

20
23 | Q1

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 Q1 Highlights



2023 Q1 Highlights

Clean Power Project Installations

- 2023 is off to a slow start with 4,079 MW of new clean power capacity installed. This marks the lowest first quarter since 2020 and represents a 36% decline compared to the first quarter of 2022.
- Developers commissioned 95 project phases in the first quarter across 27 states. Florida took the top spot this quarter, installing 947 MW of new solar capacity. Texas ranked second, commissioning 701 MW across wind, solar, and battery storage projects. Florida and Texas were the only states to surpass 500 MW of new installs in the first quarter.
- Solar was the leading technology of the quarter, with 71 new projects coming online totaling 2,200 MW. Wind ranked second, with 7 new plants totaling 1,418 MW. Finally, the industry installed 17 new battery storage projects with a total capacity of 461 MW/1,075 MWh.
- All three technologies experienced significant declines compared to the first quarter of 2022. Wind installations decreased 50%, battery storage fell 32%, and solar dropped 23%.
- Cumulatively, operating clean power capacity in the country is now nearly 232 GW, enough to power 62 million American homes.

Clean Power in Development

- Although it is premature to observe the effects of the Inflation Reduction Act (IRA) on clean power installations, its influence can be observed in the project development pipeline. The 138,808 MW in the pipeline represents an 11% increase from Q1 2022, and a 62% increase from Q1 2021.
- There are 48,957 MW under construction and 89,850 MW in advanced development.
- Year-over-year, the battery storage pipeline experienced the most significant increase at 33%. The solar pipeline also increased, up 16% year-over-year. Bucking the trend, land-based wind capacity in the pipeline fell 14%.

- 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 13%.
- Texas will continue as the clean power hub, hosting 17% of the total pipeline with 23,956 MW in development. California follows with 14,760 MW, accounting for 11% of the pipeline. New York has the third largest pipeline with 9,209 MW in development.

Clean Power Procurement Activity

- In the first quarter of the year, clean power buyers announced 3.8 GW of new power purchase agreements (PPAs), down 24% compared to the same period in 2022.
- Corporate buyers signed 63% of all announcements, while utilities accounted for 32% of deals and other non-utility buyers the remaining 5%. Both utilities and corporations announced fewer deals compared to the first quarter of 2022, though the drop in utility announcements was more significant, down 49% compared to just a 5% decline for corporate buyers.
- For the first time in a few years, wind made up the majority of PPA announcements in the first quarter, accounting for 49% of all announcements where the technology is known. Solar announcements were just shy of wind, accounting for another 49% of PPA announcements, while battery storage captured the remaining 2%.
- Wind announcements increased by 61% compared to Q1 2022. Solar announcements, on the other hand, are down by 47%.



Photo credit: NextTracker

Clean Power Capacity Growth



Lowest First Quarter Since 2020

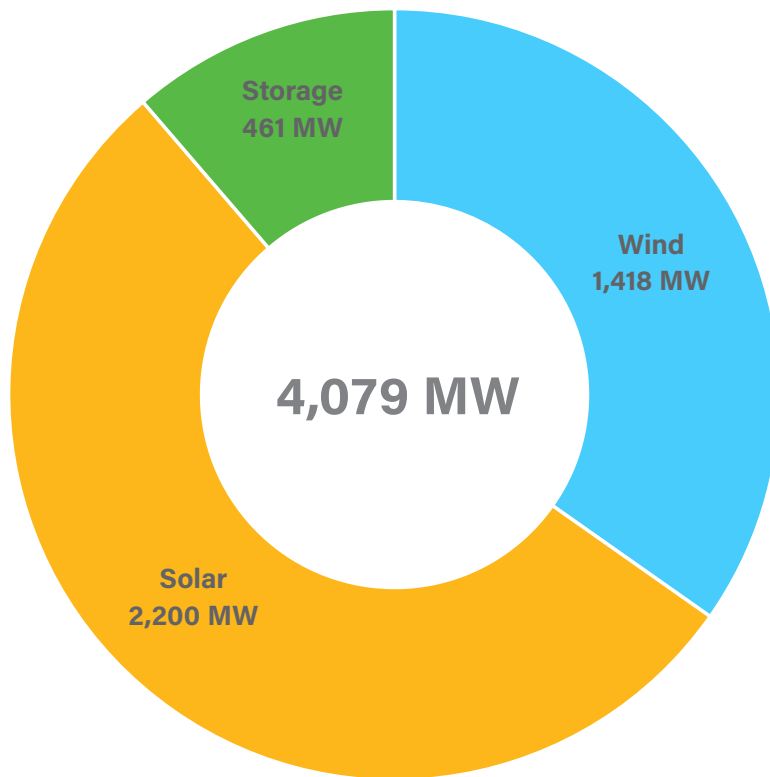
2023 Q1 installs

- The 95 project phases that came online in the first quarter added 4,079 MW of clean power to the grid.
- This is the lowest first quarter the industry has experienced since 2020. Q1 installs are down 36% from Q1 2022, which was a record first quarter.
- Developers commissioned 2,200 MW of new solar capacity in the first quarter, along with 1,418 MW of land-based wind and 461 MW of battery storage.

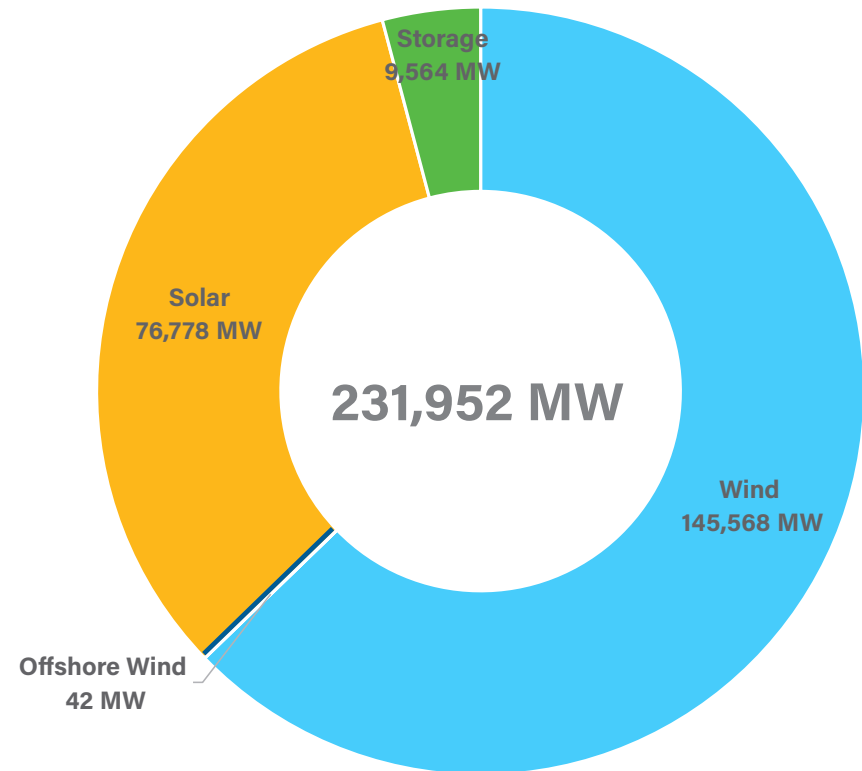
Cumulative operating clean power capacity

- The 231,952 MW of clean power operating in the U.S. is enough to power more than 62 million American homes.
- Broken down by technology, operating clean power capacity is made up of 145,568 MW of land-based wind, 76,778 MW of solar, 9,564 MW/26,276 MWh of battery storage capacity, and 42 MW of offshore wind.

Q1 2023 Clean Power Installs by Technology



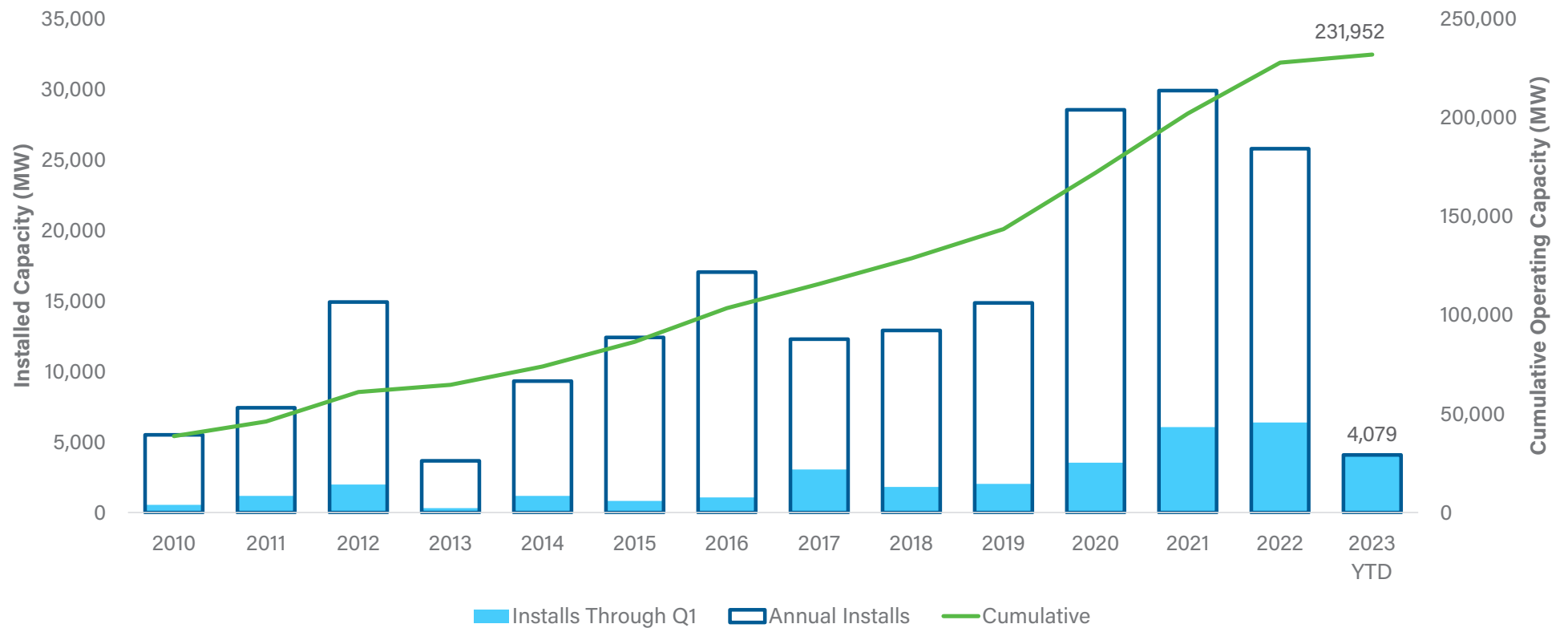
Total Operating Clean Power Capacity by Technology



