U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Distributed Wind Market Report: 2023 Edition Summary

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Distributed Wind Market Report: 2023 Edition

Purpose, Scope, and Data

- Summarizes publicly available U.S. distributed wind annual data through the end of 2022
- 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. Treasury, U.S. Wind Turbine Database, and others.

Report Authors

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Funded by

- U.S. Department of Energy's Wind Energy Technologies Office

Products and Availability

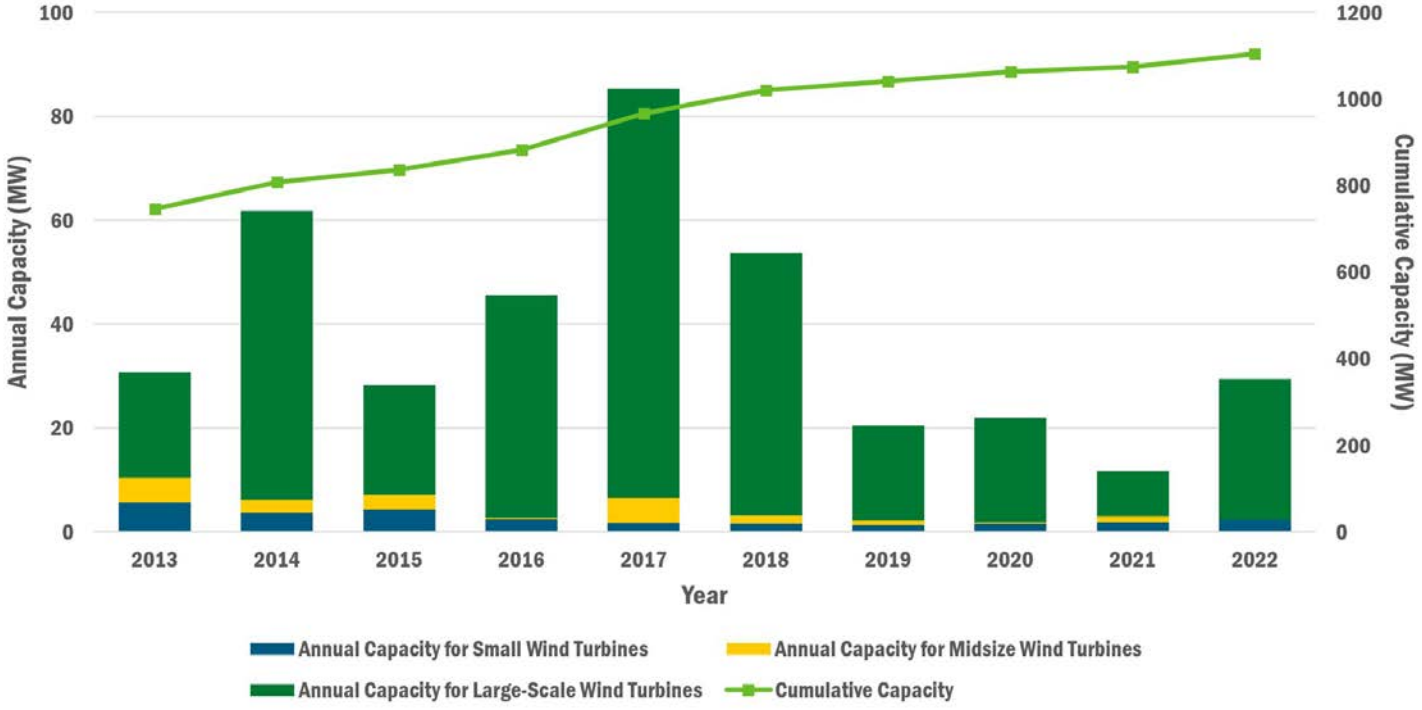
- This summary is complemented with an underlying report and data file
- All products available at: https://energy.gov/windreport

Contents

U.S. Distributed Wind Deployment

A total of 29.5 MW of distributed wind capacity was deployed in the United States in 2022

Cumulative distributed wind capacity reached 1,104 MW in 2022 from over 90,000 wind turbines deployed across all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, the Northern Mariana Islands, and Guam.

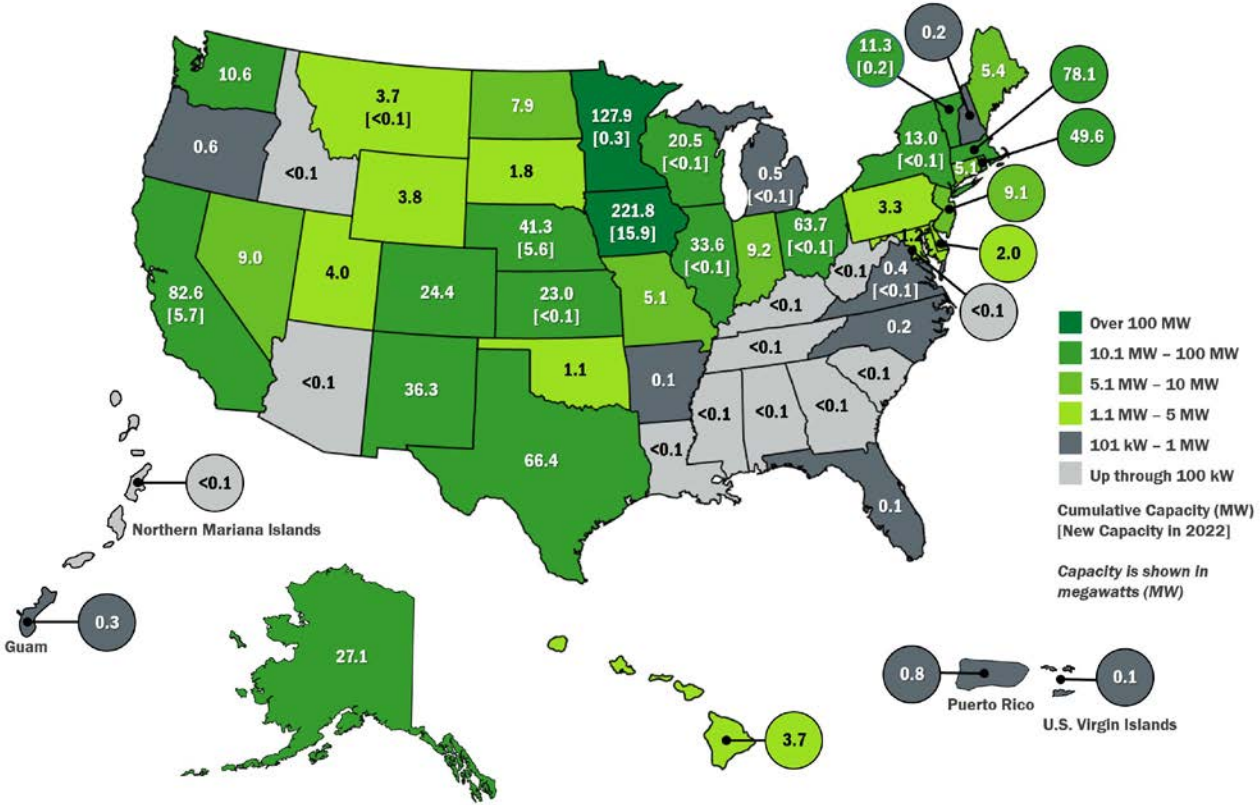


U.S. distributed wind capacity

New distributed wind projects were documented in thirteen states in 2022

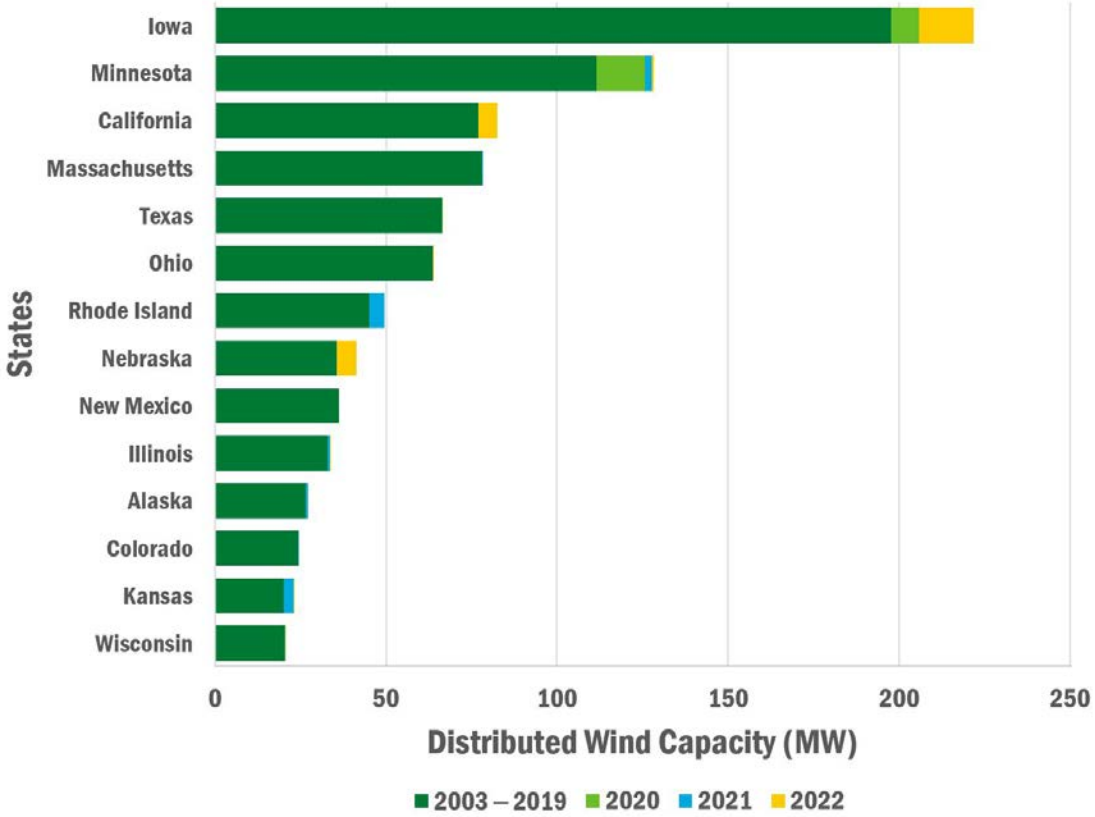
In 2022, new distributed wind projects were documented in 13 states:

- California
- Illinois
- Iowa
- Kansas
- Michigan
- Minnesota
- Montana
- Nebraska
- New York
- Ohio
- Vermont
- Virginia
- Wisconsin



U.S. cumulative (2003–2022) capacity and capacity additions in 2022 for distributed wind by state

