

20
23 | Q2

CLEAN POWER QUARTERLY

Market Report



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Clean Power Definitions & Acronyms

Definitions

Advanced development: Projects not under construction, but with a PPA, firm equipment order, or moving forward with plans to be placed under utility ownership as of the end of the most recent quarter. For offshore wind, advanced development consists of projects that have secured offtake or have had successful bids in response to a state solicitation even if final offtake negotiations have not concluded.

Capacity: Project nameplate capacity. Unless otherwise stated, ACP reports capacity in MW-ac.

Clean power: For the purposes of this report, clean power includes land-based wind, offshore wind, utility-scale solar, and battery storage technology.

Decommissioned: Project is offline and is no longer delivering power to the grid on a permanent basis. Physical removal of equipment is not a requirement.

Duration: The amount of time, in hours, a battery can discharge its power capacity before depleting its energy capacity. For example, a 2 MW battery that has 4 MWh of energy capacity has a duration of 2 hours.

Full repowering: Full decommissioning of a utility-scale project. The original equipment is physically removed from the project site and replaced with new utility-scale equipment.

Inverter Loading Ratio (ILR): The ratio of installed DC capacity to the inverter's AC power rating. Also known as the AC-to-DC ratio.

Online: Project has reached commercial operation and is delivering electricity to the ultimate point of delivery.

Partial repowering, nacelle replacement: Complete replacement of a utility-scale wind turbine's nacelle, rotor, and blades. The tower and foundation are retained.

Partial repowering, major retrofit: Complete replacement of a utility-scale wind turbine's rotor and blades, along with the replacement of at least one major component within the nacelle, typically the gearbox or the generator.

Pipeline: Projects either under construction or in advanced development.

Repowered: Full or partial equipment replacement. Currently only wind repowering activity is tracked, but ACP will expand repowering activity tracked as the market progresses.

Under construction: Construction team has begun work on the ground at the project site. For offshore wind, under construction is defined as in-ocean construction.

Acronyms

AC	Alternating Current
C&I	Commercial & Industrial
CAISO	California ISO
DC	Direct Current
ERCOT	Electric Reliability Council of Texas
GW	Gigawatts
GWh	Gigawatt hours
ILR	Inverter Loading Ratio
IOU	Investor-Owned Utility
ISO	Independent System Operator
MISO	Midcontinent Independent System Operator
MW	Megawatts
MWh	Megawatt hours
NE-ISO	New England ISO
NYISO	New York ISO
OEM	Original Equipment Manufacturer
PJM	Pennsylvania-New Jersey-Maryland Interconnection
PPA	Power Purchase Agreement
RTO	Regional Transmission Organizations
SPP	Southwest Power Pool



Photo credit: Invenergy

2023 Q2 Highlights



2023 Q2 Highlights

Clean Power Project Installations

- After a sluggish start to the year, second quarter clean power installations returned to 2022 levels, with developers connecting 5.2 GW. This represents the second highest Q2 to date after the second quarter of 2021. At the halfway point of 2023, total installations for the year stand at 9.4 GW—19% lower compared to the same period in 2022.
- California claimed the top spot this quarter by commissioning 867 MW of new projects, constituting more than 15% of second quarter installations. Following closely behind, Texas secured the second spot with 727 MW, while Michigan ranked third with 537 MW. So far in 2023, Florida leads with 1.5 GW, trailed by Texas with 1.4 GW, and California with 1.1 GW.
- Over the last two quarters, solar emerged as the sole technology surpassing 2 GW of quarterly installations. Specifically, in Q2, solar additions amounted to 2,740 MW, whereas battery storage capacity additions logged 1,510 MW and land-based wind capacity reached 968 MW of new installations.
- When comparing the second quarter of this year to the same period in 2022, wind installations experienced a decline of 24%. On the other hand, solar installations remained relatively stable, declining just 1% in the period. The battery storage industry demonstrated a remarkable 32% growth rate compared to the second quarter of 2022.
- Cumulatively, operating clean power capacity in the country has surpassed 237 GW, enough to power 63 million American homes.

Clean Power in Development

- The influence of the Inflation Reduction Act (IRA) is evident in the project development pipeline. The 145,592 MW in the pipeline represents a 13% increase from Q2 2022, and a 43% increase from Q1 2021.
- Year-over-year, the battery storage pipeline surged 45%, while the solar pipeline also exhibited a significant increase of 16%. Conversely, land-based wind capacity in the pipeline experienced a 6% decline during this period.

However, the slowdown in the wind market is beginning to turn—the wind pipeline grew by 8% compared to the first quarter, marking the first growth since Q3 2021.

- Solar continues to be the leading technology in the pipeline, accounting for 59% of all clean power capacity in development. Land-based wind accounts for 15% of the pipeline, battery storage represents 14%, and offshore wind claims the remaining 12%.
- Texas, the clean power hub, leads with 26,353 MW of clean power underway (18%). California follows with 15,918 MW (11%), and New York ranks third with 9,217 MW.

Clean Power Procurement Activity

- In the second quarter, clean power buyers announced 3,899 MW of new power purchase agreements (PPAs), a 57% decline compared to Q2 2022. Year-to-date, announcements have declined 47%.
- This quarter, corporate announcements constituted only 24% of the total, a significant drop from over 60% of agreements announced in 2022. Corporate PPA announcements saw a sharp decline of 63% in the first half of this year. Conversely, utility announcements in the second quarter rose by 49% compared to 2022. However, overall utility announcements for the first half of the year were down by 9% due to a slow first quarter.
- Solar accounted for more than half (52%) of PPA announcements in the first half of the year, while wind accounted for 41%.
- Wind and solar PPA announcements both declined, down 11% for wind and a whopping 73% for solar. Battery storage PPA announcements remained flat compared to the second quarter of 2022.

Solar capacity is reported in MWac



Photo credit: NextTracker

Clean Power Capacity Growth



Second Highest Q2 Installations to Date

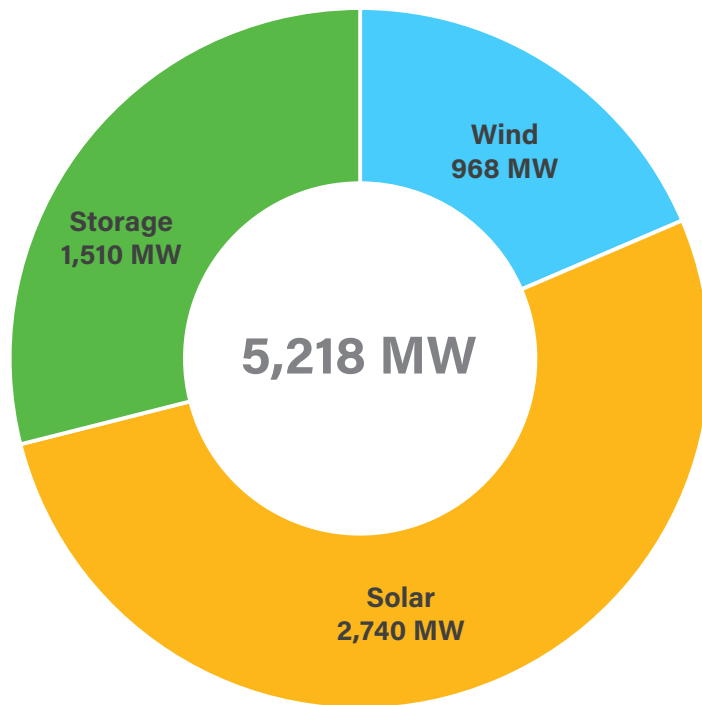
2023 Q2 installs

- Project developers brought 105 projects online in the second quarter, adding 5,218 MW of new clean power capacity to the grid.
- Second quarter installations are consistent with Q2 2022 installations, though because of a slow first quarter, clean power installations through the first half of the year are down 19% compared to the same period in 2022.
- Solar led quarterly installations with 2,740 MW coming online. Additionally, developers connected 1,510 MW/5,098 MWh of battery storage and 968 MW of land-based wind capacity to the grid.

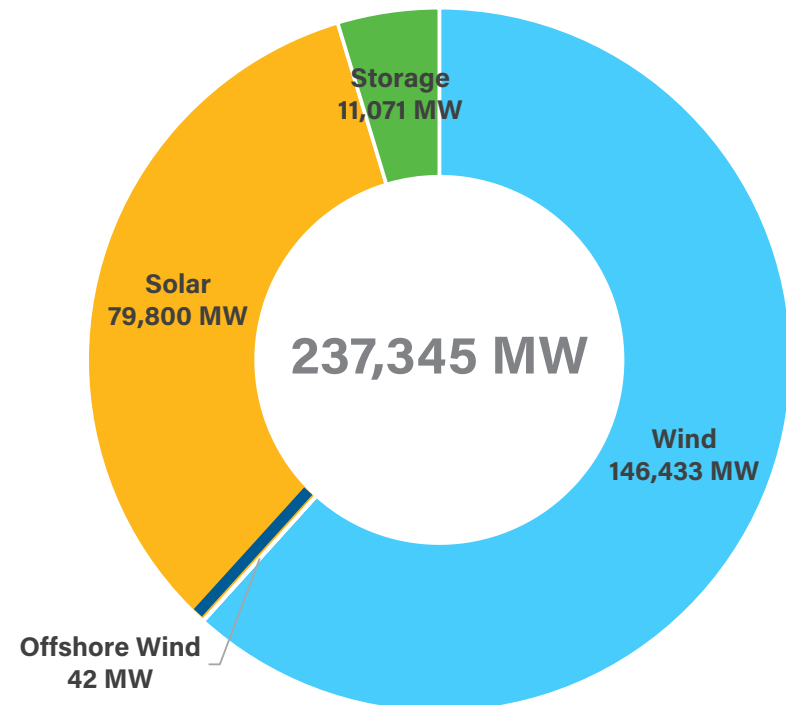
Cumulative operating clean power capacity

- The 237,345 MW of clean power operating in the U.S. is enough to power 63 million American homes.
- Broken down by technology, operating clean power capacity is made up of 146,433 MW of land-based wind, 79,800 MW of solar, 11,071 MW/31,066 MWh of battery storage capacity, and 42 MW of offshore wind.