CLEAN POWER CAPACITY GROWTH

Lowest First Quarter Since 2020 (continued)

U.S. Annual and Cumulative Clean Power Capacity Growth

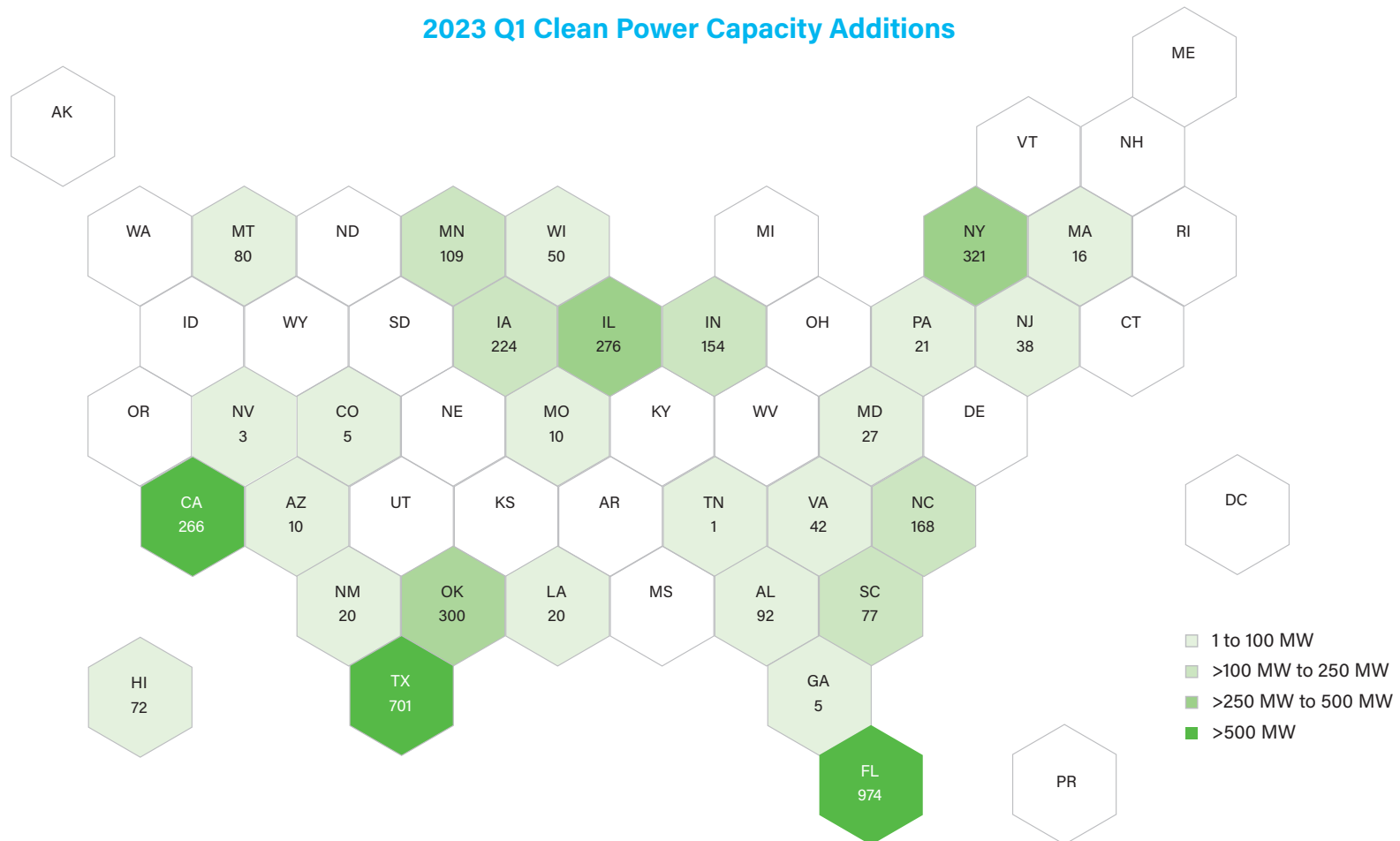


CLEAN POWER CAPACITY GROWTH

Florida Steals Top Spot in Q1

- After consistently ranking first quarter after quarter, Texas dropped to second in terms of quarterly clean power installations. Instead, Florida stole the top spot, commissioning 974 MW of new utility-scale solar projects. Texas installed wind, solar, and storage project this quarter for a total of 701 MW.
- New York ranks third for the quarter, installing 321 MW of wind and solar capacity. Oklahoma, Illinois, California, and Iowa were the only other states to top 200 MW this quarter.
- Of the 27 states that installed new clean power projects in Q1 2023, only two installed more than 500 MW, 10 installed more than 100 MW, and 14 installed more than 50 MW.

2023 Q1 Clean Power Capacity Additions

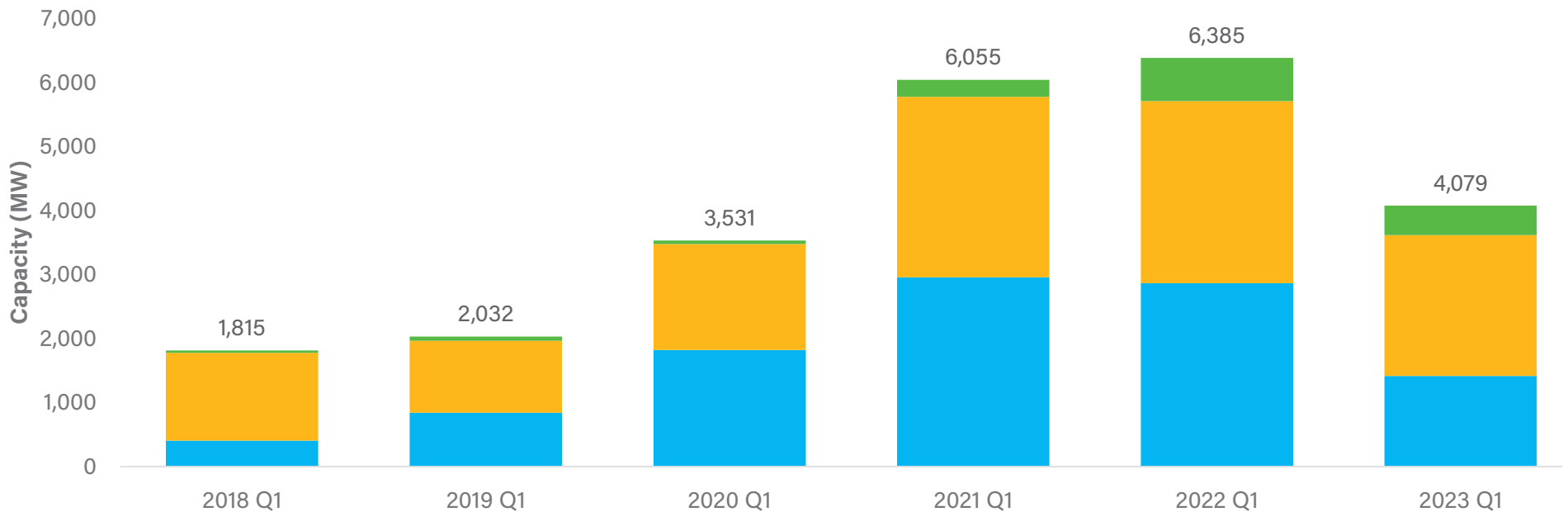


CLEAN POWER CAPACITY GROWTH

Quarterly Clean Power Capacity Growth

- First quarter installations fell 36% compared to Q1 2022, which was the highest first quarter to date. This breaks from the growth in Q1 installs the industry has delivered over the past four years.
- Wind installations fell most significantly, down 50% compared to Q1 2022. The wind industry experienced its lowest quarter since the 2019. Battery storage and solar installations also decreased by 32% and 23%, respectively.
- Seven wind project phases commissioned in 2022 with a total capacity of 1,418 MW. The largest projects include the Inertia Wind Project (301 MW) and Seven Cowboy Wind project (300 MW).
- Developers brought 71 new solar projects online in the first quarter with a total capacity of 2,200 MW. Bellflower Solar Project, owned by Lightsource BP, was the largest solar project to commission in Q1 2023 at 153 MW.
- 17 new storage projects with a total capacity of 461 MW/1,075 MWh came online in Q1. Madero Grid and Ignacio Grid Battery Storage, both owned by Able Grid solutions, tied for the largest battery storage projects online in the first three months of the year. Madero Grid has a storage energy capacity of 100 MW/215 MWh and Ignacio Grid has a storage energy capacity of 100 MW/160 MWh.

