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# Distributed Wind Energy Technology Data Update

## *2025 Edition Summary*

Version 2: 3 December 2025

**Lindsay Sheridan**

**Kamila Kazimierczuk**

**Jacob Garbe**

Pacific Northwest National Laboratory

U.S. DEPARTMENT of ENERGY BATTELLE

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Lindsay Sheridan

# Distributed Wind Energy Technology Data Update: 2025 Edition

## Purpose, Scope, and Data

- Summarizes U.S. distributed wind annual data through the end of 2024
- Analyzes distributed wind projects of all sizes
- Provides data and analysis that are separate from land-based and offshore wind
- Includes data from turbine manufacturers, project installers, state agencies, American Clean Power Association, U.S. Energy Information Administration, Federal Aviation Administration, U.S. Department of Agriculture, U.S. Wind Turbine Database, and others.

## Authors

Lindsay Sheridan, Kamila Kazimierczuk, Jacob Garbe
Pacific Northwest National Laboratory (PNNL)

## Funded by

U.S. Department of Energy's (DOE) Wind Energy Technologies Office

## Products and Availability

- This summary is complemented with a data file
- All products available at: https://www.pnnl.gov/distributed-wind/market-report

# Distributed Wind Definitions

Distributed wind turbines are distributed energy resources connected at the distribution level of an electricity system or in off-grid applications to serve specific or local loads.

Two primary interconnection types exist for distributed wind:

- On-site use: *Behind-the-meter, remote net-metering, grid-connected microgrid, and off-grid applications*
- Local use: *Load-serving distribution line and isolated grid applications*

Distributed wind installations can range from a less-than-1-kilowatt (kW) off-grid wind turbine at a remote cabin or telecommunications platform, to a 15-kW wind turbine at a home or farm, to several multi-megawatt (MW) wind turbines at a university campus, at a manufacturing facility, or connected to the distribution system of a local utility.

**Small Distributed Wind Turbines:**
Capacity ≤ 100 kW


**Midsize Distributed Wind Turbines:**
100 kW < Capacity ≤ 1 MW


**Large Distributed Wind Turbines:**
Capacity > 1 MW

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# Contents



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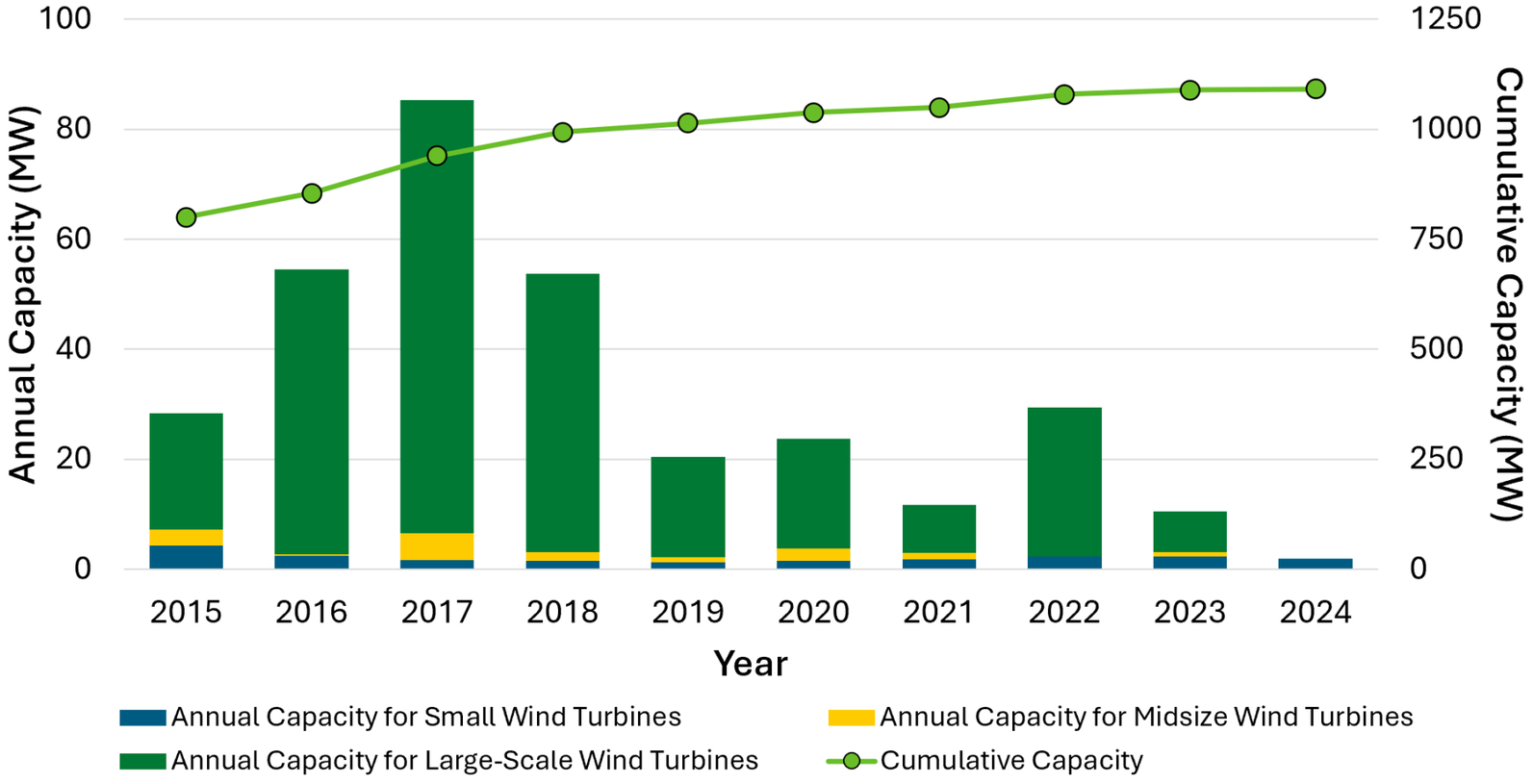
# U.S. Distributed Wind Installations

# Distributed Wind Capacity in the United States



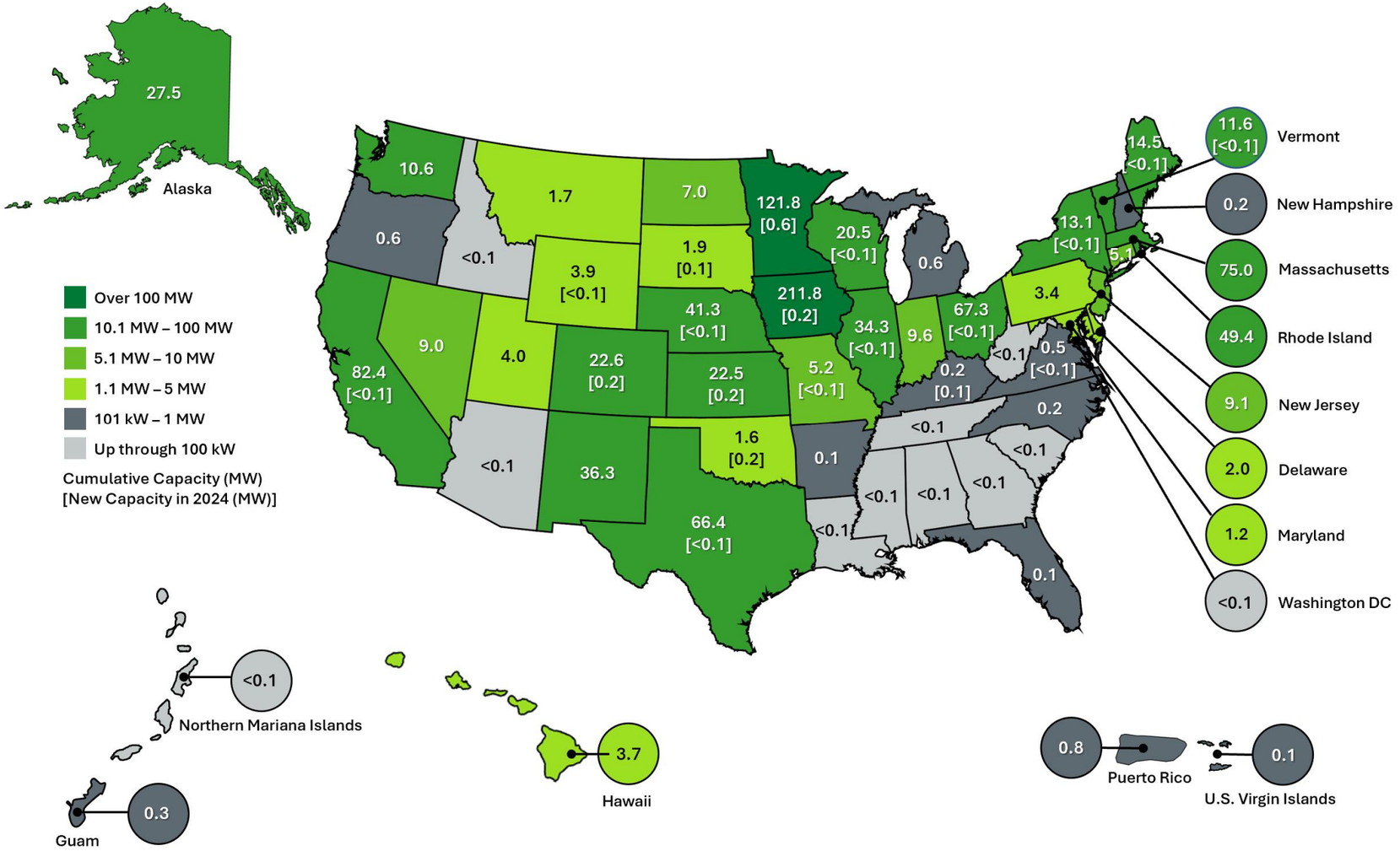

**Distributed wind capacity in the United States**

- A total of 2.0 MW of distributed wind capacity was installed in the United States in 2024.
- Cumulative distributed wind capacity reached 1,091 MW in 2024 from over 92,000 wind turbines deployed across all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, the Northern Mariana Islands, and Guam.

# U.S. Cumulative Distributed Wind Capacity and Capacity Additions in 2024

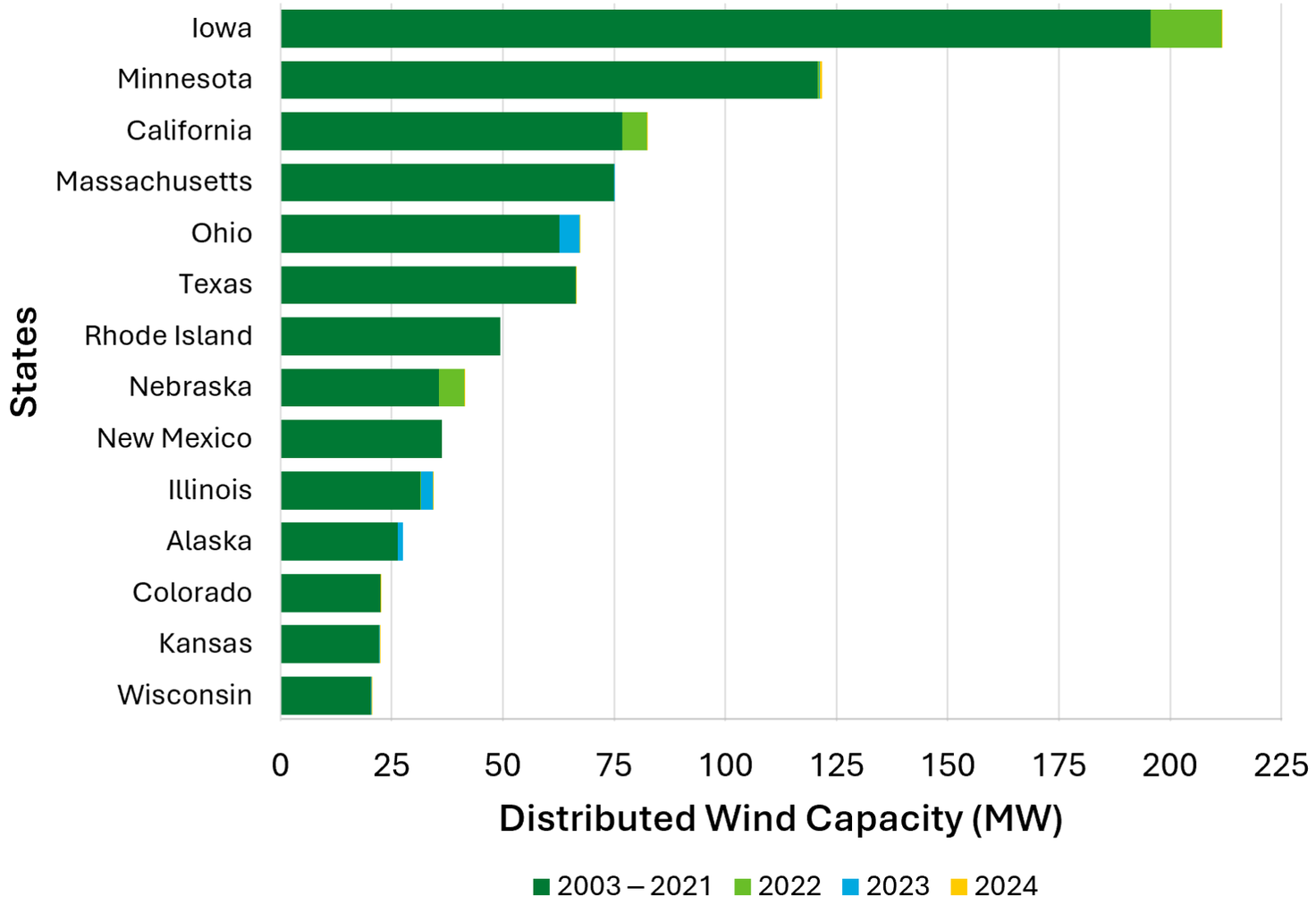
In 2024, new distributed wind projects were documented in 19 states:

- California
- Colorado
- Illinois
- Iowa
- Kansas
- Kentucky
- Maine
- Minnesota
- Missouri
- Nebraska
- New York
- Ohio
- Oklahoma
- South Dakota
- Texas
- Vermont
- Virginia
- Wisconsin
- Wyoming