Q2 2023 Clean Power Installs by Technology

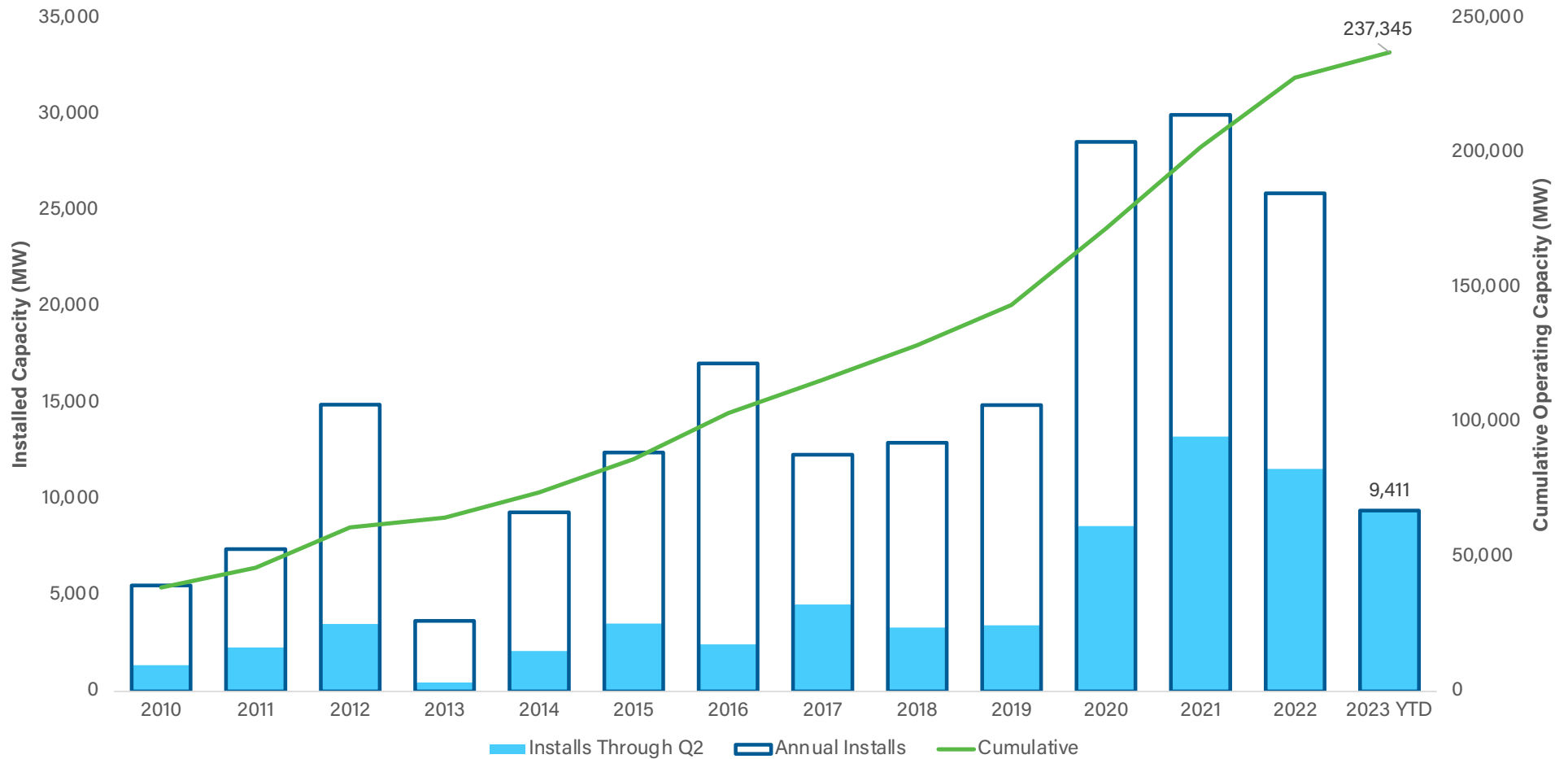


Total Operating Clean Power Capacity by Technology



Second Highest Q2 Installations to Date (continued)

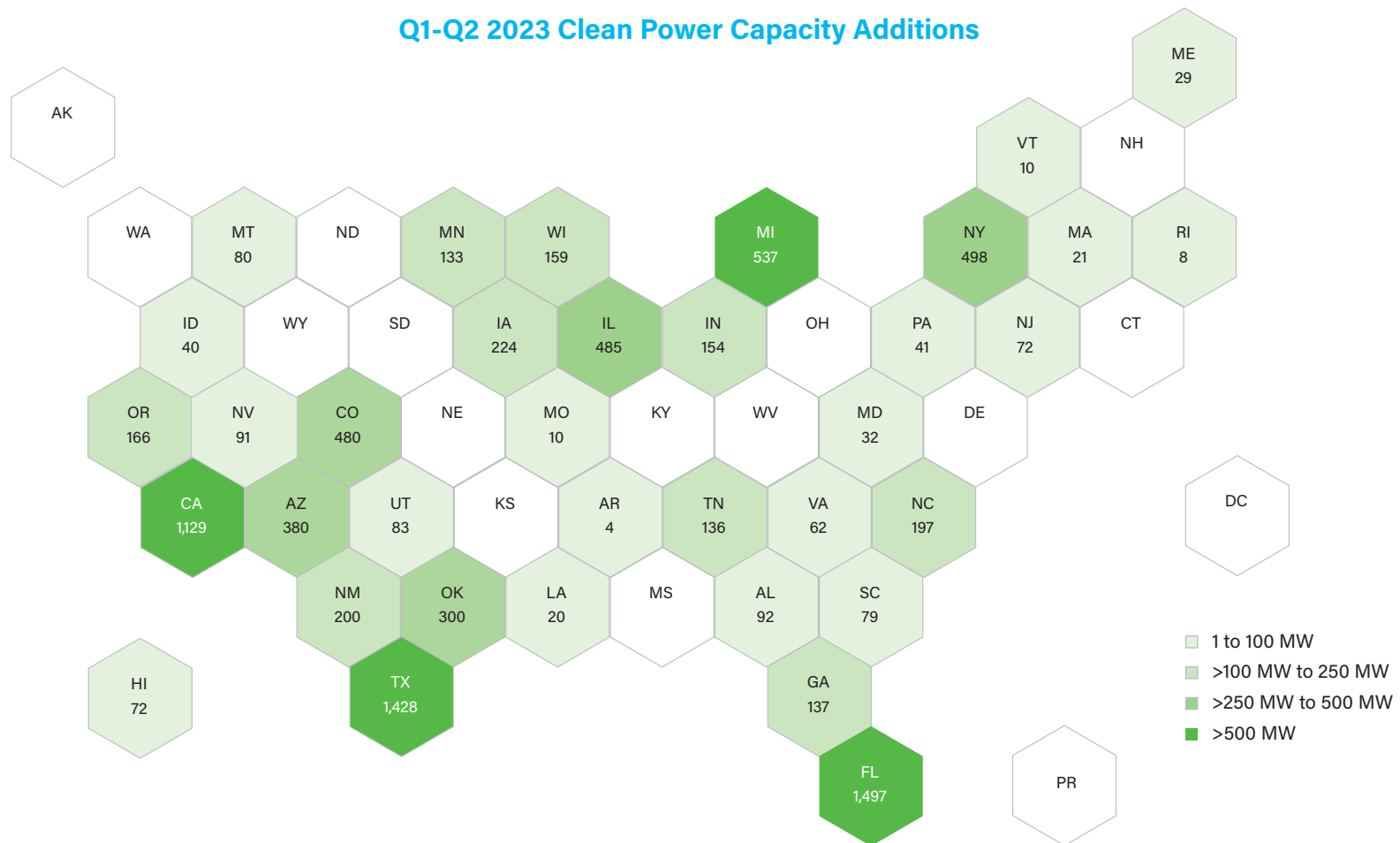
U.S. Annual and Cumulative Clean Power Capacity Growth



California Leads Quarterly Installs; Florida Leads YTD

- For the second quarter in a row, Texas fell out of the top spot for new clean power commissioned. In Q2, California led installs, bringing 867 MW of solar and battery storage capacity online. Texas ranks second for the quarter, installing 727 MW. Michigan, ranking third at 537 MW, was the only state in the top three to install new wind capacity this quarter.
- Year-to-date, Florida is leading the nation with 1,497 MW of solar capacity commissioned. Texas ranks second with 1,428 MW commissioned across all three technologies, followed by California at 1,129 MW of solar and battery storage.
- Of the 29 states that installed new clean power projects in Q2 2023, four installed more than 500 MW, 13 installed more than 100 MW, and 16 installed more than 50 MW.

Q1-Q2 2023 Clean Power Capacity Additions

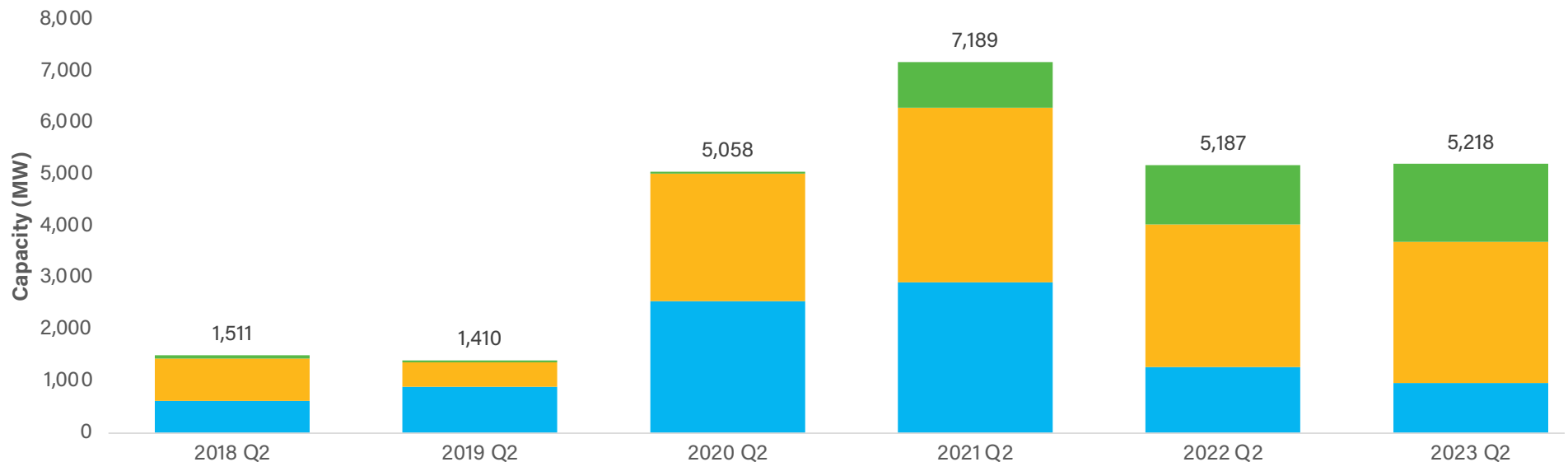


CLEAN POWER CAPACITY GROWTH

Quarterly Clean Power Capacity Growth

- The installation of 5,218 MW in the second quarter of 2023 marks the second-highest second-quarter figure in the industry's history to date.
- Battery storage showed the most significant growth this quarter, with installations 32% higher than the same period in 2022. Solar installations remained relatively stable, with just a 1% decline. Wind installations, on the other hand, decreased 24% year-over-year.
- Of the six wind farms commissioned in the second quarter of the year, the first phase of AES's Chevelon Butte Wind project is the largest at 239 MW.
- Developers brought 68 new solar projects online in the second quarter with a total capacity of 2,740 MW. Radian Solar, owned and developed by Intersect Power, was the largest solar project to commission in the quarter at 320 MW.
- In the second quarter, 31 new battery storage projects came online with a total capacity of 1,510 MW/5,098 MWh. More than half, 55%, of installed battery capacity is part of standalone projects.
- The third phase of the Moss Landing battery storage project was the largest standalone storage project online between April and June at 300 MW/1,400 MWh.
- In the hybrid space, NextEra's Thunder Wolf Solar + Storage project takes the top spot, with 248 MW of solar and 100 MW/400 MWh of battery storage capacity coming online.