Q1 Clean Power Installations, 2018-2023

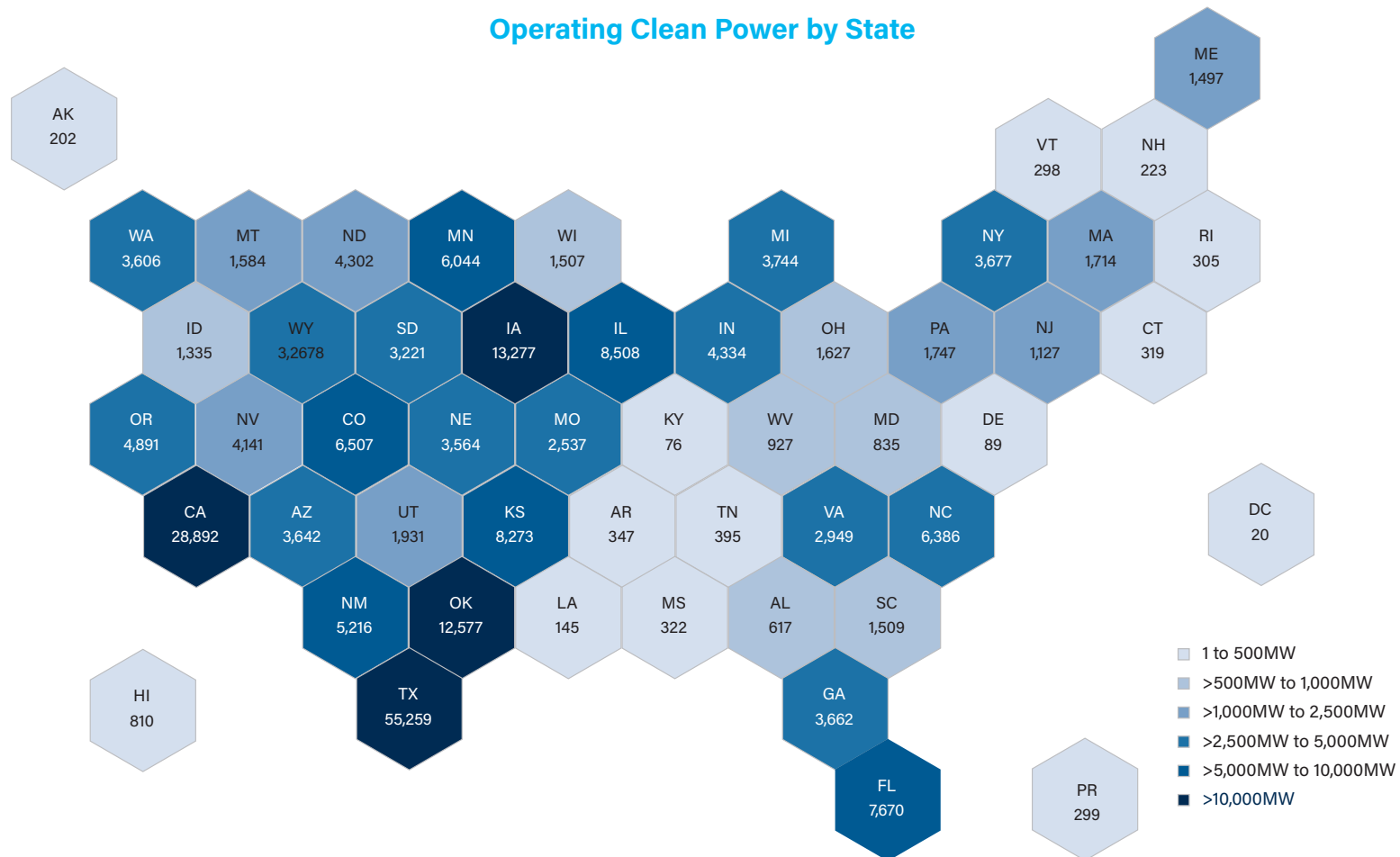


CLEAN POWER CAPACITY GROWTH

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 231,952 MW of clean power operating, enough to power more than 62 million American homes.
- Texas leads the nation with the most operating clean power capacity (55,259 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 (28,892 MW) and first in solar and battery storage.
- Iowa and Oklahoma, both wind rich states, rank third and fourth with 13,277 MW and 12,577 MW operating, respectively.

Operating Clean Power by State



Clean Power Pipeline Growth

Wind

- The land-based wind pipeline is comprised of 93 project phases with a total capacity of 20,176 MW, including 10,018 MW under construction and 10,158 MW in advanced development.
- Compared to the final quarter of 2022, the land-based wind pipeline decreased 3% due to a lack of projects entering the pipeline to replace commissioned projects. Year-over-year, the land-based wind pipeline decreased 14%.
- Wyoming has taken over the top spot in the land-based wind pipeline with 3,927 MW in development, accounting for 19% of the total pipeline. Texas now ranks second with 3,095 MW of wind in development. There are 11 states with more than 500 MW of land-based wind in development.
- With numerous states setting offshore wind targets, the technology now accounts for a significant portion of the clean power pipeline in several states. Based on the state of power delivery, New York is leading the nation with 4,230 MW in development, followed by New Jersey with 3,758 MW in development. Massachusetts is in third with 3,242 MW followed by Virginia with 2,587 MW.

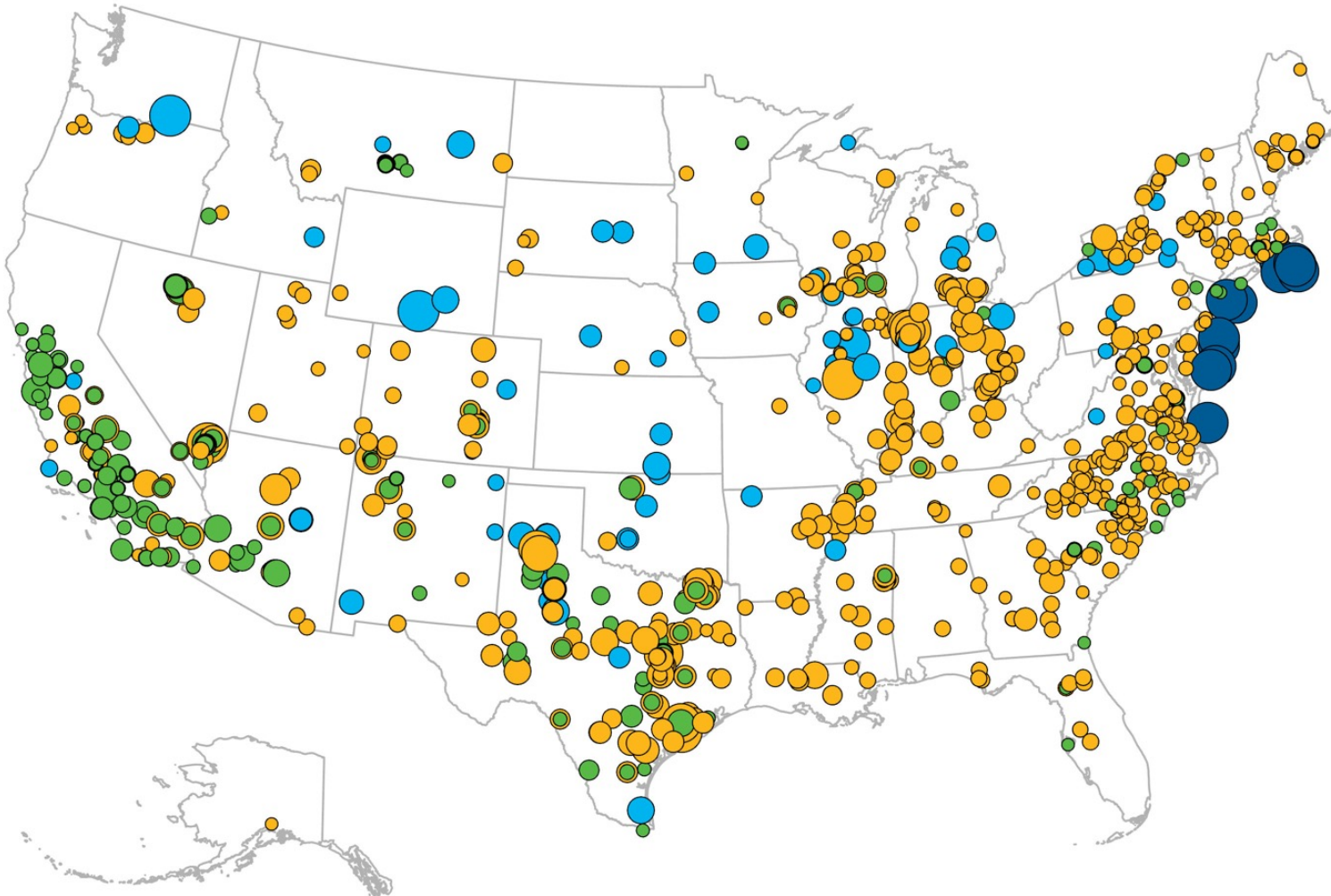
Solar

- The solar pipeline continued steady growth in the first quarter of 2023, with 794 projects totaling 81,509 MW in development.
- The solar pipeline increased 2% compared to the end of 2022 and has grown 16% year-over-year.
- Solar makes up 59% of the total clean power pipeline.
- Every state except Kansas and North Dakota has solar capacity in development. Texas leads the pipeline with 17,316 MW in development, constituting more than a fifth of the pipeline. Indiana maintained second place with 6,251 MW of utility-scale solar in development, followed closely by California with 6,197 MW in development.
- Across the country, 22 states have more than a gigawatt of solar in development.