**U.S. cumulative (2003-2024) distributed wind capacity and capacity additions in 2024 for distributed wind by state**

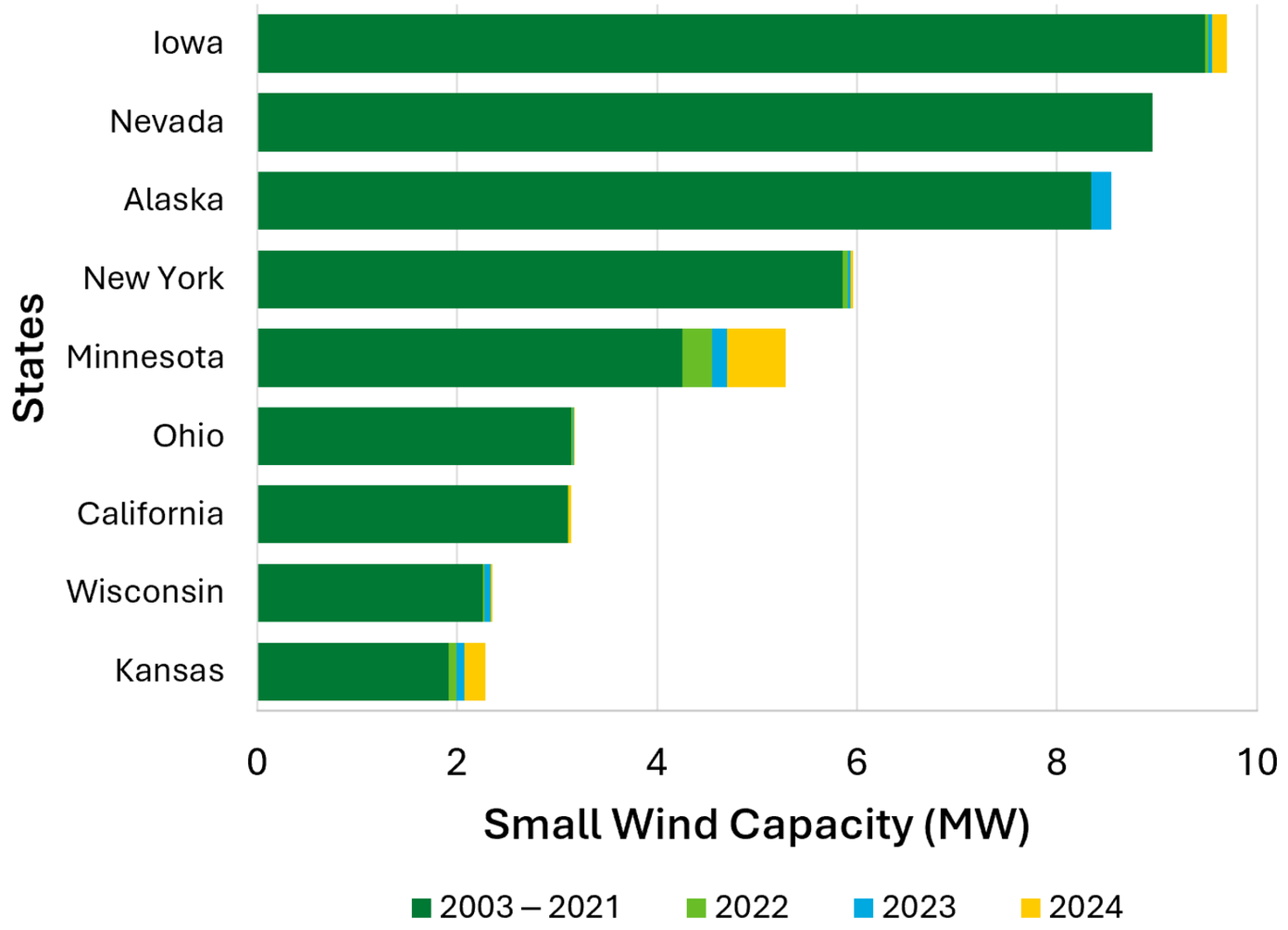
# States with Cumulative Distributed Wind Capacity Greater than 20 MW




**States with distributed wind capacity greater than 20 MW, 2003-2024**

Iowa, Minnesota, and California lead the United States in cumulative distributed wind capacity.

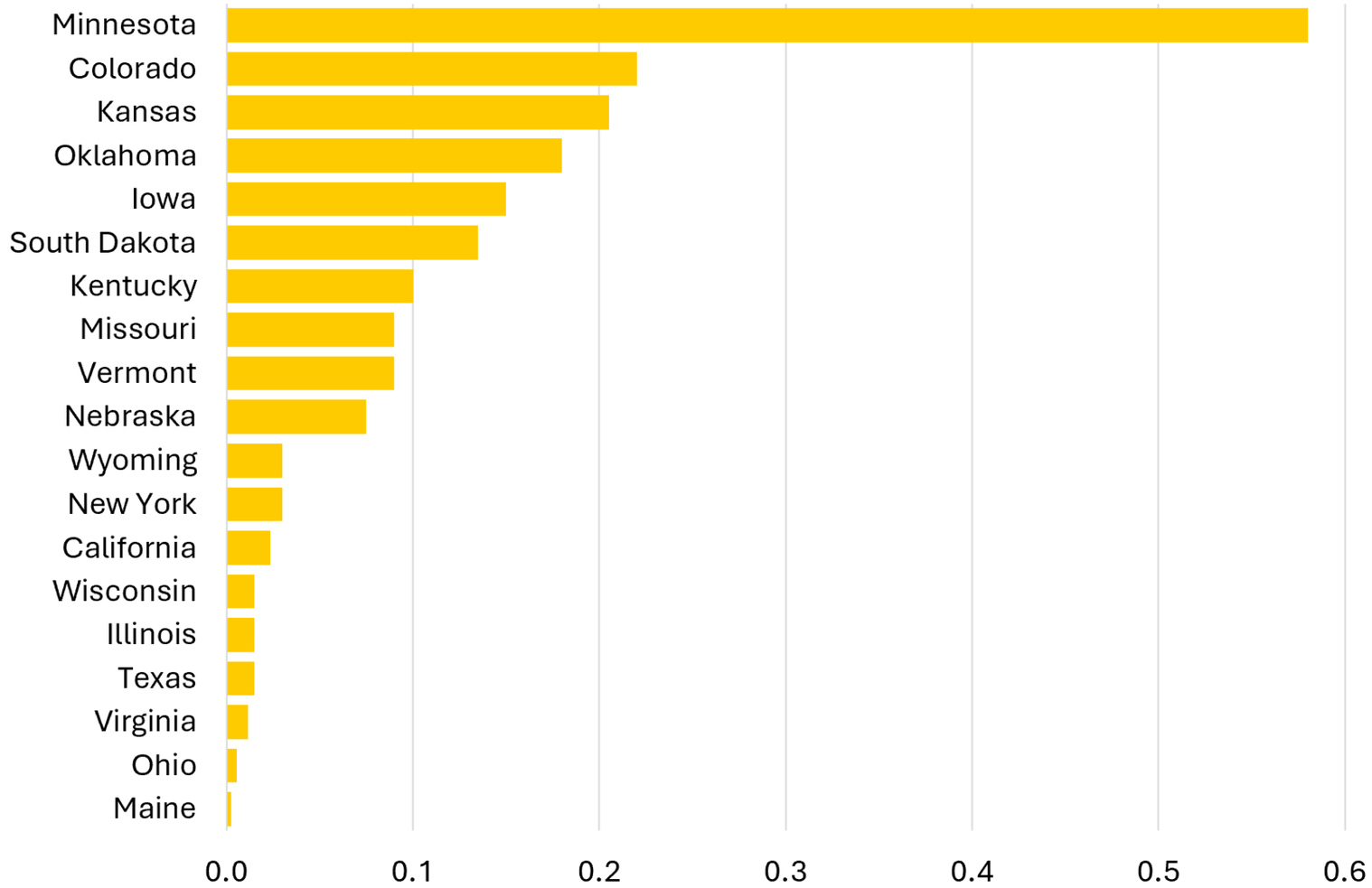
# States with Cumulative Small Wind Capacity Greater than 2 MW




**States with small wind capacity greater than 2 MW, 2003-2024**

- Small wind projects use turbines with capacities less than or equal to 100 kW.
- Iowa, Nevada, and Alaska lead the United States in cumulative small wind capacity.

# States with New Distributed Wind Capacity Installed in 2024




**States with distributed wind capacity installed in 2024**

- The projects with new distributed wind capacity in 2024 are comprised entirely of small wind turbines ranging from 1 kW to 100 kW in nominal capacity.
- Minnesota, Colorado, and Kansas led the United States in new distributed wind capacity additions in 2024.

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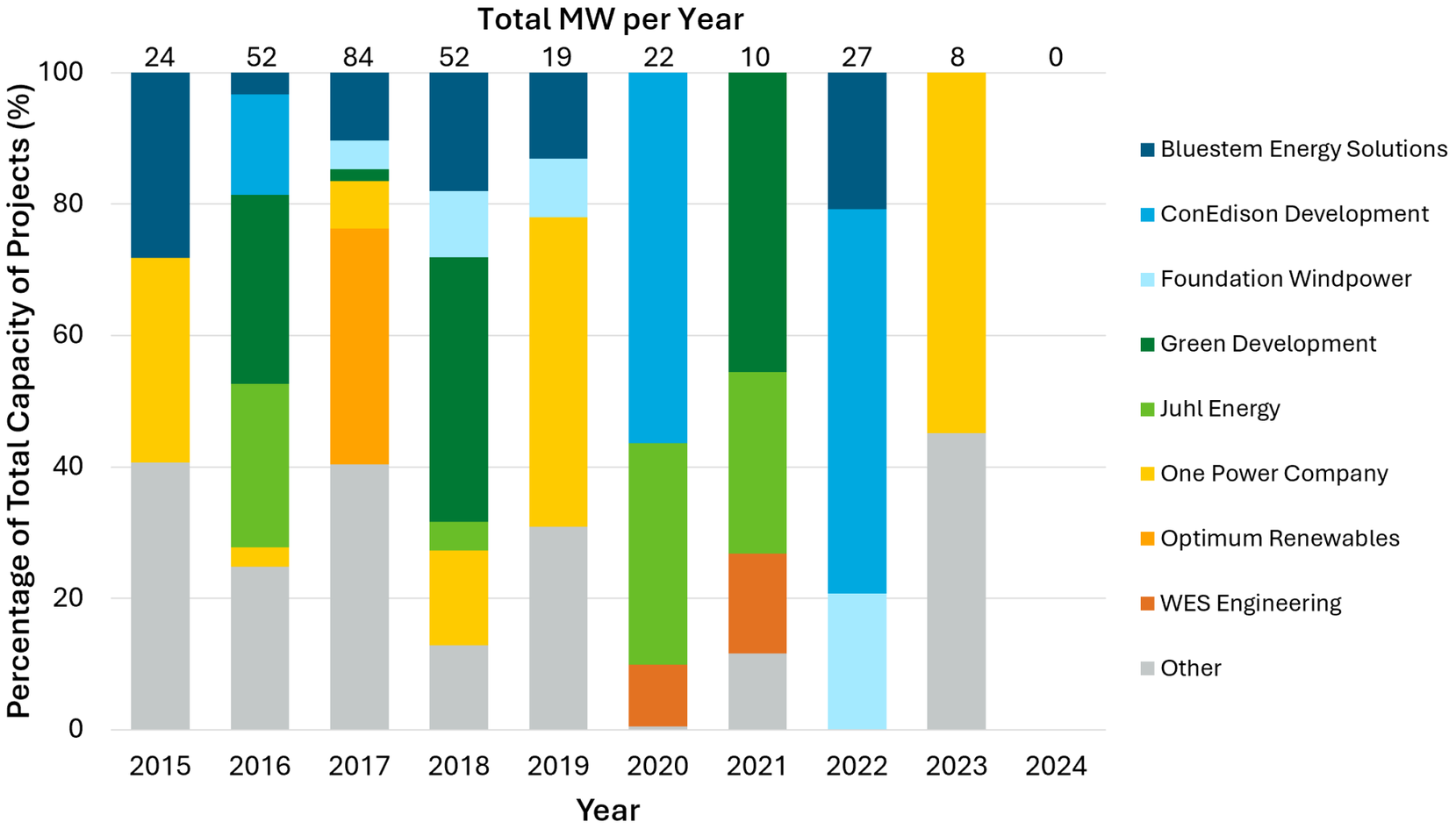
# U.S. Distributed Wind Projects and Sales