Q2 Clean Power Installations, 2018-2023

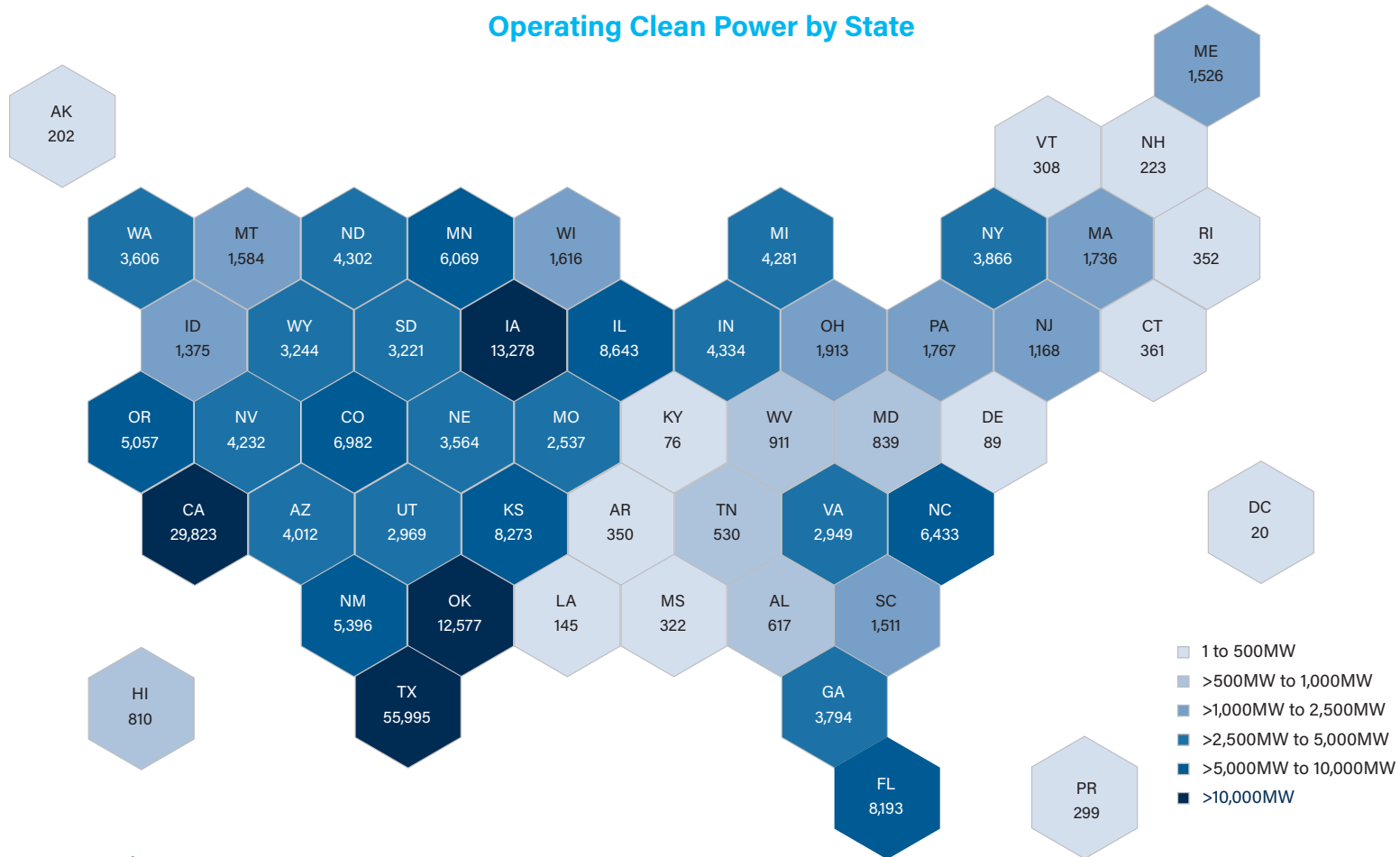


CLEAN POWER CAPACITY GROWTH

Operational Clean Power Capacity

- Clean power is being used to power homes and businesses in all U.S. states, including DC and Puerto Rico.
- There are 237,345 MW of clean power operating, enough to power 63 million American homes.
- Texas leads the nation with the most operating clean power capacity (55,995 MW). The Lone Star State also leads in total operating wind capacity and ranks second for solar and battery storage.
- California ranks second for total operating clean power (29,823 MW) and first in solar and battery storage.
- Iowa and Oklahoma, both wind rich states, rank third and fourth with 13,278 MW and 12,577 MW operating, respectively.
- Through the first half of 2023, Tennessee has experienced the most substantial growth in total operating capacity, with an impressive 35% increase in its clean power capacity.

Operating Clean Power by State



Clean Power Pipeline Growth

Wind

- The land-based wind pipeline is comprised of 100 project phases with a total capacity of 21,069 MW, including 9,533 MW under construction and 11,536 MW in advanced development. In the second quarter, 1,089 MW of wind began construction and 858 MW entered into advanced development.
- The land-based wind pipeline has been slow to refresh after record install levels in 2020 and 2021, resulting in a gradual decline in capacity in development. However, activity in the second quarter suggests a reversal from this trend, with the pipeline increasing 8% compared to the previous quarter.
- Wyoming has taken over the top spot in the land-based wind pipeline with 4,889 MW in development, accounting for 23% of the total pipeline. This is thanks to several large wind projects, such as the Chokeycherry and Sierra Madre Wind Energy Project, currently in development. Texas now ranks second with 3,452 MW of wind in development.
- As numerous states establish offshore wind targets, this technology has become a significant contributor to the clean power pipeline in several regions. Based on the state of power delivery, New York leads the nation with an impressive 4,362 MW under development, closely followed by New Jersey with 3,758 MW. Massachusetts ranks third with 3,242 MW in development, and Virginia follows closely with 2,587 MW.

Solar

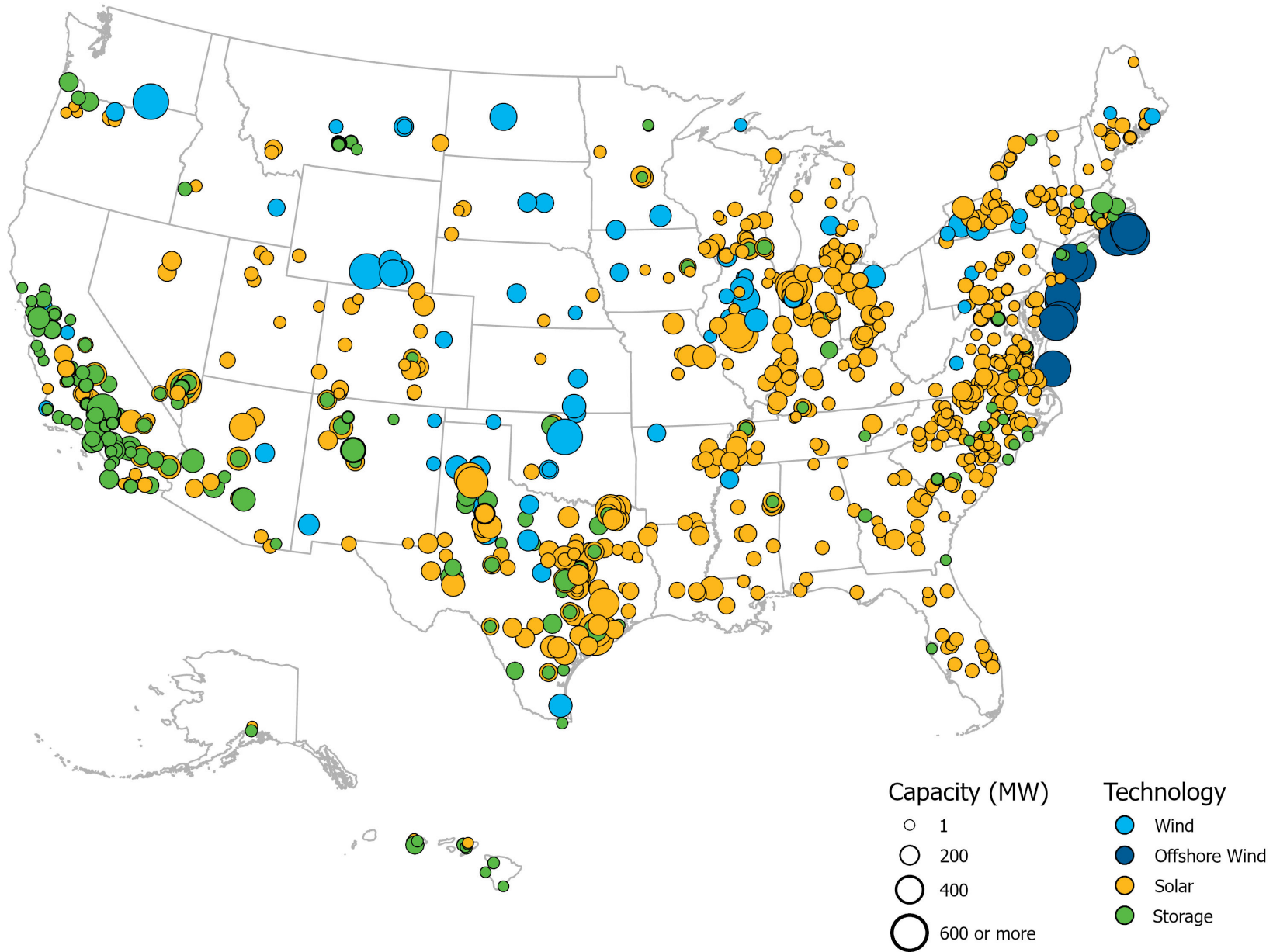
- The solar pipeline continued steady growth in the second quarter of 2023, with 848 projects totaling 85,328 MW in development.
- The solar pipeline increased 5% over the last quarter, and 16% over the past year. The technology now accounts for 59% of the pipeline.
- Every state except North Dakota and Washington has solar capacity in development. Texas leads the pipeline with 19,151 MW in development, constituting more than a fifth of the pipeline. Indiana maintained second place with 6,776 MW of utility-scale solar in development, followed closely by California with 6,315 MW in development.
- Solar has the most geographically diverse pipeline. Across the country, 23 states have more than a gigawatt of solar in development, and an additional five states have more than 500 MW in development.