Battery Storage

- The battery storage pipeline experienced the most significant growth in the first quarter, increasing 17% from the end of 2022 and 33% compared to the first quarter of 2022.
- There are 245 storage projects in development, totaling 19,621 MW/53,184 MWh.
- Hybrid projects account for 61% of storage capacity in development, down from nearly 70% last quarter. Of the 3.4 GW of battery capacity entering the pipeline this quarter, the majority, 61%, was standalone. This is likely due to the availability of the new standalone storage investment tax credit (ITC) included in the IRA.
- California leads the battery storage pipeline with 8,280 MW in development, followed by Texas with 3,545 MW in the pipeline.

Projects in Pipeline



Capacity (MW)

- 1
- 200
- 400
- 600 or more

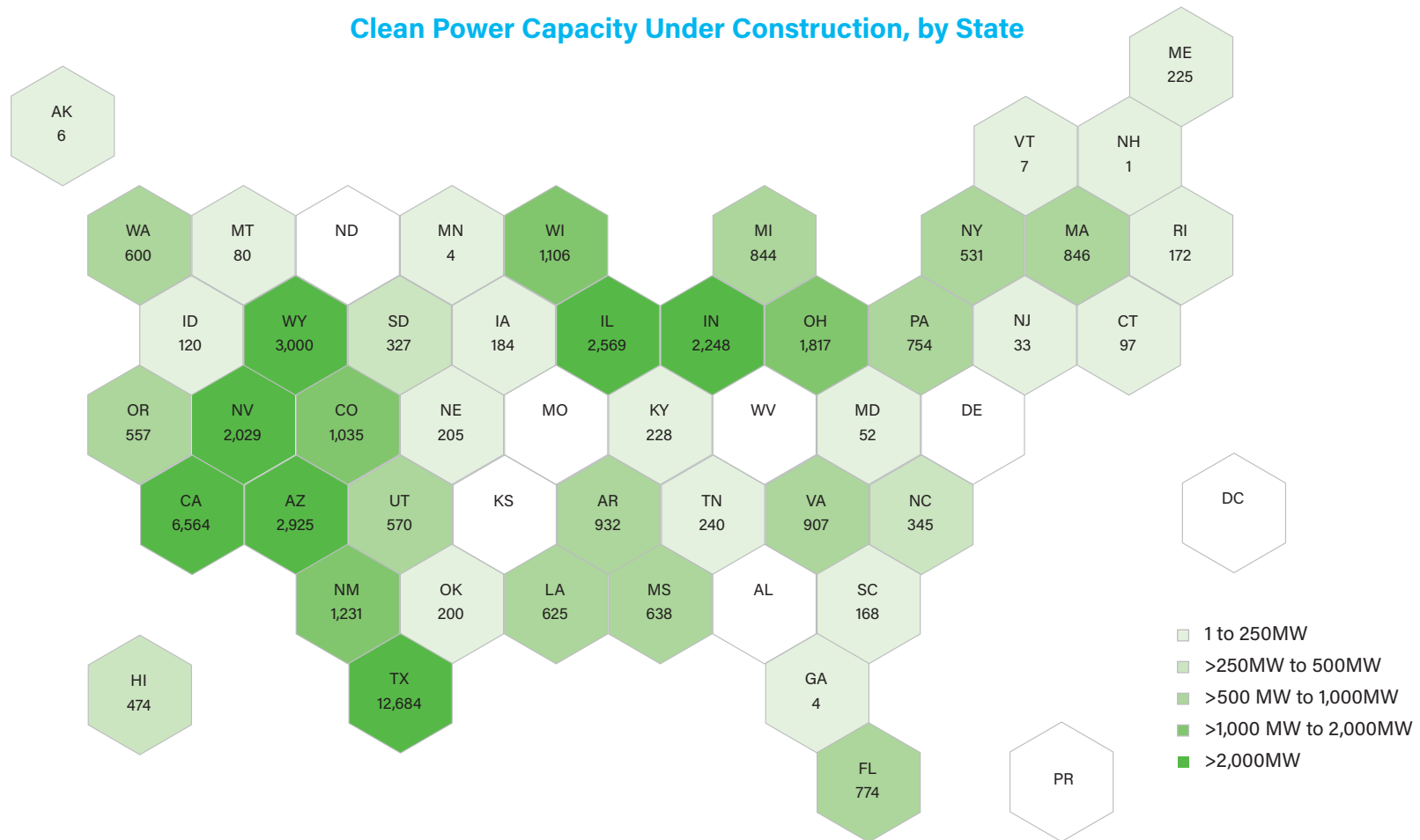
Technology

- Wind
- Offshore Wind
- Solar
- Storage

Clean Power Construction Activity

- There are 406 clean power project phases under construction across 44 states as of the close of the first quarter. These projects total to 48,957 MW.
- By technology, there are 29,309 MW of solar, 10,018 MW of land-based wind, 8,692 MW of battery storage, and 938 MW of offshore wind under construction in the U.S.
- In the fourth quarter, 7,266 MW of clean power projects began construction, more than half of which were solar.
- Texas has the highest amount of clean power capacity under construction, with nearly double the capacity of any other state. California is a distant second, with 6,564 MW under construction.
- On a regional basis, Texas is followed by the Mountain West (10,791 MW) and Midwest (6,955 MW).

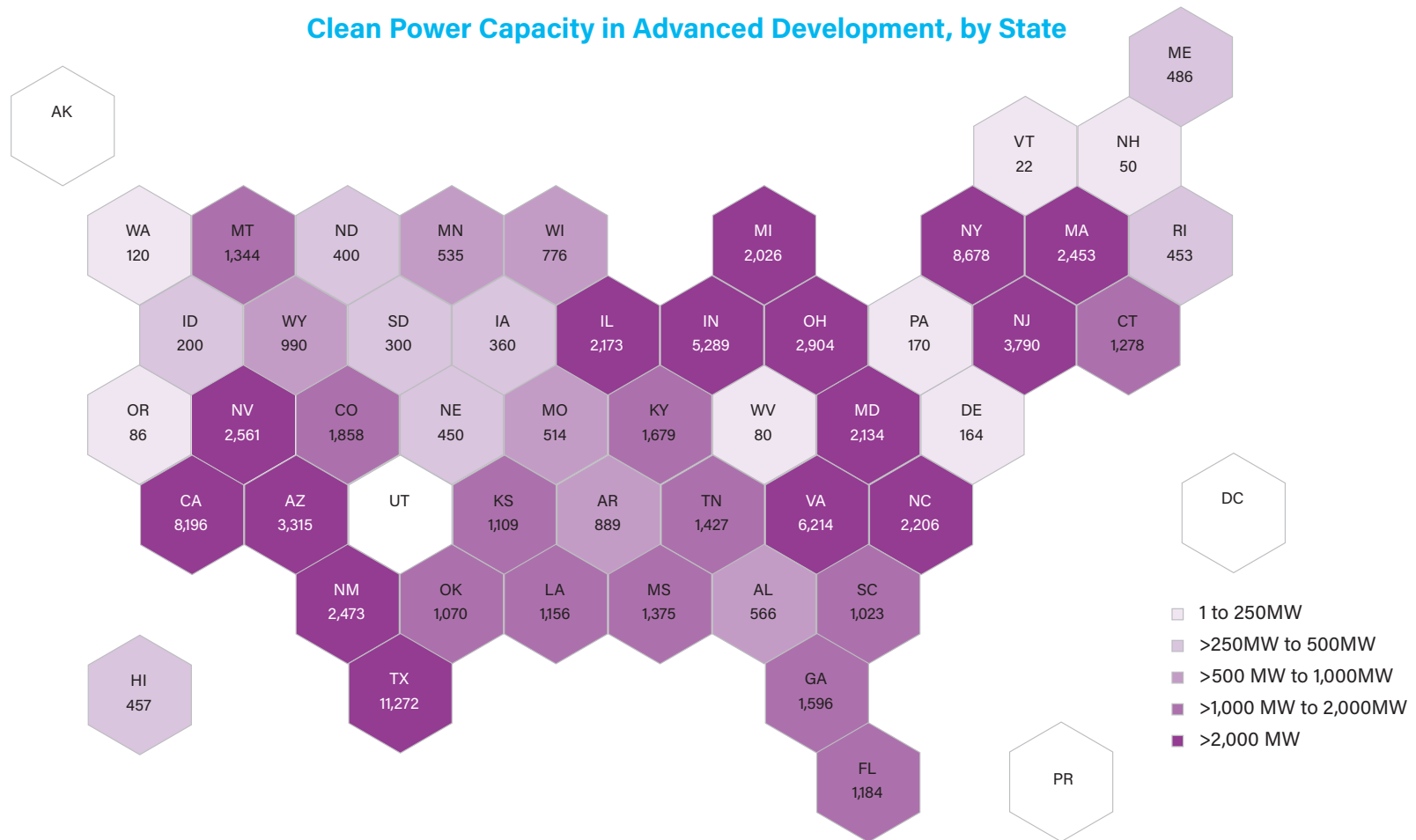
Clean Power Capacity Under Construction, by State



Clean Power Advanced Development Activity

- The advanced development pipeline of 89,850 MW spans 48 states and 744 project phases. Alaska and Utah are the only states without clean power projects in advanced development.
- Texas has the most clean power in advanced development (11,272 MW), followed by New York (8,678 MW) thanks to the states offshore wind projects, and California (8,196 MW).
- Texas leads the solar and land-based wind advanced development pipeline, while California claims the top spot for battery storage and offshore wind is claimed by New York.
- Within the advanced development pipeline, solar comprises 58% while offshore wind represents 18%. Battery storage constitutes 12% of the pipeline while land-based wind accounts for the remaining 11%.