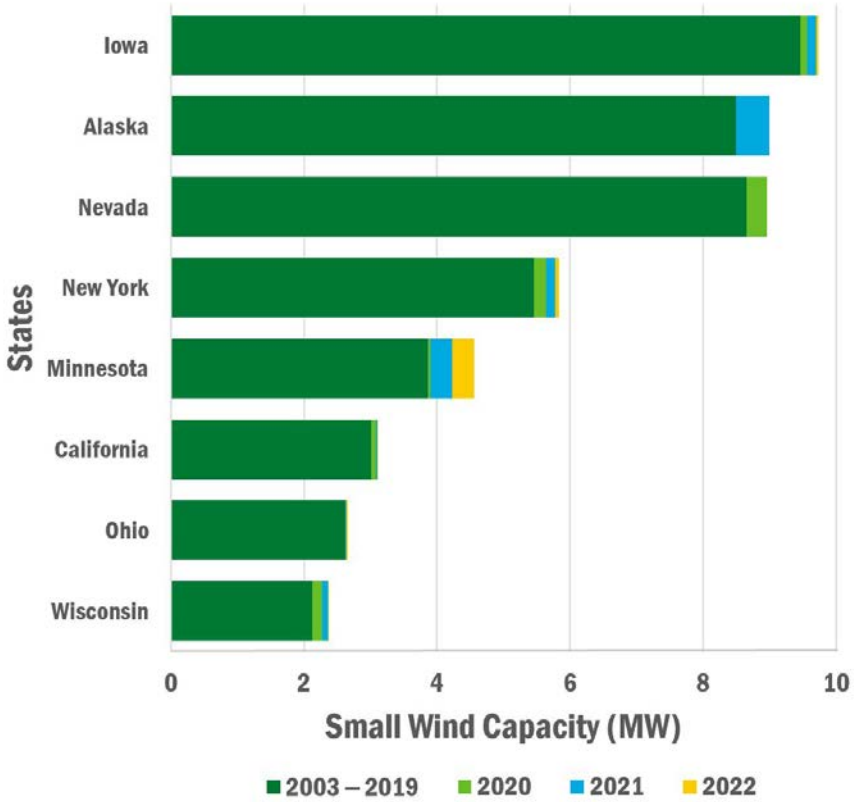
Iowa, California, and Nebraska led the United States in new distributed wind capacity additions in 2022



States with distributed wind capacity greater than 20 MW, 2003–2022

- Iowa had two large projects and California and Nebraska each had one large project that collectively represent 92% of the distributed wind capacity installed in 2022.
- Iowa and Minnesota are the overall top states for cumulative distributed wind capacity due to strong wind resources, active project developers, and the significant number of grants received from the U.S. Department of Agriculture's (USDA) Rural Energy for America Program (REAP) over the years.

Minnesota added the most small wind capacity in 2022



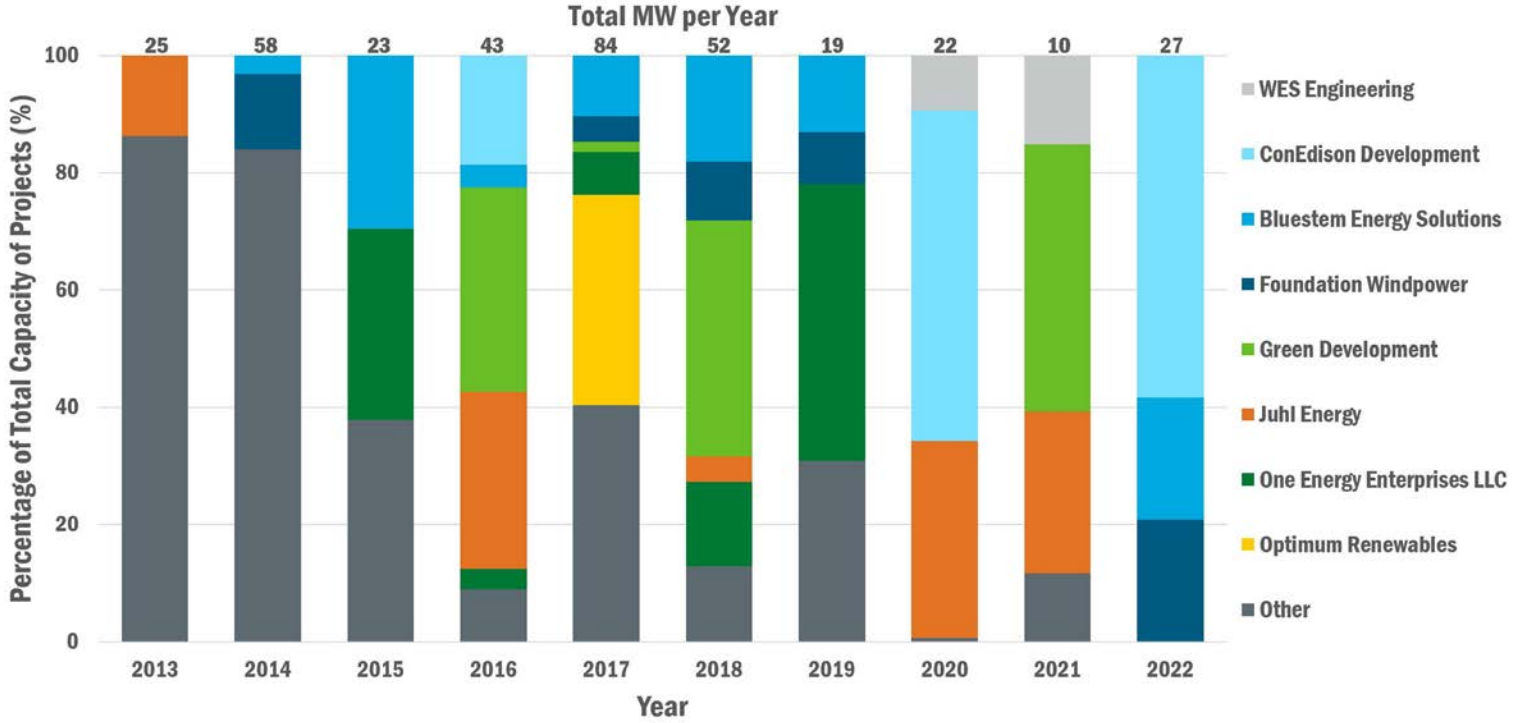
States with small wind capacity greater than 2 MW, 2003–2022

- Eocycle continued its push to sell its EOX-S16 turbine model to farmers in Minnesota to provide a decarbonization solution for the emissions-heavy agriculture industry.
- Iowa, Nevada, and Alaska are the overall top three states for cumulative small wind capacity, although there were no new small wind installations recorded for Alaska and Nevada in 2022.

U.S. Distributed Wind Projects and Sales

Eight developers have accounted for nearly 70% of the distributed wind capacity from projects using turbines greater than 100 kW turbines since 2018

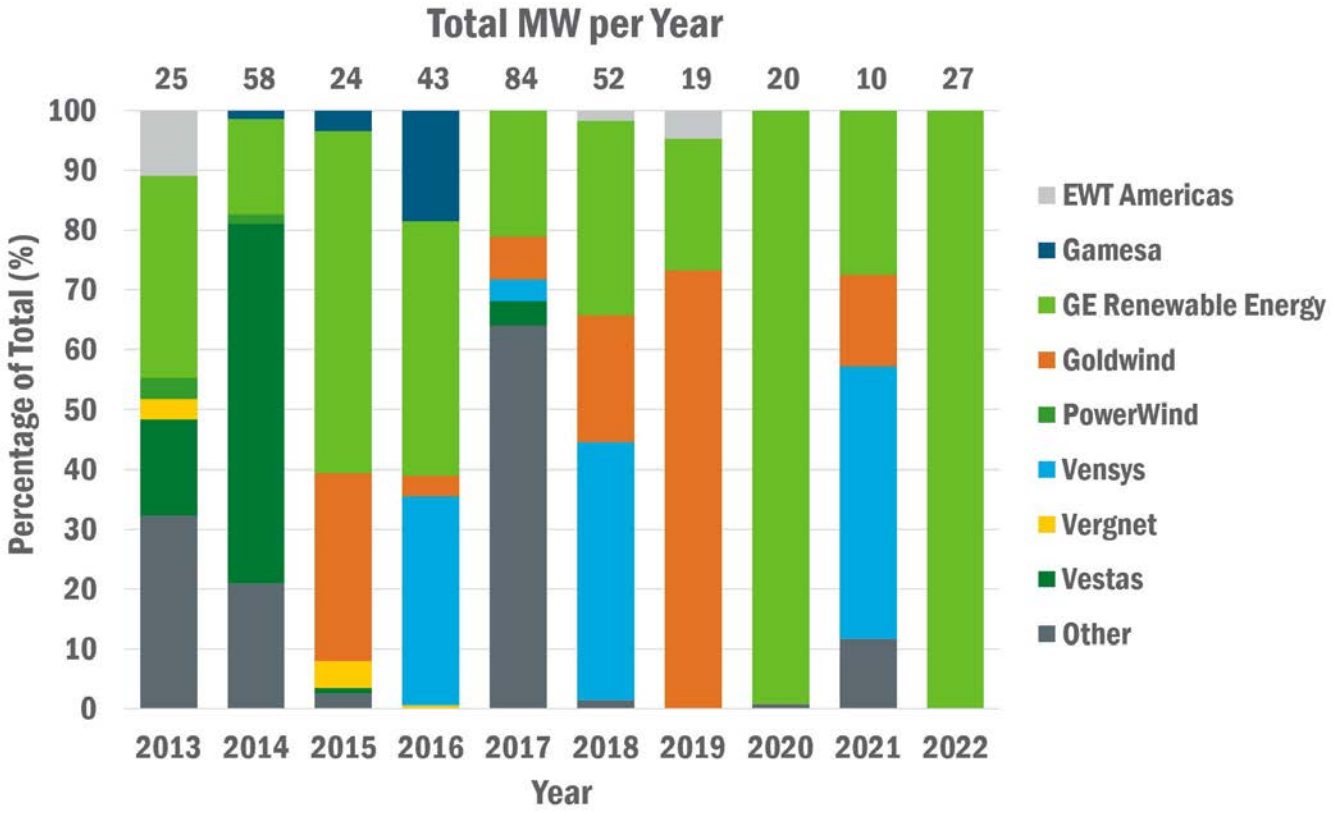
These developers work almost exclusively in a single state or region and may not install projects each year because large-scale projects take two to four years to develop.