Battery Storage

- Over the past two years, the battery storage capacity in development has more than doubled. Over the past three quarters, capacity in development has increased by an average of 14% each quarter.
- There are 260 storage projects in development, totaling 21,069 MW/59,925 MWh.
- Hybrid projects account for 56% of storage capacity in development, down from nearly 70% at the end of 2022. Of the more than 3 GW of battery storage projects that entered the pipeline this quarter, more than 60% is standalone. The increased popularity of standalone storage projects is likely due to storage becoming eligible for the investment tax credit (ITC) after passage of the IRA.
- The battery storage pipeline is spearheaded by California, which boasts an impressive 9,235 MW under development. Texas ranks second with 3,751 MW in its storage pipeline. There are 29 states with storage capacity in development.

CLEAN POWER CAPACITY GROWTH

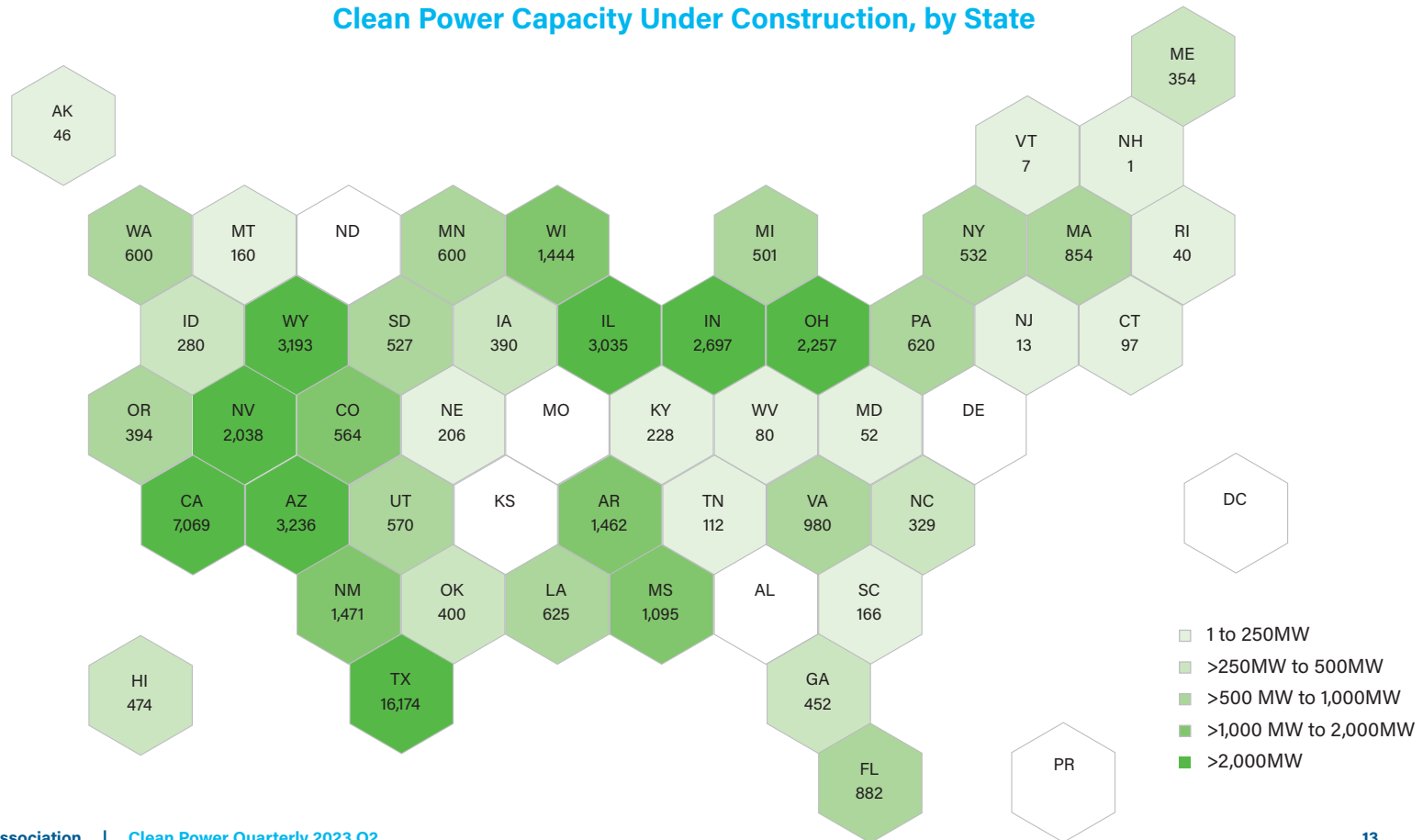
Projects in Pipeline



Clean Power Construction Activity

- As of the end of the second quarter, there are a total of 476 clean power project phases currently under construction across 45 states. When combined, these projects represent 57,307 MW.
- Solar accounts for 63% of capacity under construction at 36,086 MW. Additionally, there are 10,750 MW of land-based wind and 9,533 MW of battery storage capacity under construction. Two offshore wind projects, South Fork Wind and Vineyard Wind, meet ACP's under construction definition.
- Between April and June, 8,297 MW of clean power projects began construction, of which 69% was solar.
- Texas leads the nation with the highest amount of clean power capacity currently under construction, hosting more than double the capacity of any other state. California comes in a distant second, with 7,069 MW of clean power projects currently in the construction phase.
- On a regional basis, Texas is followed by the Mountain West (11,073 MW) and Midwest (8,665 MW).

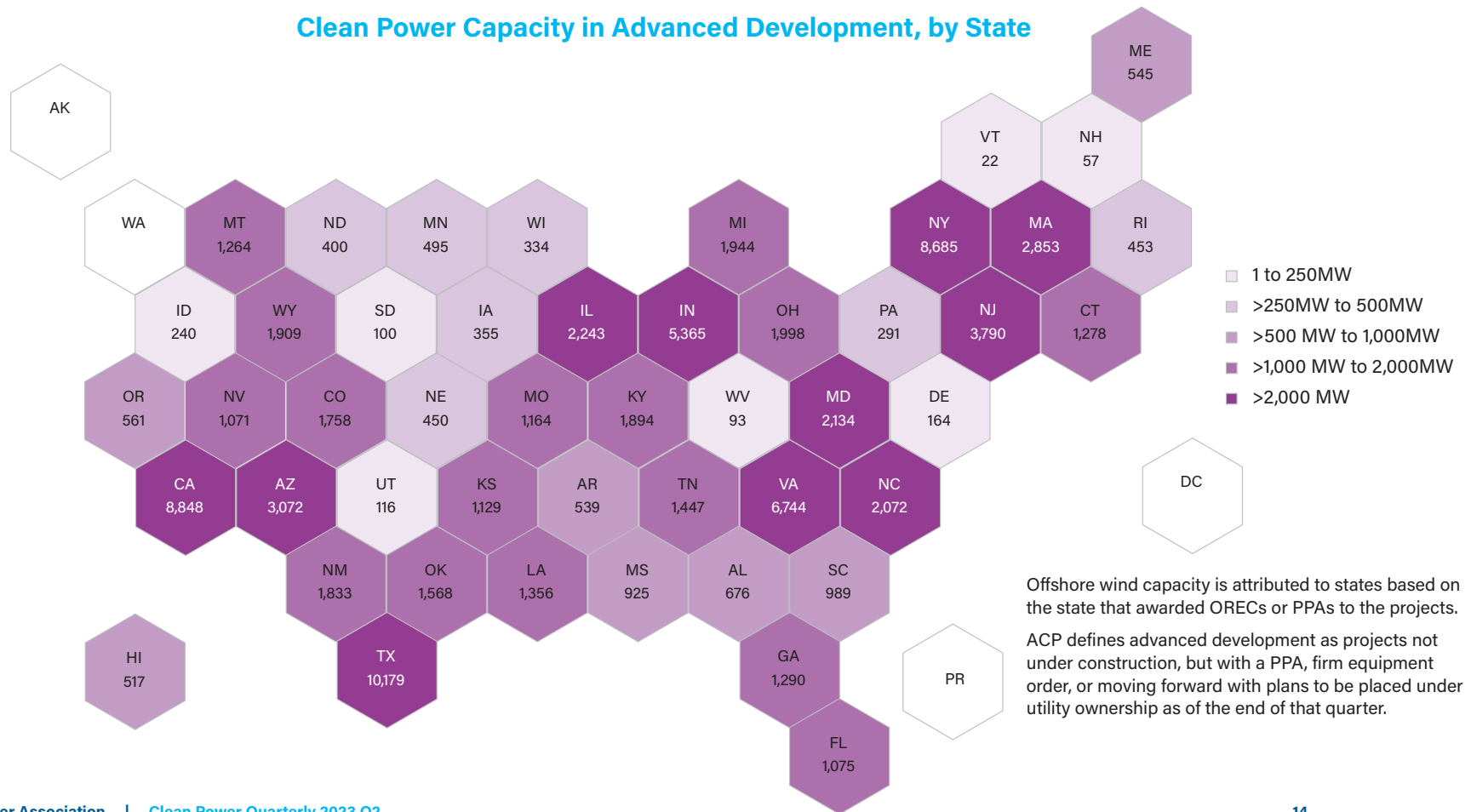
Clean Power Capacity Under Construction, by State



Clean Power Advanced Development Activity

- The advanced development pipeline comprises 88,284 MW, spanning 48 states and encompassing 750 project phases. Alaska and Washington are the only states without clean power projects in advanced development.
- Texas has the most clean power in advanced development (10,179 MW), followed by California (8,848 MW), and New York (8,685 MW).
- In the advanced development pipeline, Texas takes the lead in solar capacity, while California holds the top position for battery storage projects. Meanwhile, Oklahoma has the most land-based wind capacity in advanced development, and New York secures the leading spot for offshore wind projects.
- Within the advanced development pipeline, solar projects make up the majority, comprising 56% of the total. Offshore wind projects account for 19% of the pipeline, while battery storage projects constitute 13%. The remaining 12% is attributed to land-based wind projects.

