonathan M. Duncan,
Lauren E. McPhillips,
Quantifying soil moisture and evapotranspiration
heterogeneity within a solar farm: Implications for stormwater
management,
Journal of Hydrology,

Fire Safety

Most materials in panels are not flammable and the small part that is can't support a significant fire.

Firefighters don't need special equipment to fight a fire at a solar facility but do need specialized training.

Fire departments must be aware of the site and must know how to de-electrify the site.

National Electric Code includes requirements that make it easier for first responders to turn off a solar energy system.



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Large-Scale Solar Effects on local Property Values

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Assessment of Solar Property Effects on Property Values

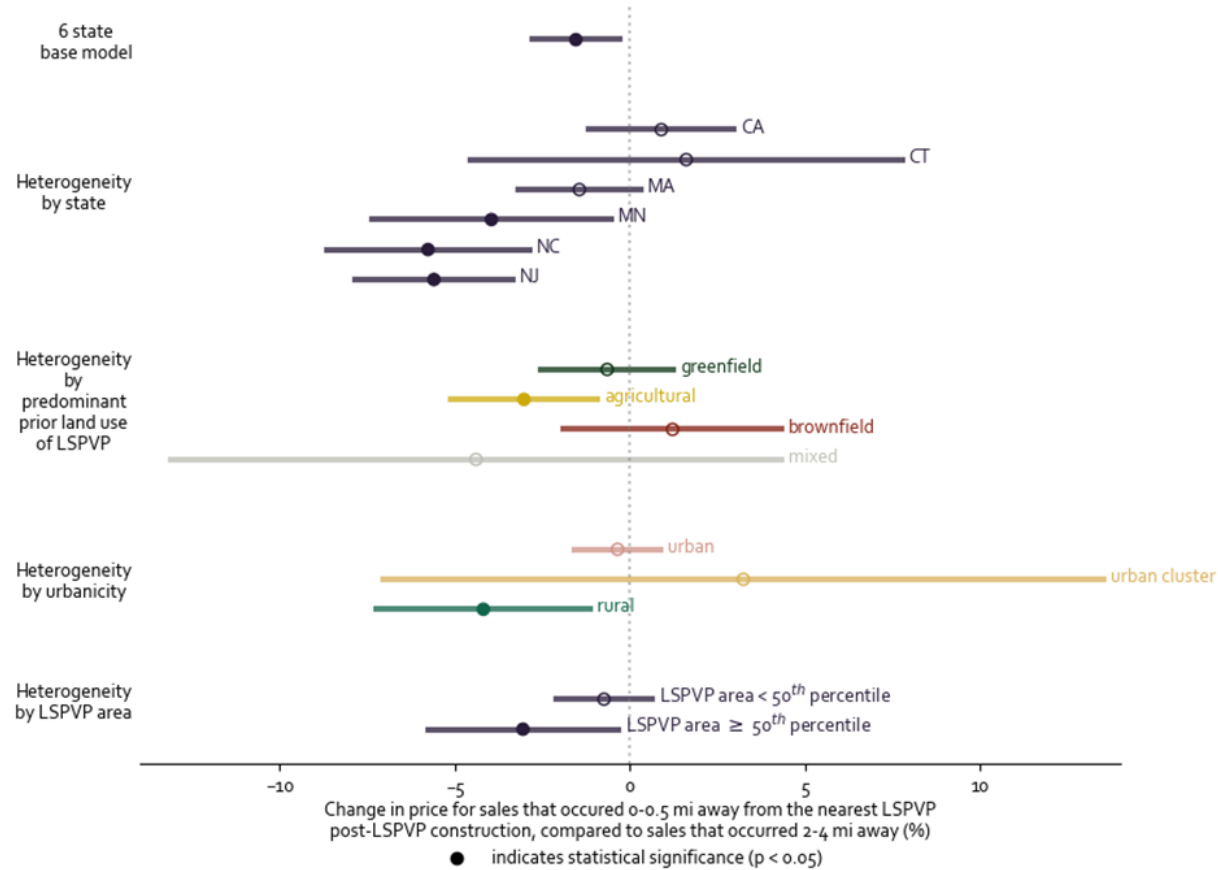
Assessors will use a sale/resale approach or a matched pair analysis to determine effects on property values

Before and after sales approach comparing home prices in the adjacent area before and after the solar array was built in a comparable area to the one being studied

Matched Pair Analysis involves

- Finding a similar location to the one with the proposed project
- Comparing home sales close enough to solar array to be affected to comparable homes in the area that aren't affected by the array
- Making adjustments to reduce third party variables

NREL Property Value Study



Effects on Property Values

Effects on values can depend on the type of property, size of project, and geographical location, among a variety of other factors

NREL study shows an average decrease of 1.5 %

The effects recorded in studies tend towards small or no impacts on residential property values

Virginia Tech study recently showed major increases in property values for agricultural land near solar sites of almost 19.4 %



Visual Impacts

- Concerns about solar arrays' effects on viewsheds and glare
- How does the array fit in with the surrounding area?
- Screening and setbacks can be mitigating factors
- Glare is generally found to be minor but glare studies can be required



Noise

- Solar arrays are generally quiet after the construction phase
- Inverters are usually the only noise producing equipment
- Performance standards requiring a low decibel amount at the property line can be required

Photo: <https://marcellus.psu.edu/solar-energy/>



Traffic

- Traffic is only a concern during the construction phase
- During the operating phase, a minimal number of vehicles are needed for maintenance
- Solar grazing can increase this traffic by a small amount

Photo: <https://marcellus.psu.edu/solar-energy/>

Questions?



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