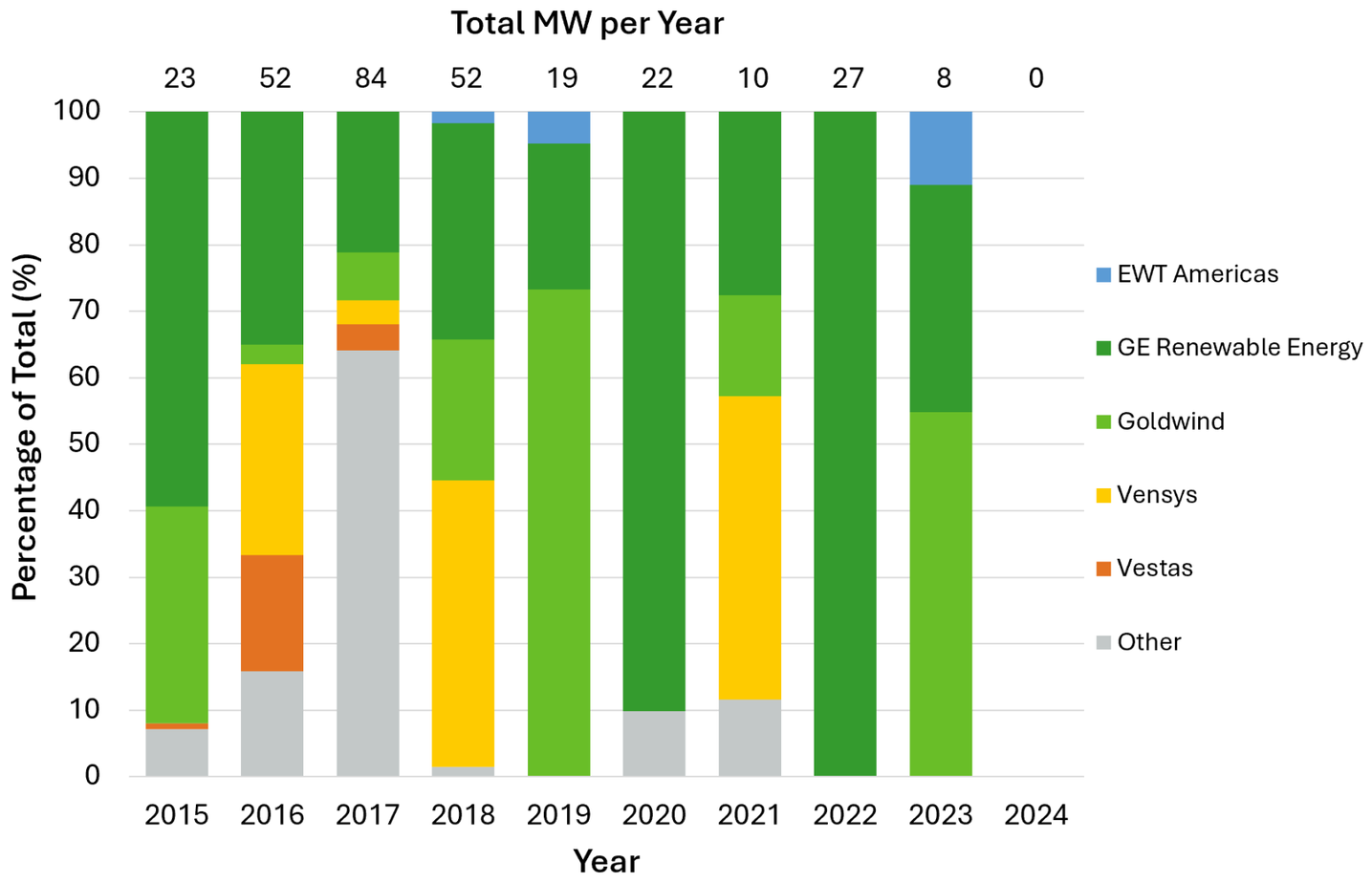
# Project Developers Using Midsize and Large Wind Turbines




**Project developers using midsize and large wind turbines, 2015-2024**

- While no distributed wind projects using large-scale turbines were installed in 2024, eight developers have accounted for 75% of the distributed wind capacity from projects using midsize (100 kW < capacity ≤ 1 MW) and large turbines (capacity > 1 MW) since 2015.
- These developers work almost exclusively in a single state or region and may not install projects each year because large-scale projects can take two to four years to develop.

# Wind Turbine Manufacturers of Midsize and Large Turbines with a U.S. Sales Presence

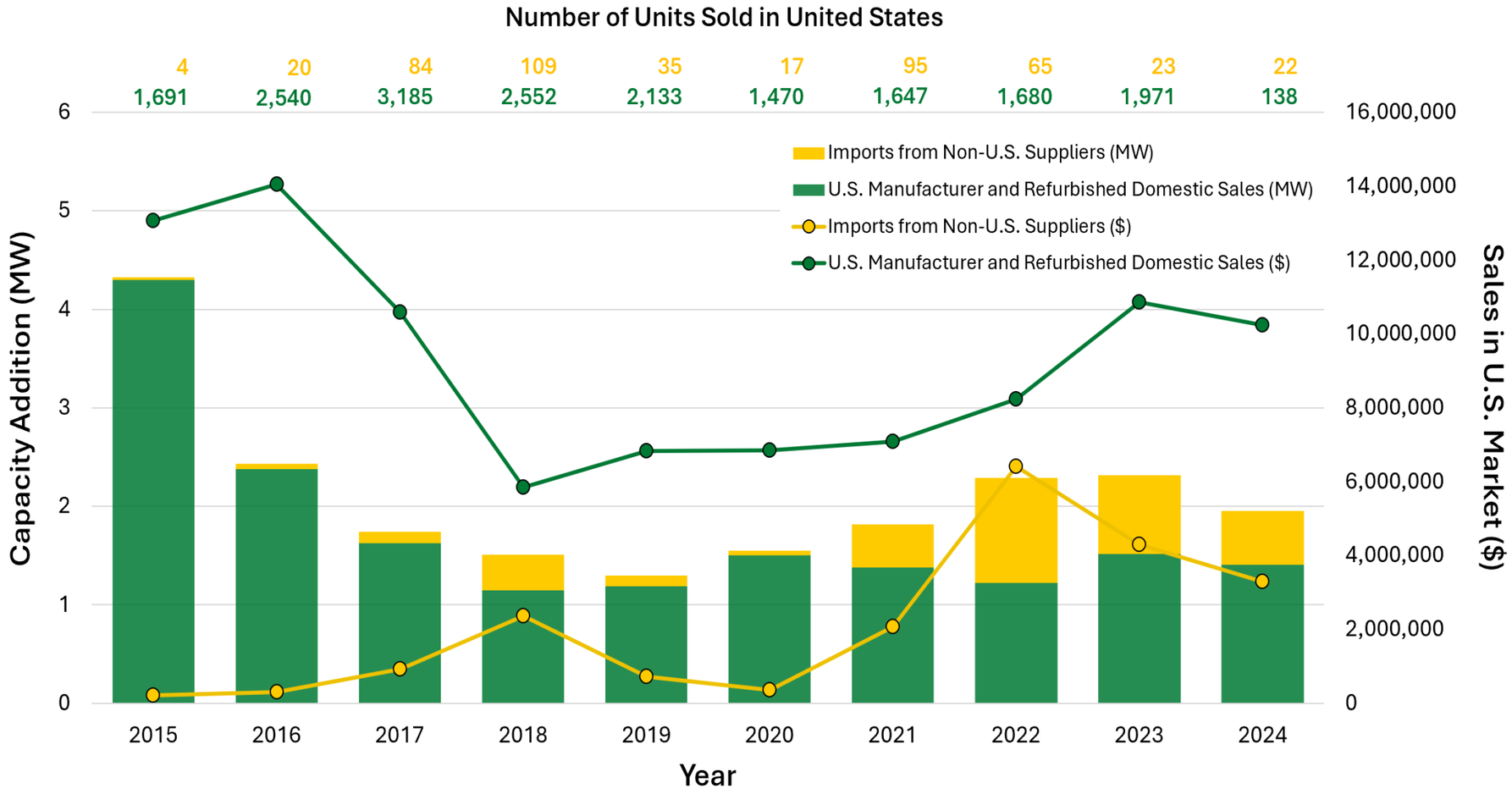



**Wind turbine manufacturers of midsize and large turbines with a U.S. sales presence, 2015-2024**

- While no distributed wind projects using large-scale turbines were installed in 2024, GE Energy has been the only consistent U.S.-based large-scale turbine manufacturer used in distributed wind projects over the last decade.
- Developers, particularly those that also operate the distributed wind projects they build and sell the power through power purchase agreements to customers, report that they source their wind turbines from one manufacturer to facilitate easier operations and maintenance across their fleet of projects.

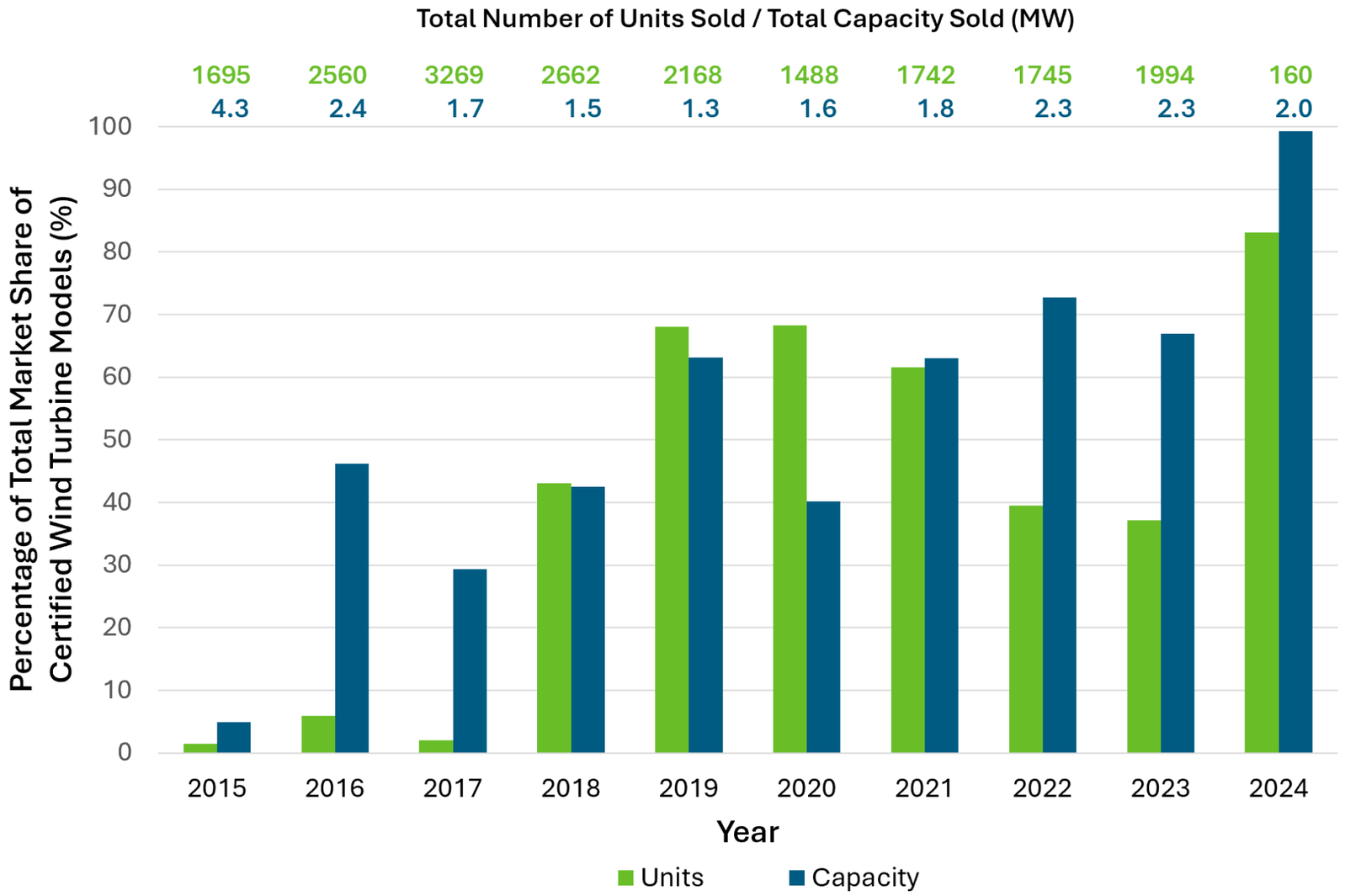
# U.S Small Wind Turbine Sales

In 2024, 2.0 MW of small wind were deployed in the United States from 160 turbine units representing $13.5 million in investment.




**U.S. small wind turbine sales, 2015-2024**

# Market Share of Certified Small Wind Turbine Models




**Market share of certified small wind turbine models, 2015-2024**

Certified wind turbines represented the largest share of small wind units sold in 2024, accounting for 83% of the total units and 99% of the total capacity of domestic small wind installations in 2024.

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# Small Wind Certification

# Small Wind Certifications as of July 2025

Ten small wind turbines were certified in the United States as of July 2025.

| Applicant | Turbine Model | Date of Initial Certification | Certified Power Rating @ 11 m/s (kW) | Certification Standard |
|---|---|---|---|---|
| Bergey Windpower Company | Excel 10 | 11/16/2011 | 8.9 | AWEA 9.1 |
| Bergey Windpower Company | Excel 15 | 02/05/2021 | 15.6 | AWEA 9.1 |
| Eveready Diversified Products (Pty) Ltd. | Kestrel e400nb | 02/14/2013 | 2.5 | AWEA 9.1 |
| Eocycle Technologies, Inc. | EOX S-16 | 03/21/2017 | 28.9 | AWEA 9.1 |
| HI-VAWT Technology Corporation/Colite Technologies | DS3000 | 05/10/2019 | 1.4 | AWEA 9.1 |
| Kodair Wind Designs Ltd. | KW20 | 02/20/2025 | 20.3 | ACP 101-1 |
| Kodair Wind Designs Ltd. | KW30 | 03/12/2025 | 29.3 | ACP 101-1 |
| SD Wind Energy, Ltd. | SD6 | 06/17/2019 | 5.2 | AWEA 9.1 |
| SkyWind Energy GmbH | SkyWind NG | 06/20/2025 | 0.31 | ACP 101-1 |
| Wind Resource, LLC | Skystream 3.7 | 04/12/2023 | 2.1 | AWEA 9.1 |

The American Clean Power Association (ACP), the successor to AWEA, published its new American National Standards Institute (ANSI) consensus standard, ANSI/ACP 101-1-2021, in October 2022 to facilitate easier certification compliance.