Project developers using turbines greater than 100 kW, 2013–2022

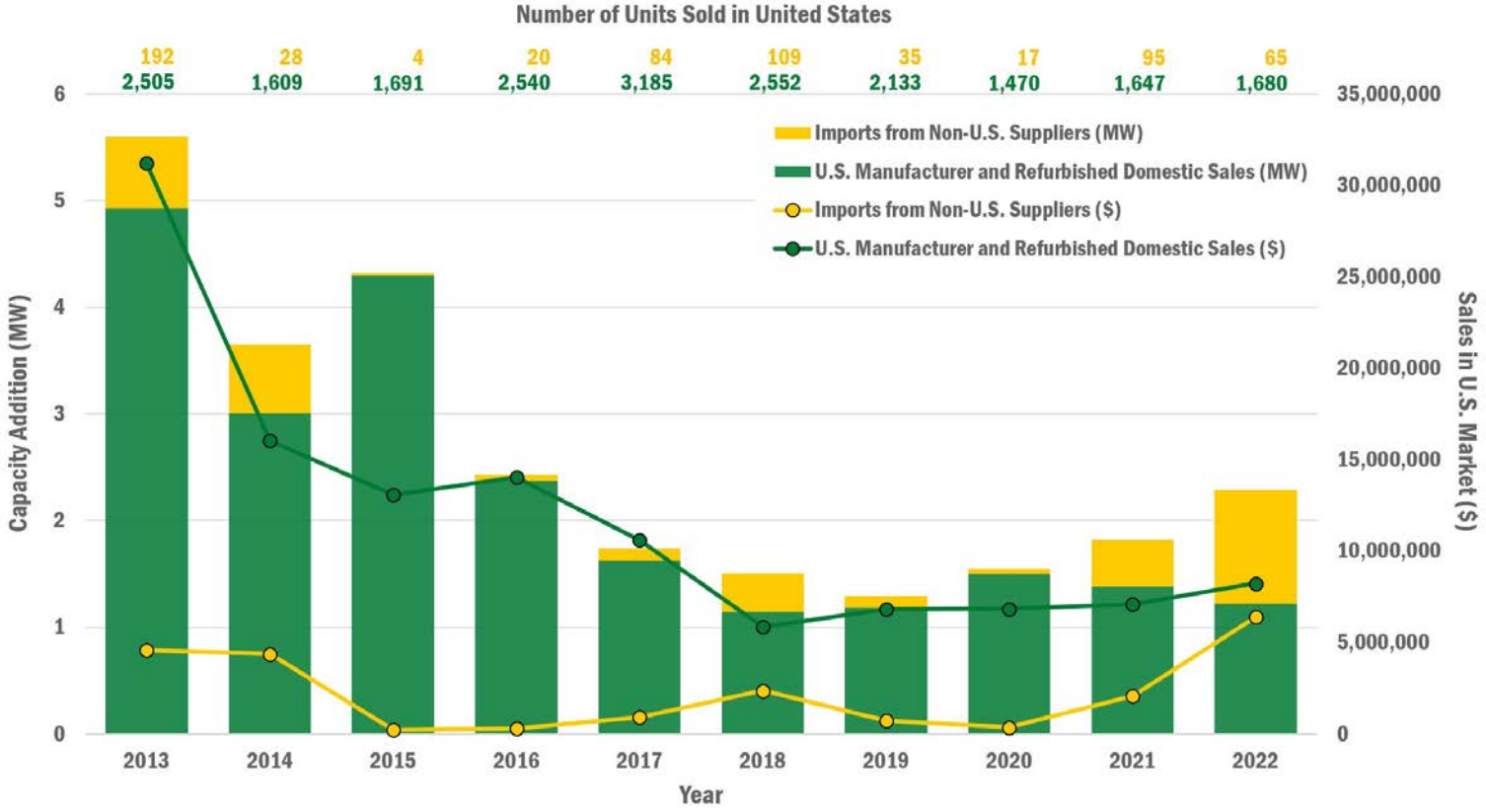
GE Energy has been the only consistent U.S.-based large-scale turbine manufacturer used in distributed wind projects over the past ten years

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.



Wind turbine manufacturers of turbines greater than 100 kW with a U.S. sales presence, 2013–2022

Small wind sales and capacity from non-U.S.-based manufacturers increased in 2022



U.S. small wind turbine sales, 2013–2022

Small Wind Certification

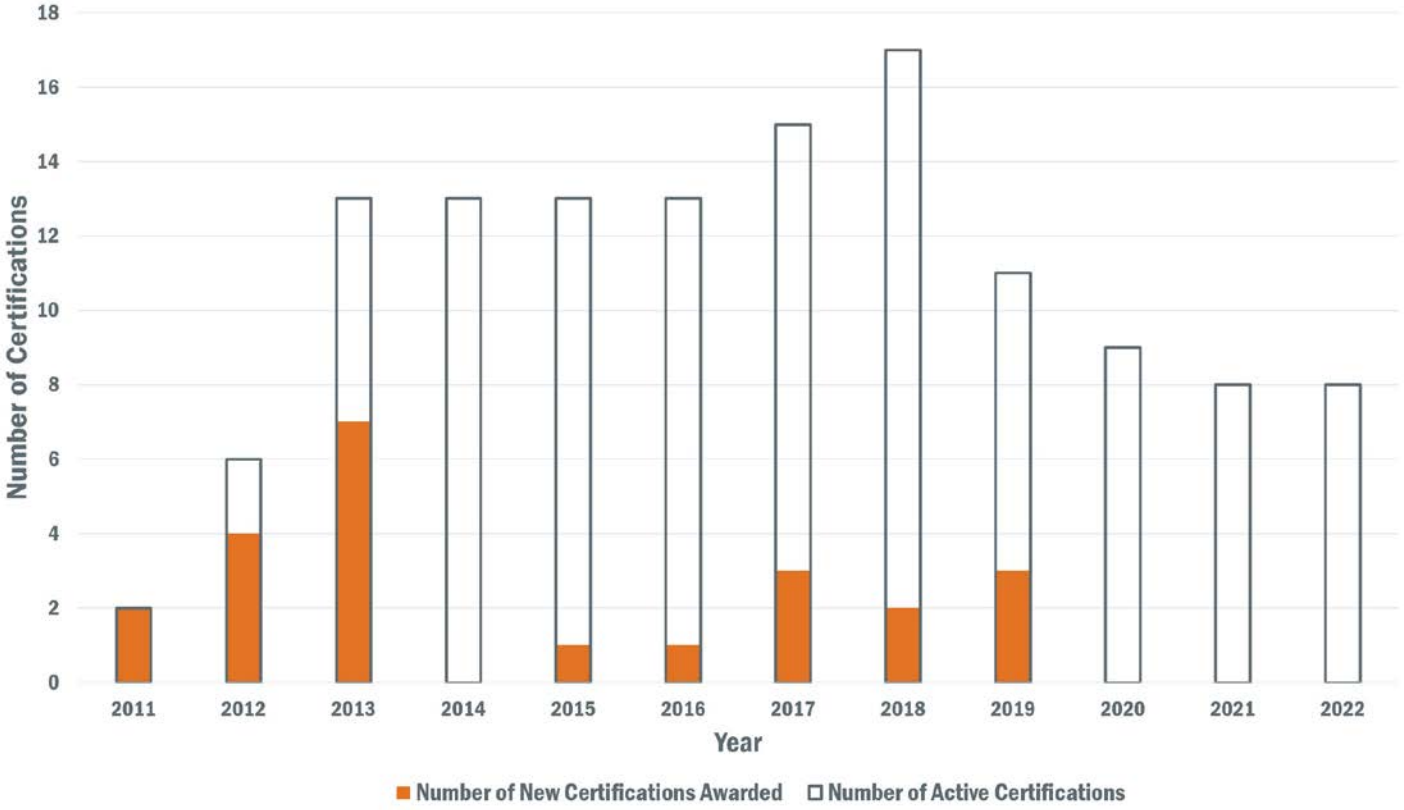
Nine small wind turbine models are certified to American Wind Energy Association (AWEA) 9.1.2009 or IEC 61400-1, -2, -11 standards as of June 2023

Certified Small Wind Turbines (as of June 2023)

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	2/5/2021	15.6	AWEA 9.1
Eveready Diversified Products (Pty) Ltd.	Kestrel e400nb	2/14/2013	2.5	AWEA 9.1
Eocycle Technologies, Inc.	EOX S-16	3/21/2017	22.5/28.9	AWEA 9.1
HI-VAWT Technology Corporation / Colite Technologies	DS3000	5/10/2019	1.4	AWEA 9.1
Primus Wind Power	AIR 30/AIR X	1/25/2019	0.16	IEC 61400
Primus Wind Power	AIR 40/Air Breeze	2/20/2018	0.16	IEC 61400
SD Wind Energy, Ltd.	SD6	6/17/2019	5.2	AWEA 9.1
Wind Resource, LLC	Skystream 3.7	4/12/2023	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.
- The Distributed Wind Energy Association and the U.S. Department of Energy have recommended that the Internal Revenue Service recognize legacy certifications to AWEA 9.1-2009 and new certifications to ANSI/ACP 101-1 going forward for Business Energy Investment Tax Credit eligibility.
- The Inflation Reduction Act extended the Residential Renewable Energy Tax Credit through 2034 and the Business Energy Investment Tax Credit through 2024.

At least 23 small wind turbine models have been certified to the AWEA or IEC standards between 2011 and 2022

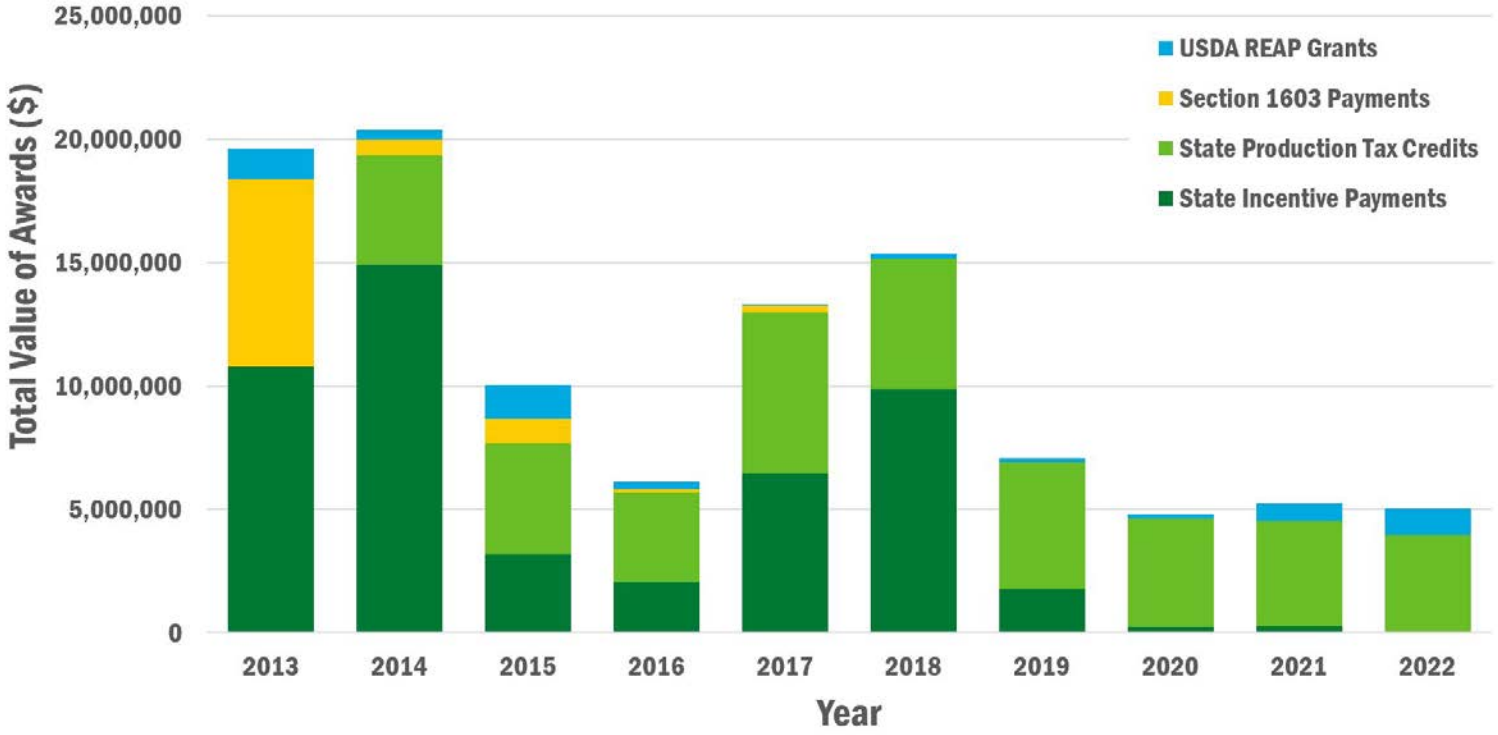


Small Wind Turbine Certifications, 2011–2022

- The number of new certifications peaked in 2013 after the Small Wind Certification Council was accredited in 2012.
- The number of active certifications peaked in 2018.
- Manufacturers may opt not to renew if they no longer want to participate in the U.S. market or if the company has discontinued operations.

