A Clean Energy Deployment Baseline for the Energy Community and Low-Income Tax Credit Bonuses

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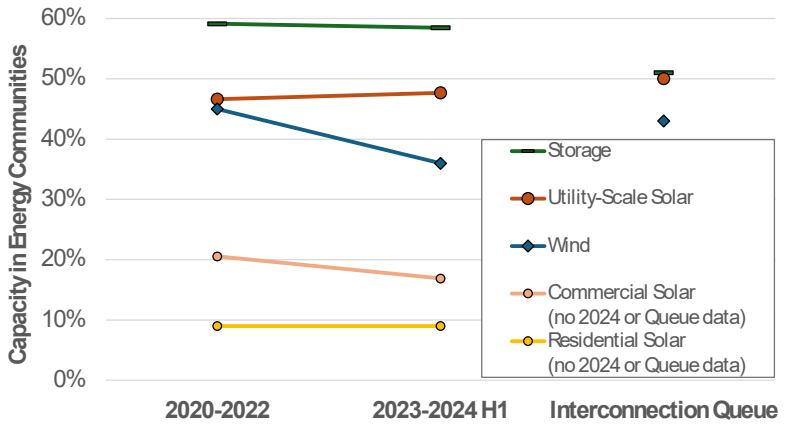
Summary of Findings

As clean energy projects take multiple years to conceptualize and develop, it is likely too early to already see shifts towards **Energy Community (EC)** locations either among newly built projects or those that entered the interconnection queues in 2023. Continued tracking of deployment trends will be important for electric system planners, modelers, and purchasers of renewable energy.

- We have established **historical baselines** of clean energy build-out in ECs
  - ~35% of onshore wind, ~50% of solar and ~60% of storage in 2023 and H1 2024.

- Since the IRA was passed, overall clean energy capacity has surged in the **interconnection queues**.
  - ~45-50% of both recently proposed and total queued clean energy capacity is in ECs.
  - While the amount of capacity that is proposed in ECs has also grown, its relative share is either stable (solar, storage) or has slightly declined (wind) among the 2023 queue entrants (graph shows total active queue, not just recent additions).



- Wind and solar can be built in ECs at a lower levelized cost of energy (LCOE).
  - LCOE after incentives was $9/MWh (24%) lower for 2023 solar projects and $2/MWh (6%) lower for 2023 wind projects.
  - Wholesale market value premiums vary by region: Compared to non-EC locations in the same market, the value tends to be lower for solar projects (-$6 to 0/MWh) but higher for wind projects (-$3 to $11/MWh).

- Only **distributed solar** that is owned by commercial entities is eligible for the EC bonus.
  - Energy Community-eligible residential capacity grew in 2023, both in absolute MW as well as market share (9%). It is primarily concentrated in California.
  - 17% of the non-residential capacity built in 2023 can qualify for the EC credit.
  - Projects can earn additional low-income community (LIC) bonuses in addition to the EC bonus, but LIC deployment was nearly 3x greater than the available annual program caps.

- We provide three case studies that illustrate the ways in which the EC bonus is being used and highlight construction and longer-term employment effects as claimed by the developers of clean energy projects.

Background

Motivation for energy community research

- The Inflation Reduction Act (IRA) added for the first time place-based federal incentives for renewable energy projects, changing the economic calculus of where projects may be best sited.
- This research intends to assess what fraction of projects may receive the new tax credits based on historical and recent trends. Understanding changes to clean energy deployment patterns is important for electric system planners, modelers, and purchasers of renewable energy.
- We develop a benchmark against which future deployment and project proposal trends can be compared to assess the longer-term impact of the new tax credits.
- We include a few case studies of clean energy projects going specifically to areas that were recently impacted by coal power plant closures to provide concrete examples of investments in Energy Communities. However, this publication does not assess how much of the incentive benefits pass from clean energy developers to hosting communities, nor does it offer a comprehensive view of the economic effects of clean energy deployment on Energy Communities.

Introduction:
IRA establishes new tax credit bonuses for renewable energy projects

- Two major types of federal tax credits are available to incentivize renewable energy and storage projects:
  - The Investment Tax Credit (ITC) which offers a credit based on a percentage of the investment, and
  - The Production Tax Credit (PTC) which rewards ongoing electricity generation with a credit.

- Prior to the IRA of 2022 both federal tax credits were not dependent of a project's location. The IRA established bonus credits for the ITC or PTC, including new place-based credits for projects in

> ***Energy Communities***
> Areas with historical ties to fossil fuel industries, such as former coal regions, that have been economically underserved. The bonus credits aim to promote local economic development and advance environmental justice by directing federal support to areas most in need of economic revitalization.

- The Energy Community Tax Credit Bonus adds:
  - 10 percentage points for ITCs: e.g., projects with a 30% ITC would now be eligible for a 40% ITC, or
  - 10% to PTCs: e.g., projects with $27.50 per MWh PTC would be eligible for a $2.75 per MWh PTC adder, bringing the total credit value to $30.25/MWh (adjusted annually for inflation).

What is an Energy Community?

For a clean energy project to qualify for Energy Community bonus tax credits, the project site must meet at least one of the following three criteria:

- **Fossil Fuel Employment + Unemployment (FFEU):**
  - A metropolitan or non-metropolitan statistical area that
    - currently has, or had after 2009, direct employment of ≥ 0.17% or derives ≥ 25% of local tax revenues from coal, oil, or natural gas; and
    - had an unemployment rate ≥ the national average for the previous year (3.6% in 2022 and 2023).

- **Coal Closure:**
  - A census tract (or directly adjoining census tract) in which
    - a coal mine has closed after 1999; or
    - a coal-fired electric generating unit retired after 2009.

- **Brownfields:**
  - A contaminated property as defined in the Comprehensive Environmental Response, Compensation and Liability Act.
  - There is no single registry, website, or map of all brownfield sites, US EPA estimates about 450k sites.
  - The best approximation is US EPA's "Cleanups in My Community" (CIMC) registry that lists brownfield sites with EPA funding.
    - Comparing CIMC locations against existing clean energy projects resulted in very few matches. However, many brownfield sites exist that have not received EPA funding: more projects may thus be eligible for brownfield EC bonuses than what we show on the following slides.
  - The new EC brownfield bonus is complementary but not congruent with EPA's RE-Powering America's Land Initiative that has supported over 100 clean energy projects on brownfields.

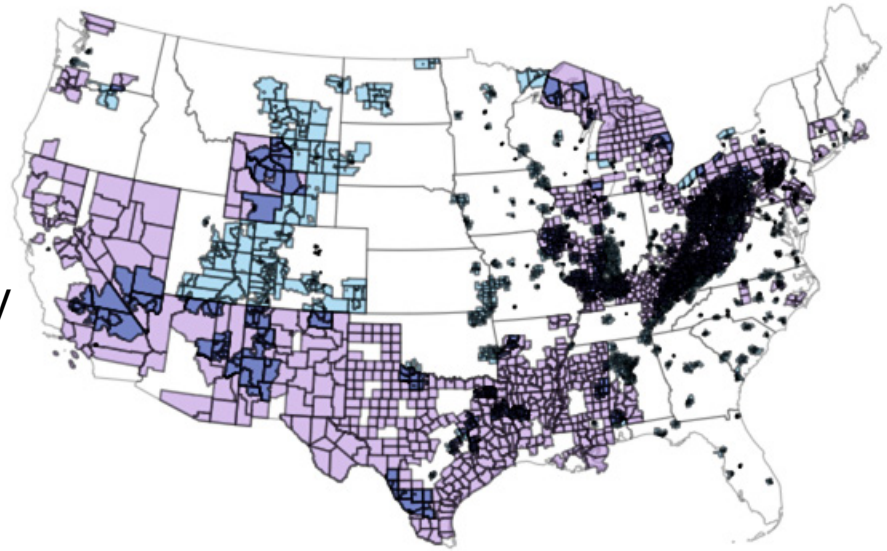
Geographic bonus eligibility changes over time

- Area eligibility definitions are updated annually and released by the IRS in the spring of each year. Changes to eligible areas are primarily driven by the **Fossil Fuel Employment + Unemployment** (FFEU) criteria, especially the local unemployment rates.

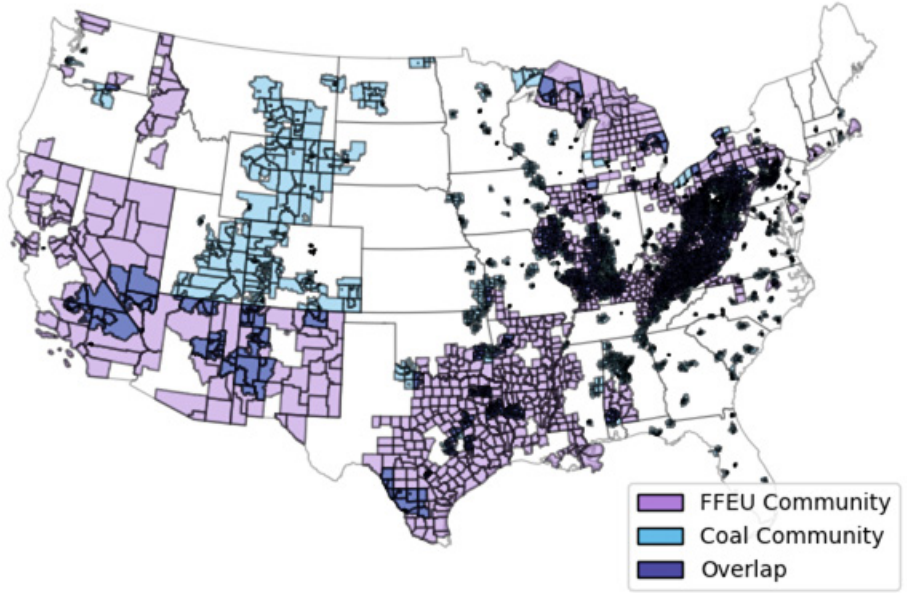
- The 2023 to 2024 changes affected regions differently. For example, eligible land area:
  - increased in the Midwest (MO +48%, AR +33%) and CA +8%
  - declined in the Northeast (NJ -72%, CT -63%) and TX -23%

- Project eligibility is determined by its construction start:
  - Projects that begin construction on or after Jan 1, 2023:
    - If the project begins construction in an energy community at that time, the project will remain eligible (for both the ITC or the ten-year credit period for PTCs)
  - Projects that began construction before Jan 1, 2023:
    - For ITCs: Location must have energy community status on the placed-in-service date
    - For PTCs: Eligibility is determined separately for each taxable year of the project's 10-year credit period

Energy Communities Map 2023



Energy Communities Map 2024



Additional bonus for smaller systems: Low Income Communities Bonus Credit

- Additional bonus credits are available for systems that are smaller than 5 MW and placed in service after 2022. Section 48(e)/48H(e) of the IRA provides credits for installations within or benefitting "**Low Income Communities**" (LIC), which are capped annually by a MW allocation, but can amount to a 10 or 20 percentage point adder onto the base tax credit. *They can be stacked on top of the energy community credit*, if located in eligible areas.
- The adders offset commercial tax burden, so residential customers themselves cannot make use of them directly. However, systems owned by third-party commercial entities are eligible – and the financial benefits may be passed through to their residential customers.
- All categories were fully allocated in 2023, except Category 2. The Program Capacity Dashboard provides updates on the remaining capacity within each category.

Category	Description	2023 Cap	Bonus
1) Located in low-income community	Poverty rate for Census Tract is at or above 20% *OR* median family income for Tract is at or below 80% of statewide median income or area median income.	700 MWac (560 Res, 140 Comm)	10%
2) Located in tribal land	As defined in 2601(2) Energy Policy Act of 1992	200 MWac	10%
3) Qualified low-income residential building	If install is on a residential rental affordable building and the benefits are allocated equitably among occupants. Buildings defined by: (1) Violence Against Women Act of 1994, (2) Dept. of Agriculture under Housing Act of 1049, (3) Tribally designated under Native American Housing Assistance and Self-Determination Act of 1996, (4) Other designated by Secretary	200 MWac	20%
4) Qualified low-income economic benefit project	At least 50% of the financial benefits of electricity generated provided to households at or below 200% of federal poverty level or 80% of area median income	700 MWac	20%

Energy Community bonuses are unlikely to affect siting decisions of large-scale projects coming online in 2023 and 2024

- Guidelines for Energy Community bonus tax credit eligibility were published by the IRS on April 7, 2023, while large-scale renewable energy projects generally have a development timeline of 4 to 6 years:

Site Selection + Feasibility Study (6–12 months):
- Identify and evaluate potential project sites based on factors like resource availability, land use, environmental impact, and grid access. Initial feasibility studies assess technical, financial, and regulatory viability.

Permitting + Regulatory Approvals (12–48 months):
- Obtain necessary permits from local, state, and federal authorities, including environmental impact assessments, land-use approvals, and interconnection agreements with utilities. This stage can be prolonged by community feedback and regulatory delays.

Project Design + Engineering (6–18 months):
- Develop detailed project designs, including technical specifications for equipment, layout, and infrastructure. Secure financing during this stage, often requiring long-term power purchase agreements (PPAs) or other financial backing.

Procurement + Contracting (6–12 months):
- Order major equipment (e.g., turbines, solar panels, transformers) and secure contracts with construction firms and suppliers. Delays can occur due to supply chain issues or manufacturing lead times.

Construction + Commissioning (12–24 months):
- Physical construction of the project, including installation of infrastructure, grid connection, and testing. Once completed, the project undergoes final testing and commissioning to ensure compliance with safety and operational standards.

- Smaller-scale renewable projects more likely to be impacted, but with the full effects emerging later.
  - Residential installations take weeks to months, while larger projects take months to years.
  - But lead times were too short for developers to adjust marketing strategies or increase third-party ownership in ECs.