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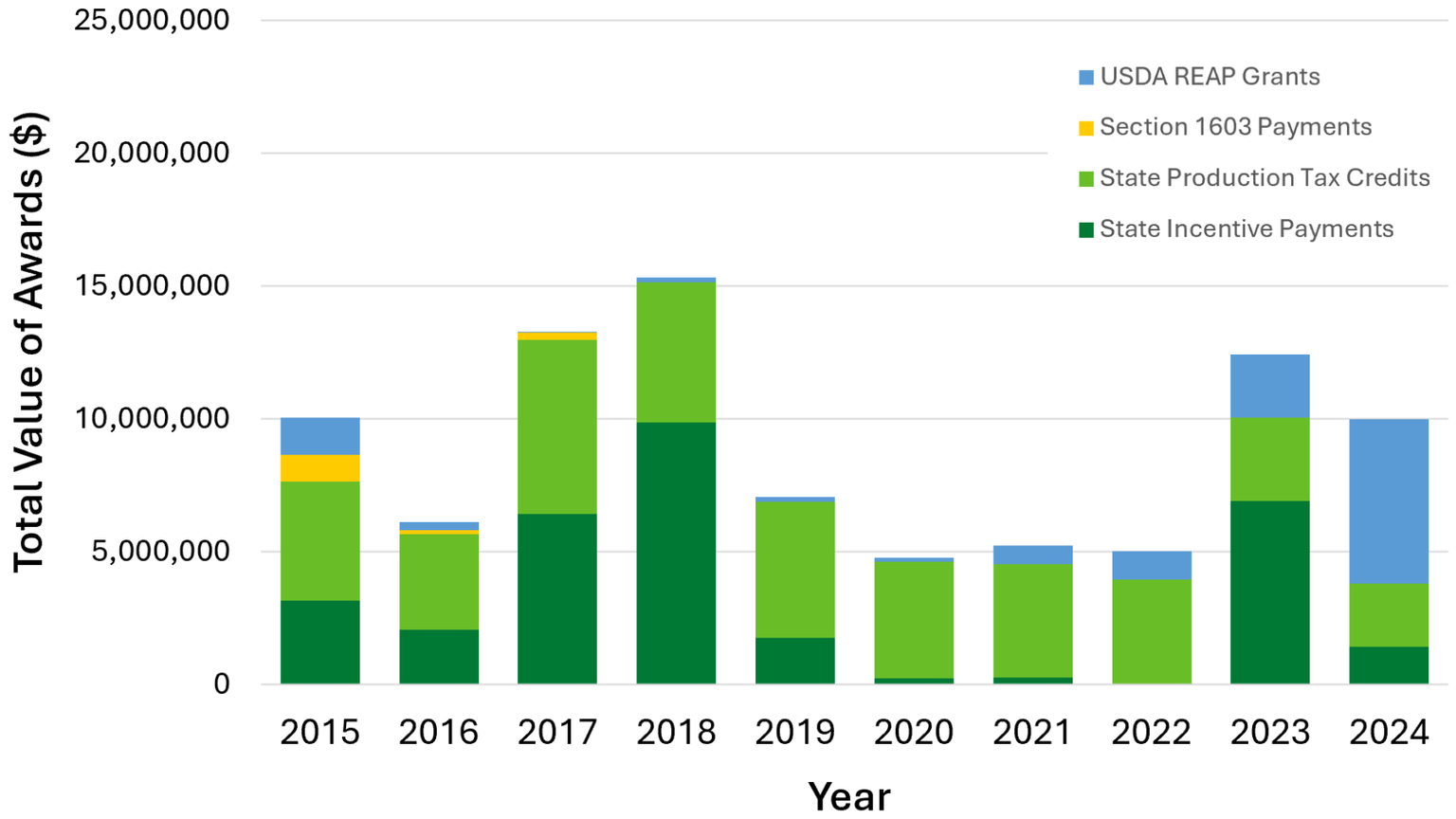
# Policies, Incentives, and Market Insights

# U.S. Distributed Wind Incentive Awards

The combined value of U.S. Department of Agriculture (USDA) Rural Energy for America Program (REAP) grants, state-level incentives, and state-level production tax credits allocated to distributed wind projects in 2024 was $10 million across 15 states.

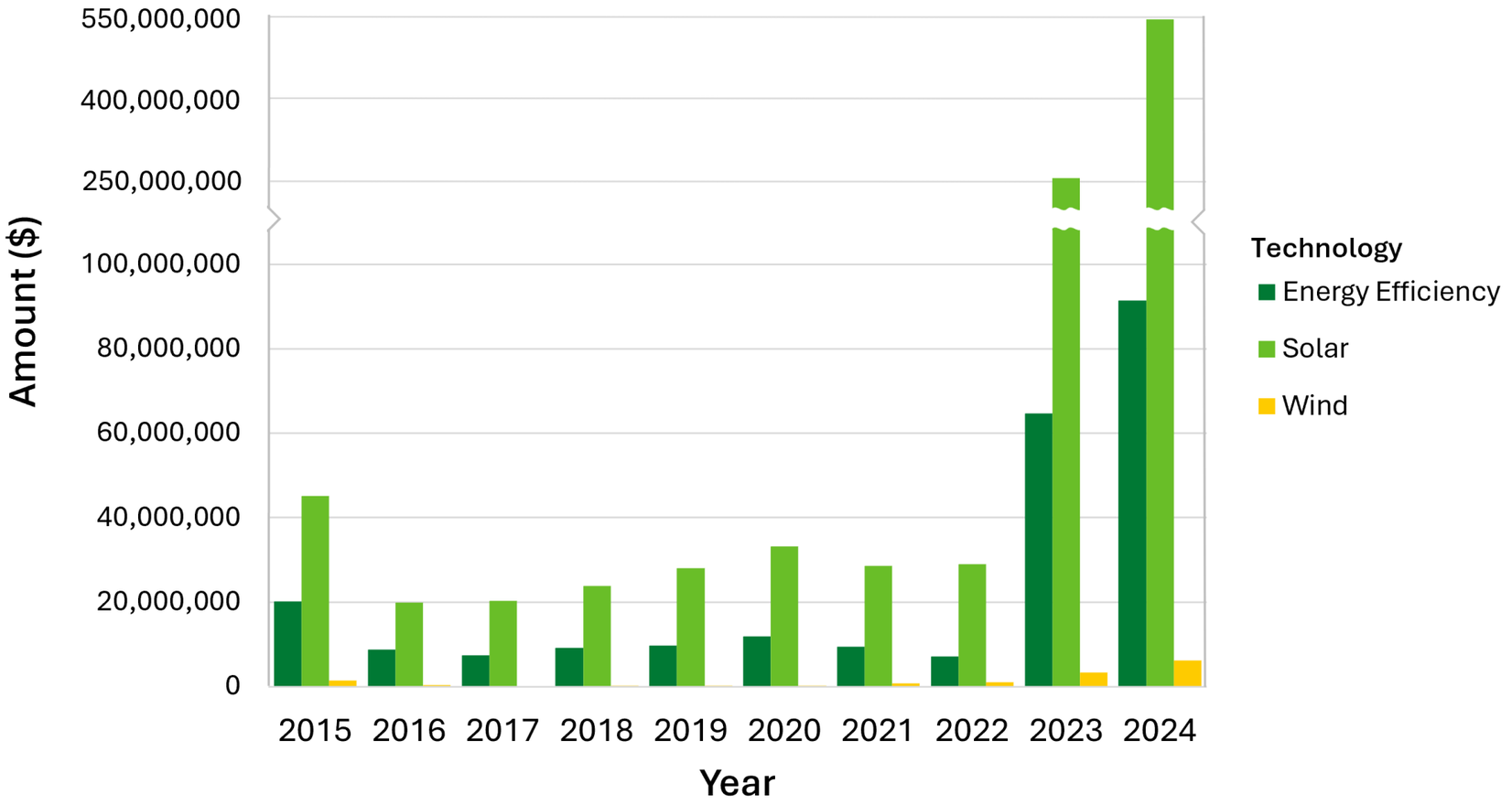



**U.S. distributed wind incentive awards, 2015-2024**

The 15 states receiving incentives were:

- California
- Colorado
- Illinois
- Iowa
- Kansas
- Minnesota
- Missouri
- Montana
- Nebraska
- New Mexico
- New York
- Oklahoma
- South Dakota
- Texas
- Wisconsin

# USDA REAP Grants by Technology




**USDA REAP grants by technology, 2015-2024**

- In 2024, a total of $6.2 million in USDA REAP grants was awarded to 62 wind projects, all of which were distributed wind projects.
- The projects receiving REAP awards represent 1.8 MW of capacity from 90 turbines across 13 states.

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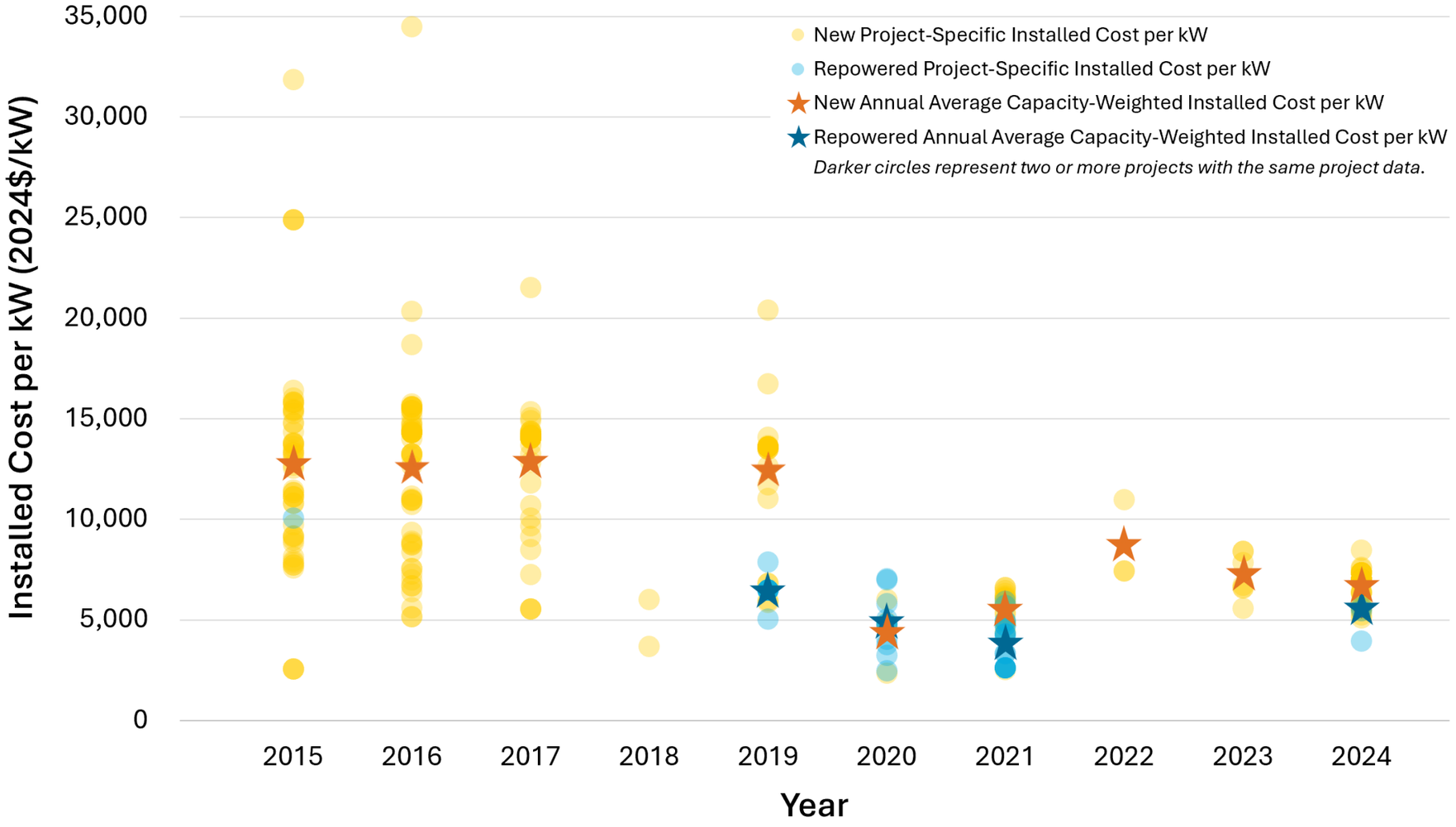
# Distributed Wind Costs

# Installed Costs for Projects Using Small Wind Turbines

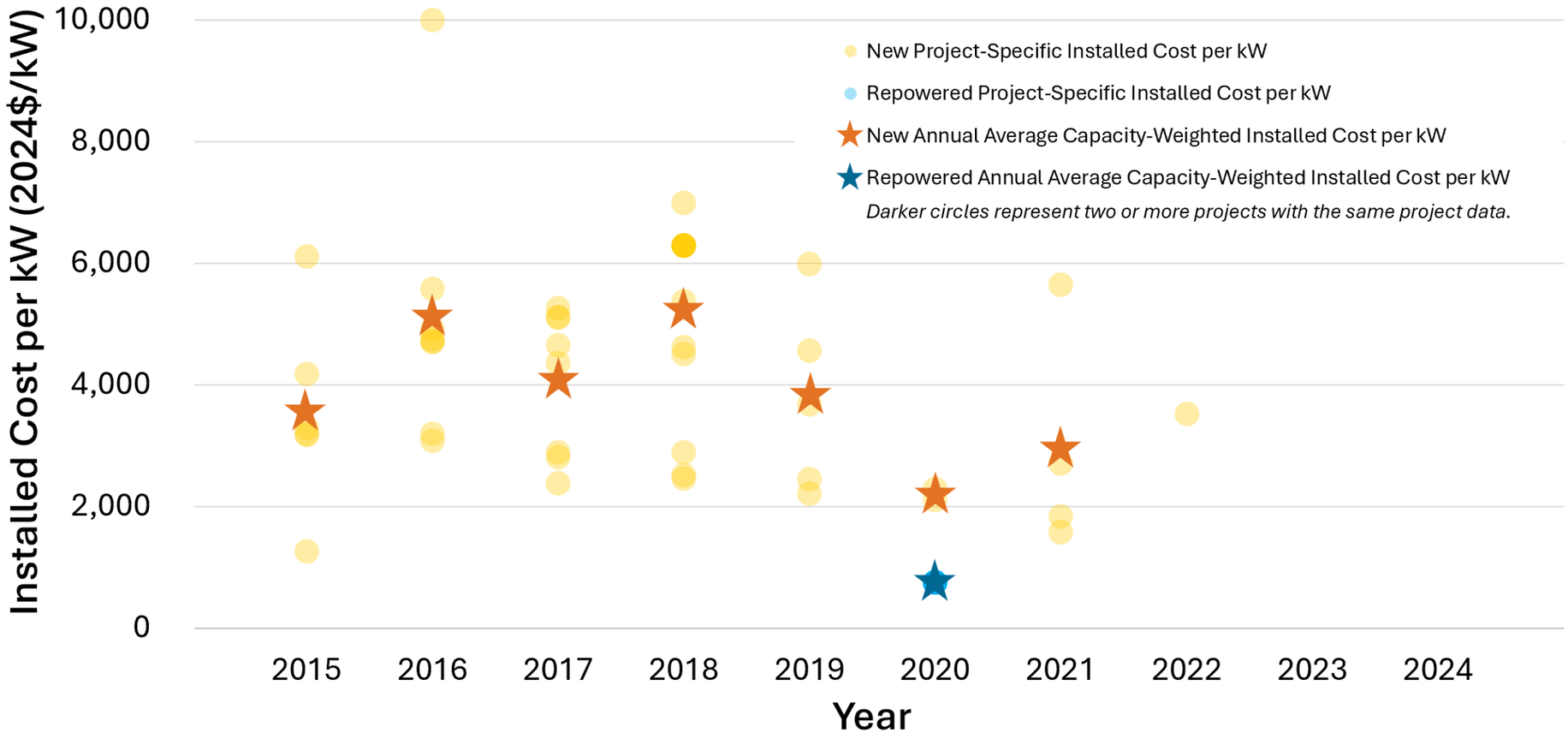



**Annual average and project-specific new and repowered small wind installed project costs, 2015-2024**

- The average installed cost for new small wind projects in 2024 was $6,680/kW.
- The small wind cost metrics for 2024 are based on a sample size of 30 projects using 45 wind turbines with a combined rated capacity of 875 kW.