Policies, Incentives, and Market Insights

The combined value of USDA REAP grants and state production tax credits given to distributed wind projects in 2022 was $5 million across eight states

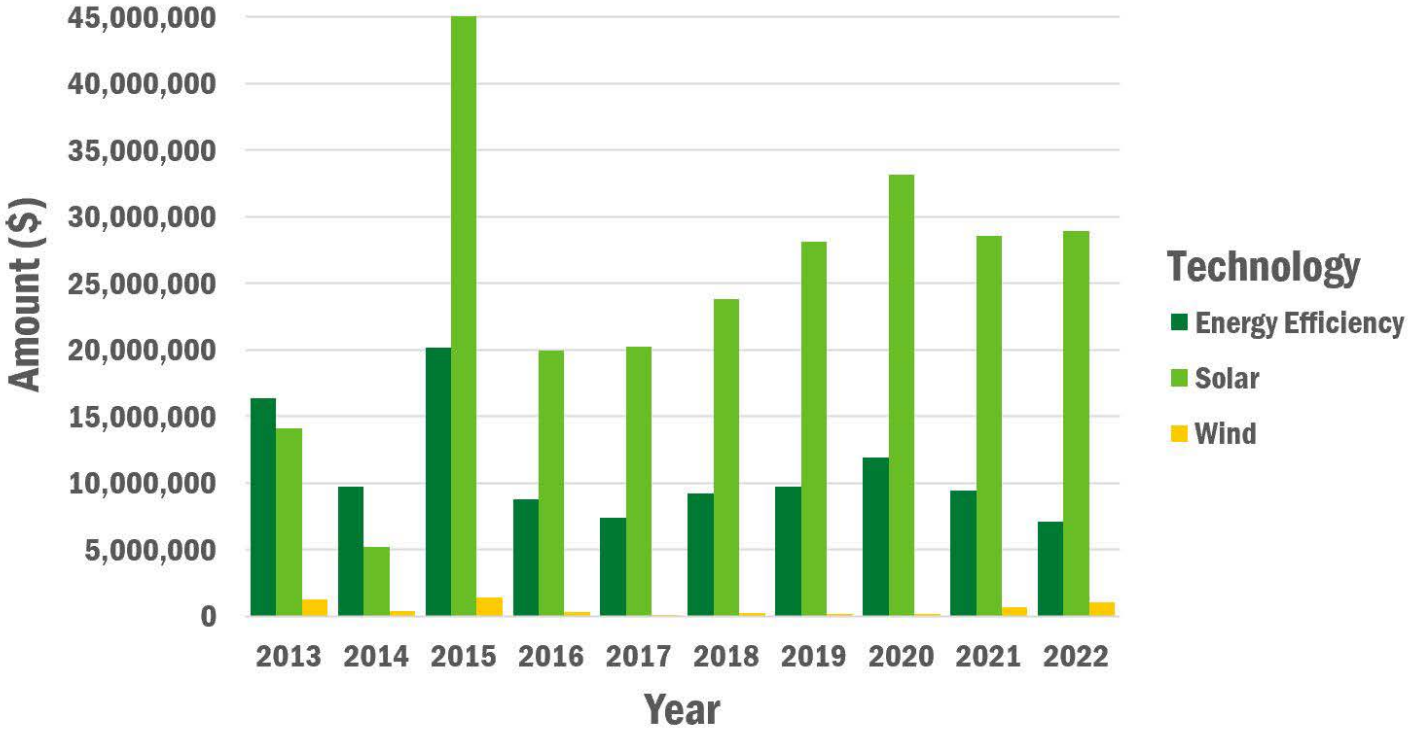


U.S. distributed wind incentive awards, 2013–2022

The eight states were Iowa, Kansas, Minnesota, Missouri, Nebraska, New Mexico, New York, and Vermont.

In 2022, a total of $1,069,922 in USDA REAP grants was awarded to 12 wind projects in six states

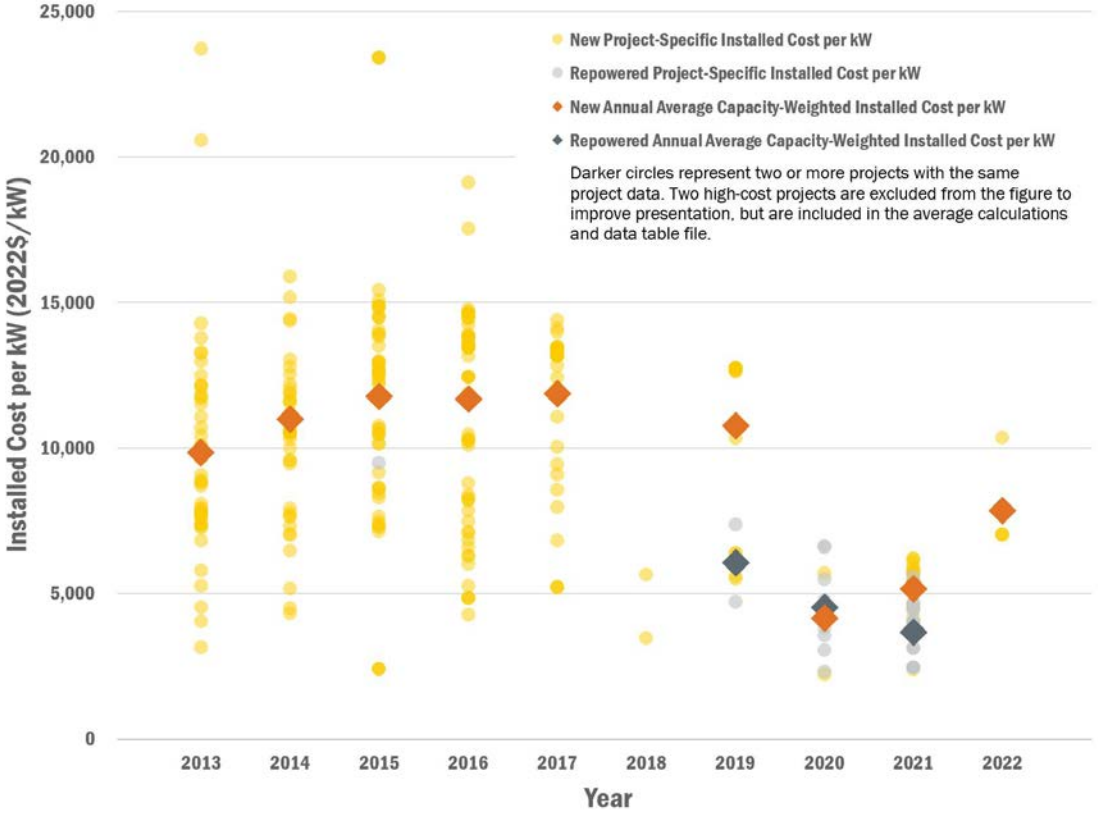
- The six states were Kansas, Minnesota, Missouri, Nebraska, New York, and Vermont.
- Through the Inflation Reduction Act of 2022, the USDA REAP received a funding allocation of over $2 billion, with $303 million set aside for underutilized technologies which includes wind.



USDA REAP grants by technology, 2013–2022

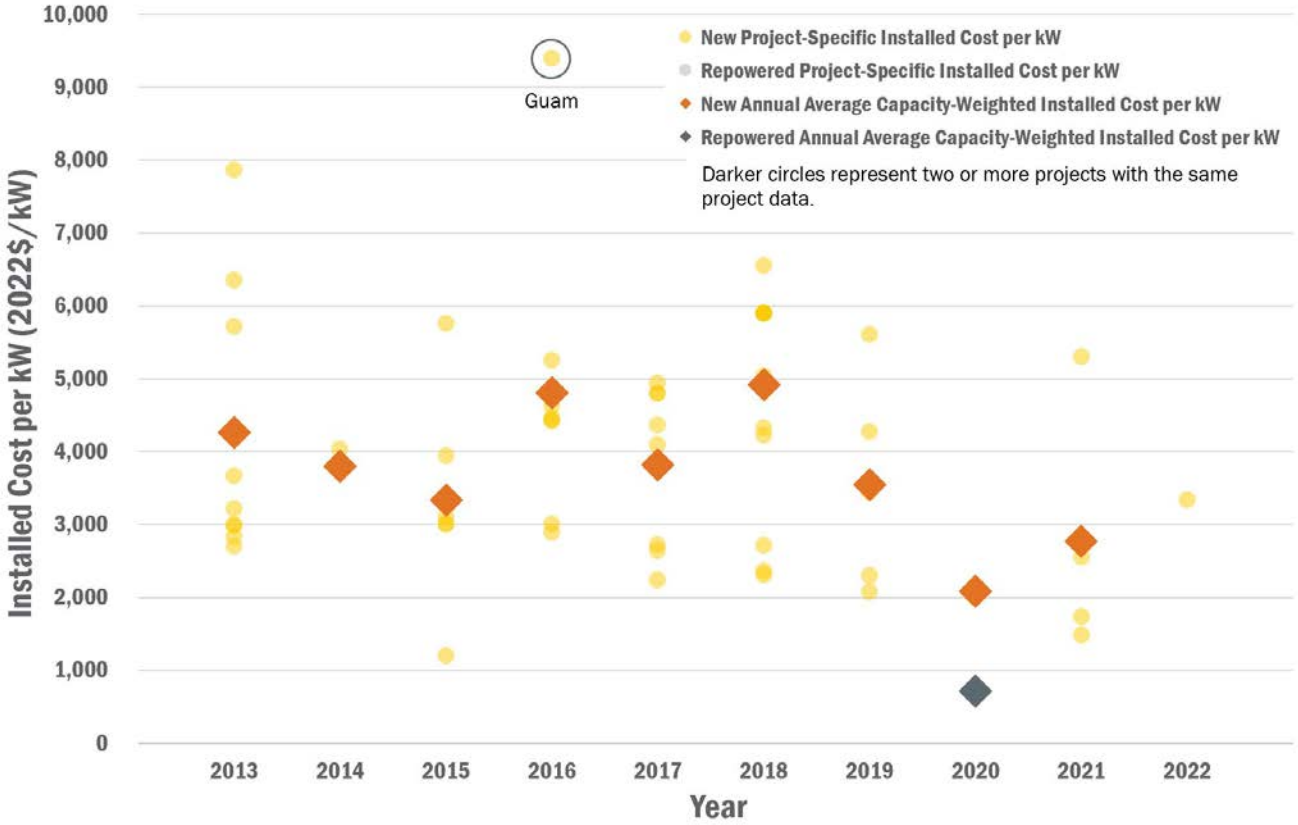
Distributed Wind Costs

The average installed cost for new small wind projects in 2022 was $7,850/kW while the overall average for 2013 through 2022 was $10,670/kW