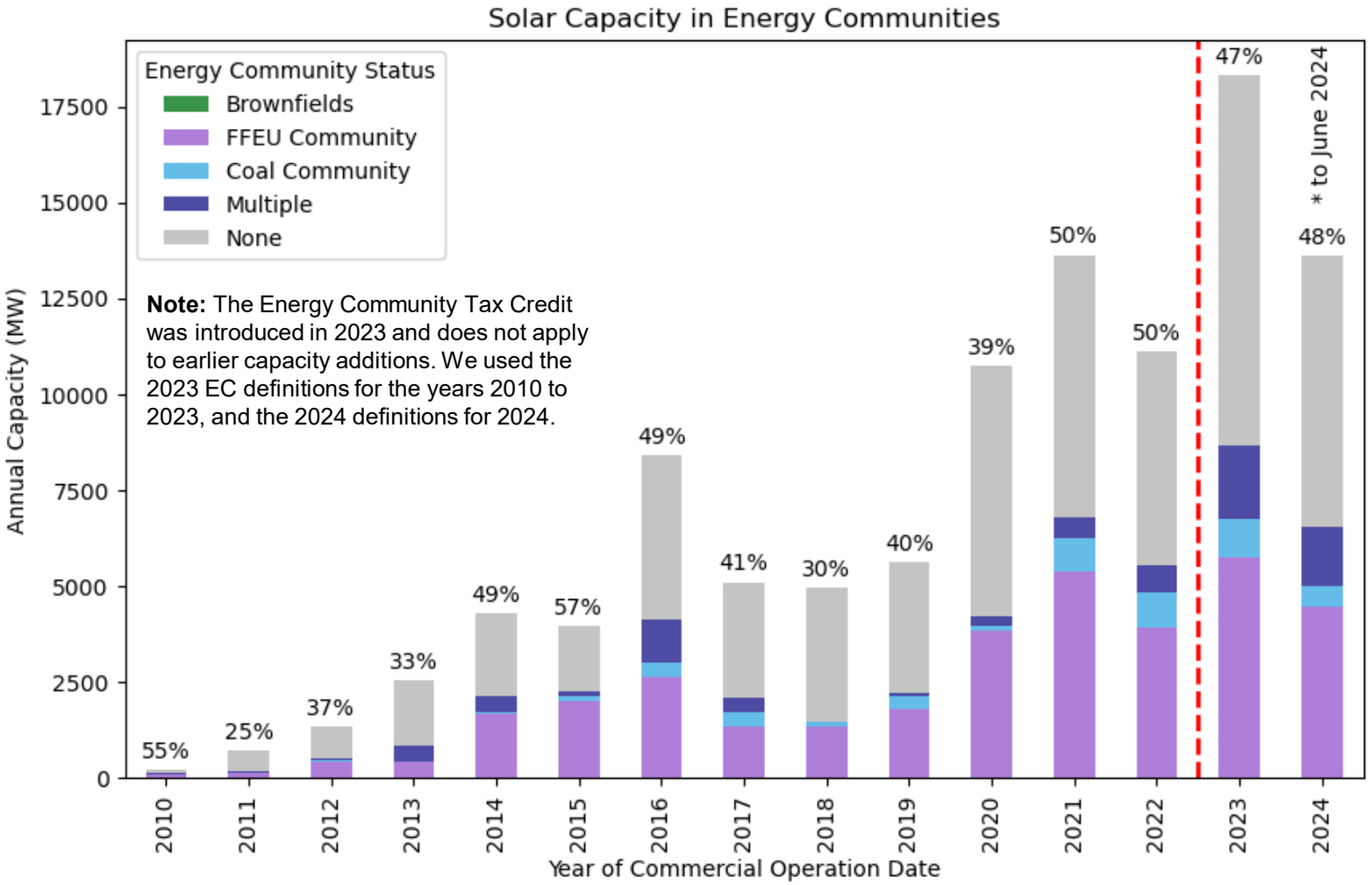
Historical Trends

Data sources and methods for historical deployment analysis of utility-scale projects

- Data sources:
  - For large-scale (>1MW) solar and storage installations we used location and capacity information from EIA 860 (augmented by project-level corrections from research conducted for Berkeley Lab's Utility-Scale Solar Annual Report and the US PV Data Base).
  - For wind we used project information from Berkeley Lab's Wind Turbine Data Base up until May 2024.
  - We exclude offshore wind projects due to limited deployments to date and lack of easily accessible data. Offshore wind's EC bonus eligibility may be determined by the location of either their point of interconnection (POI) or SCADA systems.
  - Data for H1 2024 is preliminary and only includes projects that achieved commercial operation in the first half of the year (solar and storage: June 2024, wind: May 2024). Statistics will likely change after revised annual data is available.

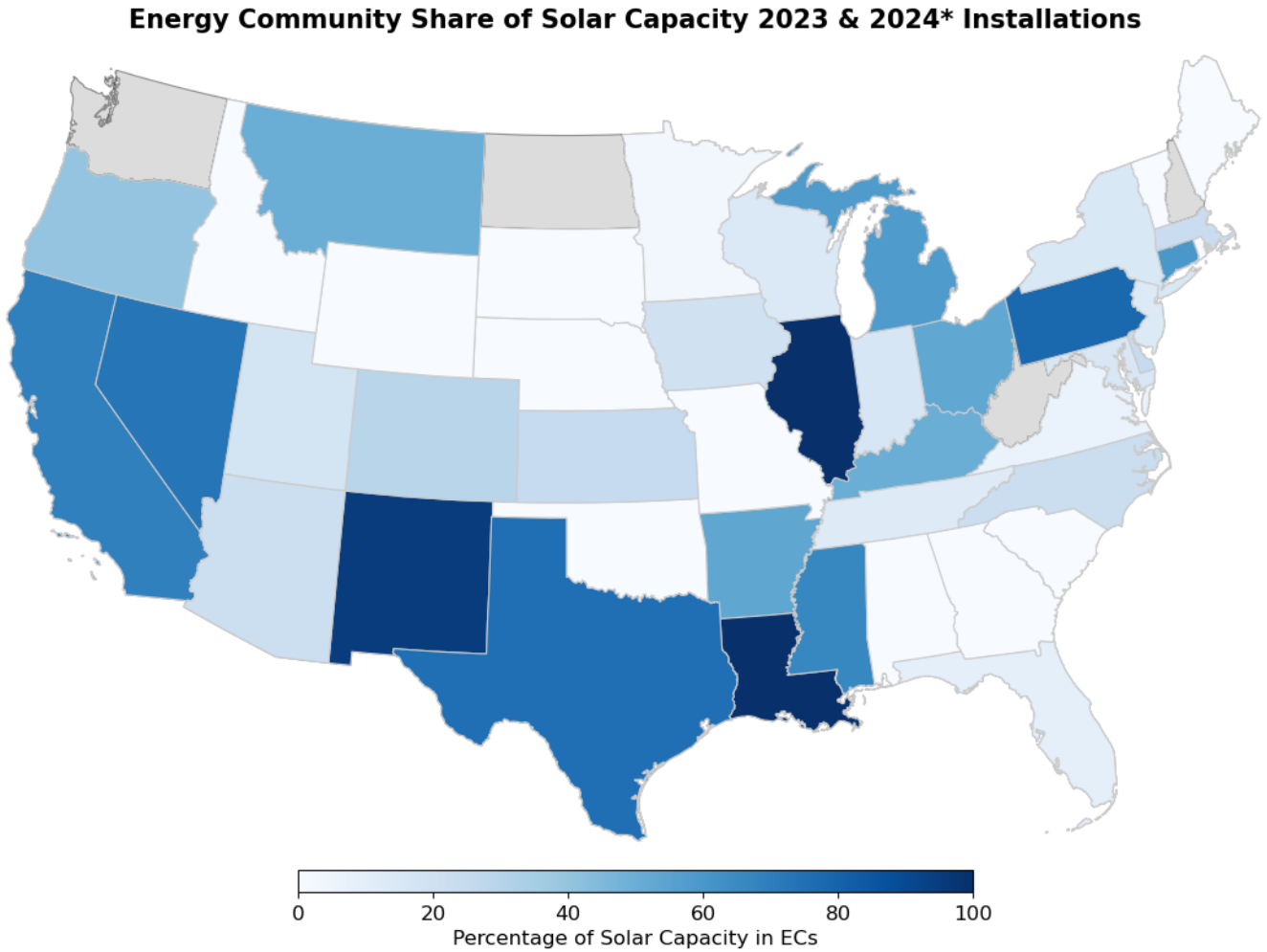
- Methods:
  - Projects with a commercial operation date prior to 2023 are not eligible for Energy Community bonuses. However, they are included in the following slides to compare deployment trends. Energy Community qualifying criteria are based on annual trends in most cases. We applied 2023 Energy Community criteria to classify all historical capacity additions without considering annual trends for a simplified retrospective hypothetical view, even though Energy Communities criteria were not applied at the time of deployment. The horizontal red dashed line indicates project eligibility.
  - We used 2024 shapefiles for projects with a 2024 commercial operation date (COD). This may underestimate the eligibility of 2024 COD projects, as most commenced construction before 2024 and may also qualify under 2023 definitions.
  - Wind project eligibility for the PTC bonus is determined at the turbine level. Using turbine-specific location information we determined what share of a project capacity qualifies as being in an Energy Community.

Historical national deployment in energy communities: Utility-Scale Solar



- Historically, most of the growth in solar capacity occurred in non-eligible locations.
- Since 2021 about half of utility-scale solar capacity has been built in what is now defined as Energy Communities, up from ~40% in the late 2010s
- Since passage of the IRA, the growth rate in deployed solar capacity has been nearly identical in both eligible and non-eligible areas, leading to largely stable participation rates.

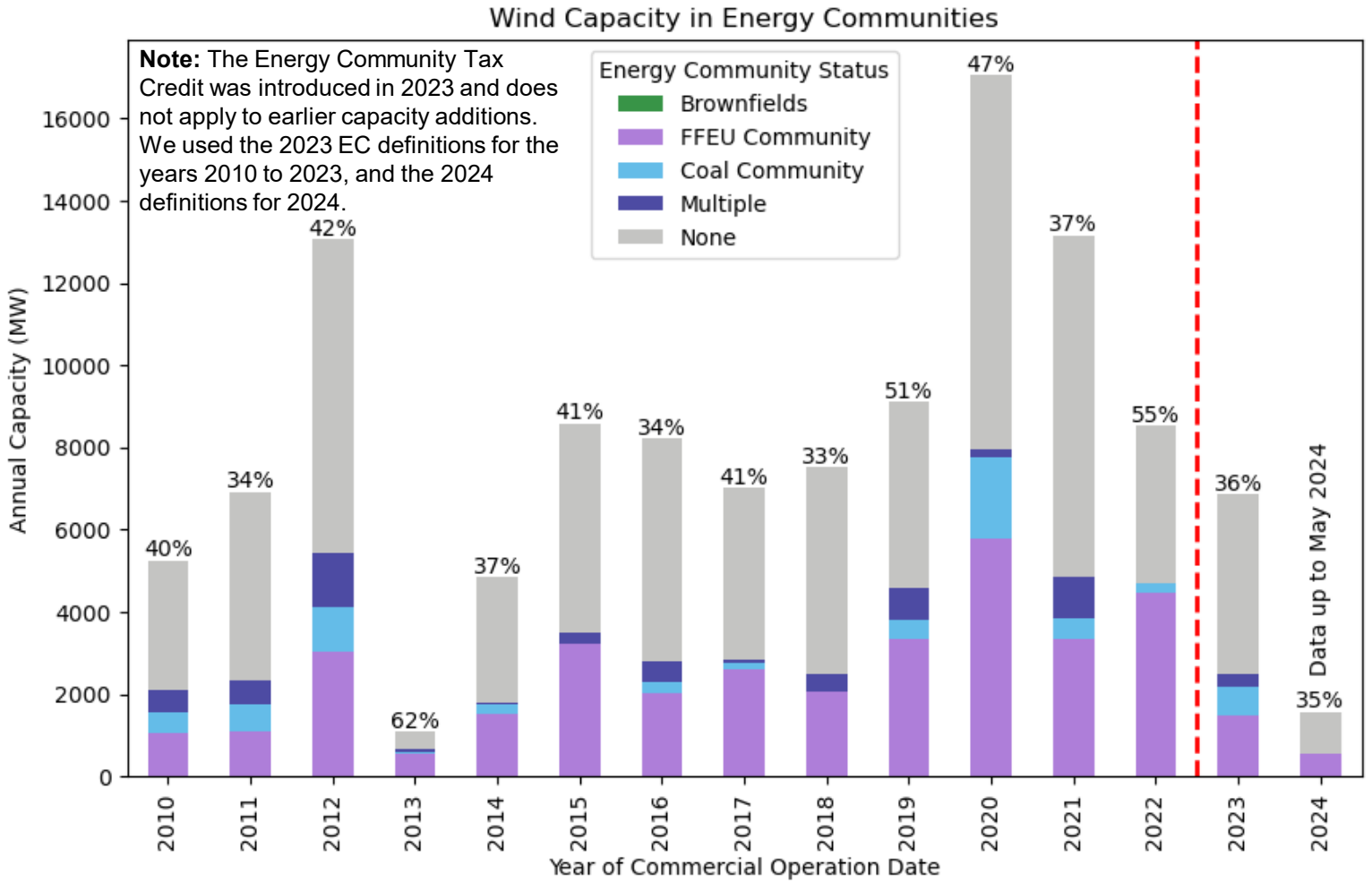
Historical deployment in energy communities by state: Utility-Scale Solar



*additions until end of June 2024

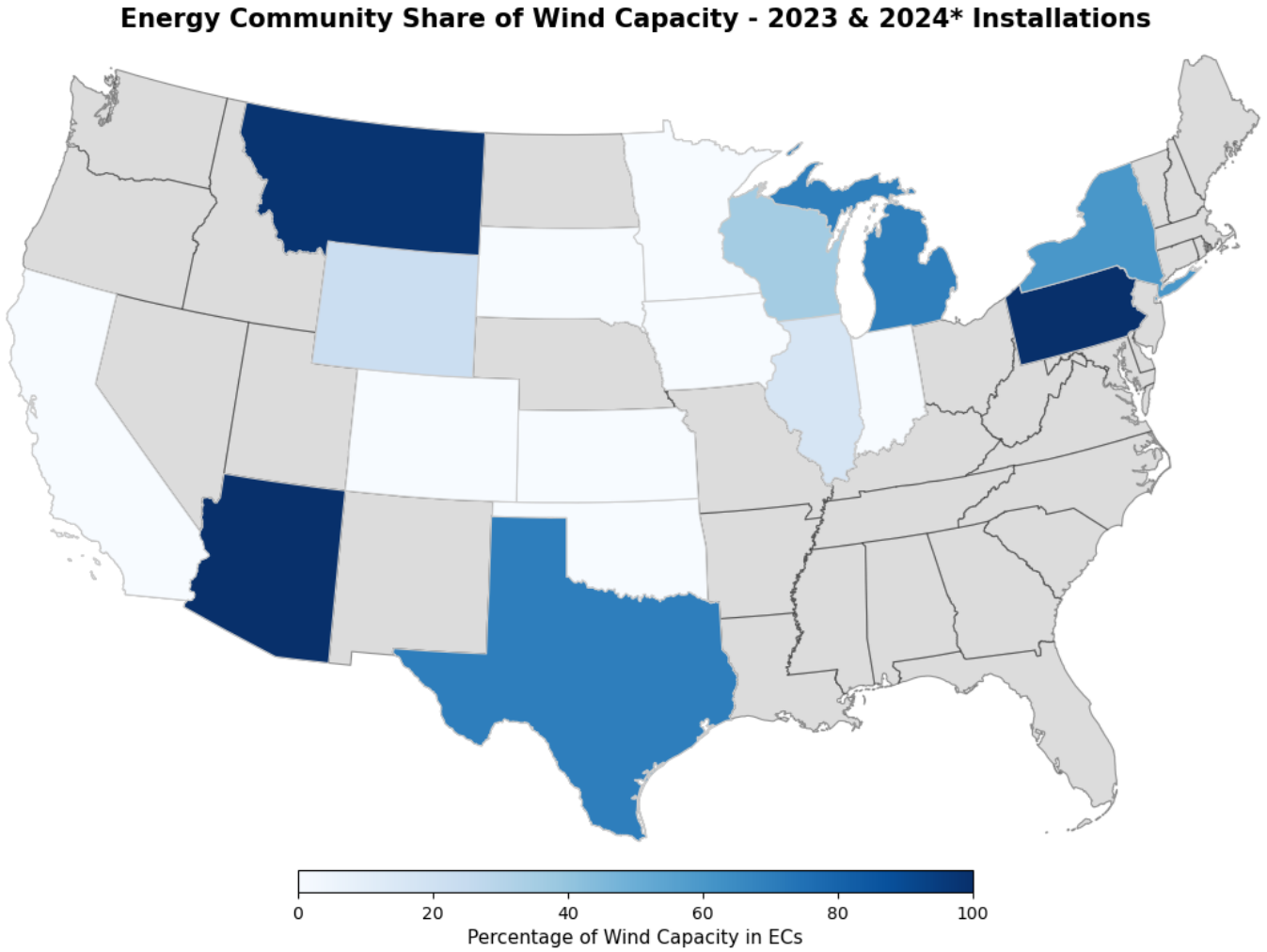
- Since IRA took effect, most solar capacity in ECs was added in ERCOT and CAISO in absolute terms.
- The map to the left shows the EC solar project share in relative terms. Louisiana and Illinois had the greatest EC share (100%), followed by New Mexico (95%), Pennsylvania (78%), Texas (75%), and California (69%).
- Many states in the interior (Idaho, Wyoming, Dakotas, Nebraska, Oklahoma, Missouri) and the Southeast (Alabama, Georgia, South Carolina) had no new EC solar projects.