Clean Power Capacity in Advanced Development, by State

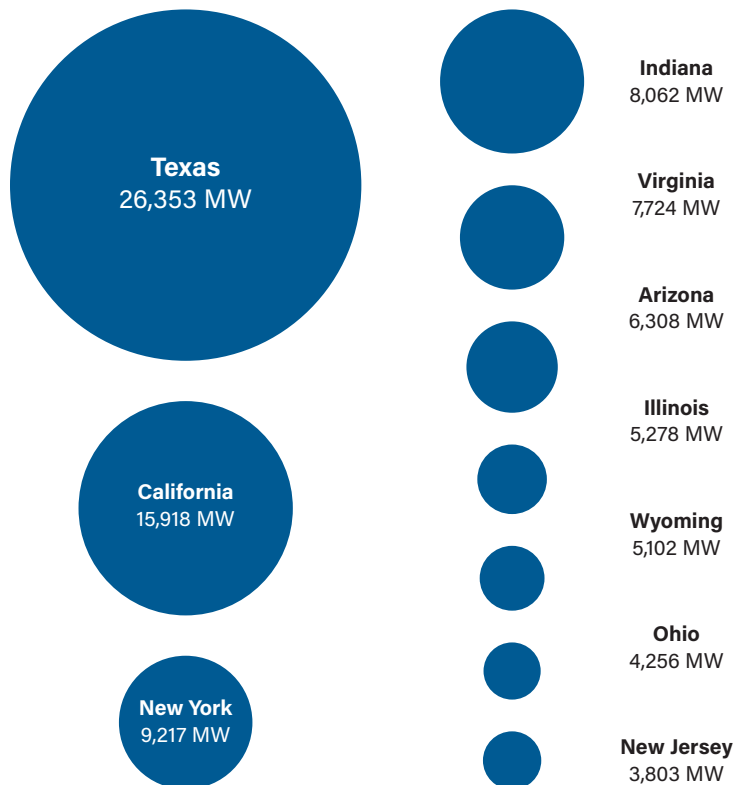


CLEAN POWER CAPACITY GROWTH

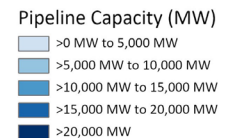
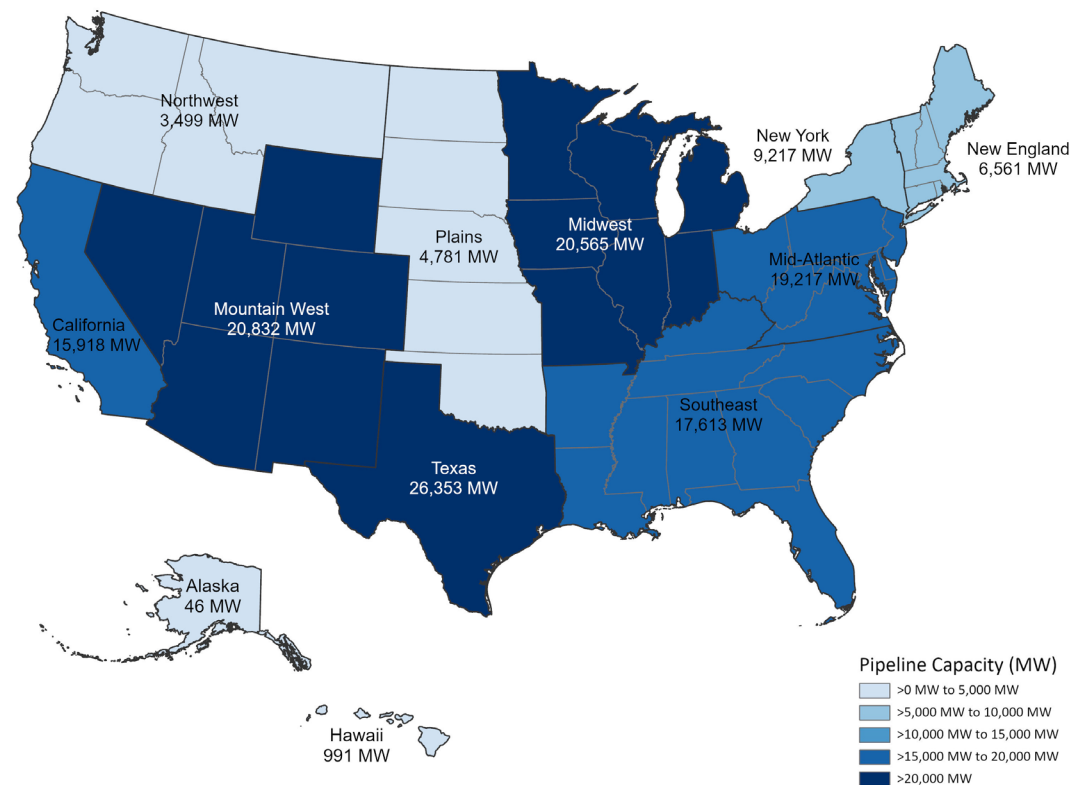
Clean Power Pipeline by State and Region

- There are 145,592 MW of clean power in development across all 50 states.
- The leading states in terms of operating capacity, Texas and California, also lead in the pipeline. Texas has 26,353 MW of capacity in development, enough to increase the state's already sizable operating capacity by 47%. The 15,918 MW in development in California would increase the state's operating capacity by 53%.
- Kentucky and Louisiana, both ranking among the bottom three states in terms of operating clean power, will see the most significant growth in operating capacity in coming years based on their pipelines. Both states currently have less than 150 MW operating and approximately 2 GW in the pipeline.
- By region, Texas has the most clean power underway, followed by the Mountain West and Midwest. The Plains ranks third in terms of operating capacity but ninth in the pipeline.

Top States, Clean Power Development Capacity



Clean Power Development Capacity by Region

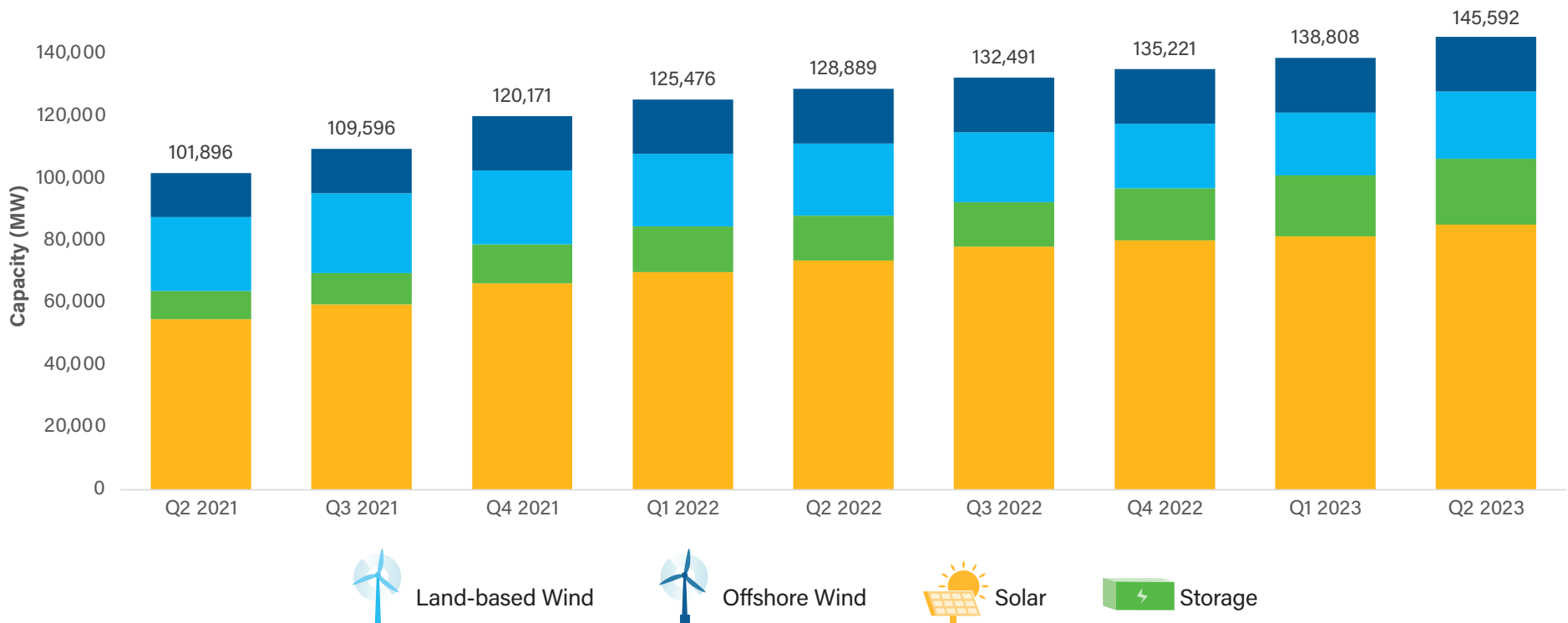


CLEAN POWER CAPACITY GROWTH

Clean Power Pipeline Over Time

- In Q2 2023, the clean power pipeline reached a record 145.6 GW. This remarkable figure demonstrates a consistent upward trend. Over the past two years, the pipeline has grown 5%, on average, each quarter.
- Year-over-year, the amount of clean power in development has increased 13%. Compared to the second quarter of 2021, capacity in development has increased 43%.
- The battery storage pipeline has exhibited the most significant growth rate over the past two years. On average, the storage pipeline has grown 12% each quarter.
- The solar pipeline has also grown, though at a slightly slower rate, 6%, each quarter.
- On average, the land-based wind pipeline has decreased by 1% each quarter over the past two years, though the pipeline increased 8% in the second quarter.