# Installed Costs for Projects Using Midsize and Large Turbines

While no installed costs were reported for projects using midsize and large turbines in 2023 or 2024, the overall average capacity-weighted installed cost for the period of 2015 through 2022 was $4,310/kW.




**Annual average and project-specific new and repowered installed costs for projects using midsize and large turbines, 2015-2024**

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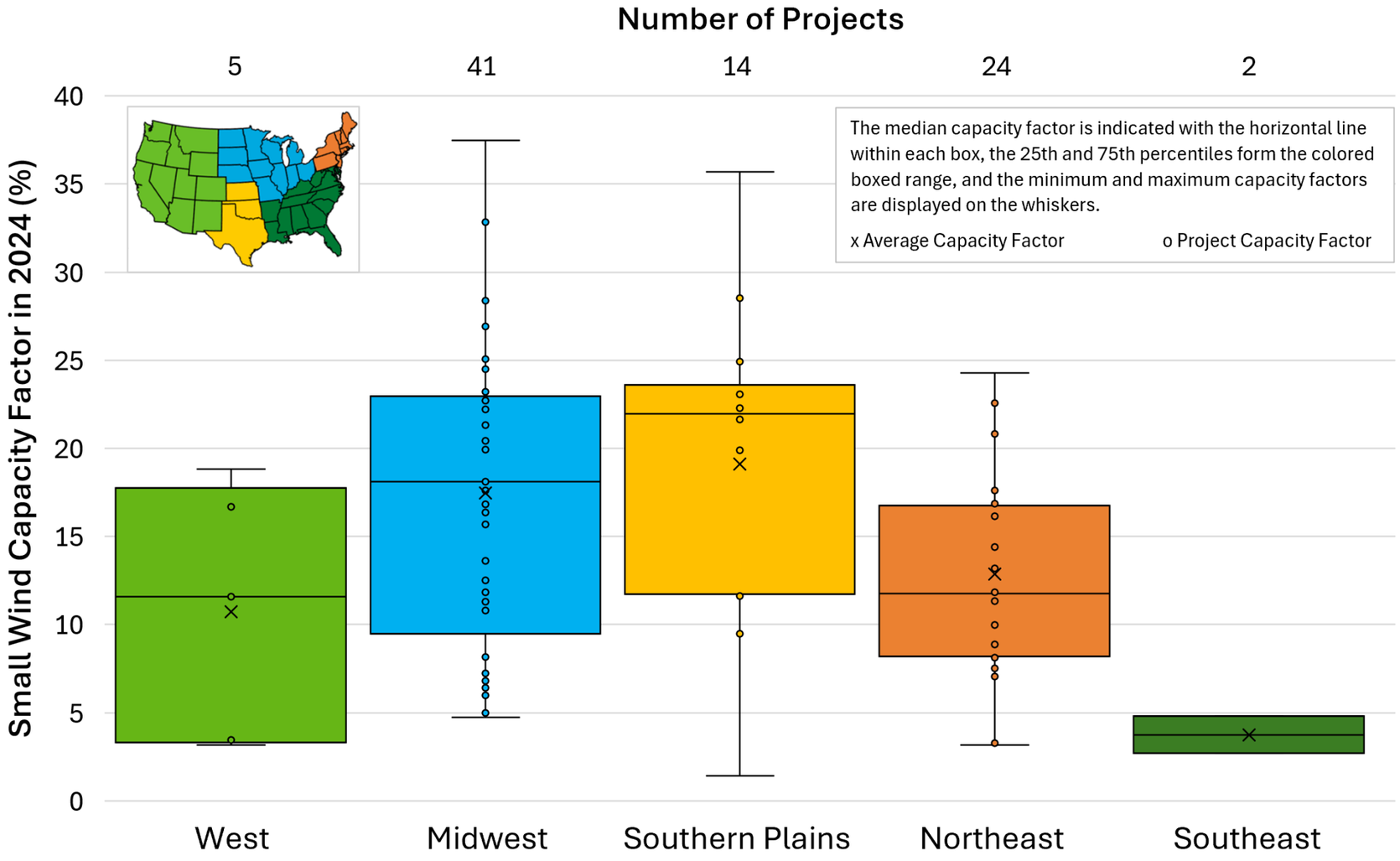
# Distributed Wind Performance

# Capacity Factors in 2024 for Projects Using Small Wind Turbines



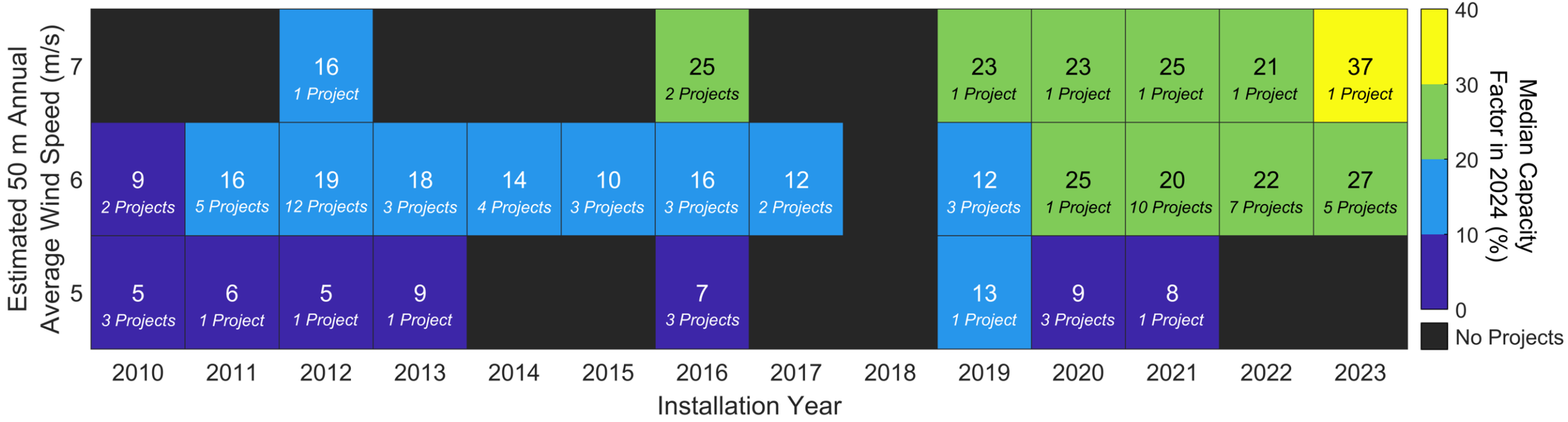

**Small wind capacity factors in 2024**

- The average capacity factor in 2024 across a sample of 88 small wind projects was 16%.
- The sample of small wind projects totals 1.4 MW in rated capacity from turbines ranging from 2 kW to 85 kW installed from 2009 through 2023.

# Small Wind Capacity Factors in 2024 by Installation Year and Annual Average Wind Speed

- Samples of small wind project capacity factors in 2024 are organized according to each project's installation year and the estimated 50 m annual average wind speed from Global Wind Atlas.[1]

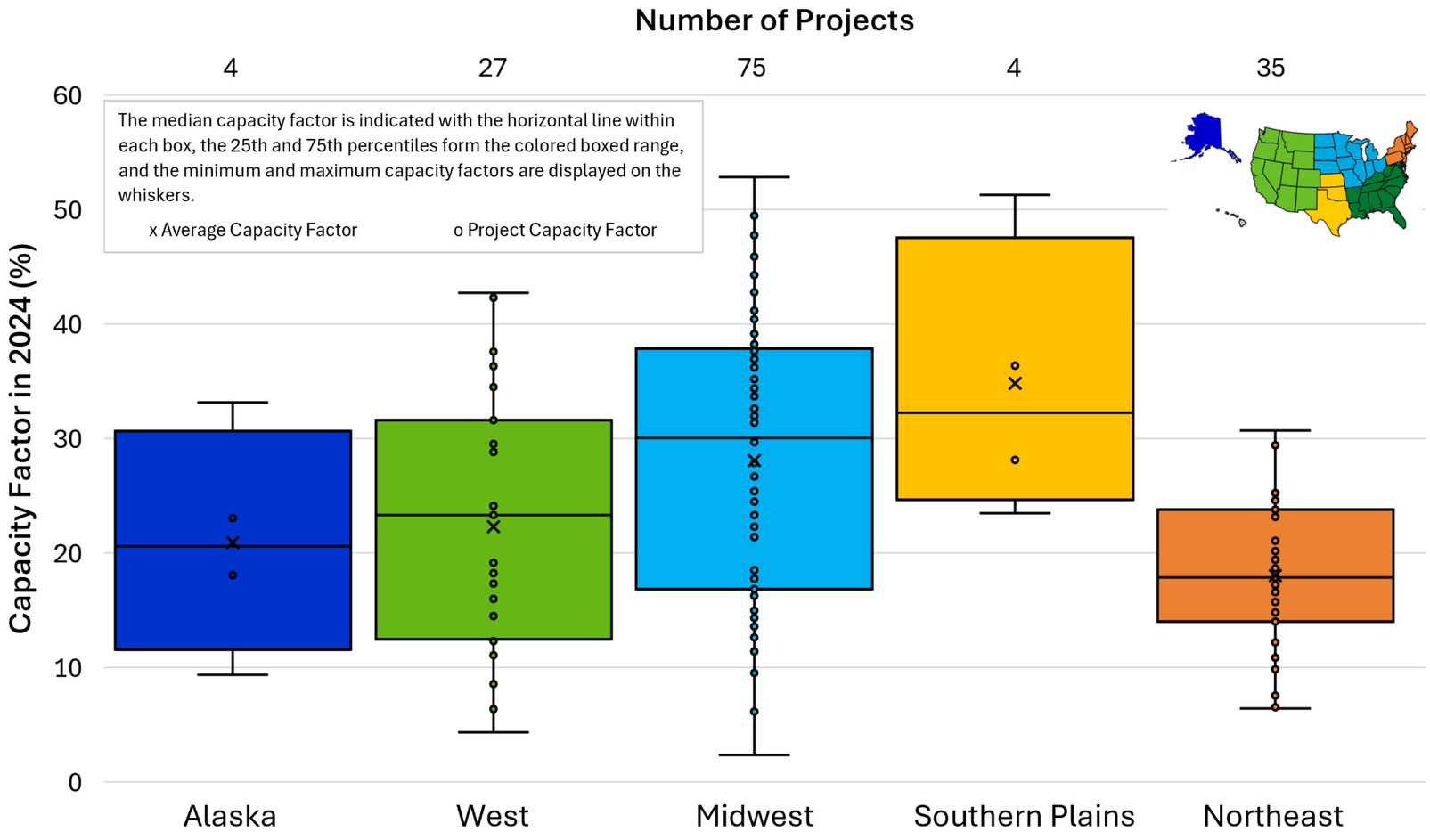
- While no trend by installation year for capacity factors in 2024 is noted for projects installed in locations with lower wind resource, an improvement in capacity factor is noted for recently installed projects when the annual average wind speed meets or exceeds 6 m/s. Possible causes for this trend include technology improvements over time, performance degradation with turbine age, and siting quality improvements over time.