Annual average and project-specific new and repowered small wind installed project costs, 2013–2022

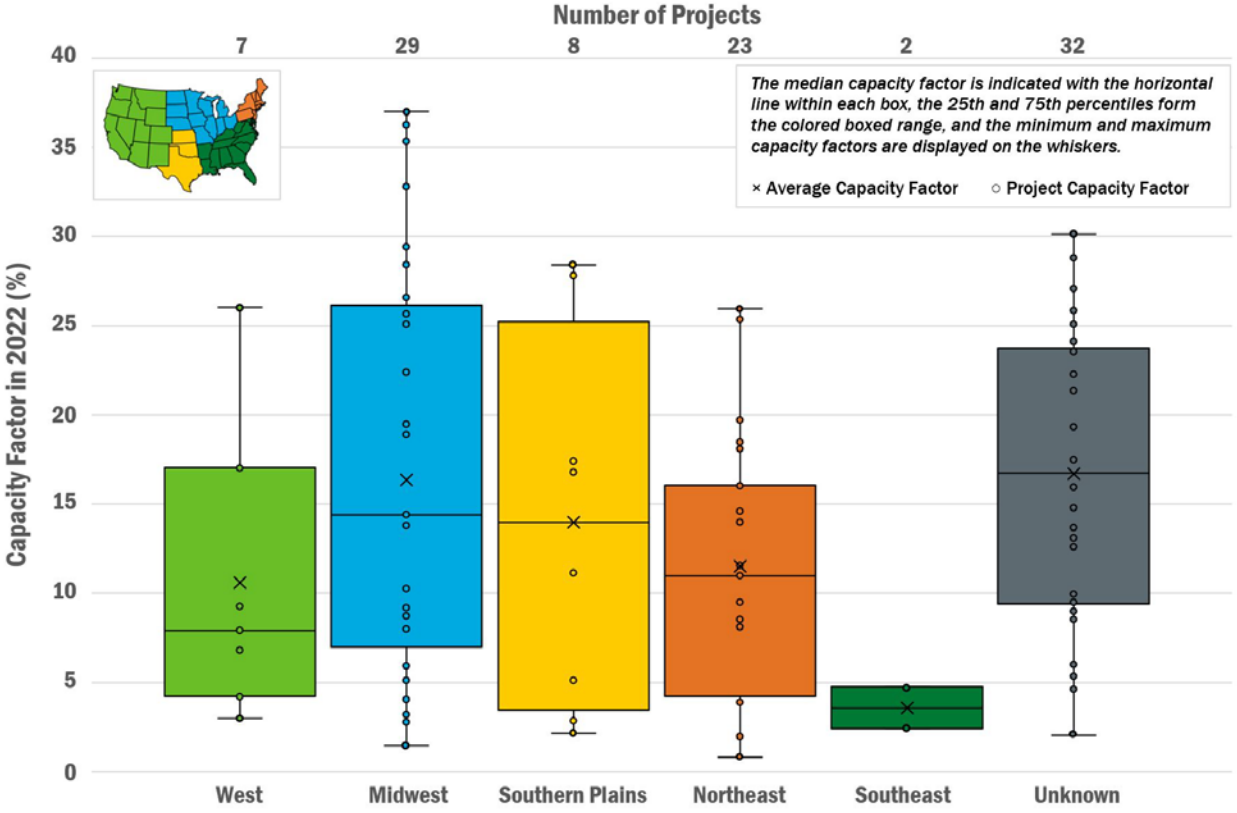
The overall average capacity-weighted installed cost for projects using turbines greater than 100 kW for the period of 2013 through 2022 is $4,050/kW



Annual average and project-specific new and repowered installed costs for projects using turbines greater than 100 kW, 2013–2022

Distributed Wind Performance

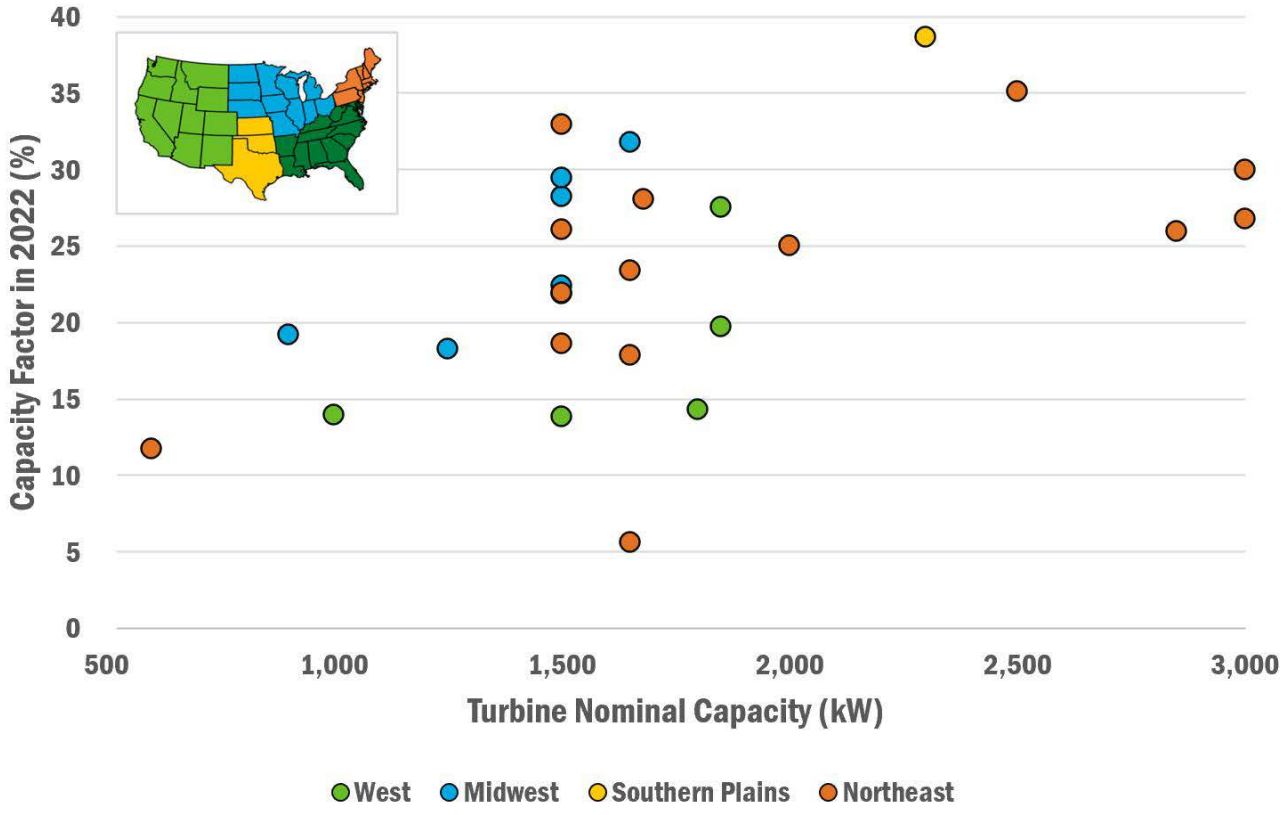
The average capacity factor in 2022 from a sample of small wind projects was 15%



Small wind capacity factors in 2022

- Observed capacity factors ranged from 1% to 37%.
- The sample includes 101 turbines totaling 1.4 MW in rated capacity ranging from 2.1 kW to 90 kW in size installed from 2009 through the beginning of 2022.

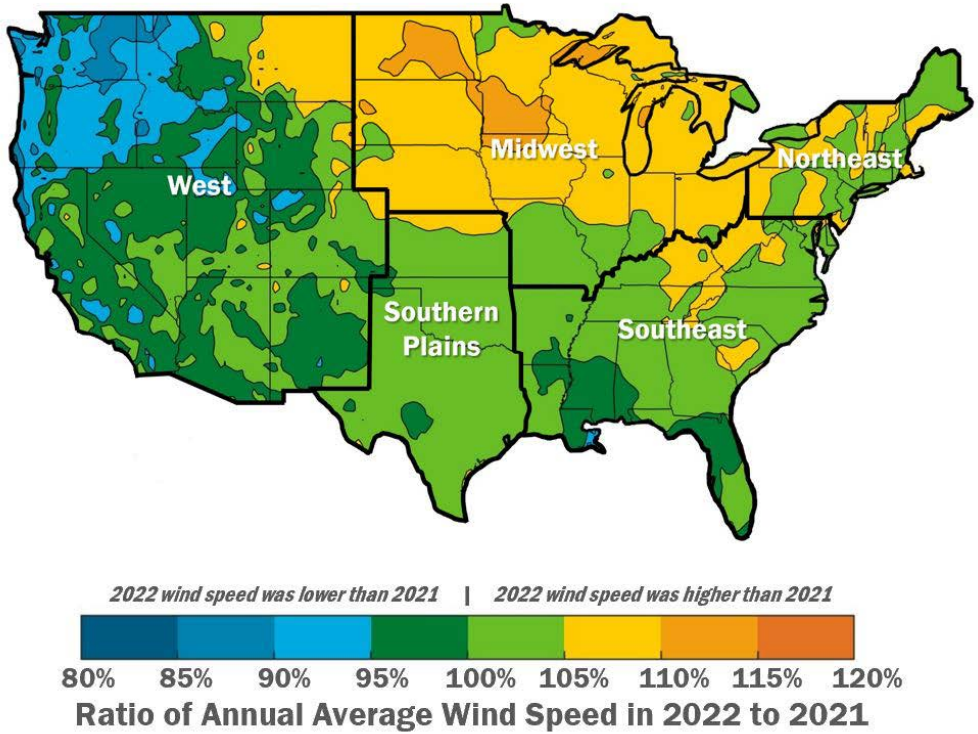
The average capacity factor in 2022 for a sample of distributed wind projects using turbines greater than 100 kW was 23%



Capacity factors in 2022 for projects using turbines greater than 100 kW

- Observed capacity factors ranged from 6% to 39%.
- The sample includes 27 distributed wind projects installed from 2005 to 2018, across 14 states, totaling 95 MW in combined capacity with turbine nominal capacities ranging from 600 kW to 3 MW.