Clean Power Development, Q2 2021-Q2 2023

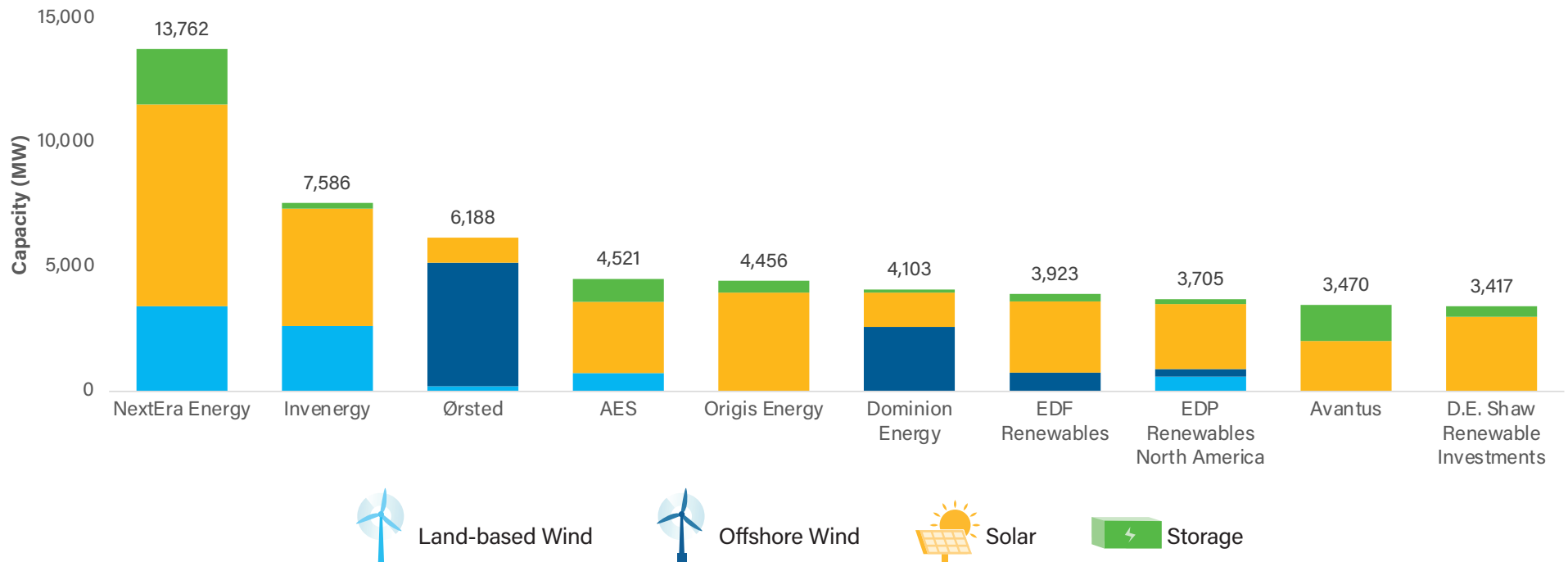


CLEAN POWER CAPACITY GROWTH

Top Clean Power Developers

- NextEra leads the developer rankings with 13.8 GW in development, accounting for nearly 10% of all capacity in development. NextEra is the leader across land-based wind, solar, and battery storage in development.
- Invenery follows NextEra with nearly 7.6 GW of clean power in development. Invenery’s pipeline is solar dominant but also includes land-based wind and some battery storage capacity.
- Offshore wind plays a key role in Ørsted and Dominion Energy ranking in the top ten developers in the pipeline, though both have over a gigawatt of solar capacity in development as well.
- Among the top ten developers, eight of them have pipelines primarily focused on solar projects. None of the developers in the top ten have portfolios dominated by battery storage projects. However, Avantus stands out as the developer with the highest share of storage projects in their overall clean power development, accounting for 42% of their total portfolio.

Top 10 Developers with Clean Power in the Pipeline

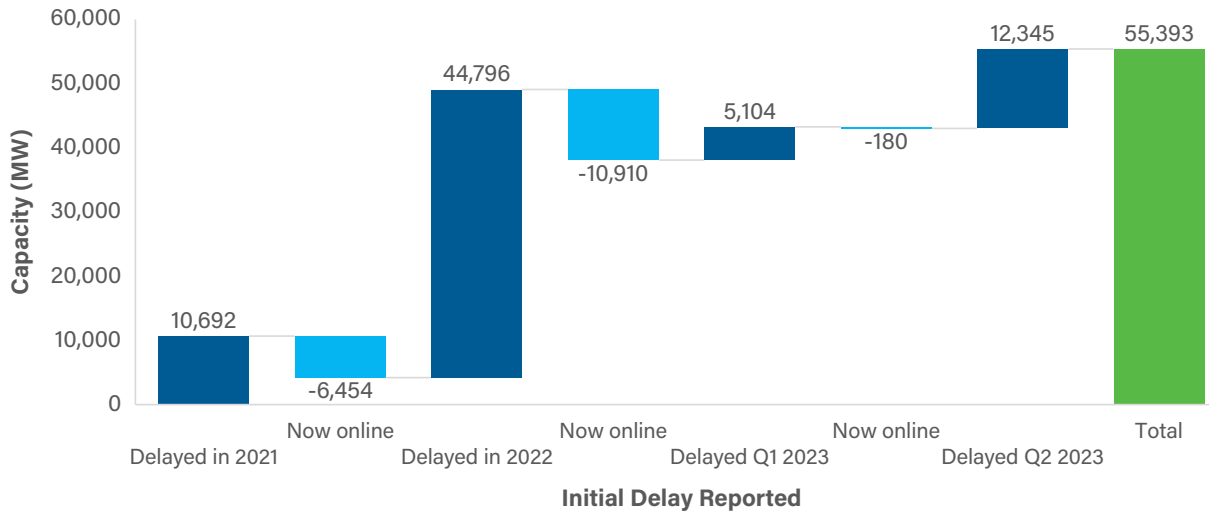


CLEAN POWER CAPACITY GROWTH

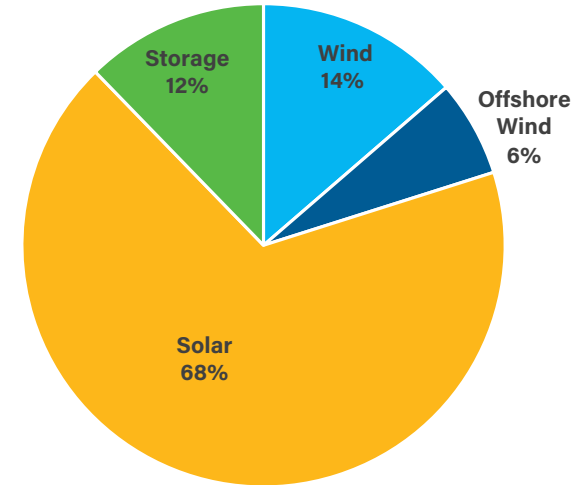
Clean Power Project Delays

- So far this year, developers have reported more than 17 GW of new project delays. Add in the more than 38 GW of projects that were delayed in 2021 and 2022, and clean power project delays now total over 55 GW.
- Delays from 2021 are starting to clear, but 40% are still to be completed. Delays from 2022 are still queued up—only 24% have since completed.
- 2023 brings further delays, 5 GW in the first quarter and 12 GW in the second quarter for an increase of 17 GW.
- Of the 55 GWs of projects that have experienced delays, 35 GW was initially expected to be operational prior to the third quarter of 2023. Nearly 60% of those projects are now targeting to begin operations by the end of the year.
- Nearly 40% of projects that have experienced delays have experienced multiple delays, with some projects being delayed as many as 5-6 times.
- On average, projects have been delayed by 13 months from their original expected online dates. Wind projects are experiencing the longest delays at 16 months on average, while solar projects are being delayed by an average of 14 months and battery storage projects 10 months.

Clean Power Project Capacity Delayed



Total Clean Power Capacity Delayed, by Technology



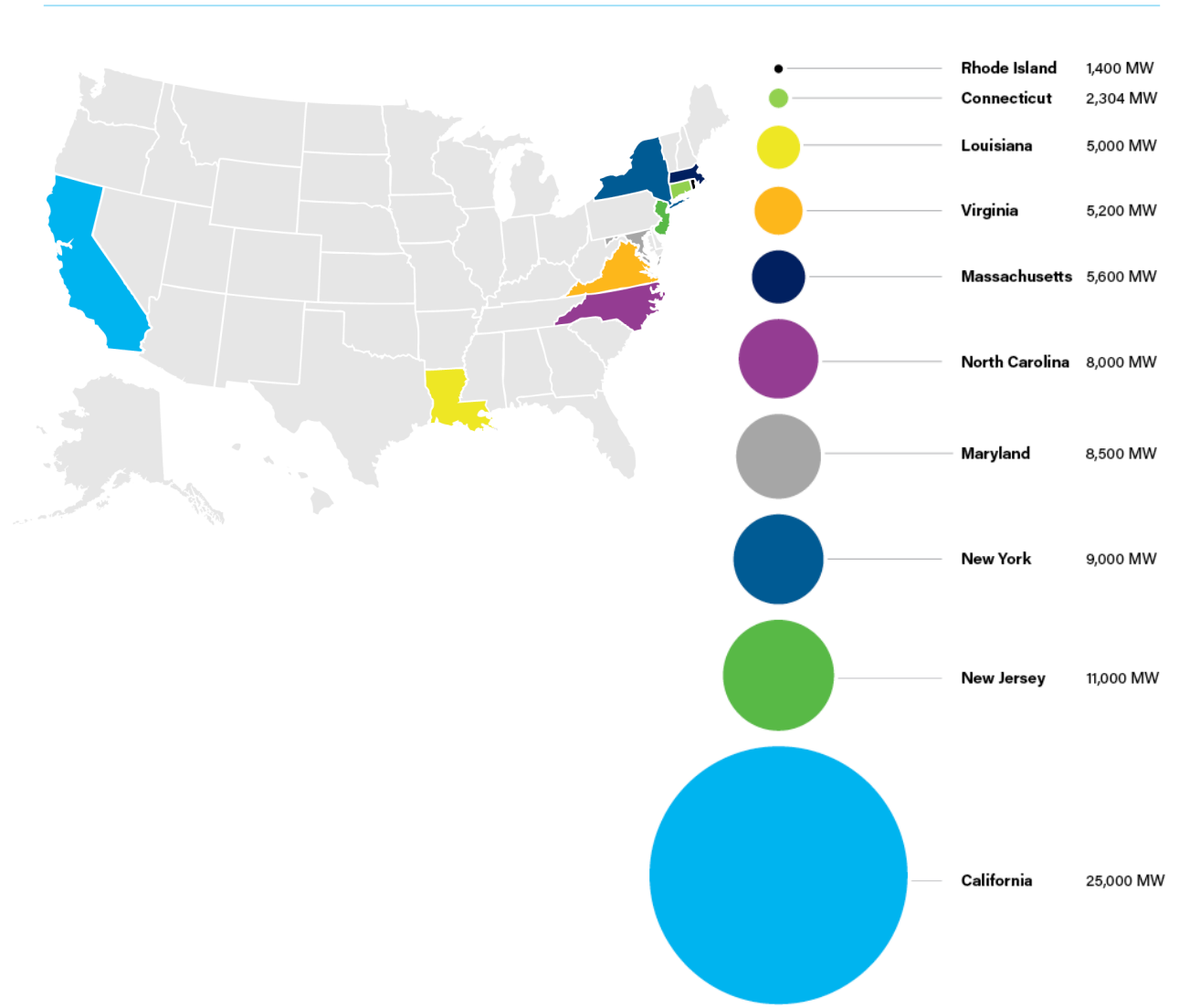
ACP has updated its delay analysis to account for projects experiencing more than two delays.