Historical national deployment in energy communities: Onshore Wind



- Historically most wind capacity in the US has been built outside of Energy Communities (38% within 2010-2018), though in recent years the Energy Community share increased (46% 2019-2022).
- In 2023 and 2024 both the absolute amount and relative share of wind capacity built in Energy Communities has fallen, to ~35%.

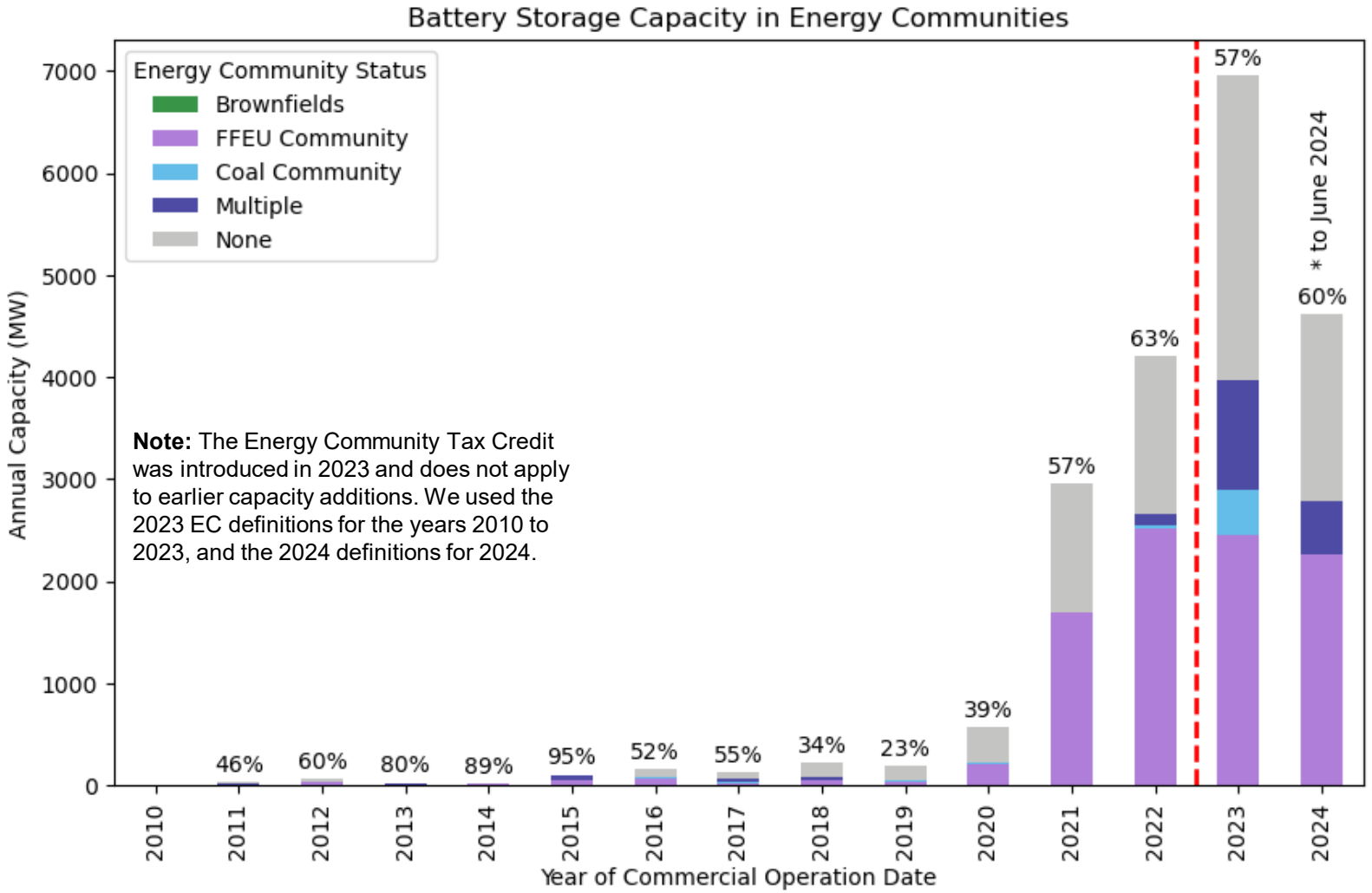
Historical deployment in energy communities by state: Onshore Wind



*additions until end of May 2024

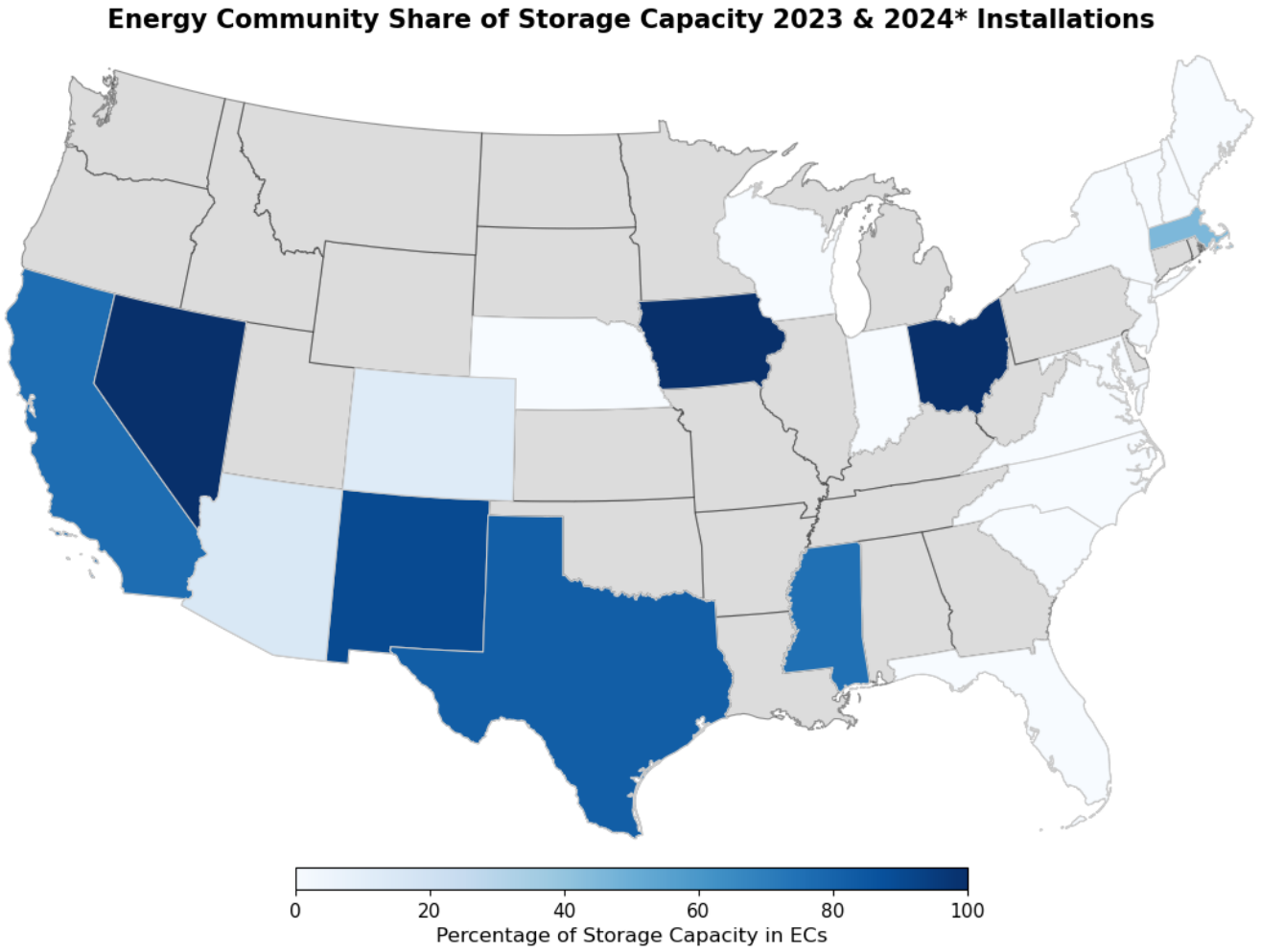
- Many states have not seen wind additions since the IRA took effect (gray areas).
- Wind turbines have been predominantly built in the “wind belt” in the Great Plains and parts of the Midwest that are characterized by high wind speeds. However, regions like SPP and MISO have fewer Energy Community eligible areas, resulting few projects that can receive the tax credit bonuses. Kansas and Oklahoma installed a lot of new wind capacity (800+ MW each), but none falls within eligible areas.
- The states with the highest share of Energy Community wind are Montana, Pennsylvania, and Arizona.
- While the relative Energy Community share in Texas was lower than in some other states (62%) it still deployed the most wind capacity in eligible areas (1.3GW), followed by New York (450 MW), Michigan (390 MW), and Illinois (370 MW).

Historical national deployment in energy communities: Storage



- Deployment of battery storage, either standalone or in conjunction with other generating technologies like solar, only started in earnest in the early 2020s, making it difficult to discern long-term patterns.
- Except for 2018-2020, most of the new battery capacity has been installed in eligible areas. Of ~20 GW cumulative national battery capacity, 58% is in what is now defined as an EC.

Historical deployment in energy communities by state: Storage



*additions until end of June 2024

- Many states did not see large-scale storage additions in 2023 and H1 2024 (gray areas). CAISO, ERCOT and the non-ISO West are the primary regions in which storage has been built.
- In absolute terms, most battery storage capacity in ECs has been built in CAISO (~3 GW) and ERCOT (~2 GW) since the IRA took effect.
- In relative terms, the greatest share of EC eligible storage projects has been built in Iowa, Nevada and Ohio (100%), followed by New Mexico (90%), Texas (82%), and California (76%).
- States along the East Coast had little storage deployment in ECs, both in absolute and relative terms.

Data sources and methods for historical deployment analysis of distributed solar projects

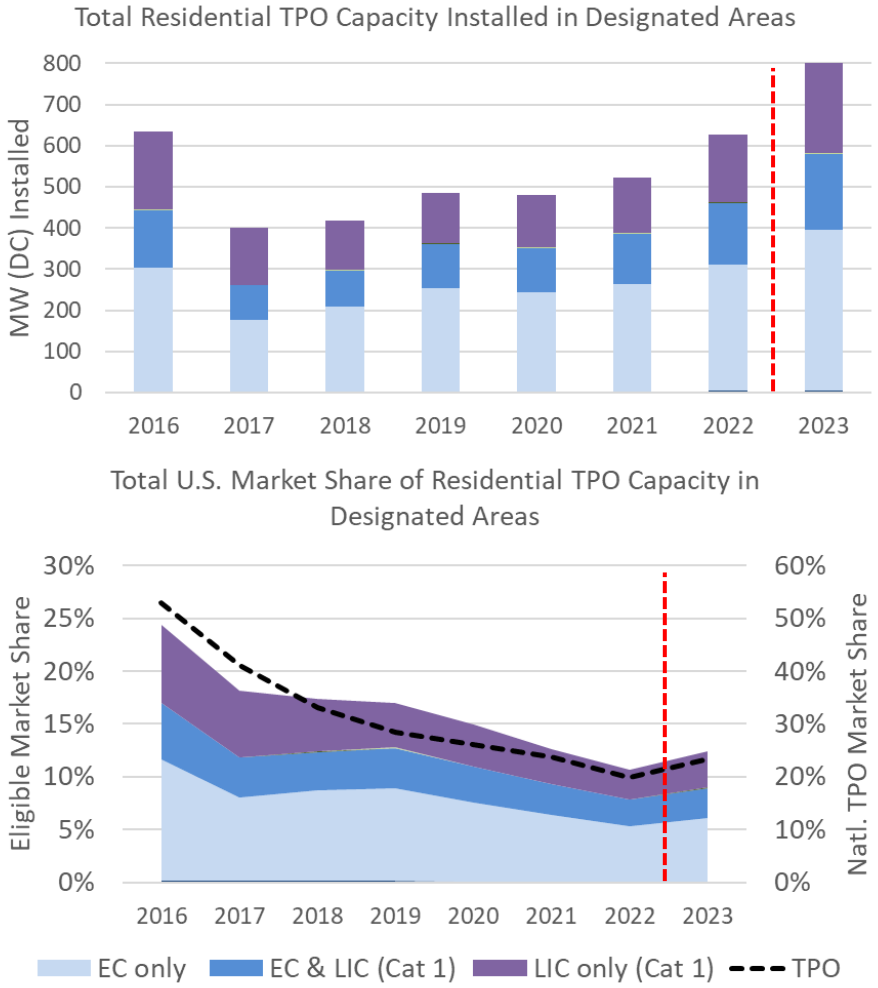
Objective is to quantify the distributed solar capacity ***eligible*** for tax-credit bonuses (i.e., commercially-owned installations) in Energy Communities and Low-Income Communities (Categories 1+2). Host-owned residential systems are thus excluded.

- Data sources
  - Berkeley Lab's *Tracking the Sun (TTS)*: empirical data on system size, cost, date of installation, location, and whether it is third-party owned (TPO).
  - Buildzoom and Ohm Analytics: permit data with location and date of installation for systems additional to TTS.
  - Wood Mackenzie: market data on installed project numbers and capacity for each state and year; TPO market share for the US and selected states (2016 onwards).

- Methods
  - Residential and non-residential capacity estimates were made using separate methods (see Appendix) due to wider data coverage of granular system size and location data for residential versus non-residential systems.
  - TTS was used directly wherever sufficient coverage existed whereas ratios from TTS were used and scaled up using Wood Mackenzie coverage where necessary.
  - To determine project eligibility for Energy Communities and/or Low-Income Communities (see slides 9-10), shapefiles were used for Energy Communities and Low-Income Categories 1 and 2 (low-income census tracts and tribal areas), respectively, to determine overlap with coordinates of installations, filtered to only third-party owned residential or commercial systems (i.e., those that would qualify for tax credit adders).