A stronger wind resource year in the Midwest and Northeast contributed to greater distributed wind project capacity factors in 2022

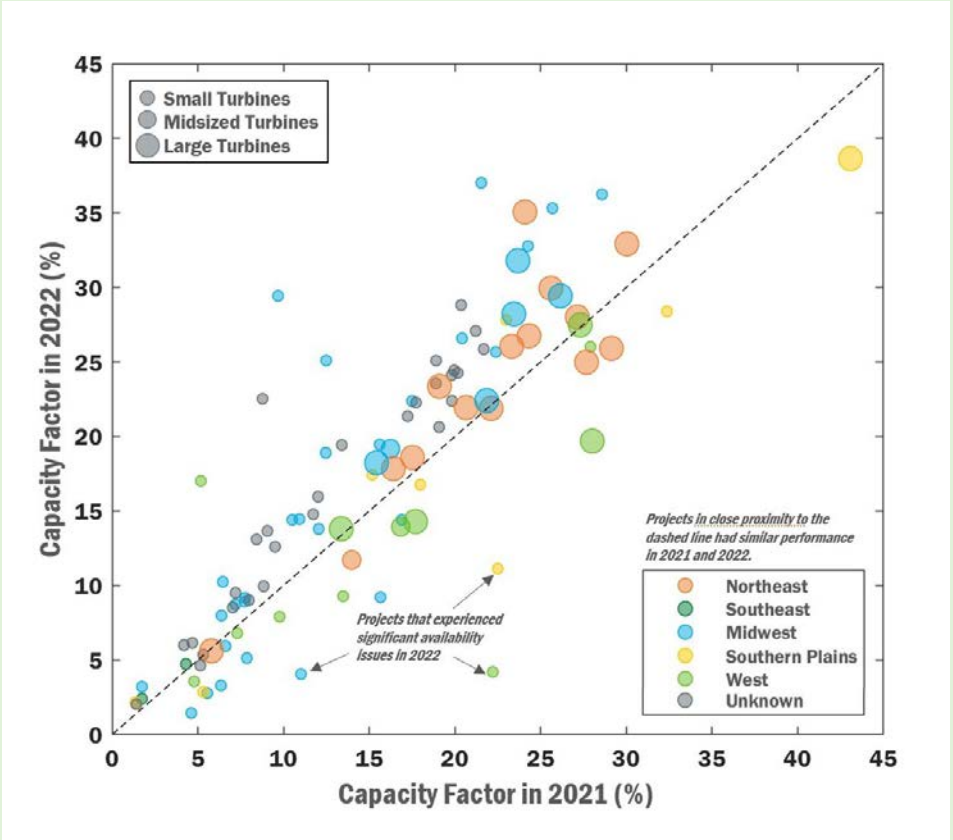


Wind resource map, 2021–2022

A total of 60% of the distributed wind projects PNNL analyzed had higher capacity factors in 2022 than in 2021

- Of the 122 projects analyzed, 73 exceeded their 2021 capacity factors (with 25 of them in the Midwest and 20 in the Northeast).
- The average capacity factor in 2022 for projects in the Midwest, Northeast, and West were 25%, 23%, and 18%, respectively.
- The single project in the Southern Plains produced the highest capacity factor in 2022 of 39%.

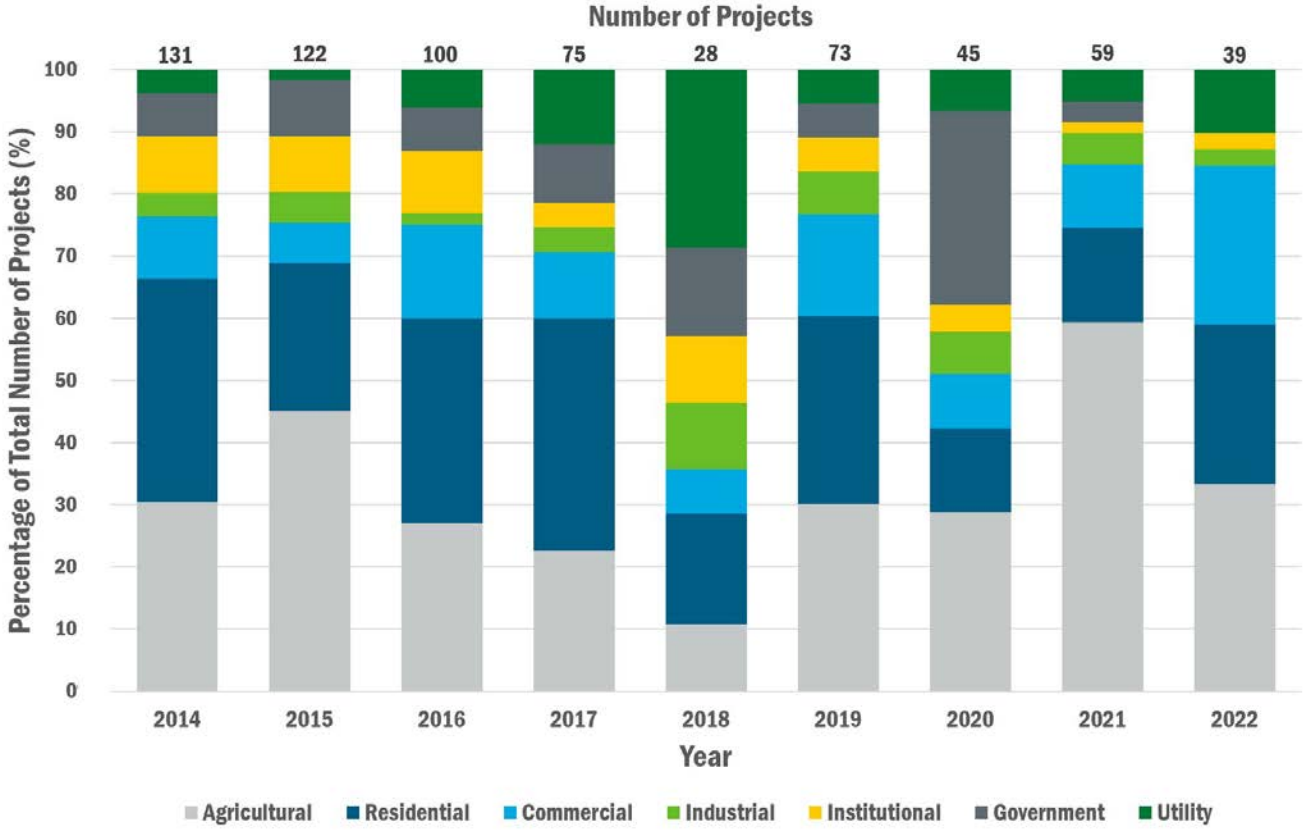
Projects above the dashed line correspond to higher generation in 2022 than in 2021. Projects below the dashed line had higher generation in 2021 than in 2022.



Distributed wind capacity factors, 2021–2022

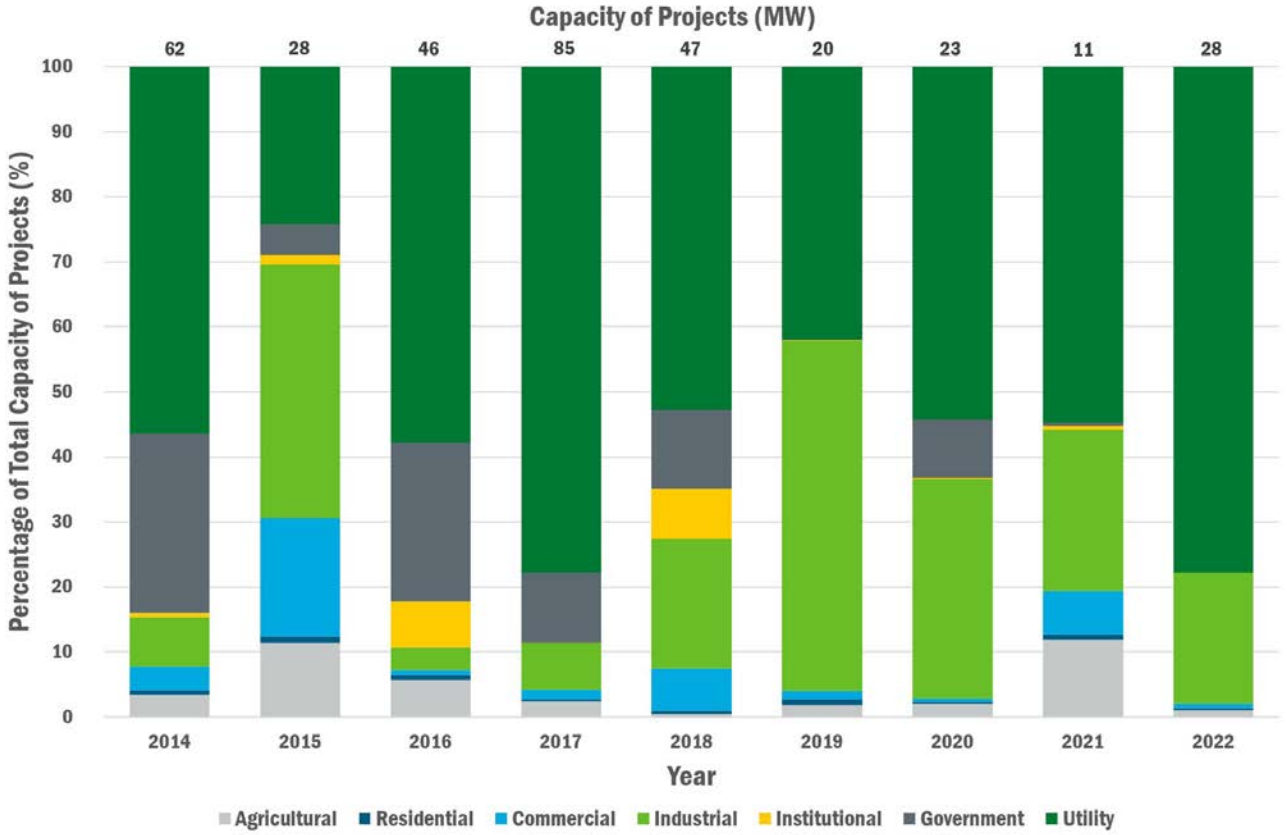
Distributed Wind Markets

Agricultural customers accounted for 33% of the number of projects installed in 2022, followed by residential & commercial customers who each represented 26%