**Small wind capacity factors in 2024 by installation year and estimated annual average wind speed**

[1] DTU and World Bank Group: Global Wind Atlas, https://globalwindatlas.info/en

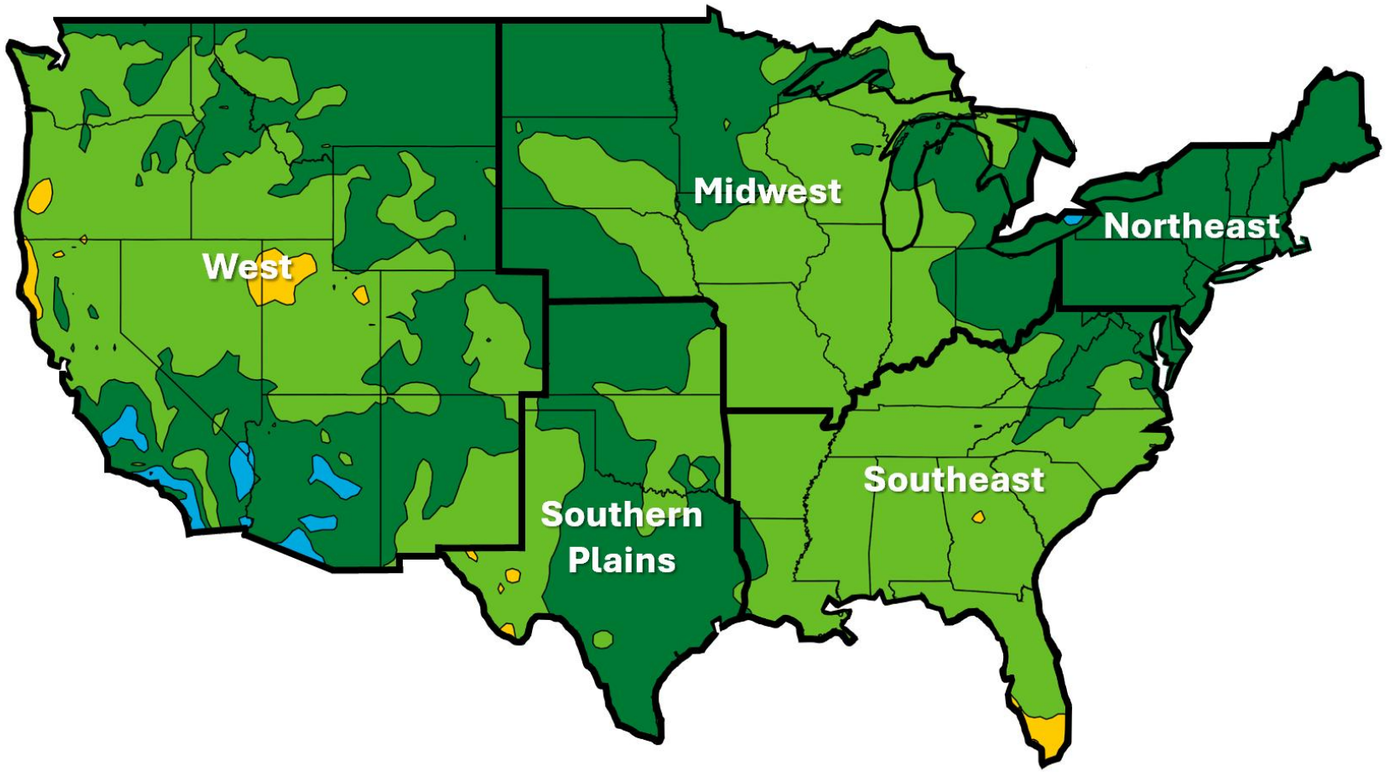
# Capacity Factors in 2024 for Projects Using Midsize and Large Wind Turbines

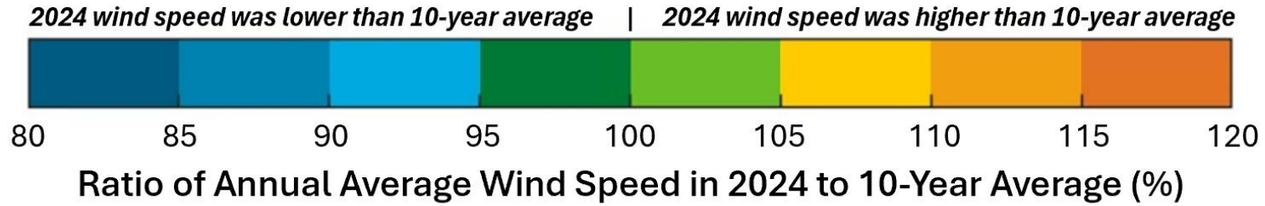



**Capacity factors in 2024 for projects using midsize and large turbines**

- The average capacity factor in 2024 across 146 projects using midsize and large turbines was 24% *(one project in the Southeast not displayed on plot)*.
- The sample includes projects using midsize and large turbines installed from 2003 to 2022, across 23 states, totaling 520 MW in combined capacity.
- Turbine nominal capacities used in the projects ranged from 225 kW to 3.6 MW.
- Several projects using midsize and large turbines in the Midwest, a region noted for high wind resource, experienced maintenance-related outages in 2024, resulting in lower capacity factors.

# Ratio of Annual Average Wind Speed in 2024 to the 10-Year Average Wind Speed



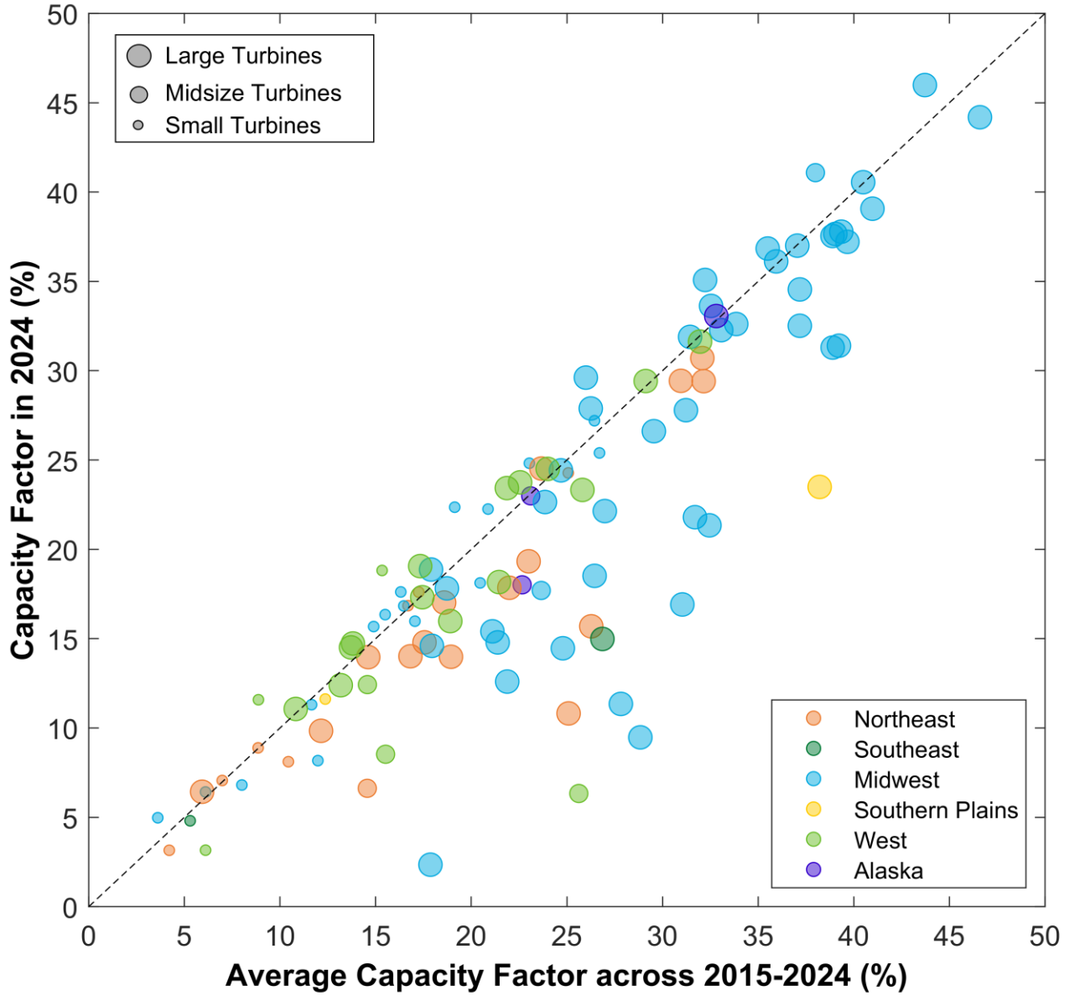




**Ratio of ERA5 100 meter (m) annual average wind speed in 2024 to the 10-year average wind speed**

- Across most of the continental United States, 2024 was an average wind resource year.
- Wind speed estimates are sourced from the ERA5 Global Reanalysis.[2]

[2] Hersbach et al., 2020: The ERA5 Global Reanalysis, https://rmets.onlinelibrary.wiley.com/doi/10.1002/qj.3803

# Comparison of Distributed Wind Capacity Factors in 2024 to their 10-Year Average Capacity Factors




**Distributed wind capacity factors in 2024 compared with average capacity factors over 2015-2024**

- Of 109 projects with consistent 10-year generation records, only 17 (16%) of the projects exceeded their 10-year average capacity factors.
- 58 projects (53%) underperformed relative to their long-term average capacity factors.
- 34 projects (31%) performed similarly compared to their long-term average capacity factors.
- Factors including turbine degradation, tree growth, and nearby building expansion can impact the capacity factors considered in the 10-year averages.
- Across the projects, the average capacity factor in 2024 was 21% and the average long-term capacity factor was 23%.

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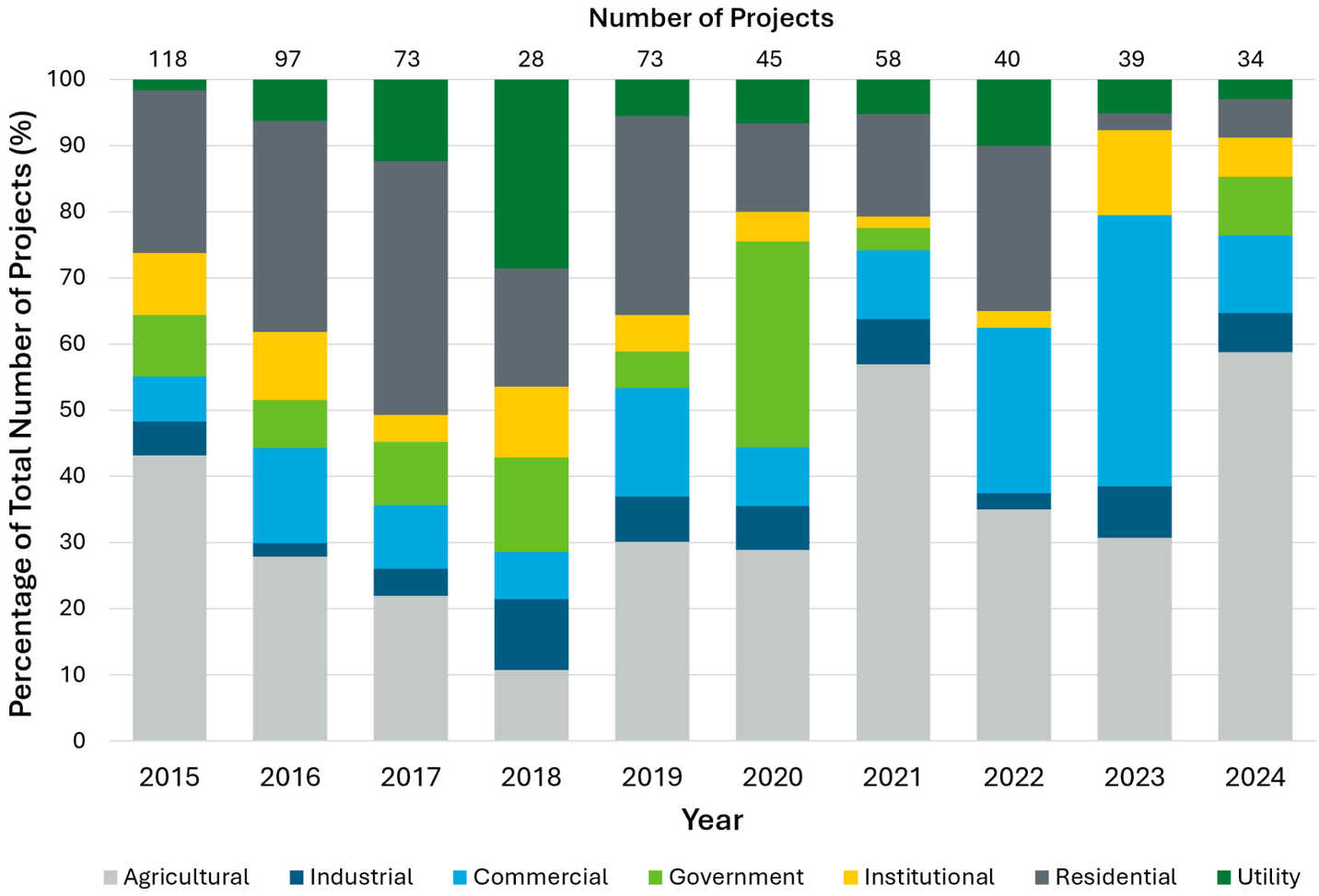
# Distributed Wind Markets


Jake West

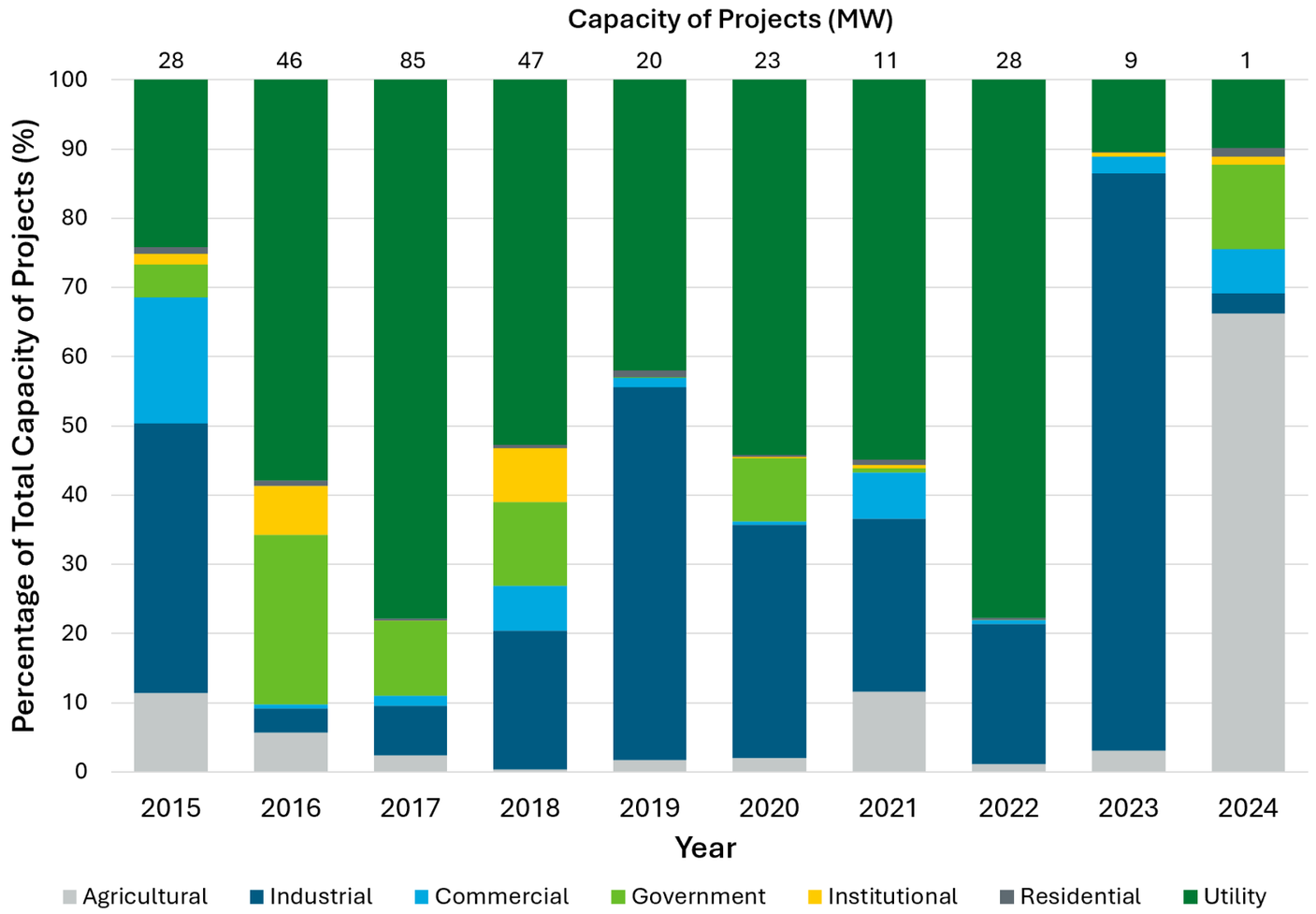
# Distributed Wind End-Use Customers Types by Number of Projects Installed in 2024




**Distributed wind end-use customer types by number of projects, 2015-2024**

- Distributed wind deployed for agricultural customers accounted for 59% of the number of projects installed in 2024.
- Commercial customers accounted for the second largest share of the number of projects installed in 2024 with 12%, followed by government customers with 9%.