- Limitations
  - Our data does not show whether the qualified distributed solar project *received* the bonus tax credit. This is especially relevant for eligible Low-Income category 1 installations where the total capacity of eligible systems vastly exceed the annual capacity cap of 700MW.
  - Certain adders are not tied to a region, but to a property (Low-Income Category 3) or project (Category 4). As such, there were no available shapefiles or indicator which installations qualified for these categories - they are thus excluded from this analysis.

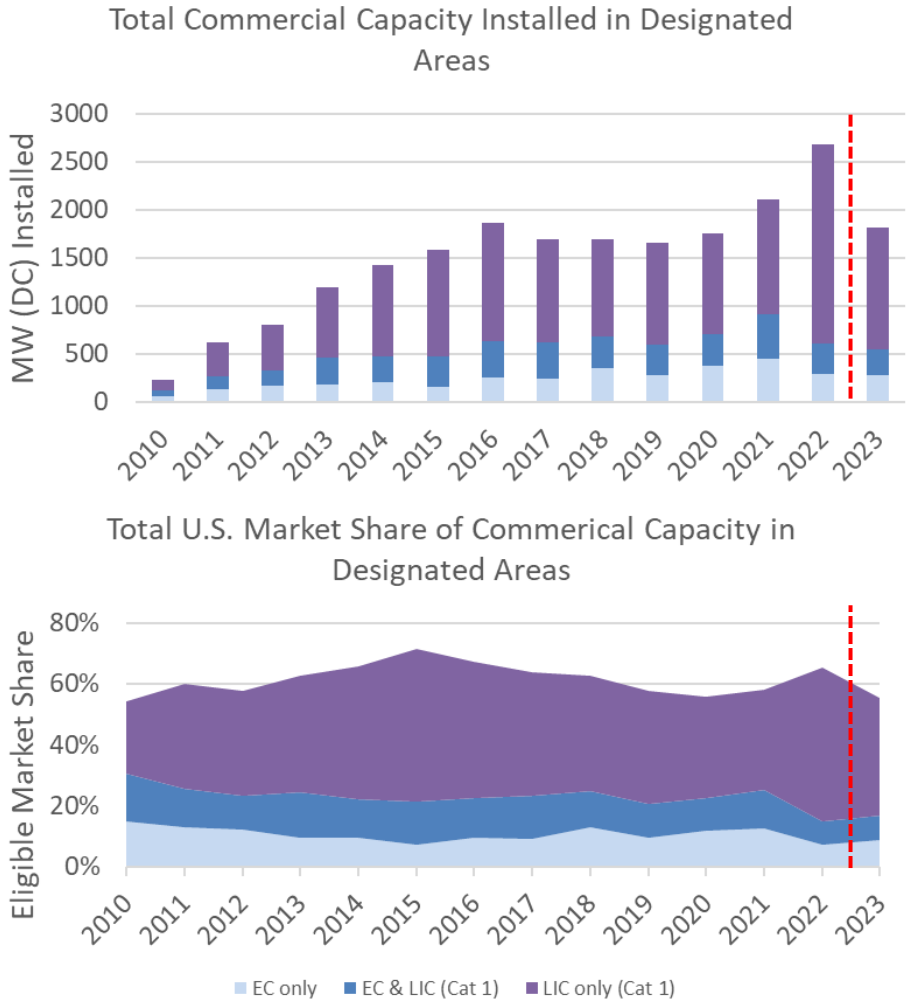
Historical deployment: Third-Party Owned Residential Solar



Notes: These figures show capacity in Tribal areas (LIC category 2), but only amount to 8.7 MW and 0.13% and are thus not visible.

- 2023 saw the most eligible capacity installed in Energy Communities ever.
  - 579 MW of eligible TPO residential solar was installed in ECs in 2023.
    - 189 MW overlapped with Low-Income (1) areas, potentially qualifying for additional stacked bonuses.
    - Tribal (2) capacity was very small with only 4.7 MW, of which 1.2 MW overlap with both EC and (1), and 3.5 MW with EC alone.
  - 223 MW of eligible TPO residential solar was installed in Low-Income areas outside ECs in 2023.
    - Most of these installs were within (1), with just 4MW of tribal capacity (2) – of which 1.4 MW overlapped with (1).
    - Total Low Income Category 1 eligible capacity in 2023 remained below the cap of 560 MW, indicating that all or most could likely qualify
- 9% of the new residential capacity (including host-owned and projects outside of ECs) was eligible for the EC bonus in 2023, growing slightly from 2022 (8%).
  - The historical market share of TPO residential capacity in eligible areas relative to the entire residential market has declined over the years, in line with the overall TPO market share.
  - TPO market share in 2023 increased for the first time since 2016 due to high interest rates on solar loans, and potentially with some impact of the tax credit adders.
  - Data in future years may show an increase of TPO market share within these designated areas to take advantage of bonus tax credits.

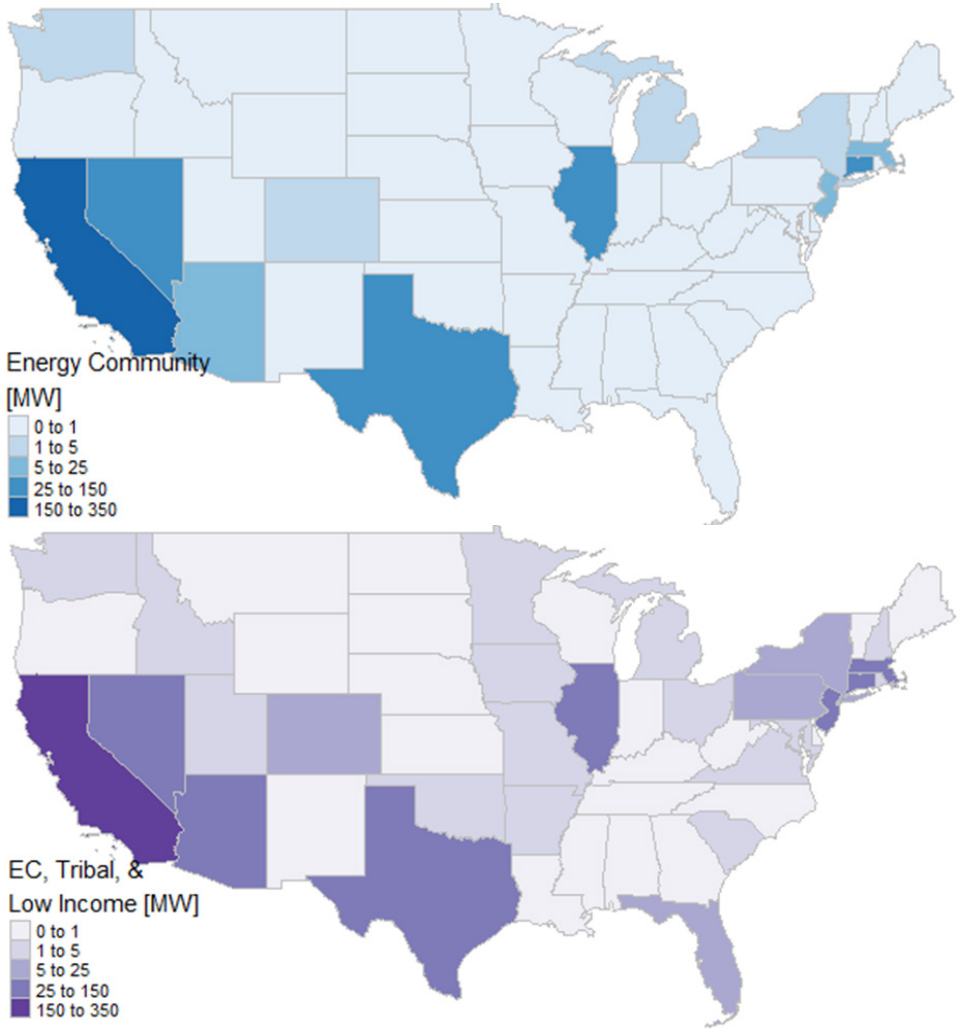
Historical deployment: Commercial Distributed Solar



Notes: Non-residential distributed solar includes community and commercial solar less than or equal to 5 MW in size

- Eligible commercial solar capacity in Energy Communities declined in 2023 to 552 MW, along with a general market contraction.
  - Large installations made up most of this capacity: 383 MW (69%) were from systems of 1 – 5 MW in size, 149 MW (27%) from systems 30 kW – 1 MW, and only 19 MW (3%) from systems under 30 kW.
- 273 MW of commercial solar was installed in areas qualifying both as EC and Low-Income in 2023. 1,260 MW was built in Low-Income areas outside of ECs in the same year.
  - This exceeds the total Category 1 Low-Income program cap of 700 MW, even before accounting for the additional 412 MW of residential TPO (1) installations.
  - Our data do not show commercial installations in Tribal areas (Category 2).
- Installations in what is now defined as Energy Communities had a historical commercial solar market share hovering around 25% before declining to 15% in 2022. In the first year of IRA bonus credits, the share rebounded slightly to 17%.
  - Compared to residential installations that require third-party ownership, commercial eligibility rates are nearly twice as high, but still much lower than for utility-scale installations.
  - In capacity terms commercial EC solar is slightly lower than eligible residential TPO capacity (579 MW) and much lower than utility-scale solar (8,682 MW).

2023 deployment by state: Third-Party Owned Residential Solar



Notes: Capacity all in MW (DC). Not all LIC Category 1 installations may be eligible due to total (residential + non-residential) capacity exceeding the annual cap

- The majority of 2023 Energy Community-eligible TPO residential capacity was installed in California
  - California added 2,278 MW (35%) of **all** 2023 residential capacity but represents 325 MW (56%) of 2023 EC installations.
  - Most states had less than 1 MW EC-bonus eligible residential growth in 2023.
    - Median total capacity across states was 0.2 MW (mean: 11.4 MW), potentially due to state regulations or restrictions related to third-party ownership.

- Areas eligible for the Low-Income bonus (Category 1+2) are not tied to fossil fuel or brownfield requirements and are much more wide-spread across the United States. Potentially eligible installations in designated areas increased capacity with a place-based bonus by a factor of 3 in most states.
  - Low-Income eligible capacity outside of Energy Communities had a state median of 1.2 MW (mean: 4.2 MW).
  - Eligible projects increased especially in the Mountain West and Midwest regions, as well as Pennsylvania, Virginia, and Florida.

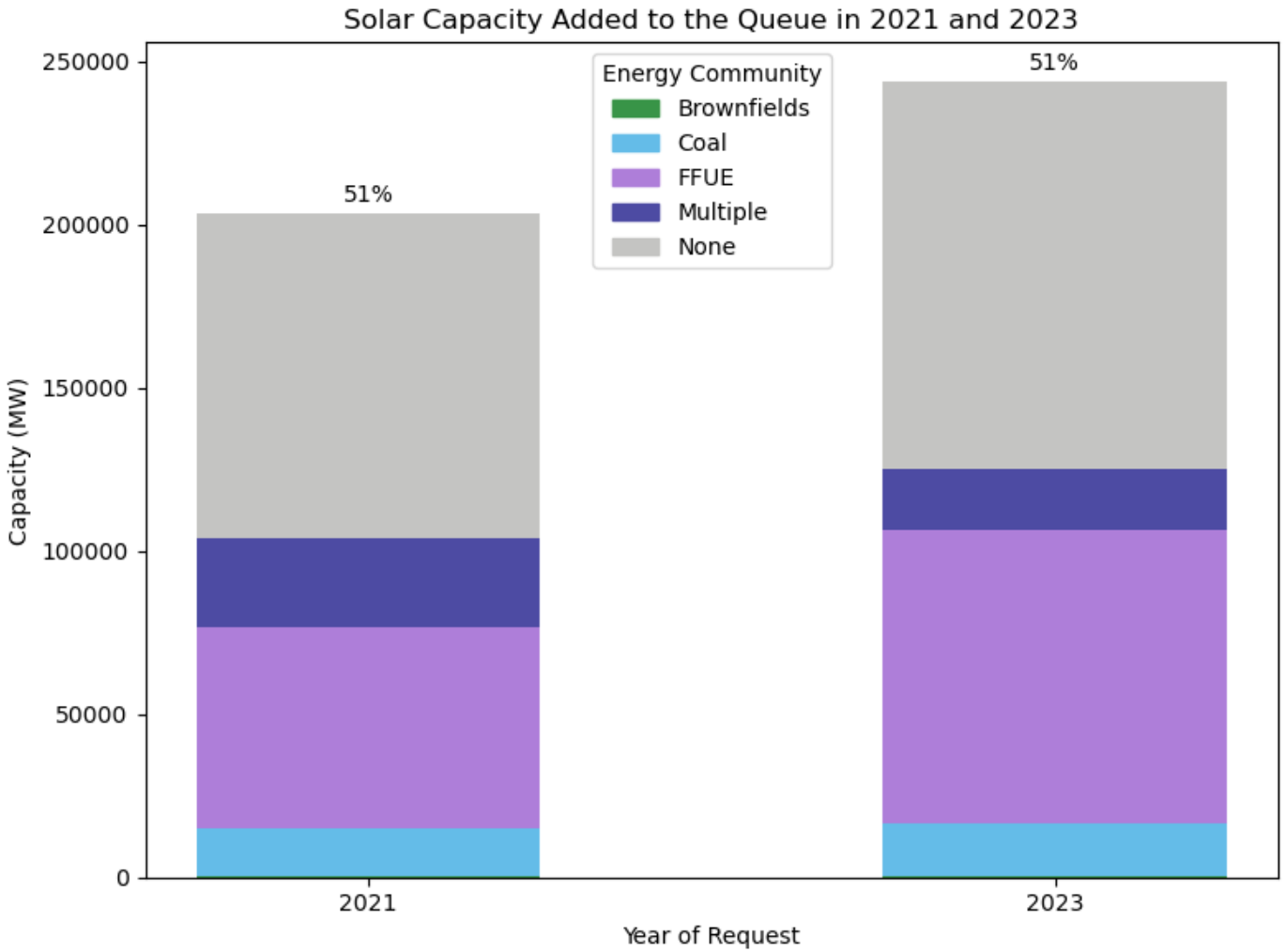
Queued Projects

Data Sources and Methods for future deployment analysis

- Data sources - Two primary data sources are available for analyzing future renewable energy development:
  - The EIA-860 “Planned” dataset, which contains developer-provided information about future capacity additions.
  - Interconnection queues: Managed by regional grid operators or utilities, these queues track generators that seek interconnection to the bulk power transmission system. Berkeley Lab has assembled a comprehensive database of prospective projects that provides a more comprehensive view of the new capacity under development than the EIA data, it will thus be used for the following analysis.