Clean Power Capacity in Advanced Development, by State

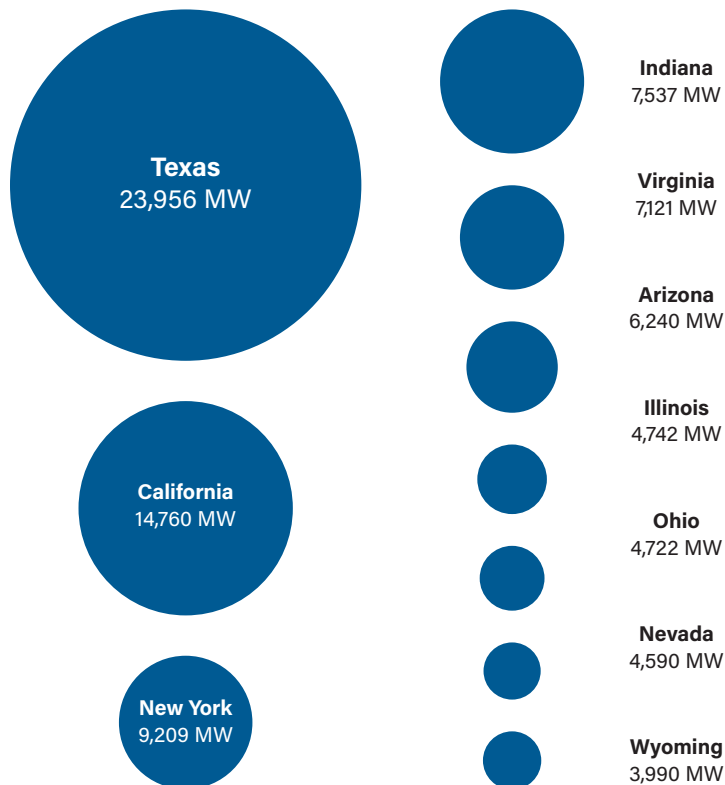


CLEAN POWER CAPACITY GROWTH

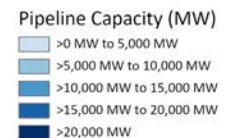
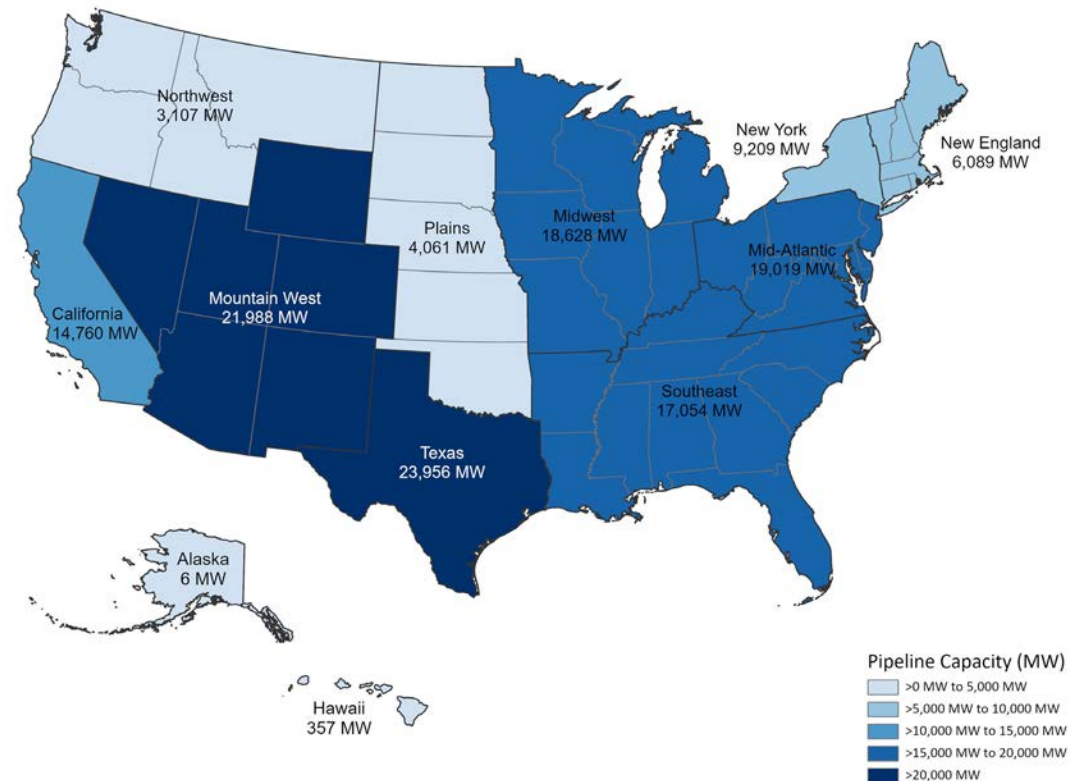
Clean Power Pipeline by State and Region

- There are 138,808 MW in development across all 50 states.
- Texas and California, the nation's leaders in operating clean power capacity, also lead the development pipeline, with 23,956 MW and 14,760 MW in development, respectively.
- New York ranks third with 9,209 MW in development, 46% of which is offshore wind power. New York is followed by Indiana with 7,537 MW in development, the majority of which is solar.
- By region, Texas is followed by the Mountain West and Mid-Atlantic. The Midwest ranks second in terms of operating capacity but fourth in the pipeline.

Top States, Clean Power Development Capacity



Clean Power Development Capacity by Region

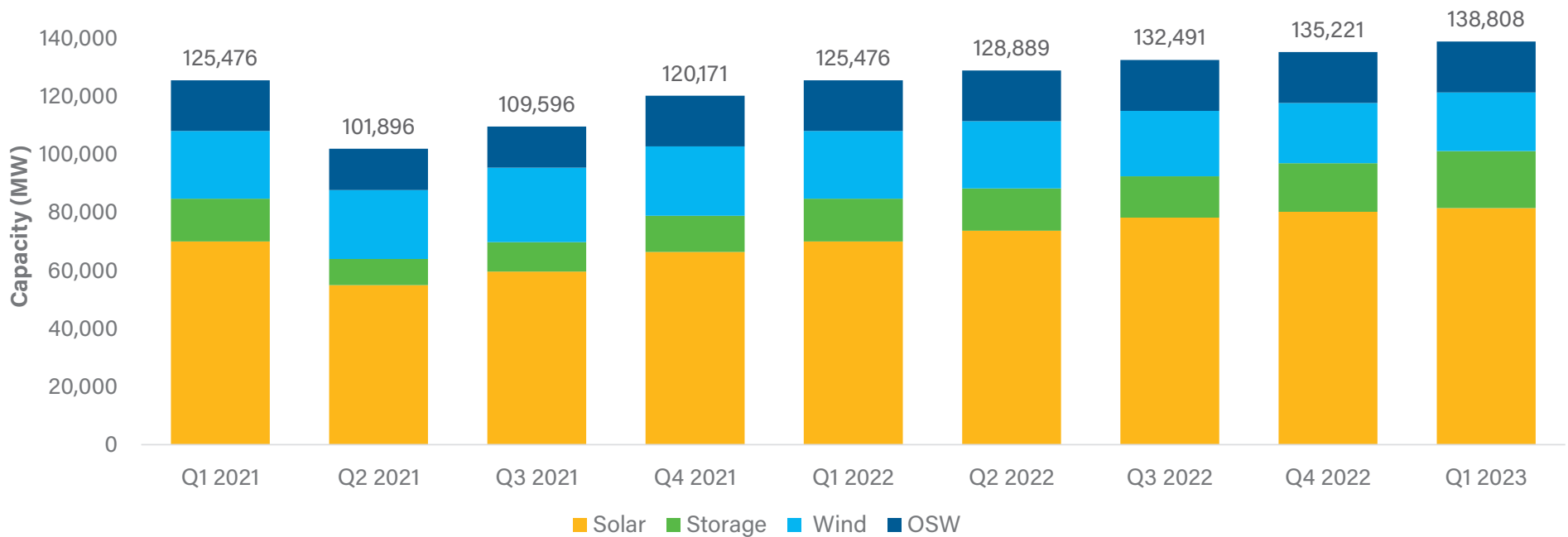


CLEAN POWER CAPACITY GROWTH

Clean Power Pipeline Over Time

- In Q1 2023, the clean power pipeline reached a record-breaking 138.8 GW. This remarkable figure demonstrates a consistent upward trend, with the exception of a temporary decline between the first and second quarters of 2021.
- Excluding the change Q1 to Q2 in 2021, the pipeline has grown at an average rate of 5% each quarter over this time period. The most significant quarterly growth occurred in the last two quarters of 2021.
- From Q3 2021 to Q1 2023, the storage pipeline experienced the highest average quarterly growth rate at 12%, followed by solar at 6%. The land-based wind pipeline, on the other hand, has decreased by an average of 2% each quarter.
- Over this two-year period, the solar share of the pipeline has increased by 5%.