OFFSHORE WIND ACTIVITY

State Activity

- On April 21st, Maryland Governor Wes Moore signed the POWER Act, increasing the state's offshore wind target to 8.5 GW. The bill also aims to address barriers to building offshore wind projects by upgrading the Maryland Eastern Shore electric grid and facilitates the construction of a shared transmission infrastructure.
- On May 2nd, Massachusetts released a draft Request for Proposals (RFP) that represents the largest ever solicitation in New England at 3,600 MW – more than 25% of the state's annual electricity demand. If approved, it would be Massachusetts' fourth and largest solicitation to date.
- The New Jersey Board of Public Utilities formally requested PJM to include the state's 11 GW offshore wind goal in PJM's Regional Transmission Expansion Planning using its state agreement approach.
- To date, ten states have set offshore wind targets totaling more than 81,000 MW.

State Offshore Wind Targets

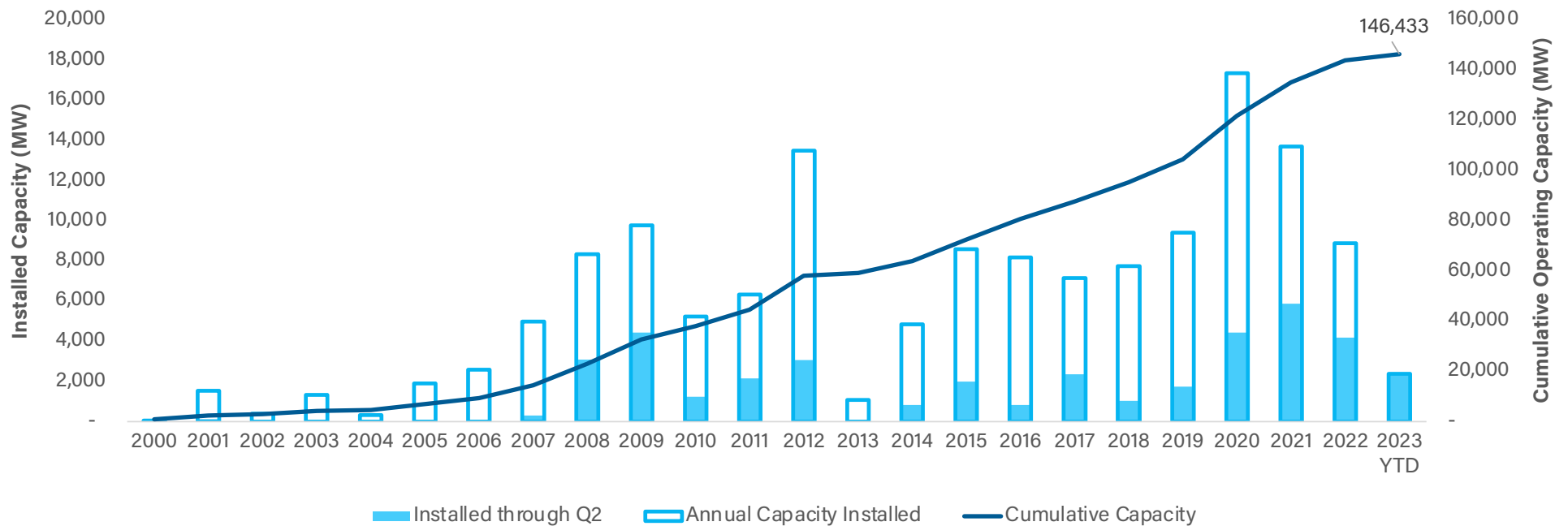


LAND-BASED WIND ACTIVITY

968 MW of Land-based Wind Capacity Commissioned

- In the second quarter of 2023, developers commissioned six land-based wind project phases, adding 968 MW of wind power to the grid.
- Installations in the second quarter of 2023 fell 27% compared to the second quarter of 2022, when 1,318 MW were added. This was the slowest second quarter the wind industry has experienced since 2019. In addition, land-based wind installations decreased 32% compared to the previous quarter, when 1,418 MW were brought online.
- The capacity-weighted average size of projects added in the second quarter of 2023 is 185 MW, a decrease from the capacity-weighted averages of 236 MW in the first quarter, 360 MW in 2022, and 310 MW in 2021.
- The largest project phase to start commercial operations in the second quarter was Phase I of AES Clean Energy’s Chevelon Butte Wind project in Arizona. Phase I of Chevelon Butte Wind is 239 MW in size.

U.S. Annual and Cumulative Land-based Wind Capacity Growth

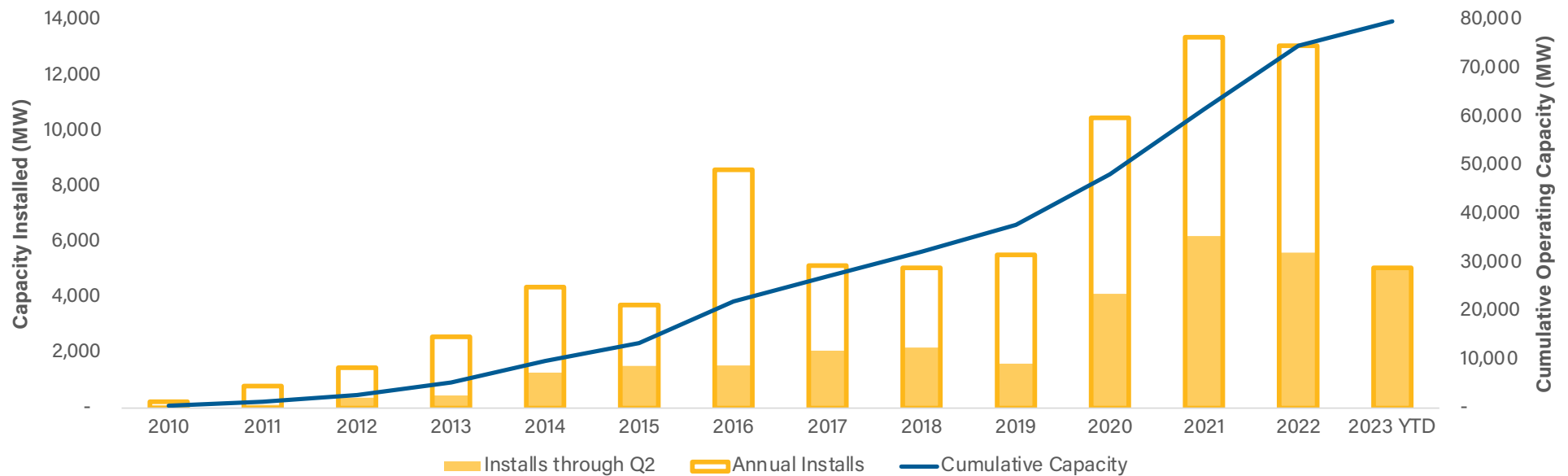


UTILITY SCALE SOLAR

Solar Additions Pick Up After a Slow First Quarter

- Utility-scale solar capacity additions experienced an increase during the second quarter of 2023. A total of 2,740 MW of solar capacity was added to the grid, a slight uptick from the 2,318 MW added in the first quarter. Capacity additions held steady compared to the second quarter of 2022, when 2,763 MW were commissioned, representing a decrease of just 1%.
- Cumulatively, there is now 79,800 MW of utility-scale solar operating in the U.S. All 50 states and the District of Columbia are home to at least one operating utility-scale solar project.
- The largest project that came online during the second quarter was Intersect Power-owned 320 MW Radian Solar Project in Texas. This was followed by the 274 MW Yellowbud Solar Project owned by National Grid Renewables in Ohio and NextEra's 248 MW Thunder Wolf Solar project in Colorado.

U.S. Annual and Cumulative Utility Solar Power Capacity Growth



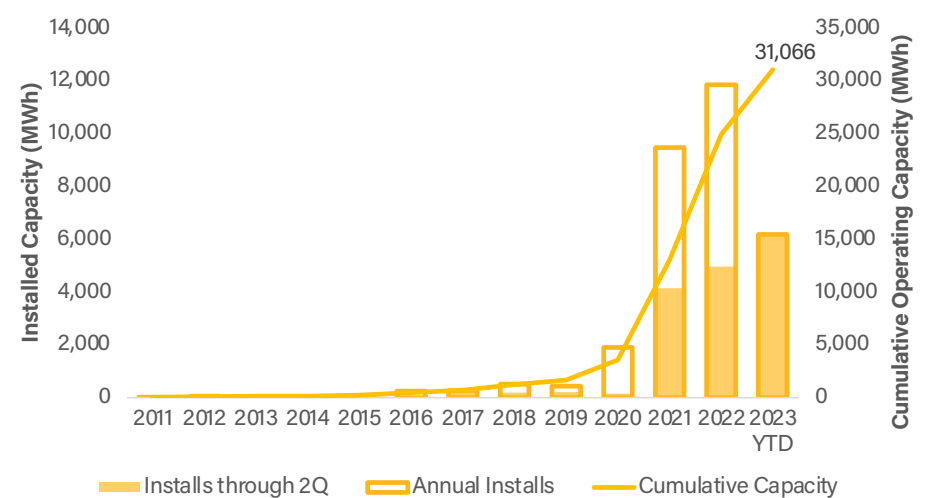
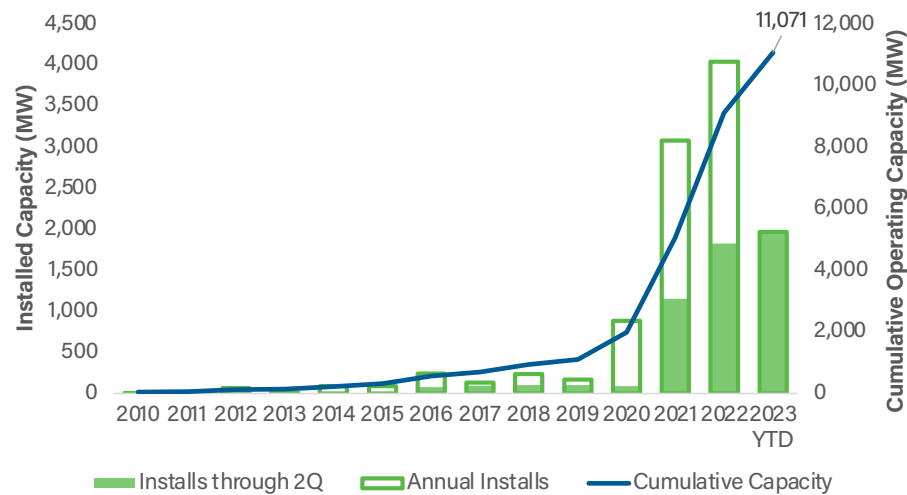
Solar capacity is reported in MWac