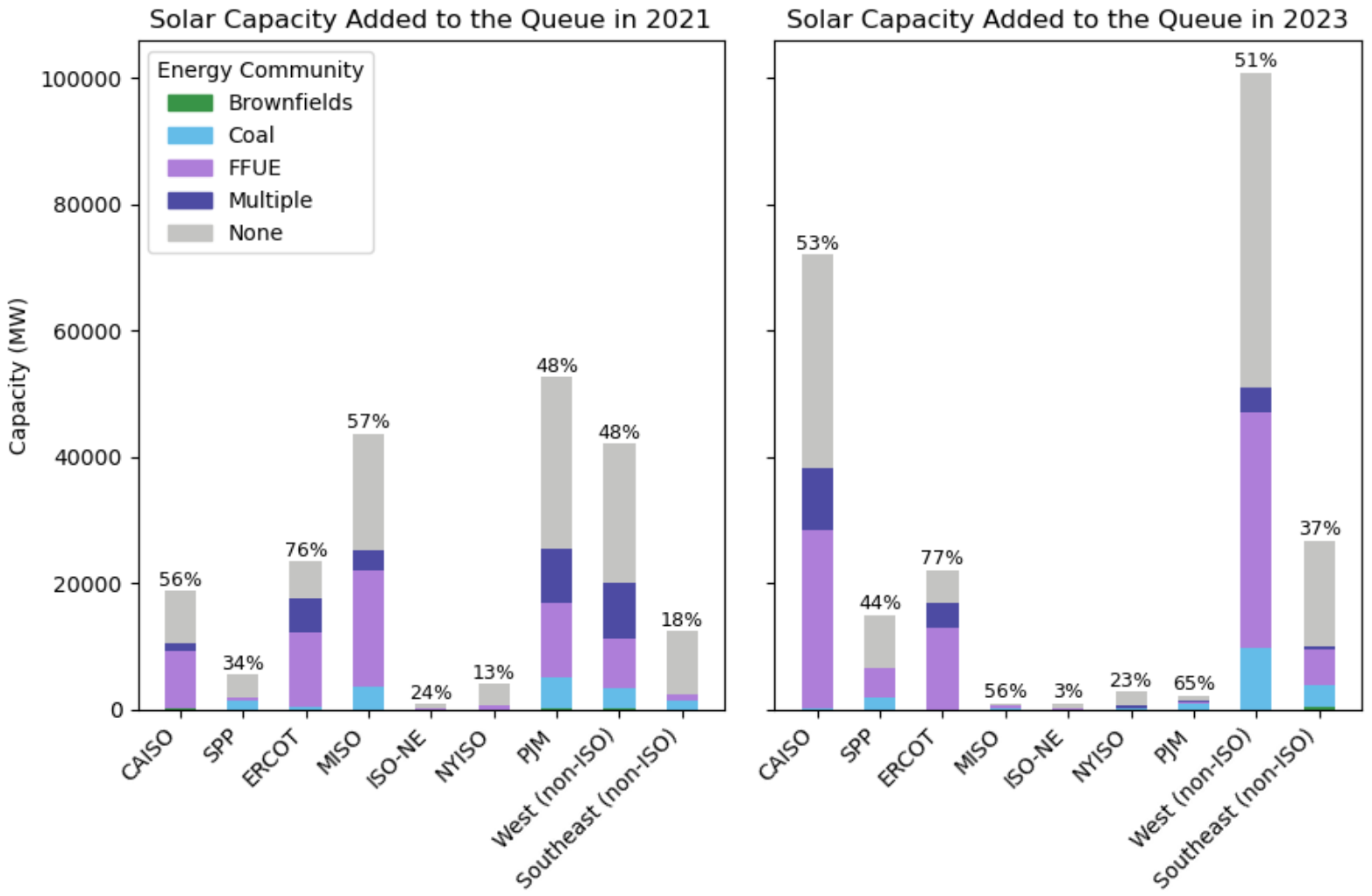
- Methods:
  - Interconnection queue data often do not include location information of the project centroid. Instead, we have approximated project eligibility based on the location of the point of interconnection (POI) to the bulk power transmission system. We use 2023 eligibility shapefiles for this exercise as this is the data developers had available at the time of project submission. Future incentive participation rates may change as the eligibility maps will further evolve during the actual construction times of a project.
  - Geographic data was linked to about 86% of projects (and 73% of capacity) in the queued-up data sample. The dataset was filtered to exclude records lacking state and county information and where latitude and longitude data could not be identified. For those interested in total queue capacity please see interactive visualizations.
  - Historically, most of the projects that seek interconnection withdraw during the study process, with only about 10-20% of projects achieving commercial operation. Our findings of Energy Community prominence in the interconnection queues may thus deviate from the final set of projects that will come online over the next years.
  - To investigate whether the IRA shifted proposed project locations towards Energy Communities, we compare capacity among interconnection queue entrants in 2021 and 2023. In response to a surge of applicants, MISO and PJM paused their interconnection queues in 2023, leaving us with little data to analyze for these two regions.

Queued national deployment in energy communities: Utility-Scale Solar



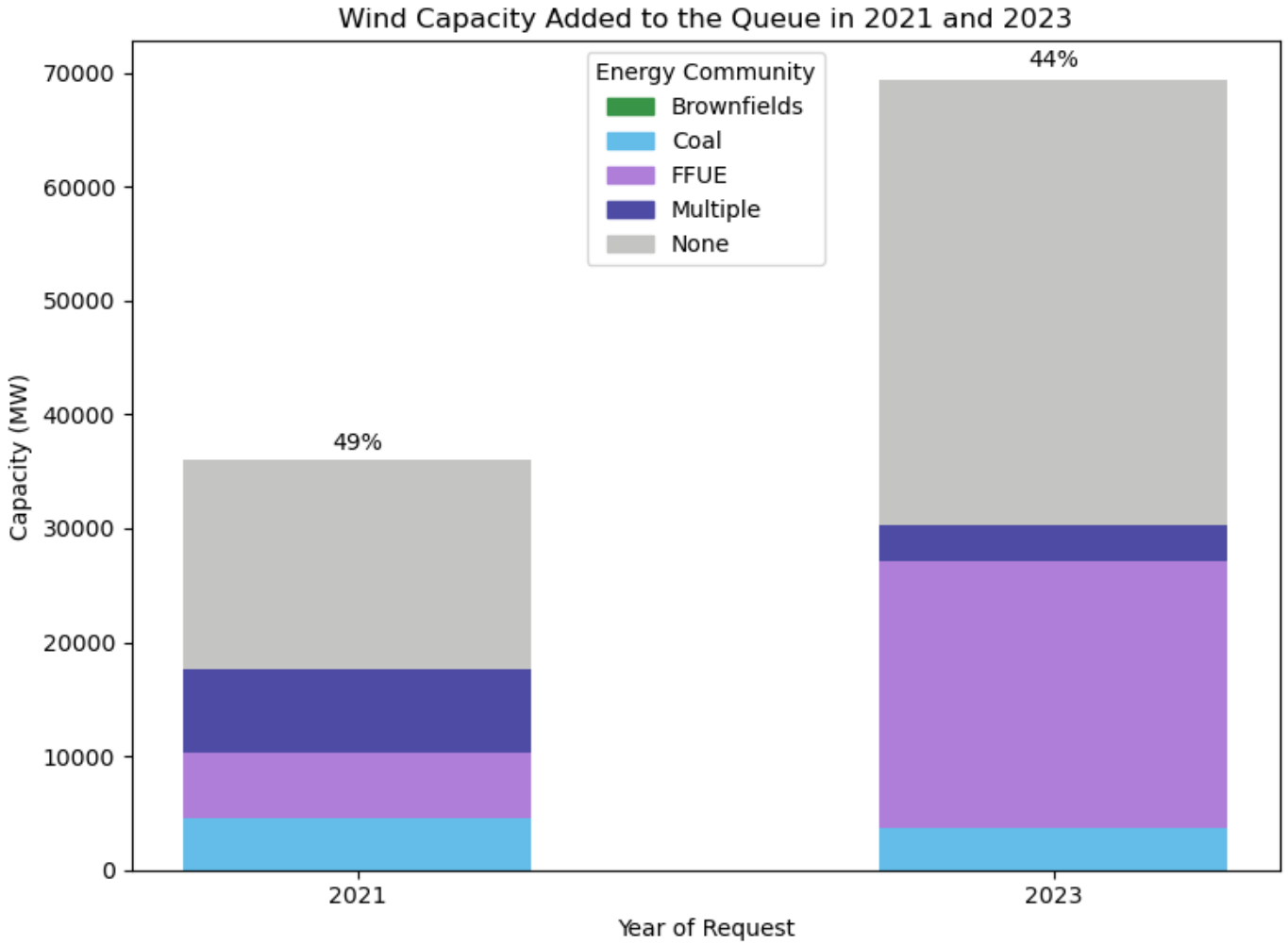
- Solar is the fuel type with the greatest cumulative capacity in the interconnection queues, with more than 1000 GW at the end of 2023.
- Among the 2021 and 2023 solar queue entrants, approximately half of the capacity is proposed in Energy Communities.
- While total new solar capacity seeking interconnection increased after the IRA took effect, the relative share of capacity within Energy Communities stayed the same.

Queued regional deployment in energy communities: Utility-Scale Solar



- The two regions with the largest increase in proposed solar capacity, CAISO and the non-ISO West, continue to hold their EC capacity share near 50%.
- The non-ISO Southeast shows growth in total capacity between the 2021 and 2023 entrants, and its share of queued capacity in Energy Communities has also doubled, indicating a potential passing of historical levels of below 20%.

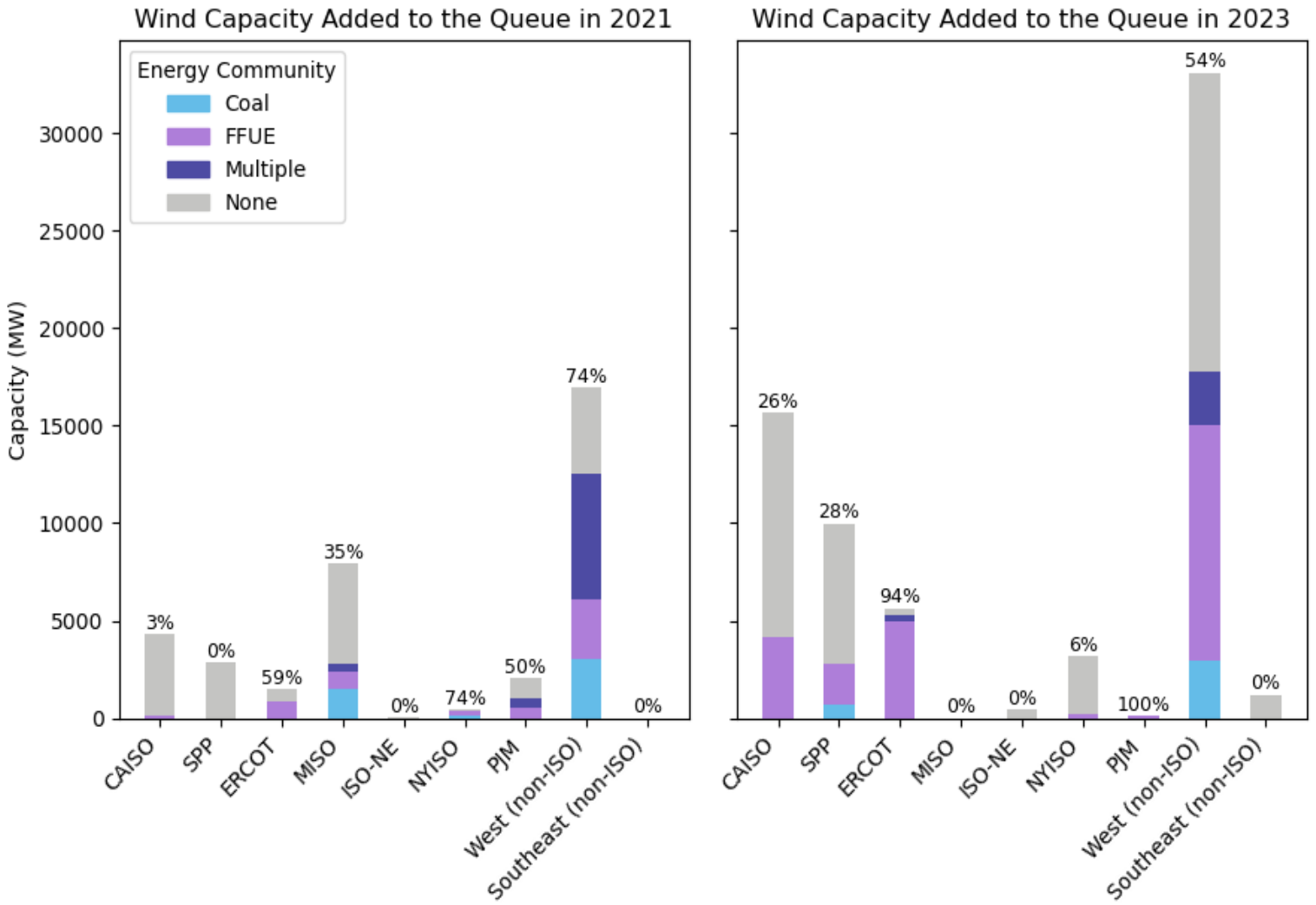
Queued national deployment in energy communities: Onshore Wind



- Onshore wind is the fuel type with the third largest cumulative capacity in the interconnection queues, but with 233 GW at the end of 2023 there is much less developer interest compared to solar and storage.