Clean Power Development, Q1 2021-Q1 2023

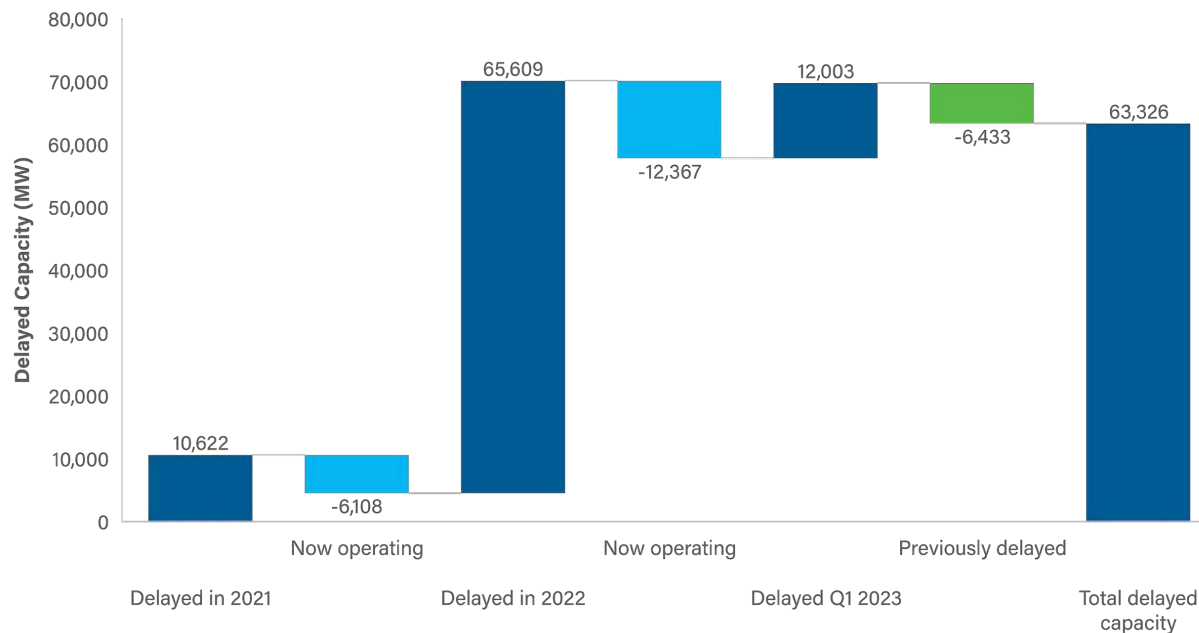


CLEAN POWER CAPACITY GROWTH

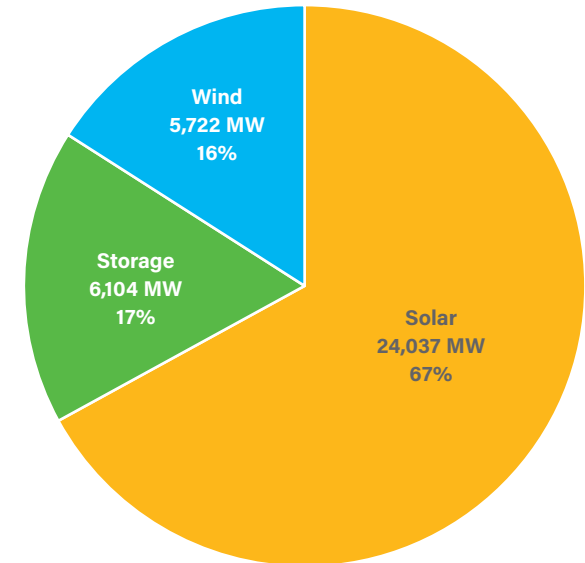
Clean Power Project Delays

- The 36% decline in Q1 clean power installations compared to Q1 2022 can be attributed, in part, to the large quantity of projects that experienced delays this quarter. More than 12 GW of projects reported delays in the first three months of 2023. Of that, more than 6.4 GW had already experienced previous delays. For comparison, only 6.9 GW of projects reported delays in Q1 2022.
- 7.3 GW of projects initially expected online in Q1 reported delays this quarter. The remaining 4.9 GW that reported delays were initially expected to commission between the second quarter of 2023 and the end of 2025.
- On average, the projects that reported delays in the first quarter were delayed by an average of 6 months.
- Considering the 10.6 GW of projects that experienced delays by the end of 2021, only 58% of them have commenced operations. For the 65.6 GW of projects delayed in 2022, only 19% have been commissioned. Including the projects that recently reported delays, along with the capacity that was delayed in 2021 and 2022 but has not yet started operations, the total delayed capacity amounts to more than 63.3 GW.
- Solar accounts for the majority, 67%, of total delayed capacity.

Clean Power Project Capacity Delayed



Total Clean Power Capacity Delayed, by Technology

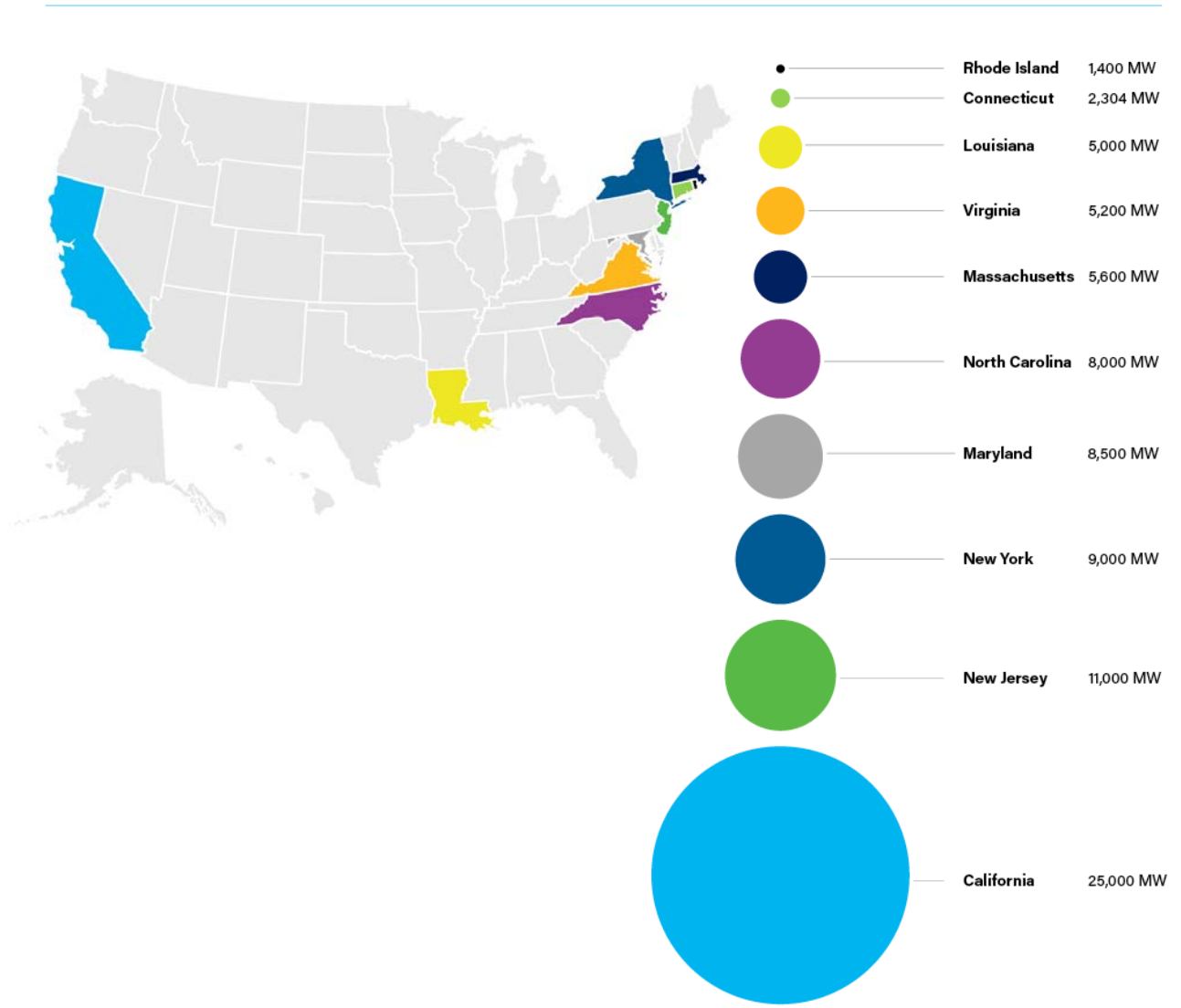


OFFSHORE WIND ACTIVITY

State Activity

- Proposals in response to New York's third offshore wind solicitation, seeking to procure at least 2 GW, were due at the end of January 2023. The state received proposals from six developers. Winners are set to be announced in the second quarter.
- Similarly, proposals in response to Rhode Island's latest RFP, seeking at least 600 MW and up to 1 GW of new offshore wind capacity were due in March 2023. The state received proposals from just one developer. The winner is set to be announced in June.
- In the second quarter, Maryland lawmakers passed a bill setting the state's offshore wind target to 8.5 GW by 2031 that was signed by the Governor.
- Ten states have set offshore wind targets totaling more than 81,000 MW.

