U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Distributed Wind Market Report: 2022 Edition Summary

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Distributed Wind Market Report: 2022 Edition

Purpose, Scope, and Data

- Summarizes publicly available U.S. distributed wind annual data through the end of 2021
- 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. DOE Wind Energy Technologies Office

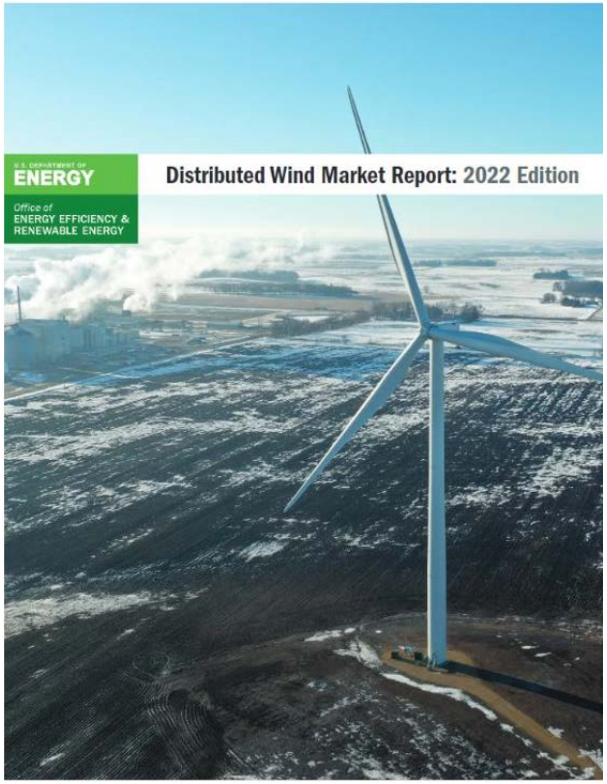
Products and Availability

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

Key Findings

- 15 states added 11.7 MW of new distributed wind capacity in 2021 from 1,751 turbine units representing a $41 million investment. Cumulative U.S. distributed wind installed capacity now stands at 1,075 MW.
- Of the 11.7 MW installed in 2021, 8.7 MW came from distributed wind projects using large-scale turbines (greater than 1 MW in size), 1.2 MW came from projects using mid-size turbines (101 kilowatts [kW] to 1 MW in size), and 1.8 MW came from projects using small wind turbines (up through 100 kW in size).
- Rhode Island, Kansas, and Minnesota led the United States in 2021 capacity additions as a result of one project in each state which combined, represent 75% of the annual distributed wind capacity installed in 2021.
- Refurbished turbines continue to account for most of the mid-size market and small wind retrofit projects continue to account for a significant portion of new small wind capacity. Of the six projects using mid-size turbines in 2019, 2020, and 2021, at least four are refurbished models. In 2021, small wind retrofits represented 42% of total installed small wind capacity.
- In 2021, utility customers accounted for the majority of the total distributed wind capacity (56%), while agricultural customers accounted for the greatest number of projects installed (55%).
- The average capacity-weighted installed cost for a sample of new small wind projects in 2021 was $5,120/kW. The average capacity-weighted installed cost for a sample of small wind retrofit projects in 2021 was approximately $3,400/kW. The average capacity-weighted installed cost for a sample of projects using turbines greater than 100 kW in 2021 was approximately $2,900/kW.
- The average capacity factor in 2021 for a sample of small wind projects was 13%. The average capacity factor in 2021 for a sample of distributed wind projects using turbines greater than 100 kW was 22%.