Distributed wind end-use customer types by number of projects, 2014–2022

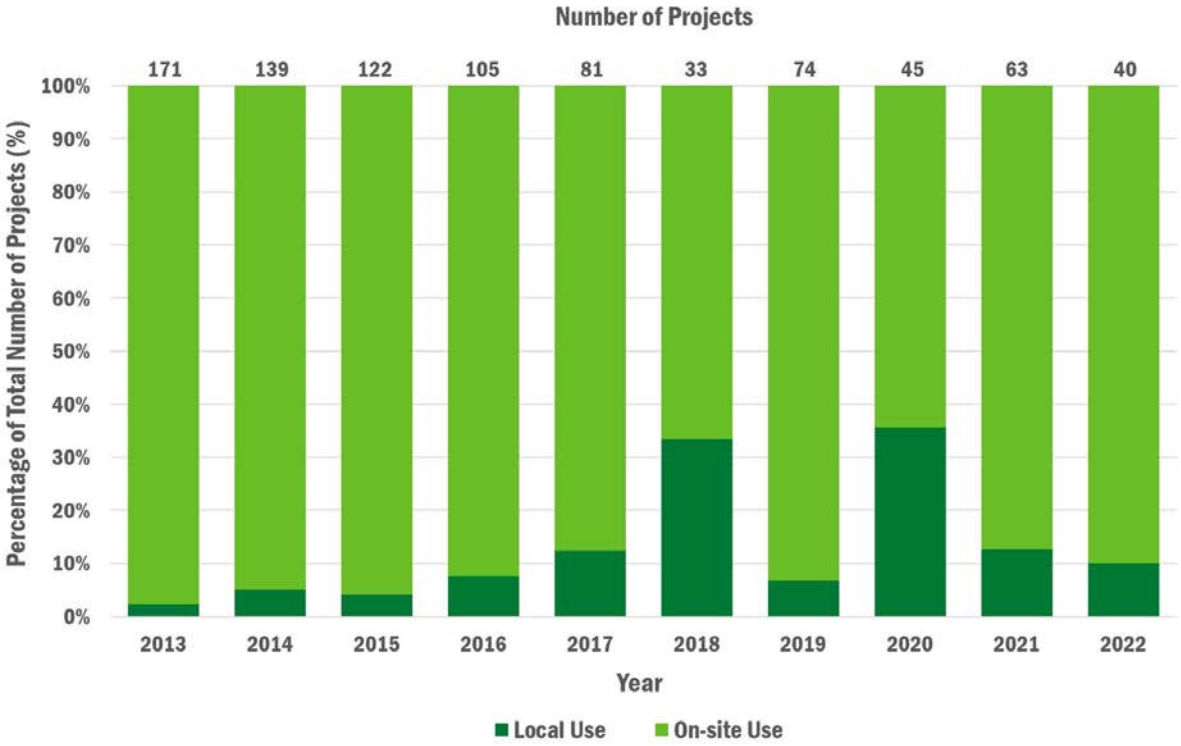
Distributed wind deployed for utility customers represented 78% of the total capacity installed in 2022



Distributed wind end-use customer types by capacity of projects, 2014–2022

In 2022, 90% of all distributed wind projects were interconnected to provide energy for on-site use

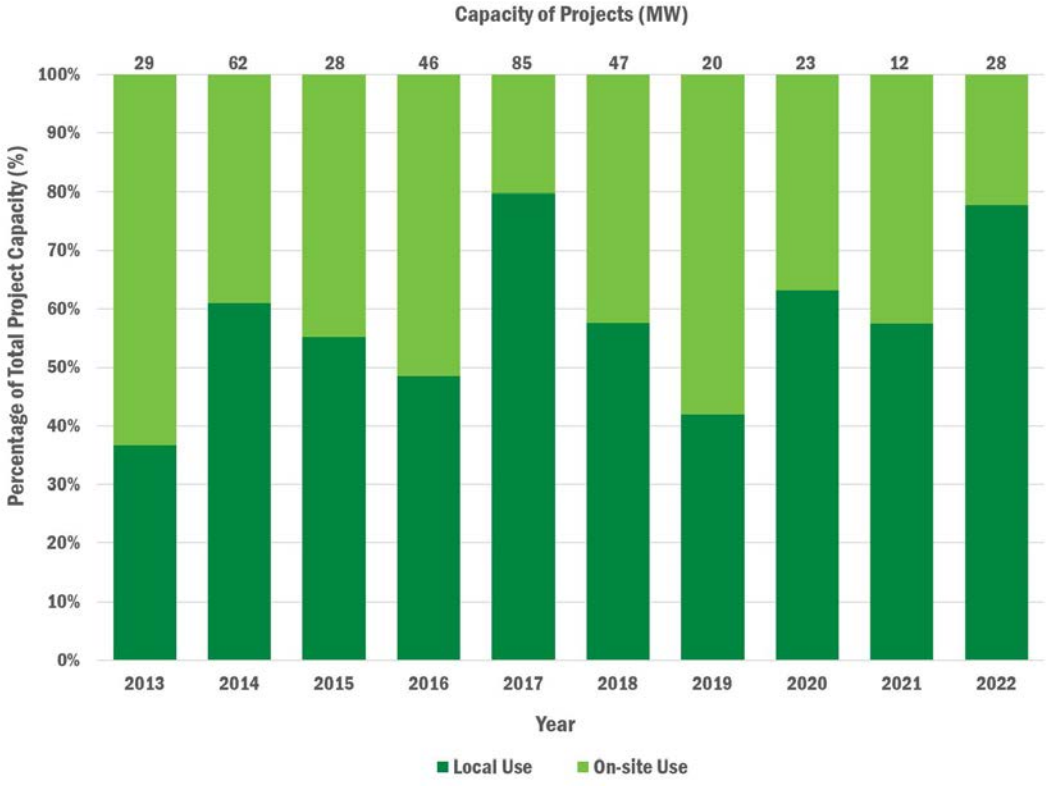
100% of the on-site use projects in 2022 were deployed as behind-the-meter installations.



Distributed wind for on-site use and local loads by number of projects, 2013–2022

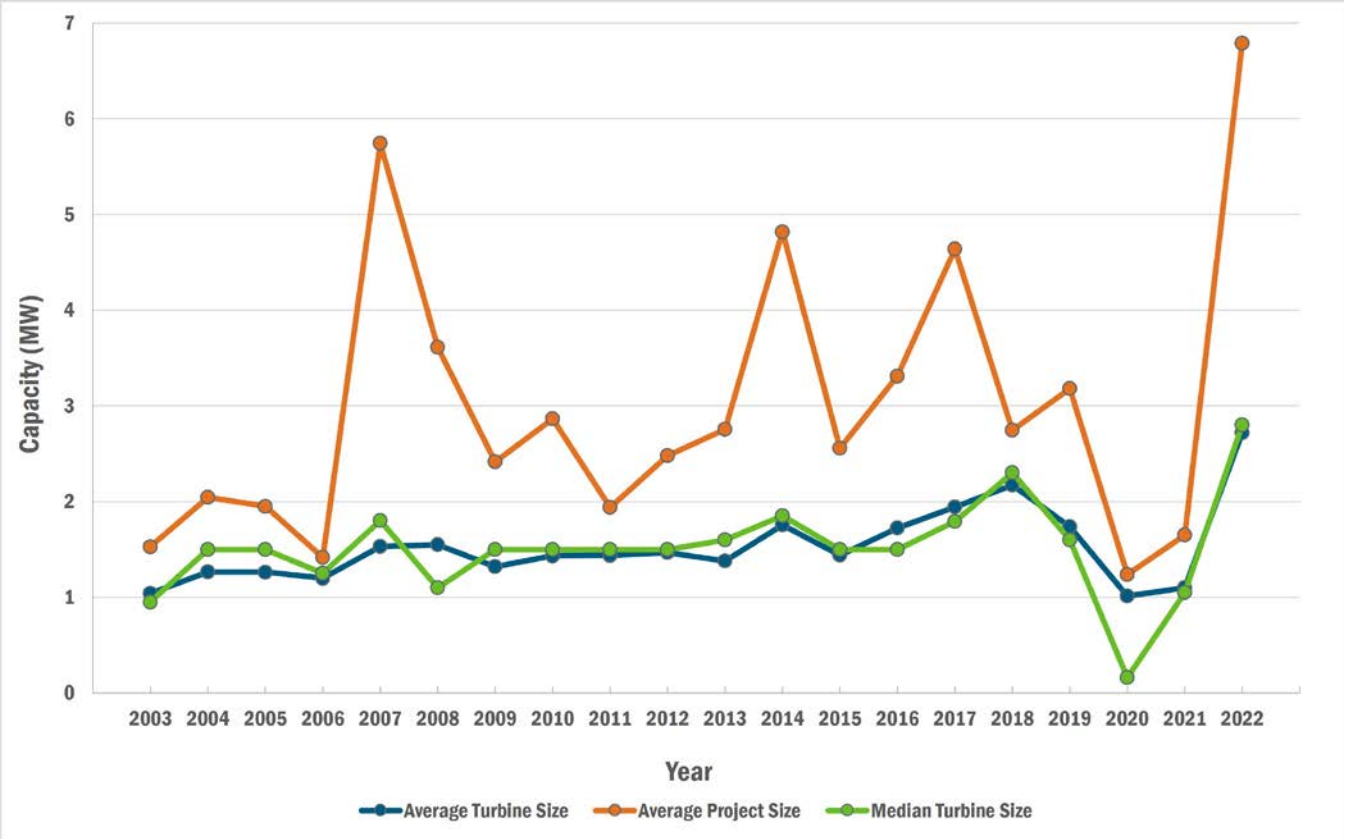
In 2022, 78% of the distributed wind capacity was deployed for local use while 22% was for on-site use

100% of the projects for local loads in 2022 serve utility customers.



Distributed wind for on-site use and local loads by capacity of projects, 2013–2022

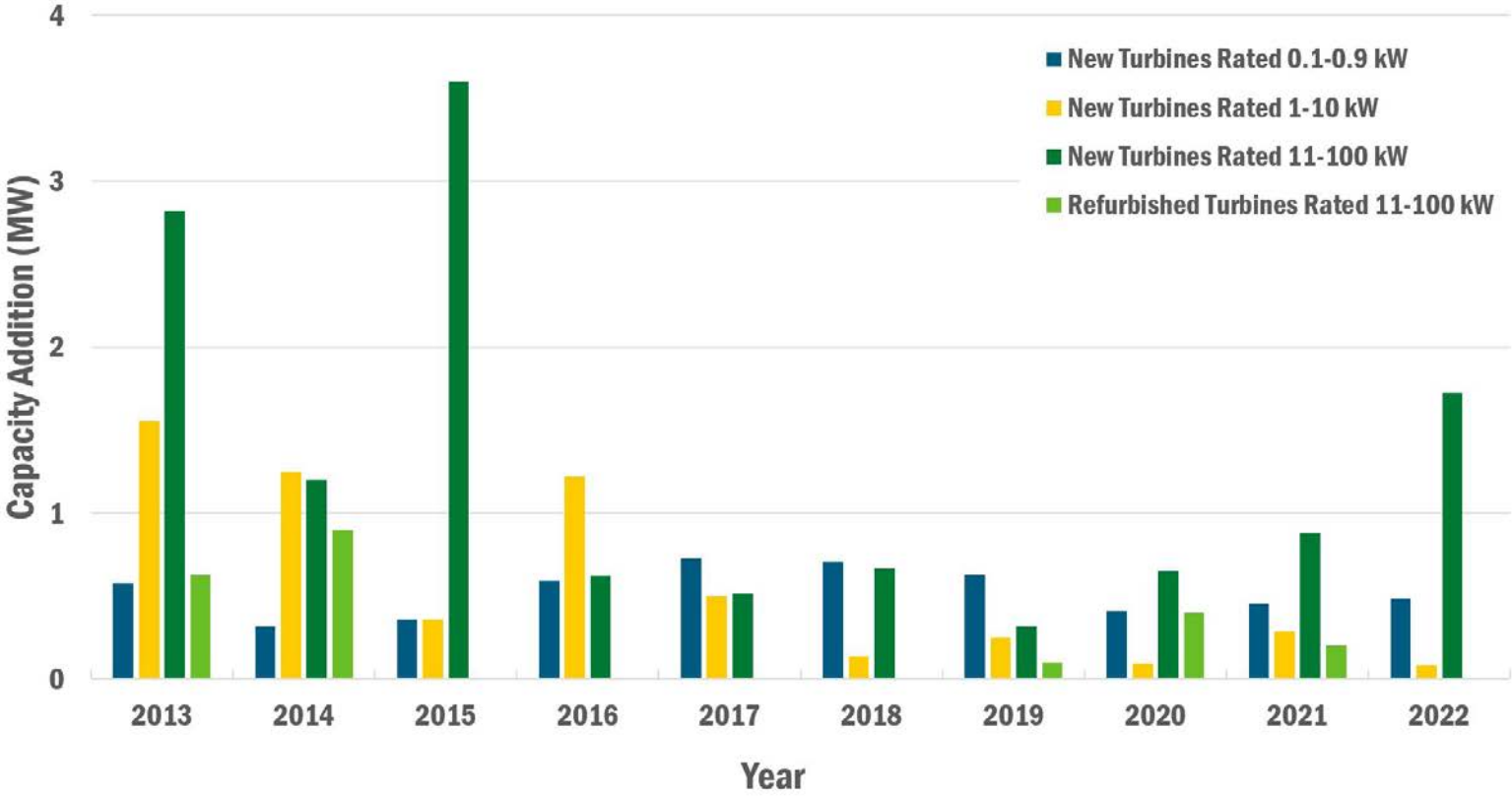
In 2022, the average capacity of turbines greater than 100 kW in distributed wind projects was 2.7 MW