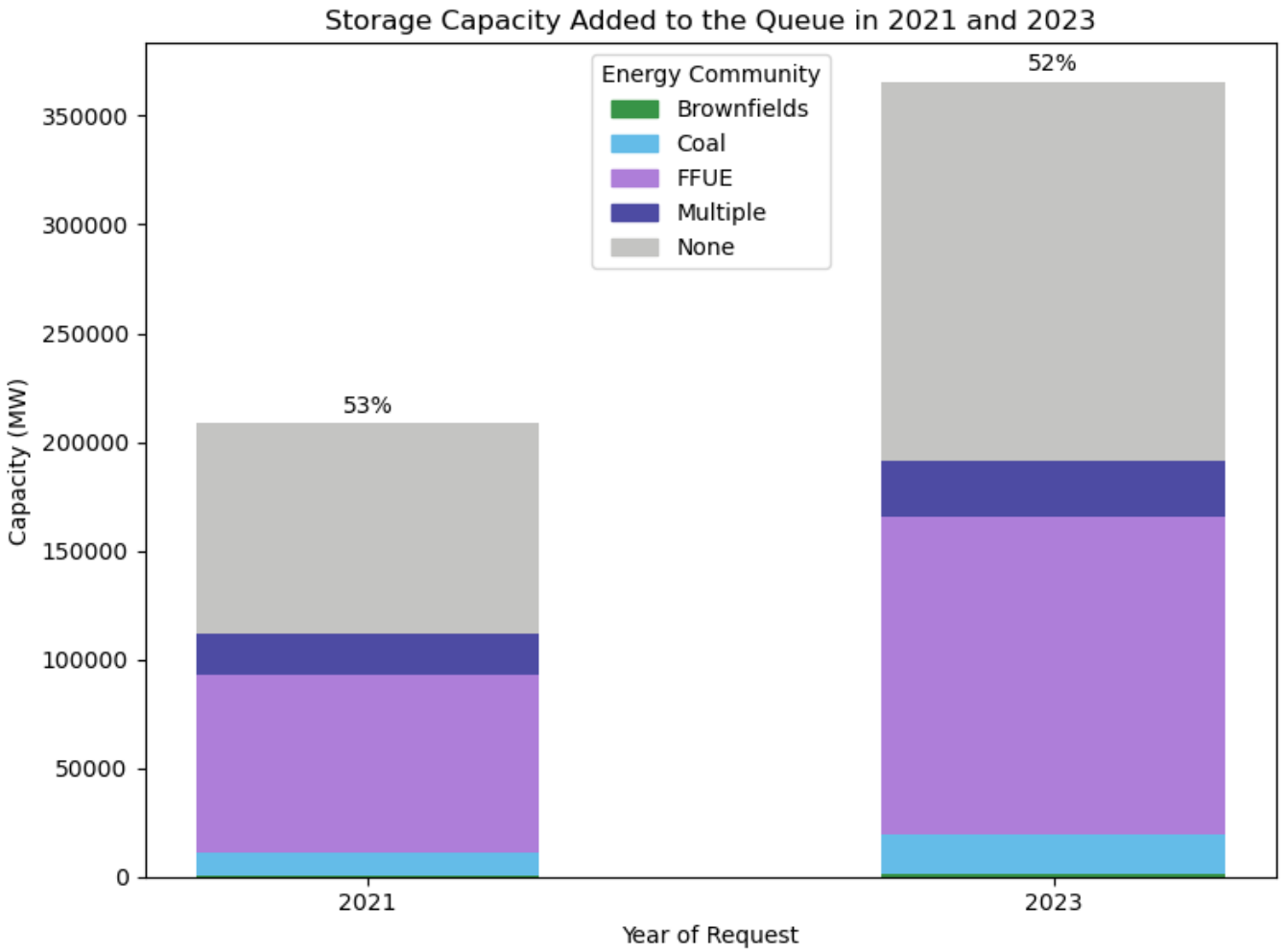
- Both the total amount of new wind capacity seeking interconnection and total capacity proposed in ECs have grown since the passage of the IRA. But wind's relative EC capacity share declined slightly in 2023 compared to 2021. Notable is the strong increase in projects sited in areas with high fossil fuel employment.

Queued regional deployment in energy communities: Onshore Wind



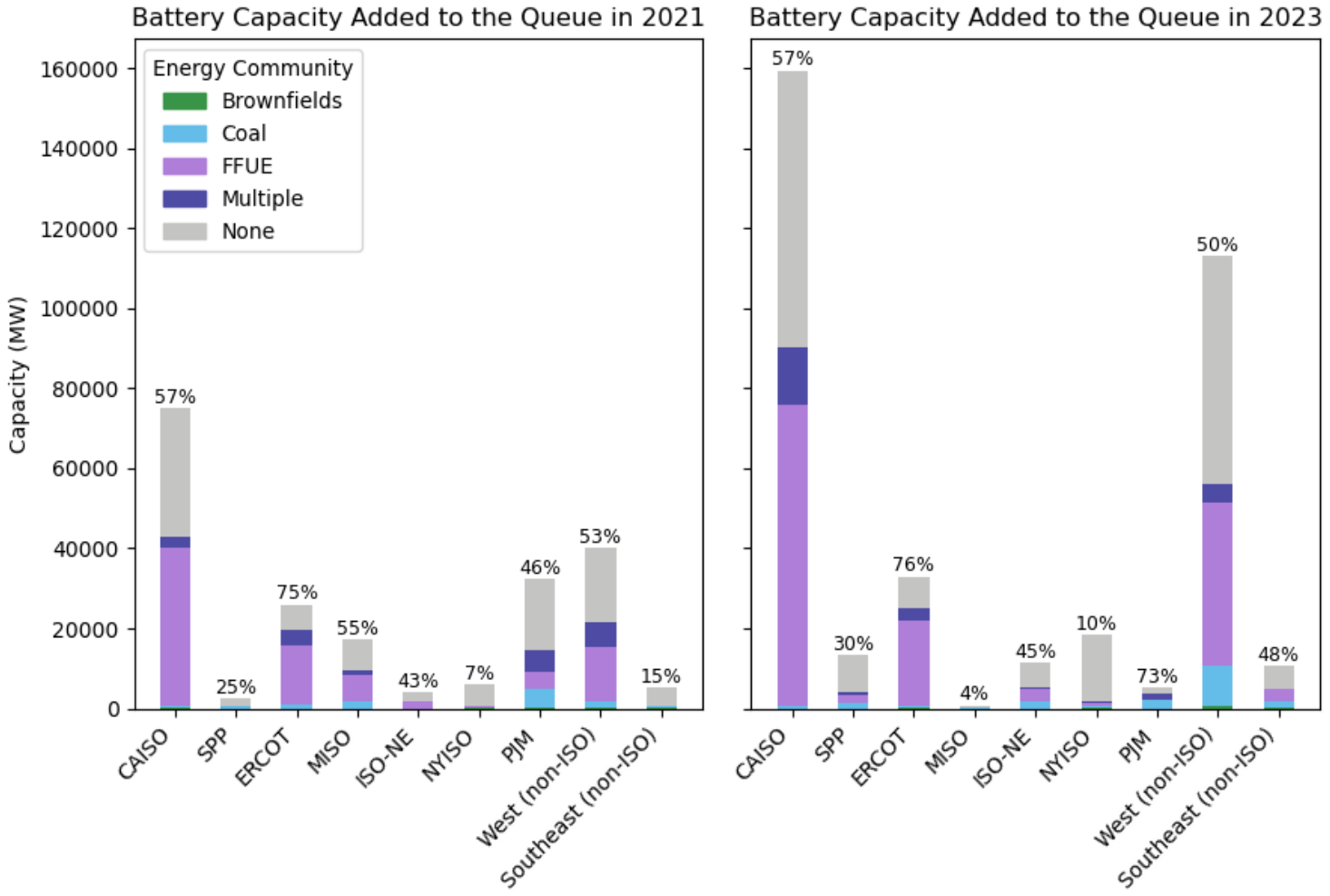
- Most of the new wind capacity added to the queue in 2023 was proposed in the non-ISO West and CAISO. MISO and PJM paused queue additions in 2023, making comparisons impossible.
- Wind's EC capacity share increased in most relevant regions except the non-ISO West.

Queued national deployment in energy communities: Storage



- Storage is the fuel type with the 2nd largest cumulative capacity in the interconnection queues, with more than 1000 GW at the end of 2023. We show here both standalone and hybridized storage.
- Again, both the total amount of new storage capacity seeking interconnection and total capacity proposed in ECs have grown strongly since the passage of the IRA. Among the 2021 and 2023 storage queue entrants, the capacity share in Energy Communities remains steady near 50%.

Queued regional deployment in energy communities: Storage



- CAISO, which dominates storage growth in the queues, has ~60% of its storage capacity proposed in Energy Communities. The other major region, the non-ISO West, follows with ~50%.
- Some regions with less proposed storage capacity like SPP or the non-ISO Southeast saw a shift towards in Energy Communities.

Withdrawal rates in Energy Communities have not changed significantly since bonus tax credits became available.

- Historically, most clean energy projects that apply for bulk power interconnection withdraw before coming online, potentially due to unfavorable economics (e.g., high interconnection costs), permitting hurdles, or development delays. Estimating the effect of the Energy Community Bonus Tax Credits on project withdrawal rates is difficult so far:
  - Only ~60% of projects that withdraw report withdrawal dates, leading to small sample sizes for some fuel types (wind).
  - Some regions (like MISO and PJM) revised their interconnection processes and did not accept new entrants in 2023.
  - Tax credit guidelines were published in April 2023 and required additional time to be digested by developers, potentially coming too late for some projects that withdrew in early 2023.
  - Data about withdrawal rate dynamics in 2024 is not yet available.

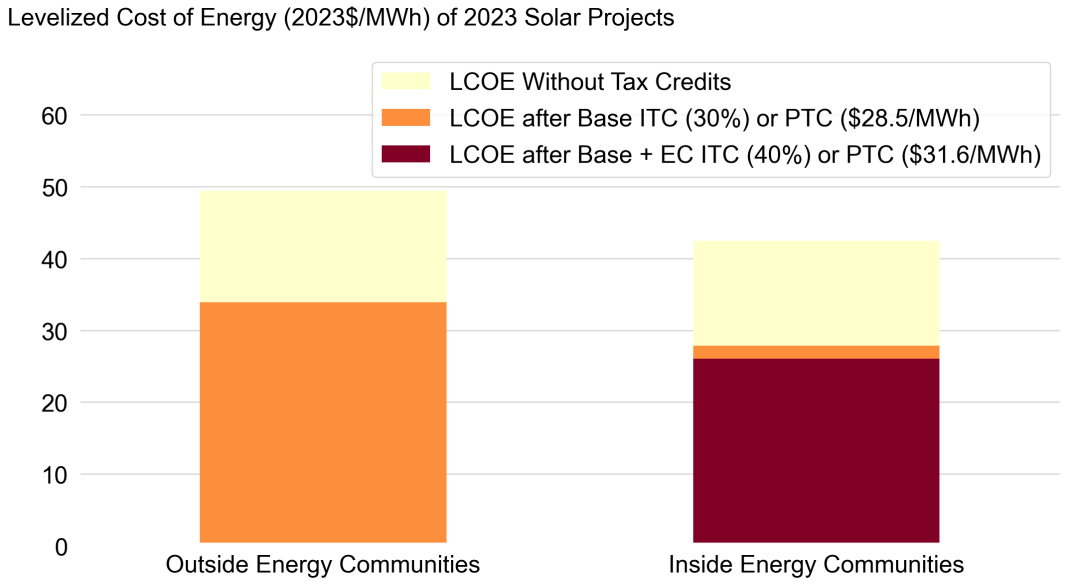
- Since the passing of the IRA, fewer clean energy projects have withdrawn, but EC-specific changes were not significant so far:
  - General withdrawal rates of solar and storage decreased significantly in 2023 relative to the recent past (2020-2022).
  - Withdrawal rates in Energy Communities also decreased while they remained steady in non-eligible areas, but this effect was not statistically significant.
  - Models evaluating the combined effect of time and geographies did not yield statistically significant results.

→ It is difficult to determine whether developers have already specifically responded to the EC bonus in their 2023 withdrawal decisions.

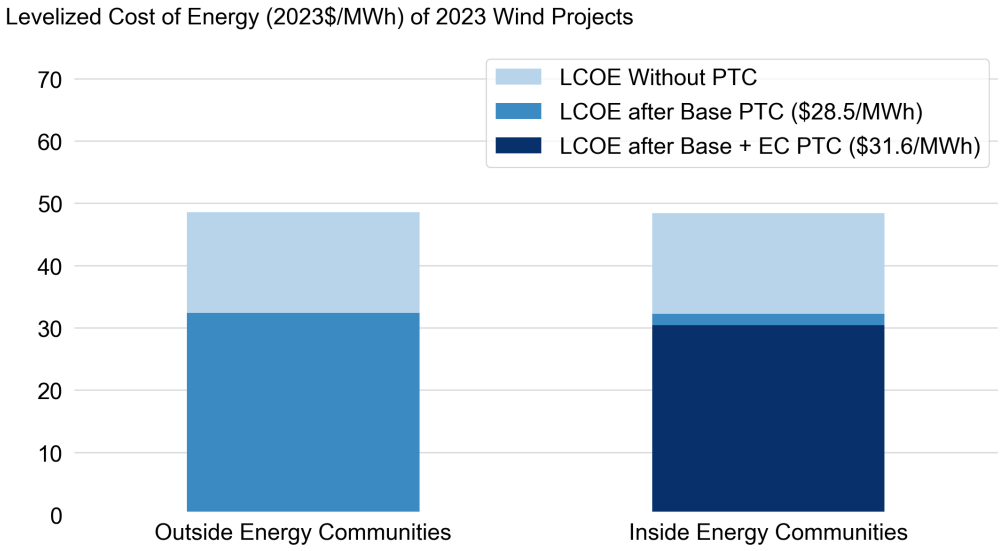
Economic Side Analyses

Average Levelized Cost of Energy (LCOE) after tax credits for projects built in 2023 is $26/MWh for solar and $30/MWh for wind in Energy Communities

- **Solar** (sample: 74 projects, >5MWac)
  - Capex of solar projects are lower in Energy Communities than elsewhere ($0.22/Wac*** in simple multivariate regression model), giving those solar projects a competitive head start.
  - Projects have a gen-weighted LCOE after tax credits (ITC or PTC) of $26/MWh in ECs vs. $34/MWh outside of EC areas (24% less).



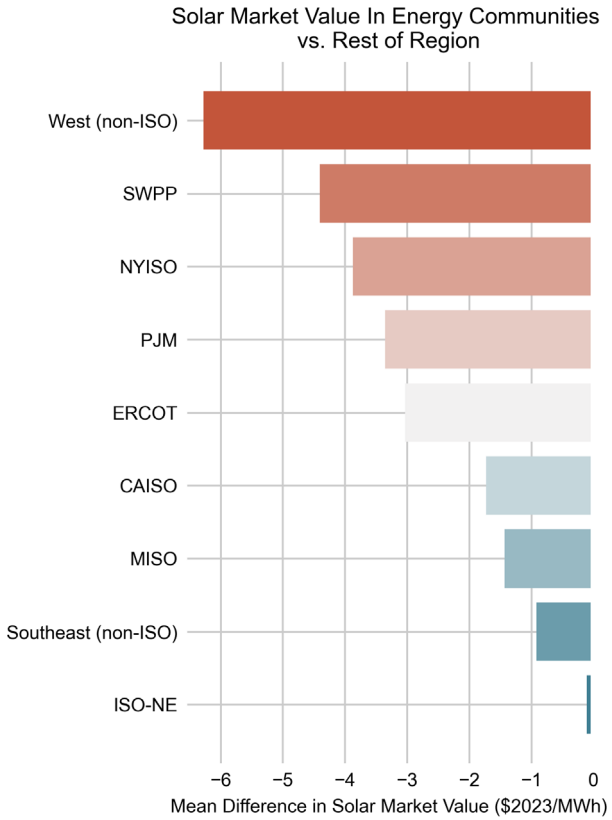
- **Wind** (sample: 19 projects, >45MW)
  - Capex and capacity factors of wind projects in Energy Communities is not significantly different than elsewhere, yielding similar gen-weighted pre-incentive LCOE.
  - LCOE after tax credits is $30/MWh in ECs vs. $32/MWh outside of EC areas (6% less). As the PTC is only available during the first 10 years, the levelized bonus over a 30-year project life equates $1.8/MWh.



Note: Only preliminary project data is available for new wind and solar projects coming online in 2023. Findings may shift as more Capex data and project-specific performance data become available. Capacity factors are approximated based on regional averages.