State Offshore Wind Targets

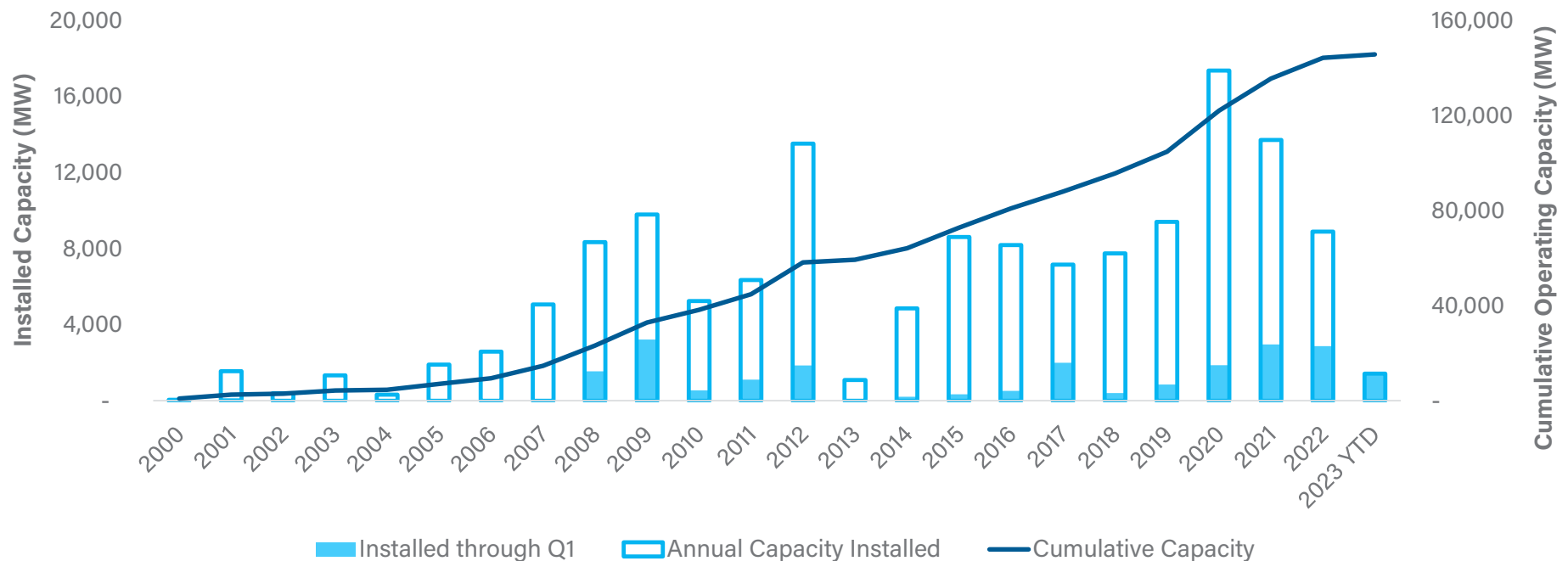


LAND-BASED WIND ACTIVITY

Over 1.4 GW of Land-Based Wind Capacity Added to the Grid

- During the first quarter of 2023, 7 new land-based wind project phases with a combined capacity of 1,418 MW started commercial operations.
- First quarter installations decreased by 50% compared to the first quarter of 2022, when 2,863 MW were added. This was the slowest first quarter the wind industry has experienced since 2019. Additionally, land-based wind installations dropped by 59% compared to the fourth quarter of 2022, when 3,459 MW of wind capacity was added.
- The capacity-weighted average size of projects added in the first quarter of 2023 was 236 MW, a decrease from the capacity-weighted averages of 360 MW in 2022 and 310 MW in 2021.
- The largest projects that came online were the Inertia Wind Project in Texas with a capacity of 301 MW and the Seven Cowboy Project in Oklahoma with a capacity of 300 MW. The Inertia Wind Project and Seven Cowboy Project are owned and developed by NextEra Energy Resources and Enel Green Power, respectively.

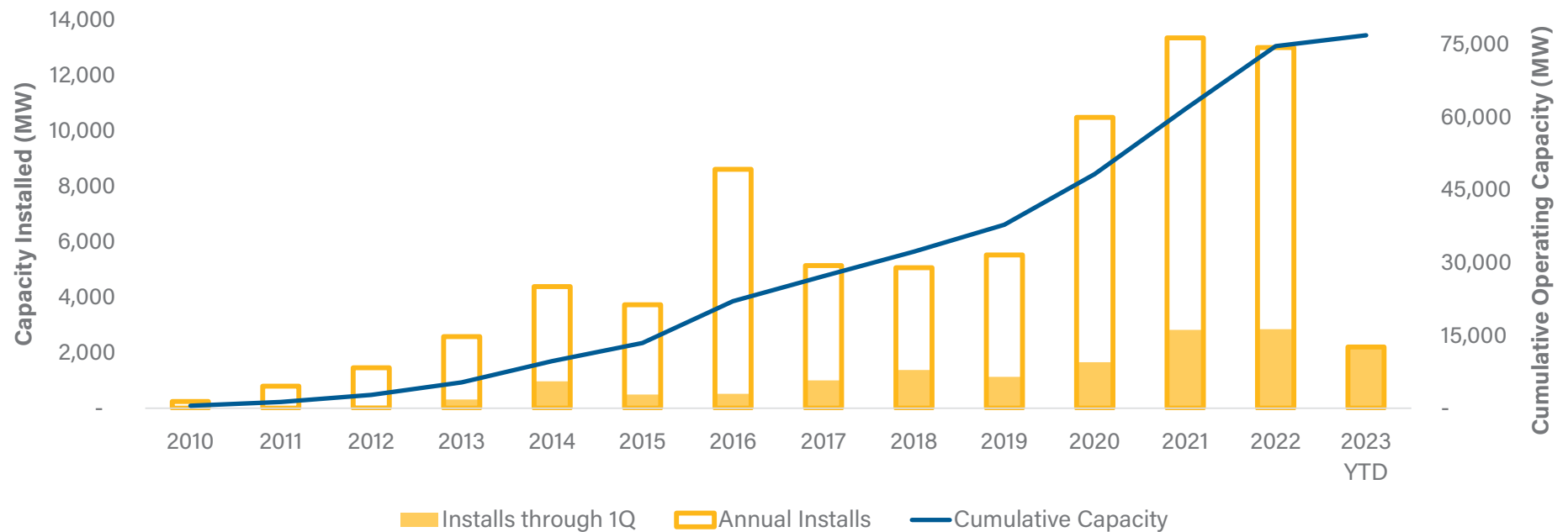
U.S. Annual and Cumulative Land-based Wind Capacity Growth



Solar Additions Slow Down After Record Fourth Quarter

- The first quarter of 2023 saw a drop in capacity installations for utility-scale solar. About 2,200 MW of solar capacity was added to the electric grid, representing a 23% decrease compared to the same period in 2022. Compared to the fourth quarter of 2022, solar installations fell by 56%.
- Cumulatively, there is now 76,778 MW of utility-scale solar operating in the U.S. All 50 states and the District of Columbia host operating utility-scale solar projects.
- The largest project that came online during the first quarter was Lightsource BP's 152 MW Bellflower Solar Project in Indiana. This was followed by the 102 MW Chaparral Springs Solar in California and 102 MW Cutlass Solar Project in Texas.

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

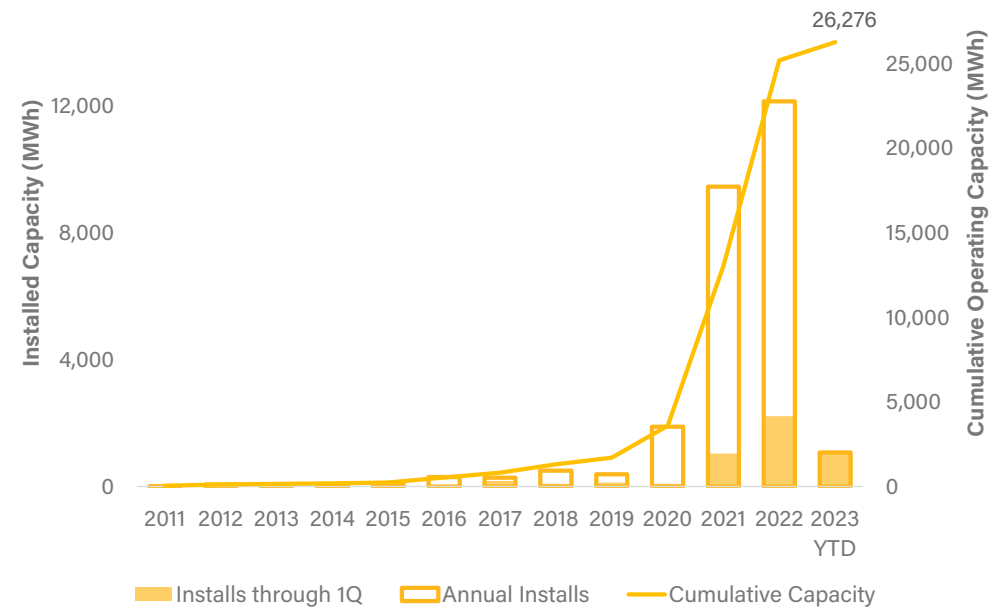
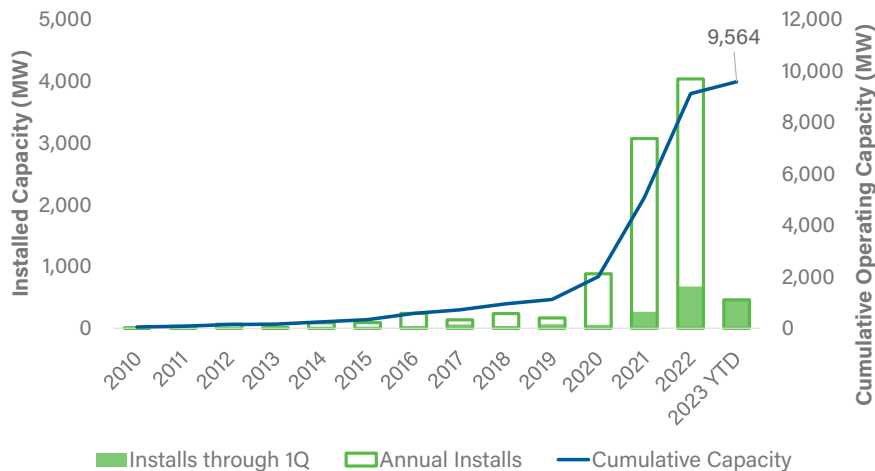