UTILITY-SCALE BATTERY STORAGE

Quarterly Storage Installs Rebound

- Battery storage capacity is tracked in terms of rated power capacity (MW), the maximum possible instantaneous discharge, and energy capacity (MWh), the maximum amount of stored energy.
- After a slow first quarter, battery storage installations resumed their growth trend, with the 1,510 MW/5,098 MWh installed in Q2 representing a 32% increase from the same period in 2022. Year-to-date, installs have increased 8%.
- Of the 31 battery storage projects that came online in the second quarter, 17 are standalone and 14 are paired with wind or solar.
- The third phase of the Moss Landing battery storage project was the largest standalone storage project online between April and June at 300 MW/1,400 MWh.
- NextEra's Thunder Wolf Solar + Storage project takes the top spot in the hybrid space, with 248 MW of solar and 100 MW/400 MWh of battery storage capacity coming online.

U.S. Annual and Cumulative Utility Battery Storage Capacity Growth

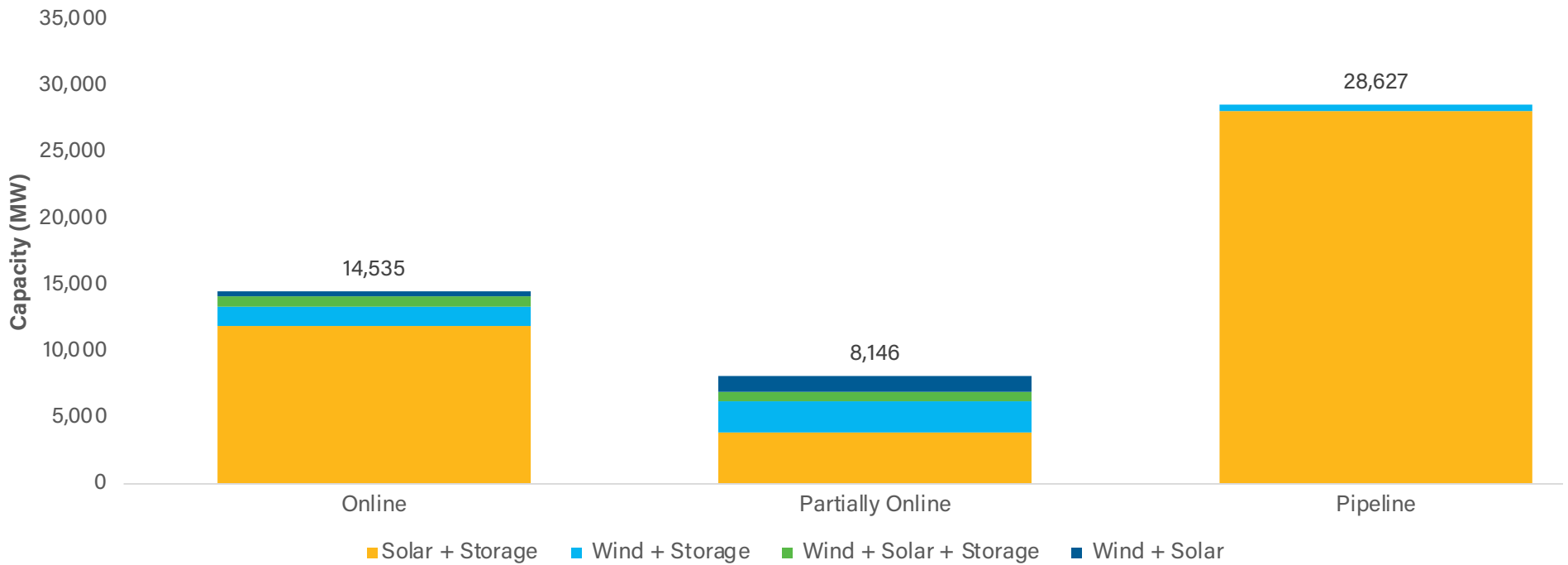


HYBRID PROJECTS

Nearly a Gigawatt of Solar + Storage Added in Q2

- In the second quarter of 2023, 982 MW of new hybrid project capacity came online, a 56% increase from the same period last year. Year-to-date, due to a slow first quarter, installations are down 11%.
- Only solar + storage projects have commissioned in the first half of 2023.
- In total, 14,535 MW of hybrid projects are fully online, meaning that all phases and technologies included in the project are operating. More than 80% of those projects are solar + storage projects.
- Additionally, there are 8,146 MW of hybrid projects partially online, meaning one or more phases/technologies are operating, but other phases or technologies within the project are still in development.
- Finally, there are 28,627 MW of hybrid projects currently in the pipeline. The vast majority of that capacity, 98%, are solar + storage projects. The remaining 2% is wind + storage projects in development.
- NextEra's Thunder Wolf Solar + Storage project was the largest hybrid project online this quarter. The Pueblo County, Colorado project includes 248 MW of solar and 100 MW/400 MWh of battery storage capacity.

Hybrid Clean Power Projects

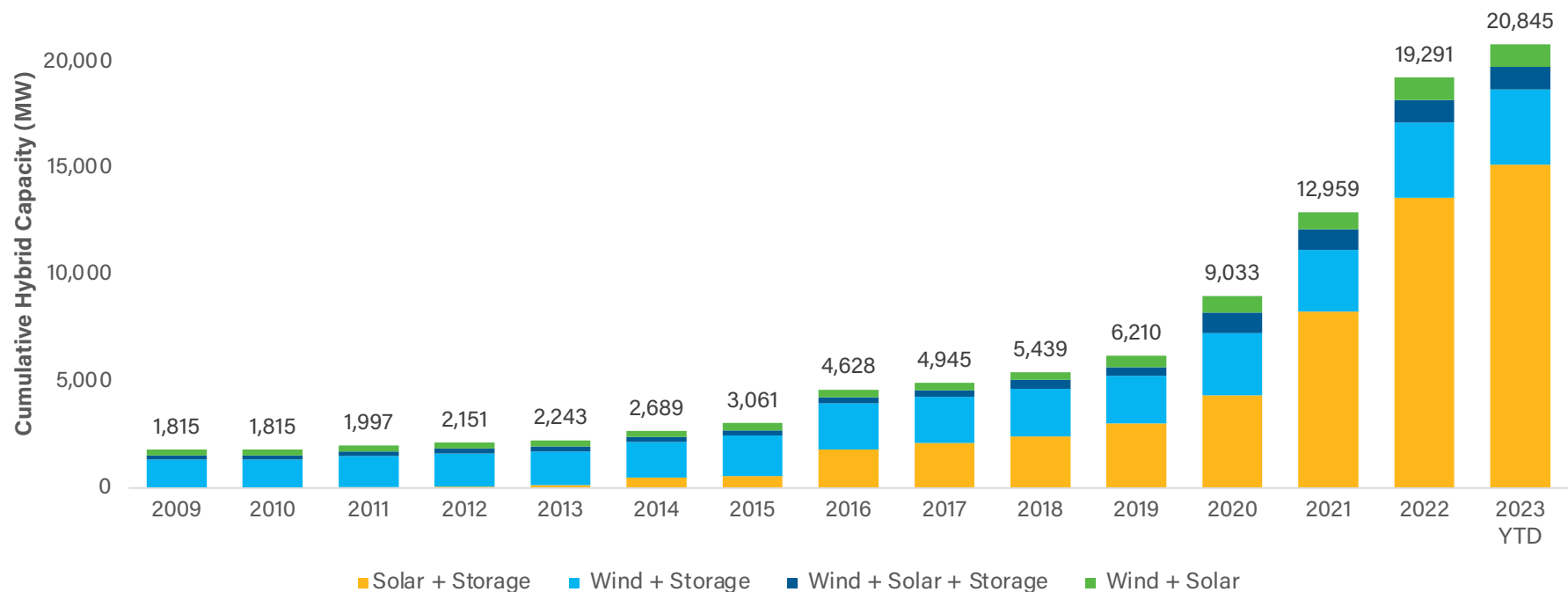


HYBRID PROJECTS

Operating Hybrid Capacity Surpasses 20 GW

- Operating hybrid capacity, including fully operational projects and phases of projects that are operating, is now 20,845 MW.
- Solar + storage projects are the prevailing hybrid type, constituting a significant 73% of all operating hybrid capacity. During the initial half of 2023, solar + storage projects are the sole type of hybrid project that have been brought online, showcasing their prominence in the current landscape.
- Wind + storage, the prior dominant hybrid type, now accounts for just 17% of operating hybrid capacity.
- There are very few wind + solar + storage or wind + solar projects operating in the U.S., combined accounting for 10% of operating hybrid capacity.

Operational Hybrid Capacity Over Time



American Clean Power is the voice of companies from across the clean power sector that are powering America's future, providing cost-effective solutions to the climate crisis while creating jobs, spurring massive investment in the U.S. economy and driving high-tech innovation across the nation. We are uniting the power of America's renewable energy industry to advance our shared goals and to transform the U.S. power grid to a low-cost, reliable, and renewable power system. Learn more about the benefits clean power brings to America at www.cleanpower.org.



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