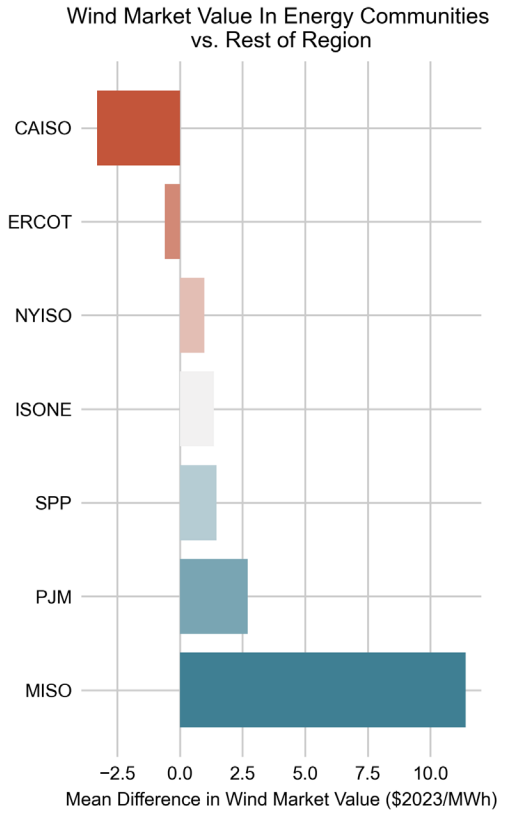
The average wholesale market value in 2023 in Energy Communities is lower for solar but higher for wind in most regions

Solar



- Compared to the rest of each region, EC solar projects have on average a lower wholesale market energy and capacity value.
- For solar the value difference is negative in all regions – the most in the non-ISO West and SWPP. In the non-ISO Southeast and ISO-NE the market value is nearly the same.

Wind



- Compared to the rest of each region, EC wind projects have on average a higher wholesale market energy and capacity value.
- For wind the value difference is positive in all regions, except for ERCOT and CAISO. EC wind projects have the biggest value premium in MISO with more than $10/MWh.

Note: No wholesale market value data is available for projects with COD 2023 as we lack generation data for full calendar year. Instead, we analyzed 2023 wholesale market values for existing projects with COD prior to 2023 to infer locational value differences in and outside of Energy Communities.

Case Studies

Replacing Minnesota's largest coal plant with the state's largest solar project

Sherco 3 coal-fired power plant, Minnesota

Source: Xcel Energy

- Xcel Energy is retiring its Sherburne County Generating Station (Sherco), one of the Midwest's largest coal plants.
- After a 680 MW coal unit closed in December 2023 (making the location eligible for EC benefits), Xcel is now building a 710 MW solar and a 10MW/1000MWh iron-air battery project. Construction on the solar project began in 2023 and is expected to be complete by the end of 2025.
- According to Xcel, the solar array will create an estimated $350 million in local economic benefits over the 35-year life of the project, bringing 395 construction and 18 ongoing O&M jobs to the area affected by the coal plant retirements.

Source: Xcel Energy: https://mn.my.xcelenergy.com/s/renewable/developers/sherco-solar-project

Onshore wind farm is built near a retiring coal plant in Arizona

Chevelon Butte wind farm in northeastern Arizona.

Source: KTAR News

- Chevelon Butte Wind Farm will be Arizona's largest wind energy project, delivering 454 MW. The site qualifies as an energy community due to the ongoing closure of the nearby Cholla Coal Power Plant and meeting fossil fuel unemployment criteria in a region with a poverty rate over 24%.[1]
- The first phase (238 MW) is already complete, and the second phase (216 MW) is expected to begin commercial operations at the end of 2024, repurposing transmission infrastructure from the retiring coal plant.
- AES claims the creation of >200 construction jobs, the generation of $8 million in indirect spending for the local economy, around 10 permanent full-time jobs and $18 million in local property tax payments over its lifespan. The developer also reports donations to local education centers and libraries, and over $10 million to the Arizona State Land Department Trust.

[1]*Source: U.S. Census Bureau. (2022) American Community Survey 5-Year Estimates*

Offshore wind using a substation from a retiring coal unit in Delaware

- The northeastern U.S., where most offshore wind projects are proposed, has fewer qualifying energy communities (meeting either the fossil fuel employment or coal closure criteria) than the West and Gulf Coasts.
- In 2022, NRG Energy closed its coal plant at Indian River, Delaware, qualifying offshore wind projects connecting to the adjacent substation for energy community tax credits.
- The Maryland developer US Wind will interconnect its MarWin (~300 MW) and Momentum Wind (809 MW) projects at the site. MarWin claims over 3,000 construction jobs and ~100 operations jobs.
- The projects will contribute to Maryland's renewable energy goal of 50% of retail electricity sales by 2030. In addition, a negotiated quantity of renewable energy credits (RECs) will be transferred to Delaware utilities.

NRG coal-powered plant, Indian River, Delaware.

Source: Delaware Business Times

Distributed Solar Case Study: Solar for All

Solar for All is a $7B U.S. EPA program through which 60 awards were granted in the first half of 2024 to various states, territories, tribes, and other non-profit groups to promote low-income solar (too early to see impacts in these data)

- Energy Communities
  - Bonneville Environmental Foundation (WY): Coal is a large industry in WY and 21 of the state's 23 counties are designated energy communities, so these funds will go towards workforce development and adoption in these areas
  - Growth Opportunity Partners, Inc. (31 communities across 8 Midwest states): The first African American-led green bank will focus development in coal communities, brownfields, and low-income community solar
  - Michigan Dept. Of Environment, Great Lakes, and Energy: The state department will focus development on landfills and brownfields
  - New Mexico Energy, Minerals, and Natural Resources Dept.: Will have a workforce development component and focus on tribal & energy communities
  - Pennsylvania Energy Development Authority (PA): Will concentrate on the Appalachian region (high number of coal communities), workforce development
- Affordable Housing
  - GRID Alternatives (US): Solar Access for Nationwide Affordable Housing program to support TPO direct install and community solar options (also has a tribal program)
  - Hope Enterprise Corporation (South): CDFI will offer low-cost financing for third-party owned residential solar, including to multi-family housing
  - North Carolina Dept. Of Environmental Quality: Will focus on affordable mutli-family and supportive housing owned and operated by non-profits, public orgs
  - Massachusetts Dept. Of Energy Resources: Solar on Public Housing Initiative (state and federal housing) & Solar on Affordable Housing Initiative (regulated affordable housing including Low-Income Housing Tax Credit properties)
  - Vermont Dept. Of Public Service: A third of funds will go towards Managed Affordable Solar Housing Program for multi-family rental properties
  - Wisconsin Economic Development Corporation: Public-private partnership to provide financial assistance to multi-family affordable housing building owners and developers and focus development on affordable housing constructed or rehabilitated after 2000
- Tribal Communities
  - Midwest Tribal Energy Resources Association, Inc. (MO): The majority of low-income and disadvantaged tribal communities in MO are located in or near coal facility closures, so can leverage multiple adders (Energy Community as well). (MI, WI, MN) will focus on tribal installations.
  - Oweesta Corporation: Will support tribal solar across the nation for residential and community solar
  - Tahana Chiefs Conference (AK): Alaska has the highest Native population in the country (20%) and this program will increase installs for these tribal members
  - Hopi Utilities Corporation: 35% of residents have no access to electricity, so will focus on electrification and resilience for these homes
  - Three Affiliated Tribes (Mandan, Hidatsa, Arikara Nation- ND, SD, MT; later WI, WY): Tribal owned and managed installations along with workforce development

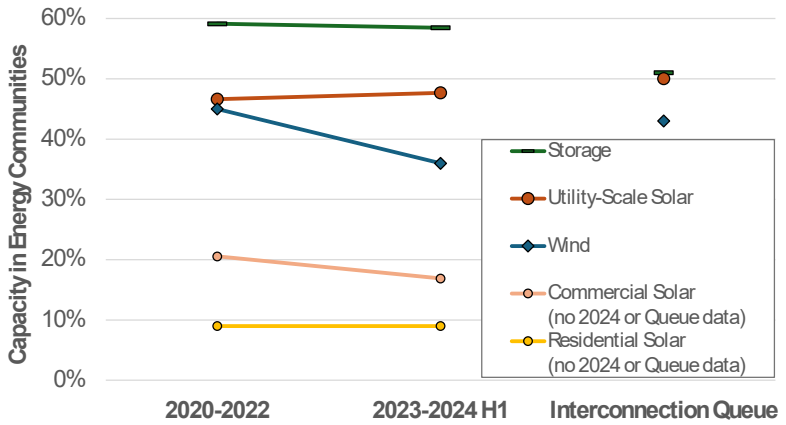
Summary of Findings and Future Research

Summary of Findings

As clean energy projects take multiple years to conceptualize and develop, it is likely too early to already see shifts towards **Energy Community (EC)** locations either among newly built projects or those that entered the interconnection queues in 2023. Continued tracking of deployment trends will be important for electric system planners, modelers, and purchasers of renewable energy.

- We have established **historical baselines** of clean energy build-out in ECs
  - ~35% of onshore wind, ~50% of solar and ~60% of storage in 2023 and H1 2024.

- Since the IRA was passed, overall clean energy capacity has surged in the **interconnection queues**.
  - ~45-50% of both recently proposed and total queued clean energy capacity is in ECs.
  - While the amount of capacity that is proposed in ECs has also grown, its relative share is either stable (solar, storage) or has slightly declined (wind) among the 2023 queue entrants (graph shows total active queue, not just recent additions).



- Wind and solar can be built in ECs at a lower levelized cost of energy (LCOE).
  - LCOE after incentives was $9/MWh (24%) lower for 2023 solar projects and $2/MWh (6%) lower for 2023 wind projects.
  - Wholesale market value premiums vary by region: Compared to non-EC locations in the same market, the value tends to be lower for solar projects (-$6 to 0/MWh) but higher for wind projects (-$3 to $11/MWh).

- Only **distributed solar** that is owned by commercial entities is eligible for the EC bonus.
  - Energy Community-eligible residential capacity grew in 2023, both in absolute MW as well as market share (9%). It is primarily concentrated in California.
  - 17% of the non-residential capacity built in 2023 can qualify for the EC credit.
  - Projects can earn additional low-income community (LIC) bonuses in addition to the EC bonus, but LIC deployment was nearly 3x greater than the available annual program caps.

- Clean energy projects can **bring economic activity to disadvantaged communities**, both during the construction period and in form of longer-term employment and community benefits.

Limitations and Future Research

- The purpose of this work was to establish initial baselines against which future clean energy deployment can be measured. While we know that the Inflation Reduction Act has brought greater overall growth rates of renewable energy, we do not yet have enough data to confidently test whether renewable projects are increasingly sited in Energy Communities.

- Future research can leverage longer time series to conduct:
  - Deeper statistical analyses to show how the availability of bonuses impacts choice of project locations relative to other constraints (interconnection capacity, attractive wind or solar resourced, high market value, or proximity to offtaker…)
  - Longer-term qualitative and quantitative assessments of local community benefits of renewable projects in Energy Communities
  - Studies on whether local community benefits differ in and outside of Energy Communities (because additional bonuses can be passed down to hosting communities)
  - Studies on how bonuses may help projects overcome development hurdles resulting in lower withdrawal rates
  - Studies on how tax credit adders encourage multi-family, community, municipal, and/or non-profit distributed solar
  - Studies quantifying financial benefits to residential adopters and their perceptions (adders must pass through third parties)

ENERGY MARKETS & POLICY

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Appendix

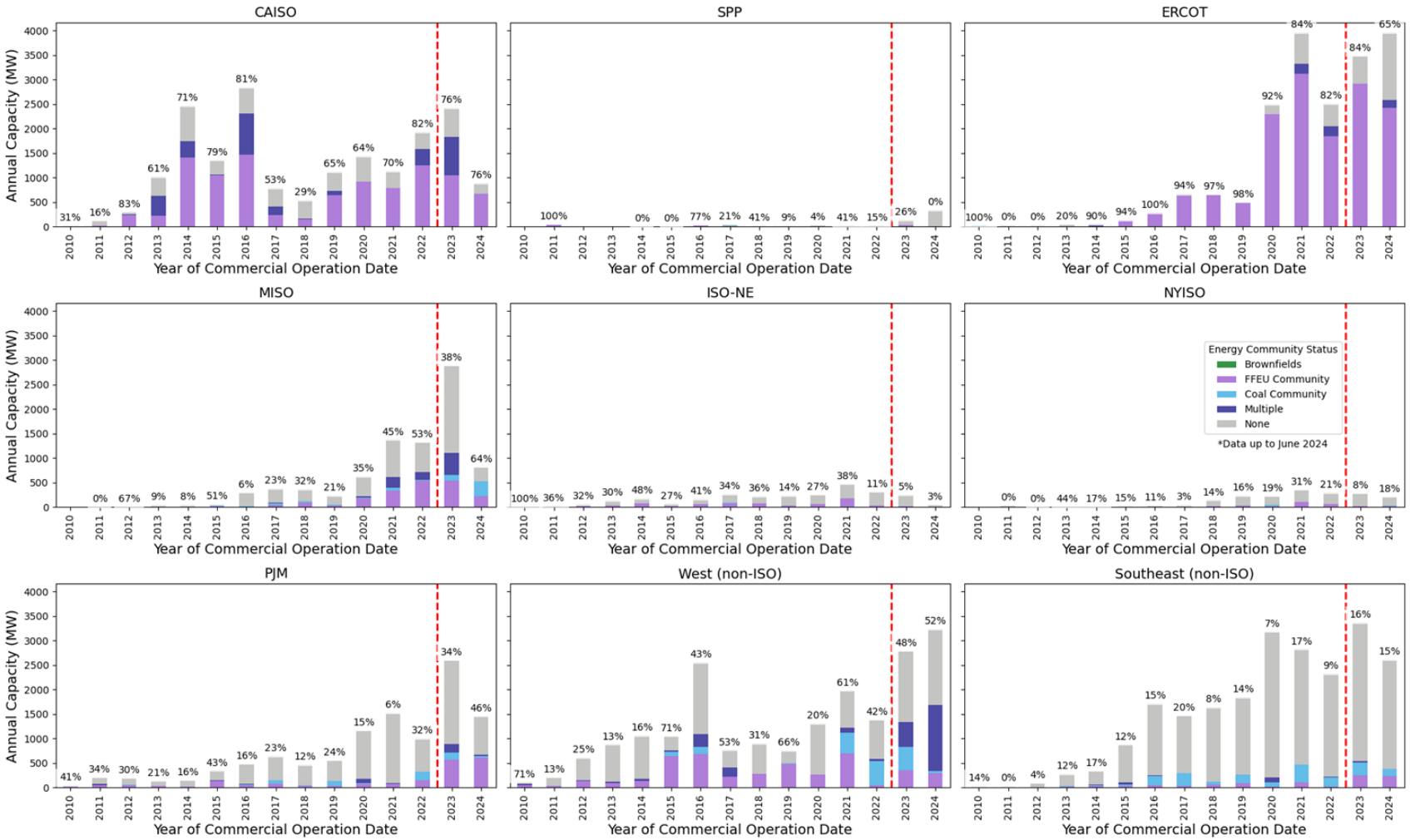
Additional information on methods for historical deployment of distributed solar projects