UTILITY-SCALE BATTERY STORAGE

Storage Installations Down 32% Year-Over-Year

- 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.
- In the first quarter, 17 battery storage projects commissioned with a total capacity of 461 MW/1,075 MWh. This represents a 32% decline from the first quarter of 2022.
- An additional 1.6 GW of battery storage projects were initially expected to be commissioned in Q1. Nearly all of those projects are now expected to be commissioned later in 2023, with an average delay of 1.5 quarters.
- 12 of the 17 projects installed in Q1 are paired with solar or wind capacity. Those projects on average have smaller capacity than standalone projects commissioned in the quarter, as 53% of capacity online in Q1 is standalone.
- Madero Grid, located in Texas and owned by Madero Grid, was the largest battery storage project to come online this quarter in terms of both MW and MWh capacity. The 100 MW battery has a storage energy capacity of 215 MWh.

Annual Clean Power Offtake Announcements, By Offtake Mechanism

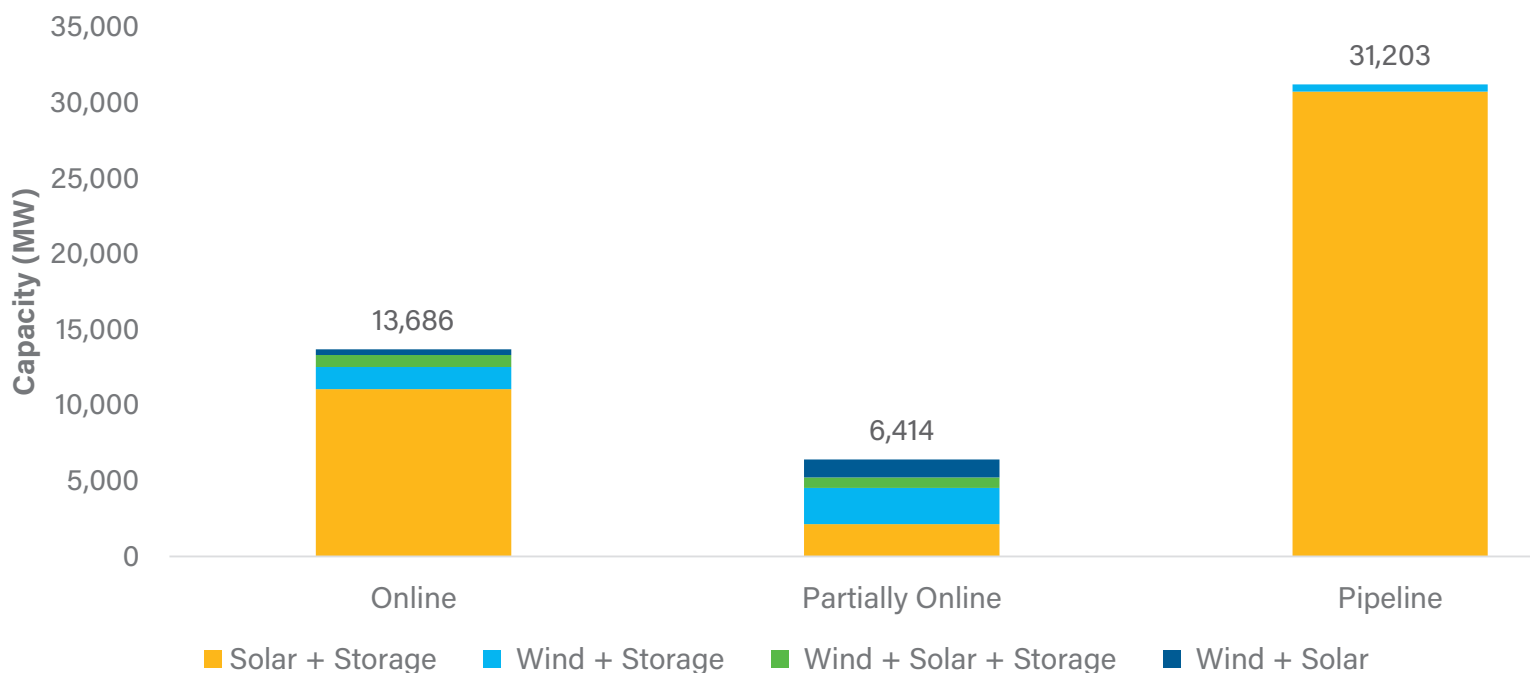


HYBRID PROJECTS

Nearly 500 MW of Solar + Storage Online in Q1

- In the first quarter of 2023, only 485 MW of solar + storage projects came online.
- In total, 13,686 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 6,414 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 31,203 MW of hybrid projects currently in the pipeline. The vast majority of that capacity, 98%, is from solar + storage projects. The remaining 2% is wind + storage projects in development.
- The Azure Sky Solar + Storage project was the largest project to fully commission in Q1. Owned by Enel, the solar portion of the Texas project (225 MW) came online at the end of 2021, and the storage portion (78 MW/135 MWh) commissioned in Q1 2023.

Hybrid Clean Power Projects

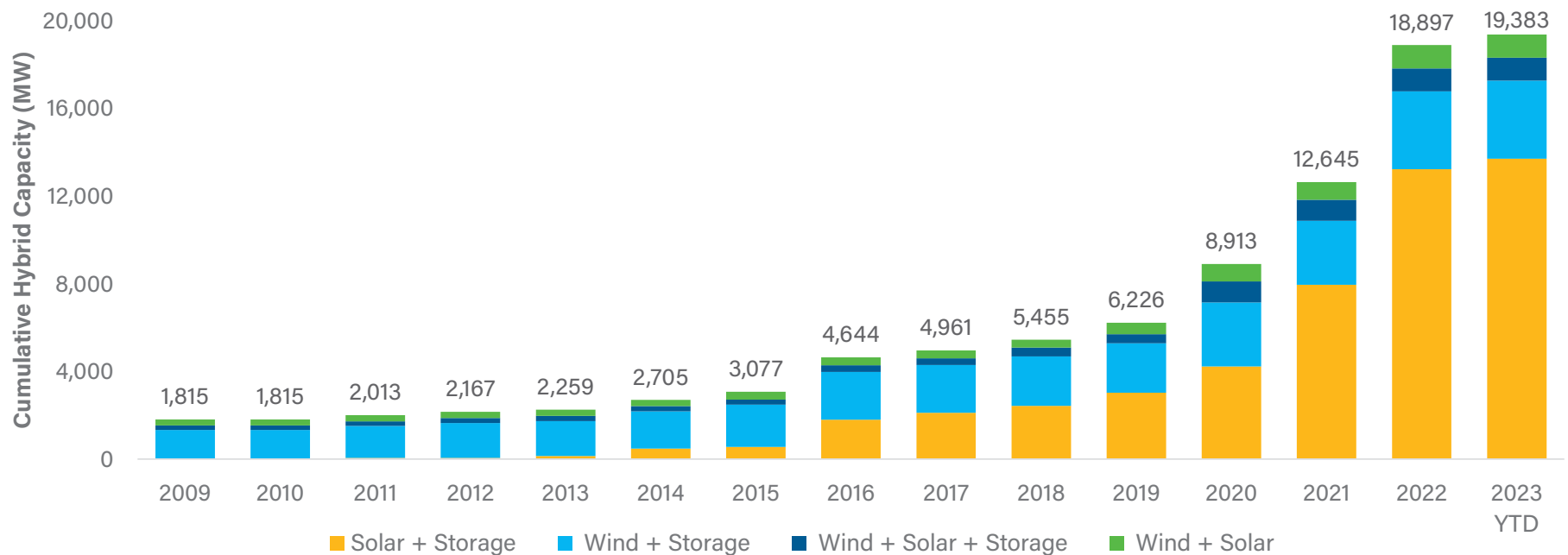


HYBRID PROJECTS

Operating Hybrid Capacity Tops 19 GW

- Operating hybrid capacity, including fully operational projects and phases of projects that are operating, is now 19,383 MW.
- Very few hybrid projects came online in the first quarter, so the increase in cumulative operating hybrid capacity is minimal. However, over the past five years operational hybrid capacity has increased by an average of 32% each year.
- Solar + storage projects are the dominant hybrid type, accounting for 71% of all operating hybrid capacity. Wind + storage, the prior dominant hybrid type, now accounts for just 18% of operating hybrid capacity.
- There are very few wind + solar + storage and wind + solar projects operating in the U.S., combined accounting for 11% 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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