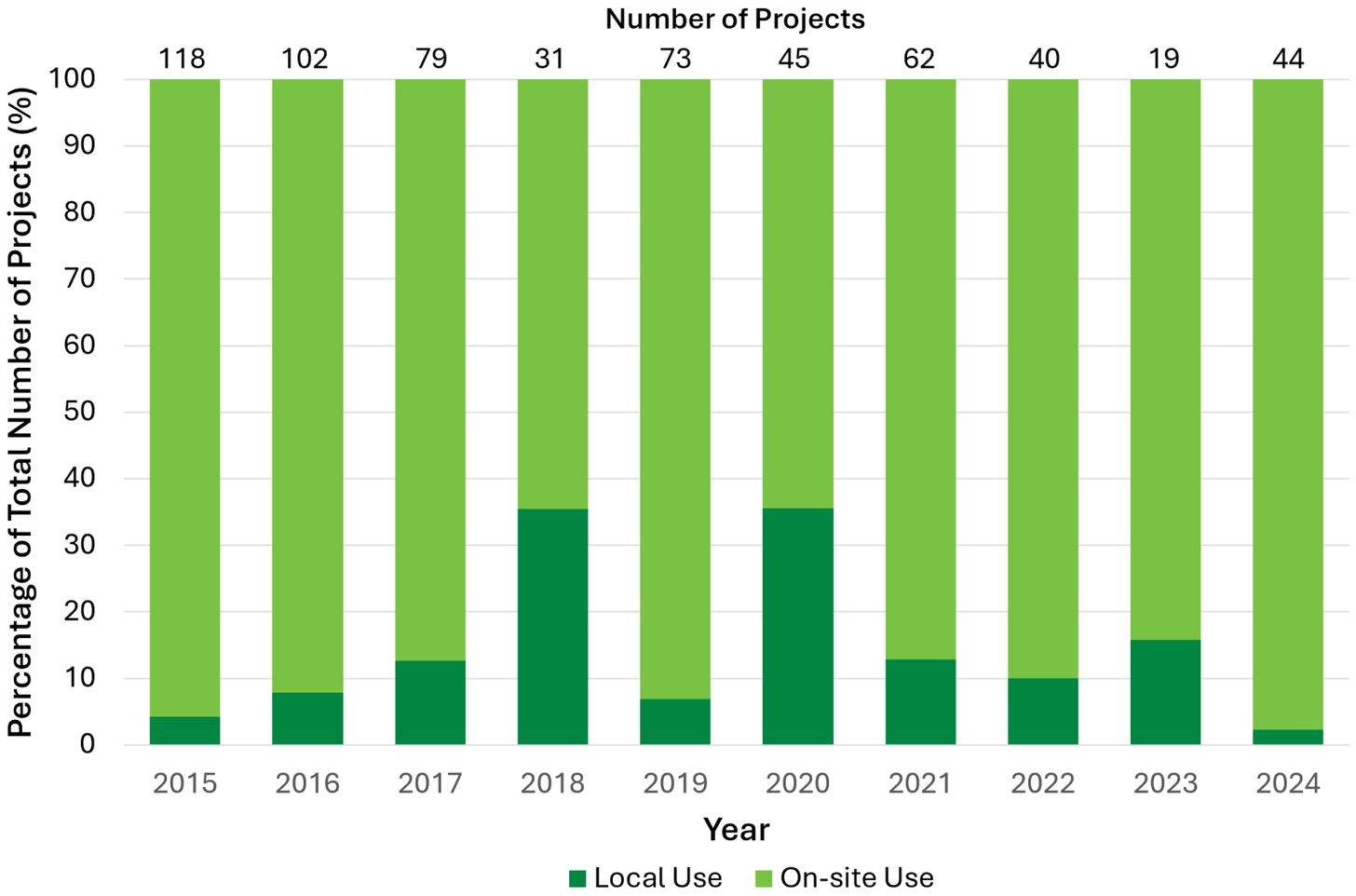
# Distributed Wind End-Use Customer Types by Capacity of Projects Installed in 2024




**Distributed wind end-use customer types by capacity of projects, 2015-2024**

- Distributed wind deployed for agricultural customers represented 66% of the total capacity installed in 2024.
- Government customers represented the second largest share of total capacity in 2024 with 12%, followed by utility customers with 10%.

# Distributed Wind for On-Site Use and Local Loads by Number of Projects




**Distributed wind for on-site use and local loads by number of projects, 2015-2024**

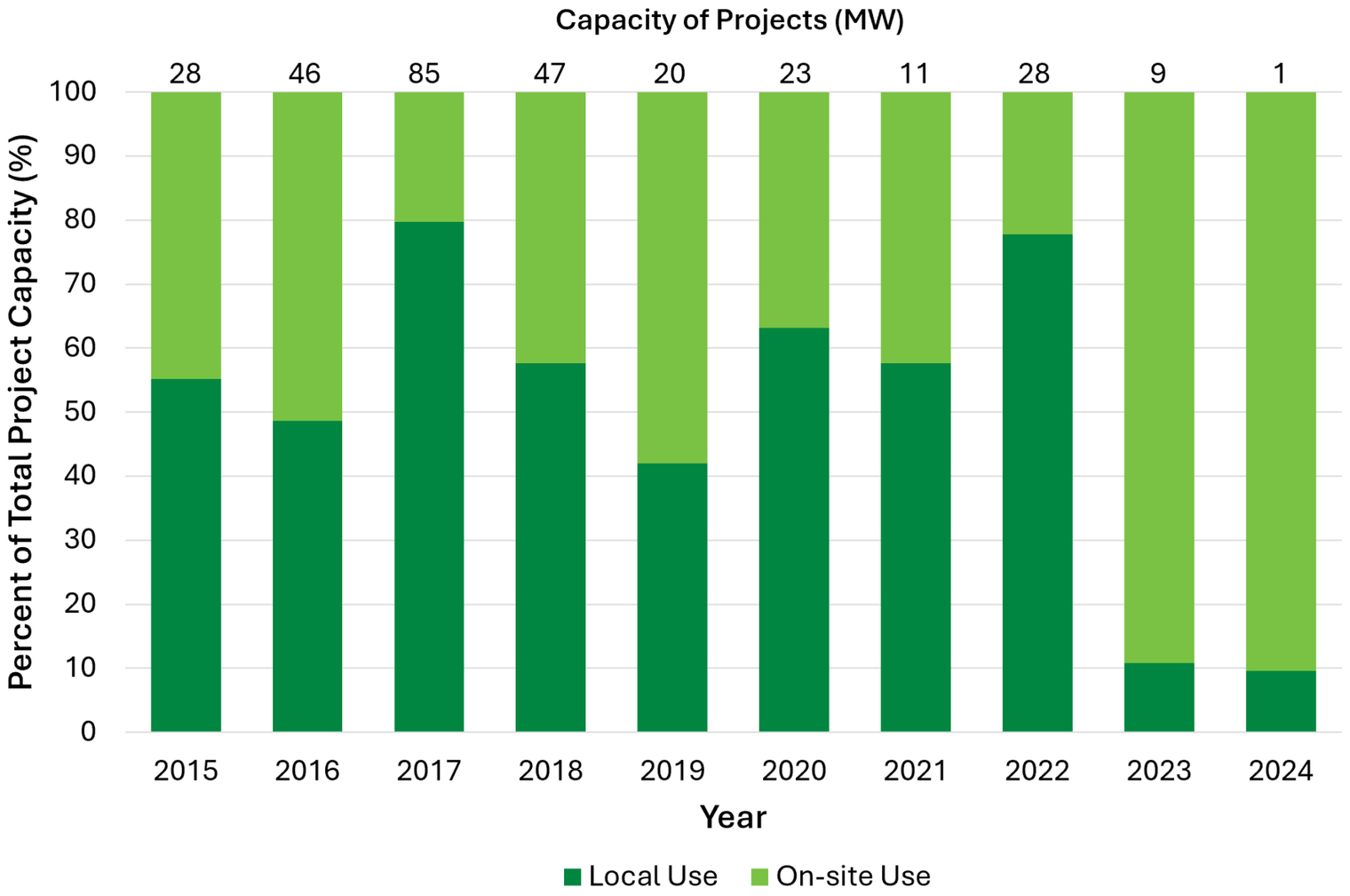
Two primary interconnection types exist for distributed wind:

- On-site use
  *Behind-the-meter, remote net-metering, grid-connected microgrid, and off-grid applications*
- Local use
  *Load-serving distribution line and isolated grid applications*

In 2024, 98% of distributed wind projects were interconnected to provide energy for on-site use.

Of the on-site use projects in 2024, 91% were deployed as behind-the-meter installations and 9% were deployed as off-grid installations.

# Distributed Wind for On-Site Use and Local Loads by Capacity of Projects




**Distributed wind for on-site use and local loads by capacity of projects, 2015-2024**

- In 2024, 90% of distributed wind capacity was deployed for on-site use, while 10% was for local use.
- Projects for local use have traditionally represented more of the installed distributed wind capacity due to the projects' larger sizes and use of larger wind turbines.
- One local use project was reported in 2024, consisting of a single 100-kW turbine in a grid-connected-microgrid.

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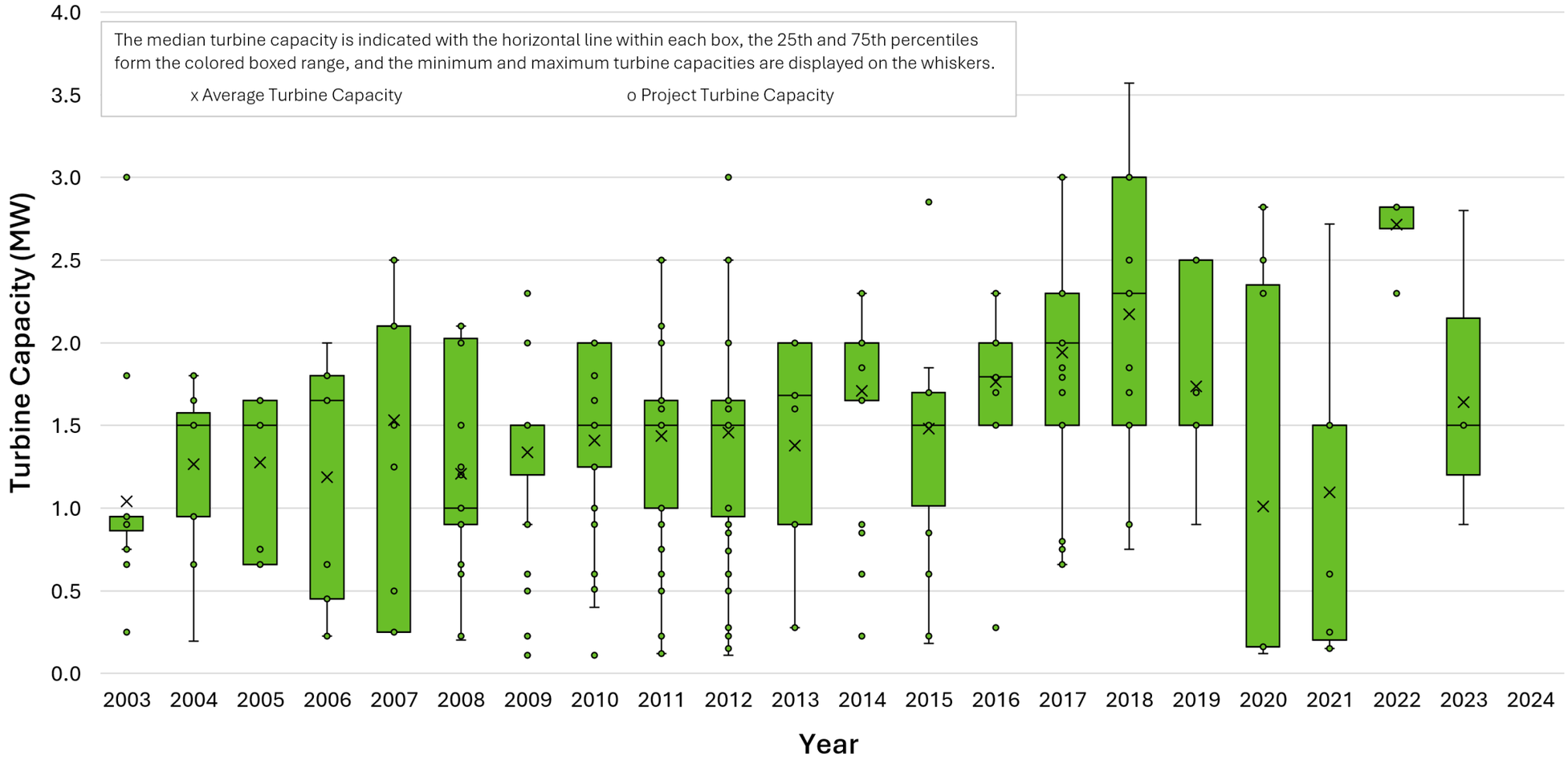
# Distributed Wind Technology