- Data sources
  - LBNL's *Tracking the Sun (TTS):* empirical data on system size, cost, date of installation, location, and whether it is third-party owned (TPO)
  - Buildzoom and Ohm Analytics: permit data with location and date of installation for systems additional to TTS
  - Wood Mackenzie: Market data on installed project numbers and capacity for each state and year; TPO market share for the US and selected states (2016 onwards)

- Residential methods
  - Total installs by year and state: Wood Mackenzie
  - Average system sizes statewide, and within EC/LIC areas only: TTS was used when coverage was sufficient across each year and state. If not, TTS was used to create an annual statewide ratio of system size within EC/LIC to the total market average and Wood Mackenzie total state/year market average was used
  - Fraction of TPO installs statewide, and within EC/LIC areas only: TTS was used when coverage was sufficient across each year and state. If not, TTS was used to create an annual statewide ratio of EC/LIC fraction to the total market average and Wood Mackenzie total state/year market average was used (either state specific or the aggregated states that were not specified by Wood Mackenzie for a given year)
  - Distribution of systems across designated areas: TTS was used where coverage was sufficient. Either by state, census division, or census region

- Non-residential (commercial and community solar) methods
  - Installed capacity was only known for TTS systems, and not those from Buildzoom or Ohm. The average system size in TTS for each year was scaled up to match the total installations from TTS, Buildzoom, and Ohm
  - Location was known for all systems in TTS, Buildzoom, and Ohm (and thus the distribution across designated areas). These distributions were applied for each year to scale up to the full number of installations and MW of capacity specified by Wood Mackenzie

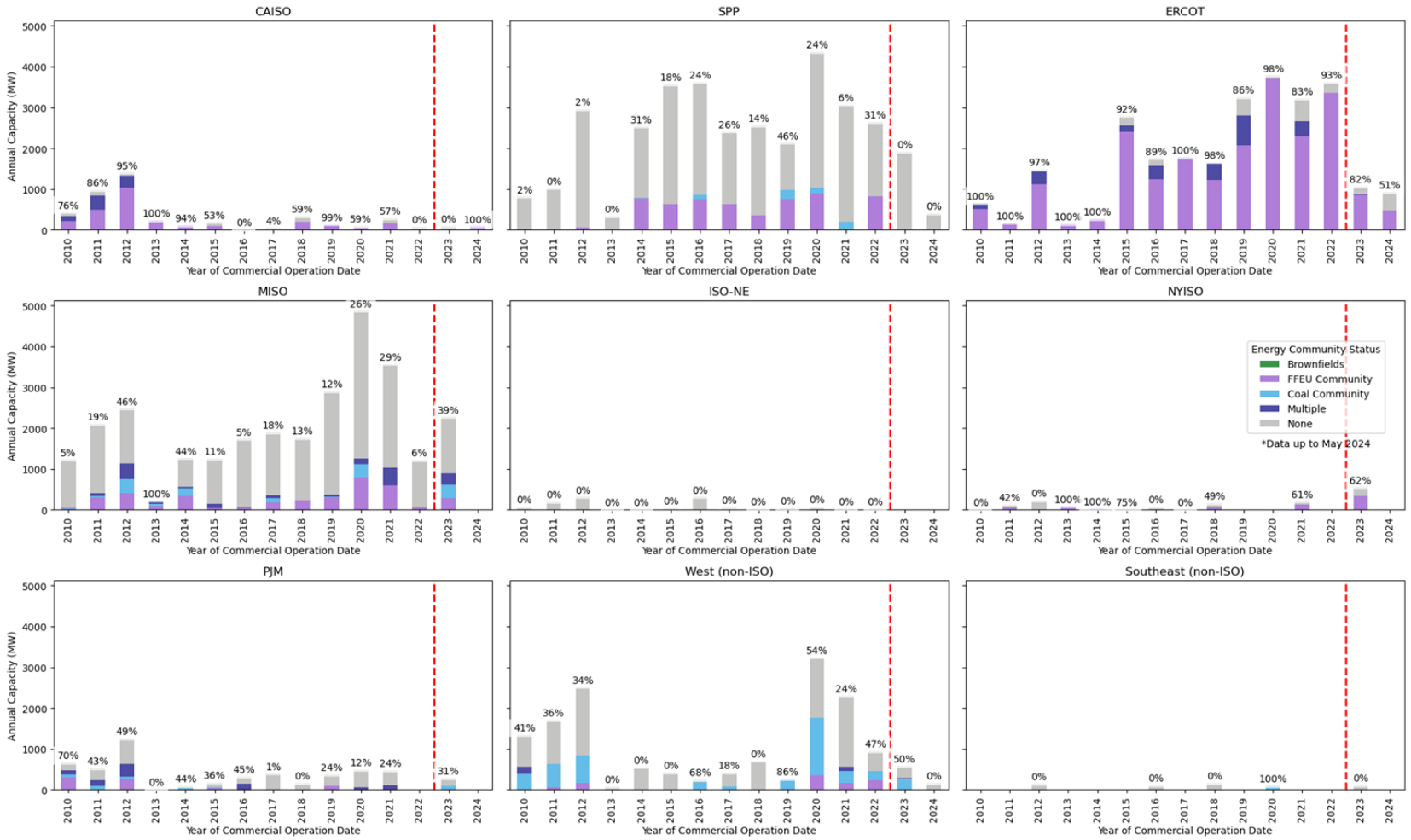
Historical regional deployment in energy communities: Utility-Scale Solar



- CAISO and ERCOT have the highest solar capacity in absolute terms as well as consistently high shares of solar capacity in eligible locations, often exceeding 80% post-2016.
- Despite total capacity increases, NYISO and the Southeast (non-ISO) often saw less than 20% of new capacity in eligible locations.

Note: The Energy Community Tax Credit was introduced in 2023 and does not apply to earlier capacity additions. We used the 2023 EC definitions for the years 2010 to 2023, and the 2024 definitions for 2024.

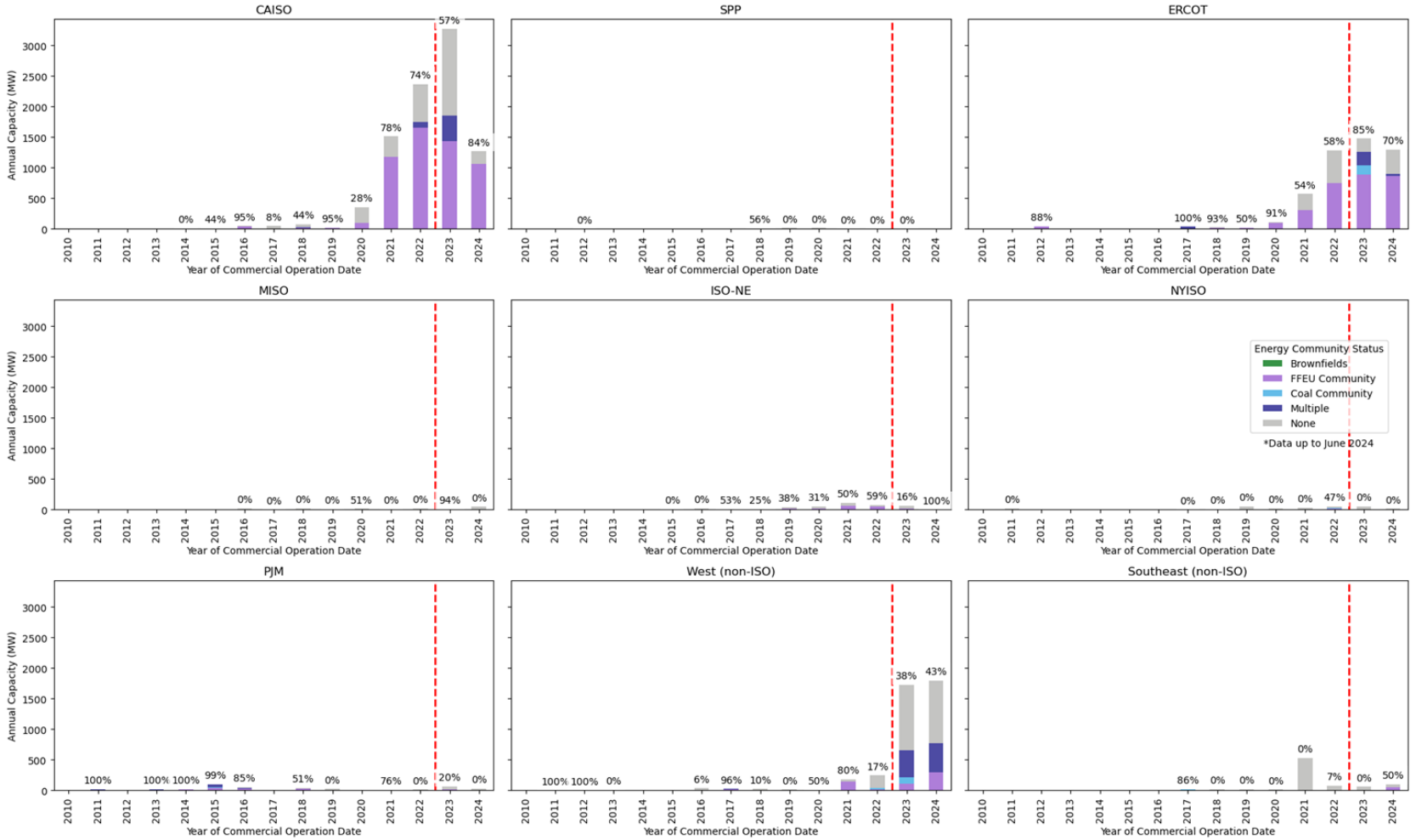
Historical regional deployment in energy communities: Onshore Wind



- Wind turbines have been predominantly built along the “wind belt” in the Great Plains and parts of the Midwest that is characterized by high wind speeds.
- However, regions like SPP and MISO have fewer Energy Community eligible areas, resulting in low capacity shares that may receive the tax credit bonuses (0%, 39%).
- In contrast, much of ERCOT’s wind capacity is in Energy Communities, especially those with fossil fuel employment. The non-ISO West stands out for having greater shares of Energy Communities due to recent coal closures.
- Many other regions have had little wind deployment, even though some have greater shares of projects in energy communities (NYISO and CAISO).

Note: The Energy Community Tax Credit was introduced in 2023 and does not apply to earlier capacity additions. We used the 2023 EC definitions for the years 2010 to 2023, and the 2024 definitions for 2024.

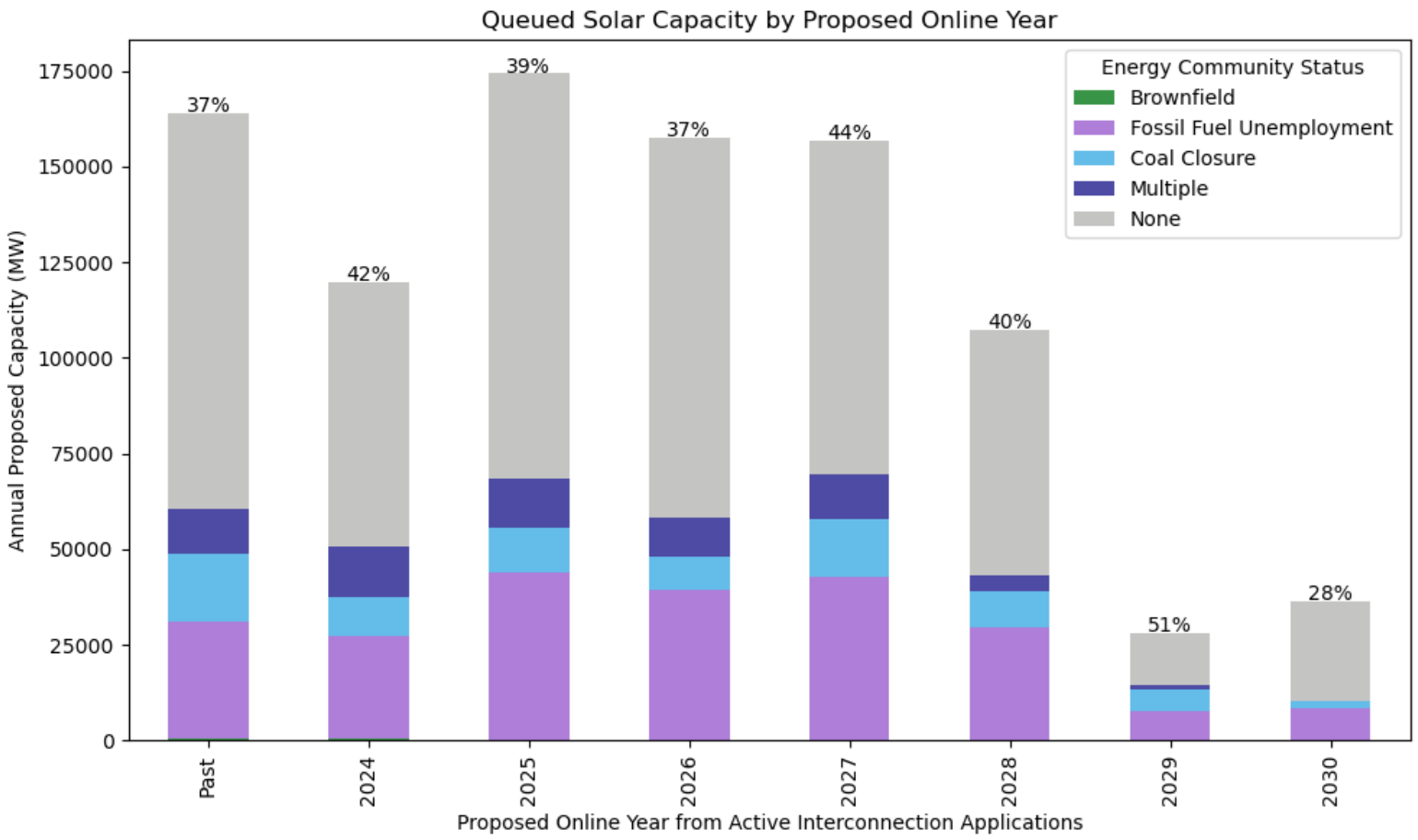
Historical regional deployment in energy communities: Storage



- CAISO, ERCOT and the non-ISO West are the primary regions in which storage has been built.
- For both CAISO and ERCOT, battery storage capacity is much higher in eligible areas than outside (55-85%).
- CAISO has the greatest total battery storage capacity within eligible areas (5.9 GW) followed by ERCOT (3.2 GW).
- In the non-ISO West storage has a lower Energy Community share (~40%).

Note: The Energy Community Tax Credit was introduced in 2023 and does not apply to earlier capacity additions. We used the 2023 EC definitions for the years 2010 to 2023, and the 2024 definitions for 2024.

Queued deployment by proposed online year: Utility-Scale Solar



- Shown here are projects that are actively working through the interconnection queues by their proposed online year (those with an intention to have already achieved commercial operation by 2023 are in the “past” column).
- A hypothesis is developers may need additional time to integrate Energy Community status as a siting criteria for new projects, and that deployment is skewed to later years.
- But we do not find much evidence that the share of clean energy capacity in Energy Communities increases in later year, either for solar as shown here or wind and storage on the following slide.

Queued deployment by proposed online year: Onshore Wind and Storage