- As the number of customers using large-scale turbines has increased, so has the average nameplate capacity of turbines greater than 100 kW used in distributed wind projects.
- The trend was disrupted by 12 midsize turbine repowers in 2020 and several midsize projects in 2021 before restarting in 2022.

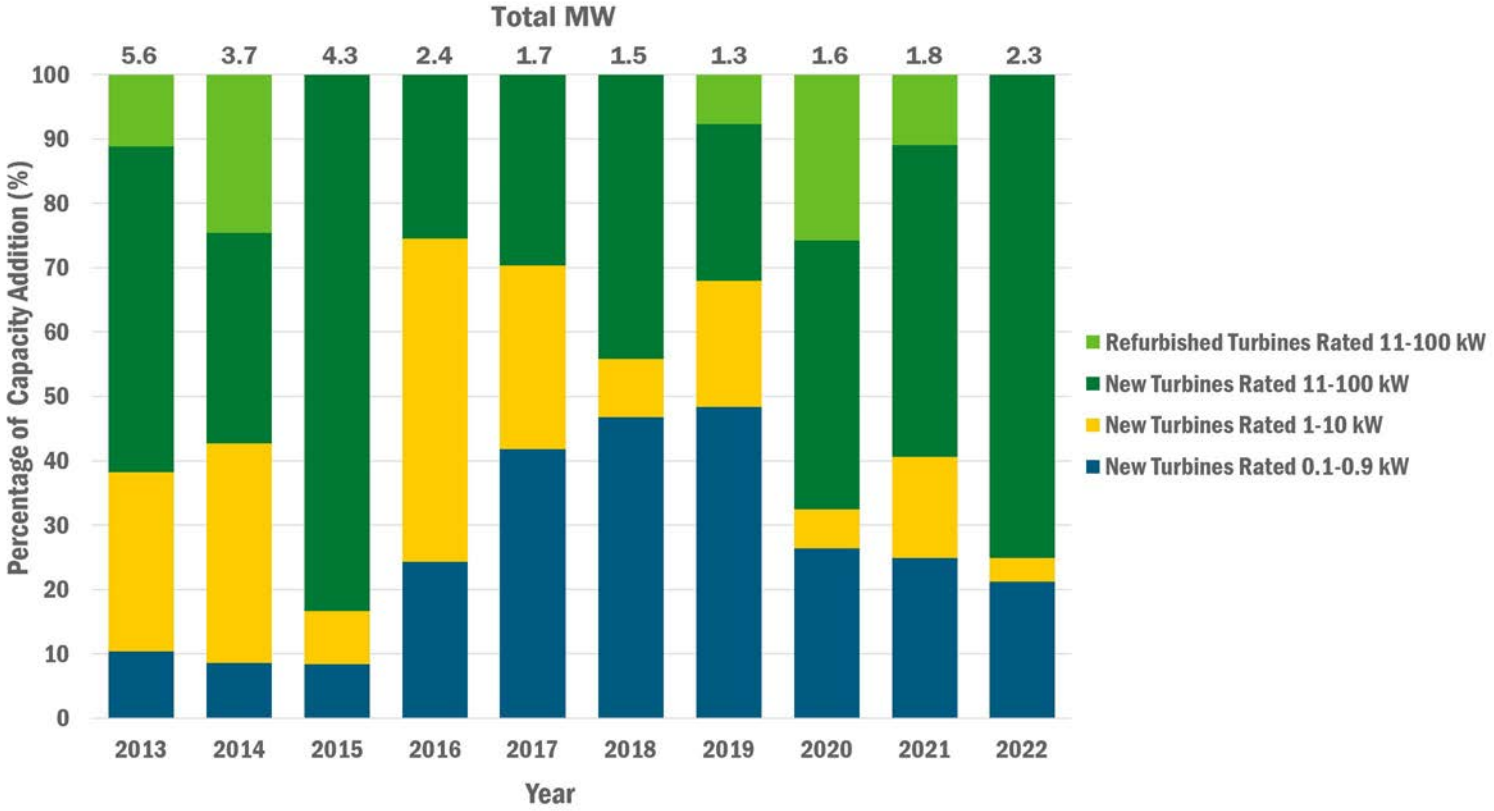
Average size of turbines greater than 100 kW in distributed wind projects and average size of those projects, 2003–2022

New turbines in the size segment of 11 – 100 kW represented 75% of the small wind sales capacity in 2022 for a total of 1.7 MW



U.S. small wind sales capacity by turbine size, 2013–2022

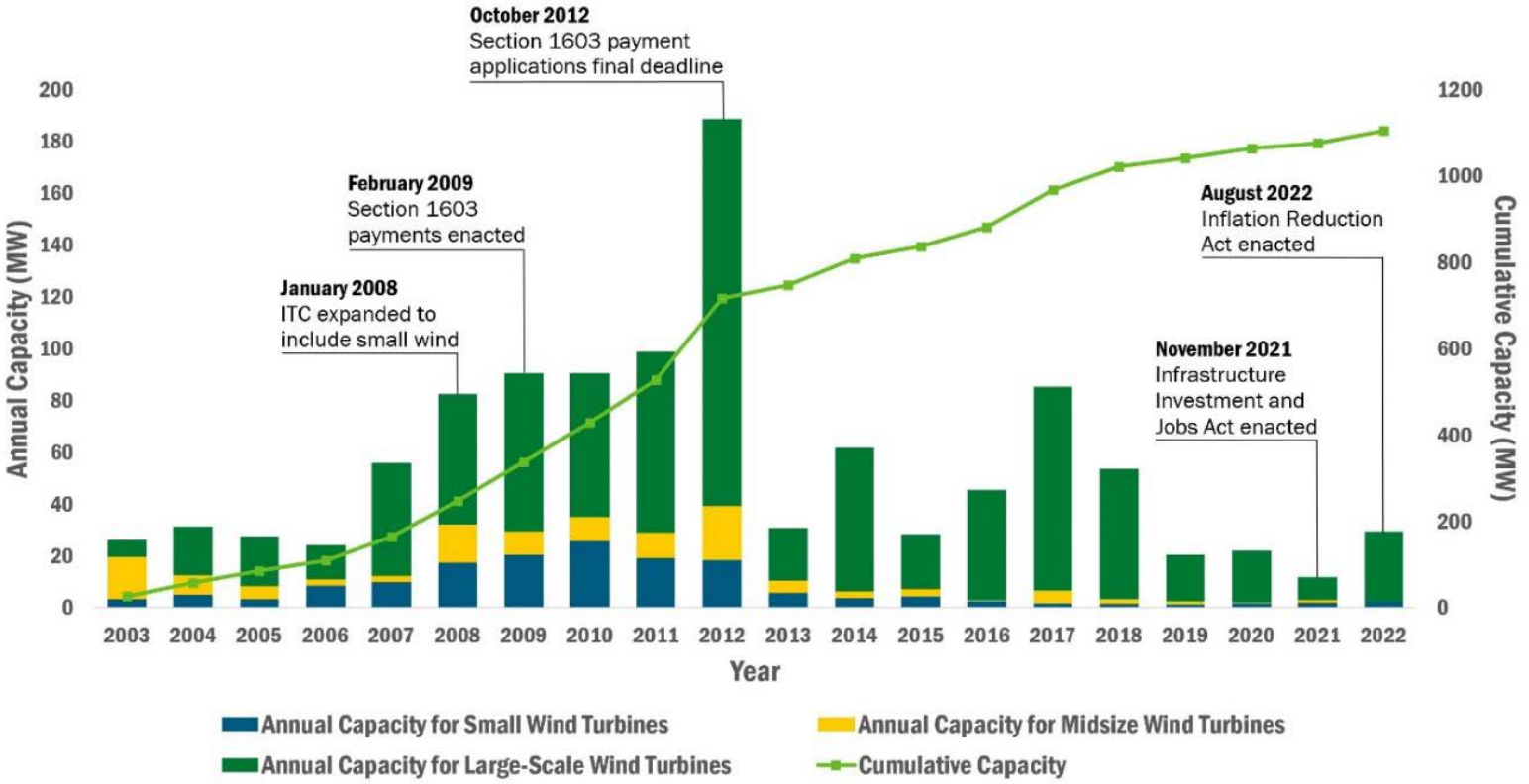
The market share for less-than-1-kW turbines decreased from 2021 to 2022, while the market share for turbines 11– 100 kW increased



U.S. small wind sales percentage of capacity by turbine size, 2013–2022

Future Outlook and Conclusions

Based on past federal policy changes and funding, certain segments of the distributed wind market could experience growth in the next years



U.S. distributed wind capacity and federal policies, 2003–2022

Conclusions

- The U.S. distributed wind market does not always exhibit consistent trends and there can be significant variation from year to year with respect to customer demand, installed costs, incentive availability, and deployment levels among and within the different turbine size segments.
  - Small wind sales increased from 2021 to 2022 with more new installations and fewer repowers than in 2021.
  - There were no midsize turbine deployments in 2022.
  - Installed capacity from projects using large-scale turbines increased by more than double in 2022 from 2021.
- With the new program funding and tax credit opportunities available from the Inflation Reduction Act and the Infrastructure Investment and Jobs Act, the distributed wind market is expected to grow, but this kind of variation is likely to continue considering the diverse ways in which distributed wind can be deployed.

Photo credit: American Windpower

See the full report for additional findings and details:

https://www.energy.gov/eere/wind/articles/distributed-wind-market-report-2023-edition

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For the PNNL Photo Gallery, visit:

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For PNNL's Project Dataset, visit:

https://www.pnnl.gov/distributed-wind

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