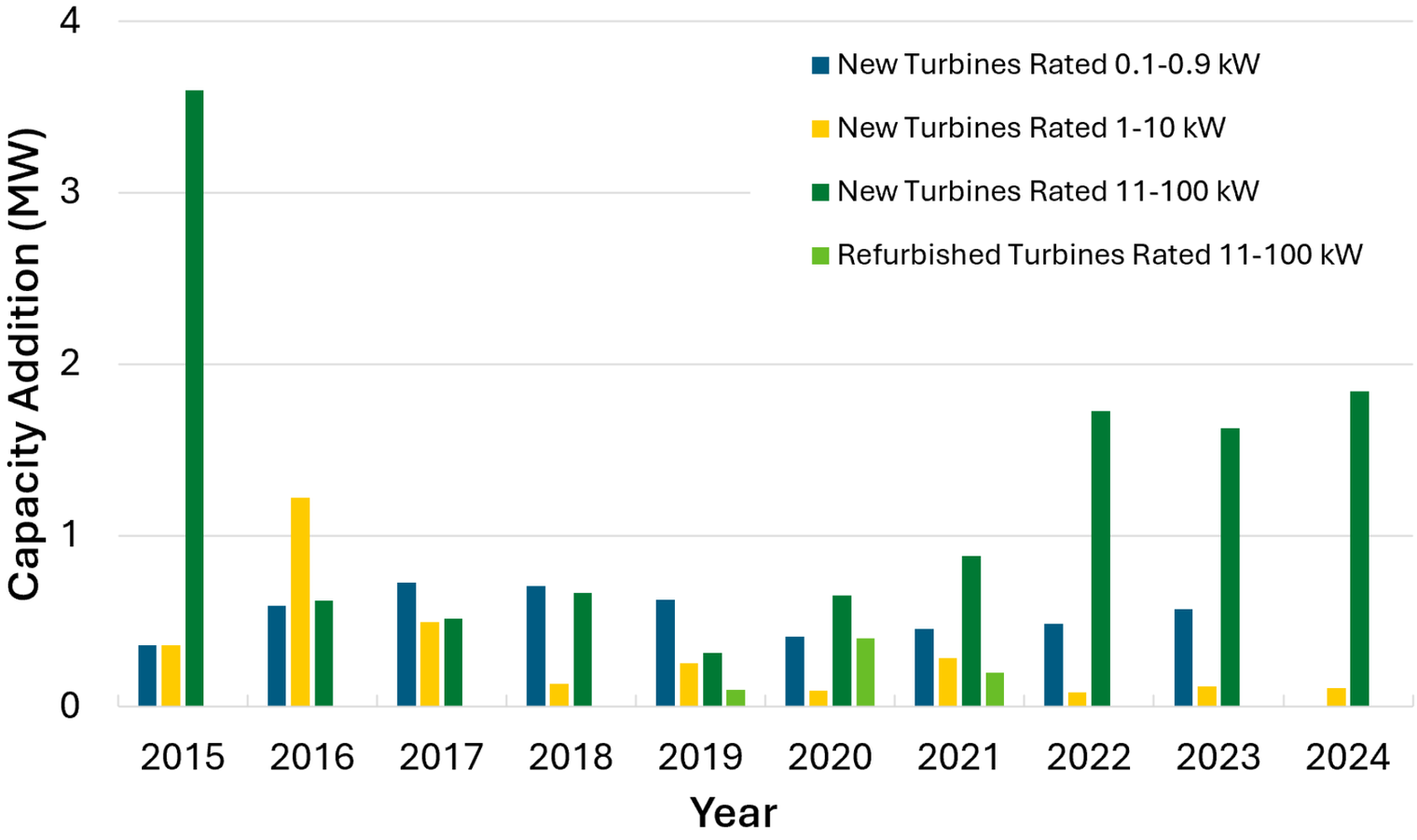
# Sizes of Midsize and Large Turbines in Distributed Wind Projects

In 2023, the average capacity of midsize and large turbines used in distributed wind projects was 1.6 MW, while no midsize or large turbines were installed in 2024.




**Size of midsize and large turbines in distributed wind projects, 2003-2024**

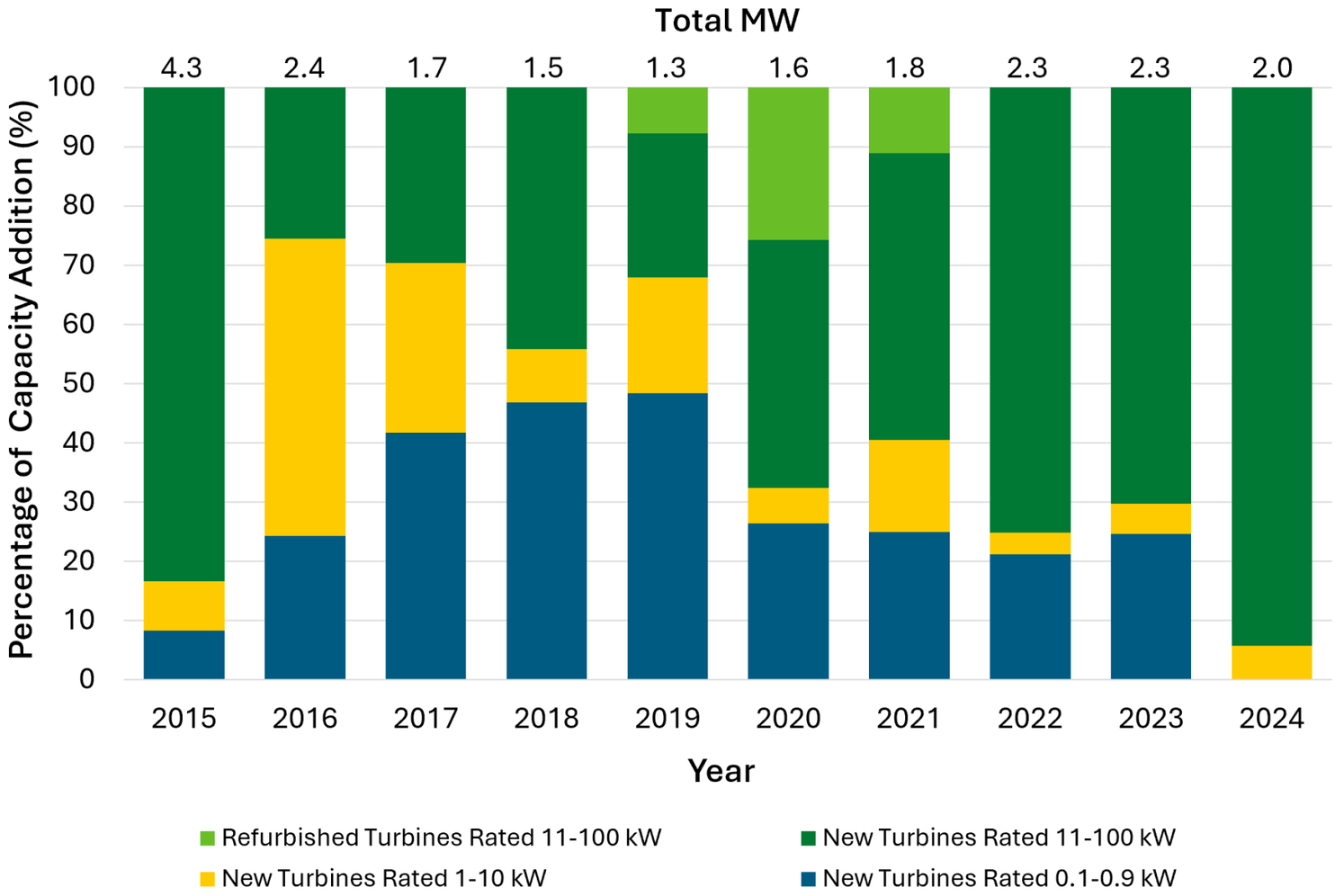
# U.S. Small Wind Sales Capacity by Turbine Size




**U.S. small wind sales capacity by turbine size, 2015-2024**

- Turbines in the size segment of 11 – 100 kW accounted for a total of 1.8 MW of small wind sales capacity in 2024. This is a slight increase from the 1.6 MW of small wind sales capacity for the 11-100 kW size segment in 2023.
- The size segment of 1-10 kW accounted for 0.1 MW in 2024, about the same capacity as 2023.
- The size segment of less-than-1-kW accounted for just 3 kW in 2024, a notable decrease from the 0.6 MW of capacity in 2023. It is important to note that the number of sales data reports for the less-than-1-kW segment differ significantly between 2024 and prior years.

# U.S. Small Wind Sales Percentage of Capacity by Turbine Size




**U.S. small wind sales percentage of capacity by turbine size, 2015-2024**

- Turbines in the size segment of 1-100 kW represented 94% of the small wind sales capacity in 2024, the most of any size segment.
- The size segment of 1-10 kW accounted for 6% and the size segment of less-than-1-kW accounted for near 0%.
- The size segment of 11-100 kW reported 108 turbine units sold in 2024, an increase from 78 in 2023.
- The size segment of 1-10 kW reported 32 turbine units sold in 2024, an increase from 28 in 2023.
- The size segment of less-than-1-kW reported 20 turbine units sold in 2024, a significant decrease from 1,888 in 2023.

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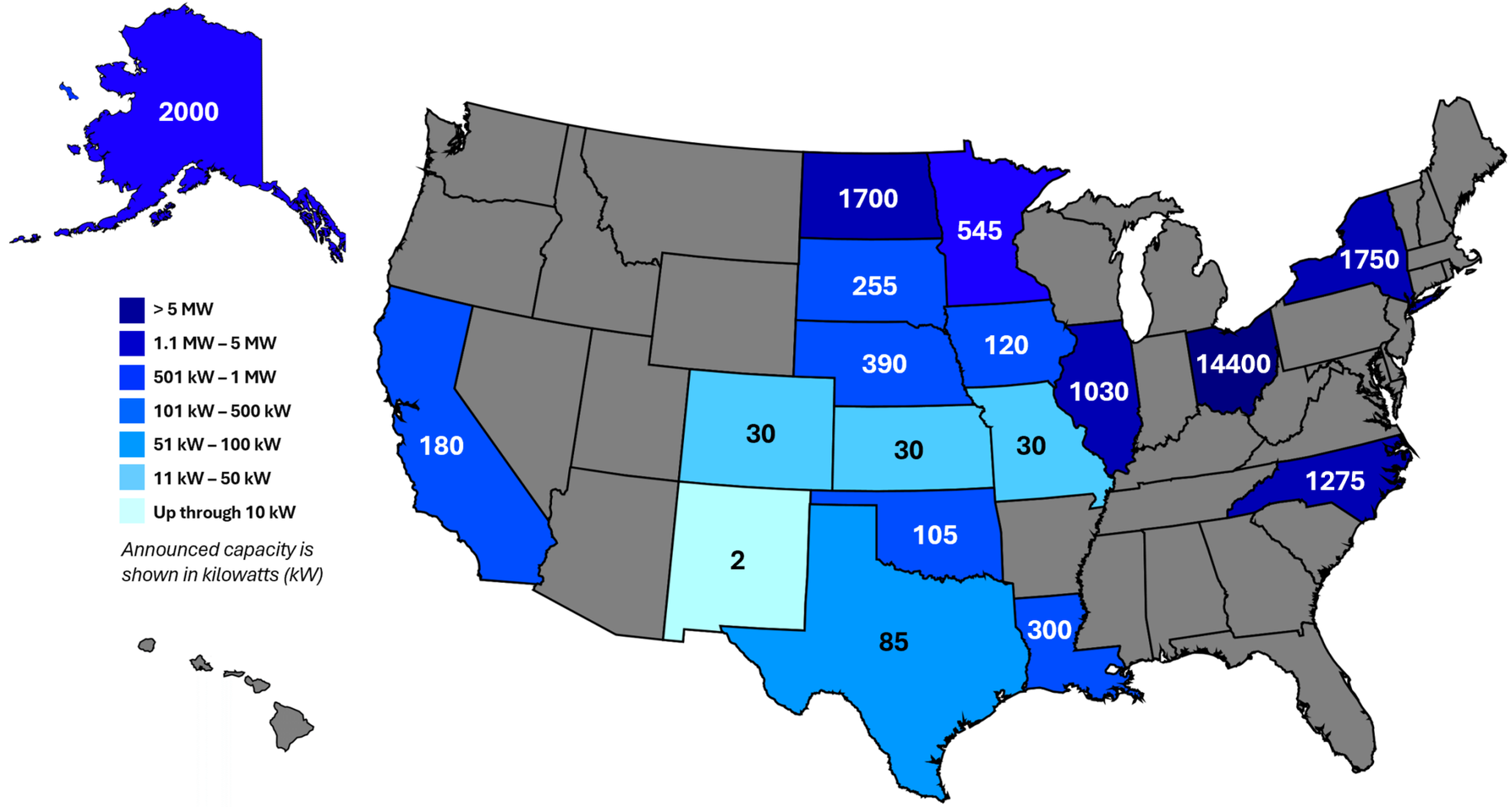
# Distributed Wind Project Pipeline

# U.S. Planned Capacity Additions for 2025 and 2026

24 MW of capacity additions are planned for 2025 and 2026 across 18 states representing small, midsize, and large turbine sizes.




**U.S. planned capacity additions by state, 2025-2026**

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**See past and current Distributed Wind Energy Technology Data materials:**
https://www.pnnl.gov/distributed-wind/market-report

**To contact the authors:**
distributedwind@pnnl.gov

**For PNNL's Project Database, visit:**
https://www.pnnl.gov/distributed-wind/data

**For PNNL's Photo Gallery, visit:**
https://www.pnnl.gov/distributed-wind/photo-gallery

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