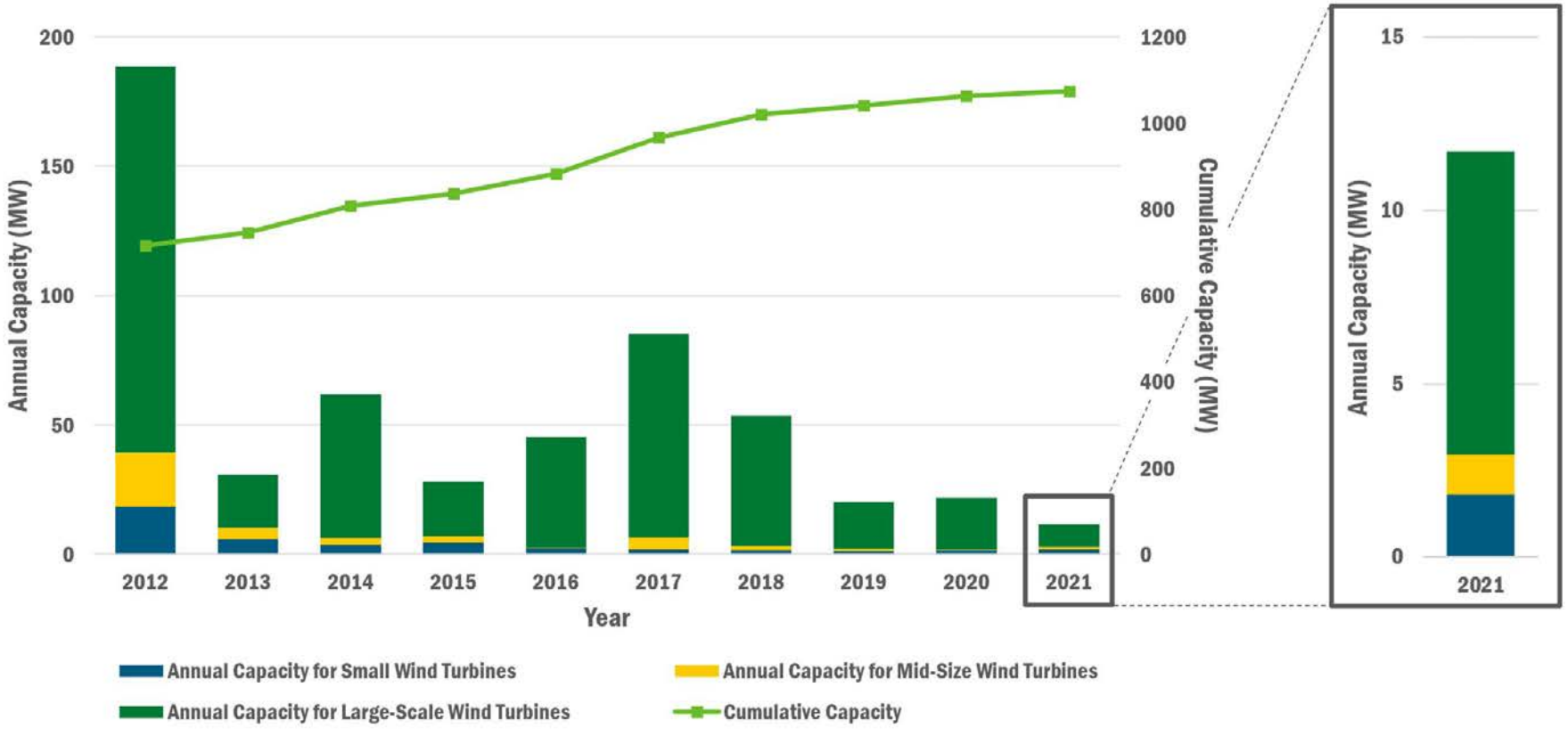
Contents



U.S. Distributed Wind Deployment

11.7 MW of distributed wind capacity was deployed in the United States in 2021

- Cumulative distributed wind capacity reached 1,075 MW in 2021 from over 89,000 wind turbines across all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam.

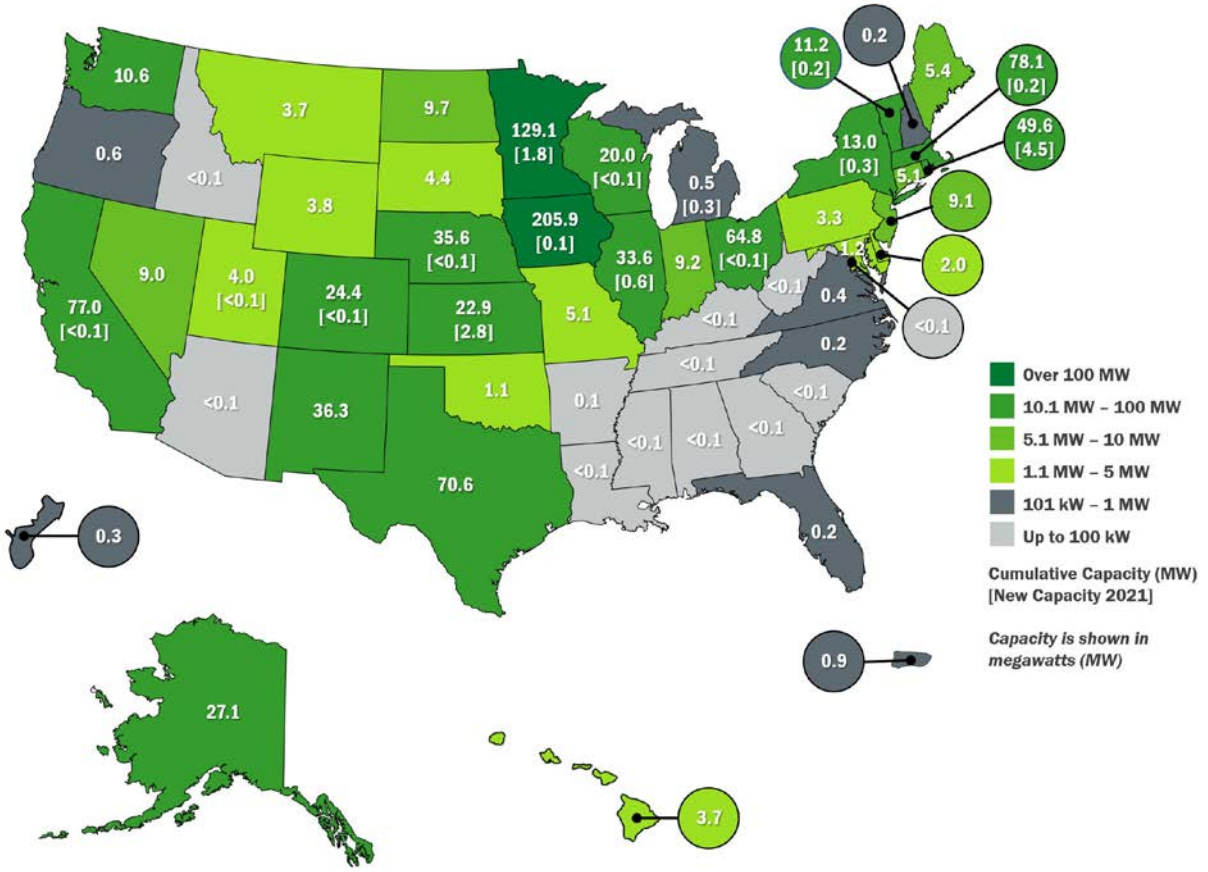


U.S. distributed wind capacity

Three states led the United States in new distributed wind capacity: Rhode Island, Kansas, and Minnesota

- In 2021, new distributed wind projects were documented in 15 states.

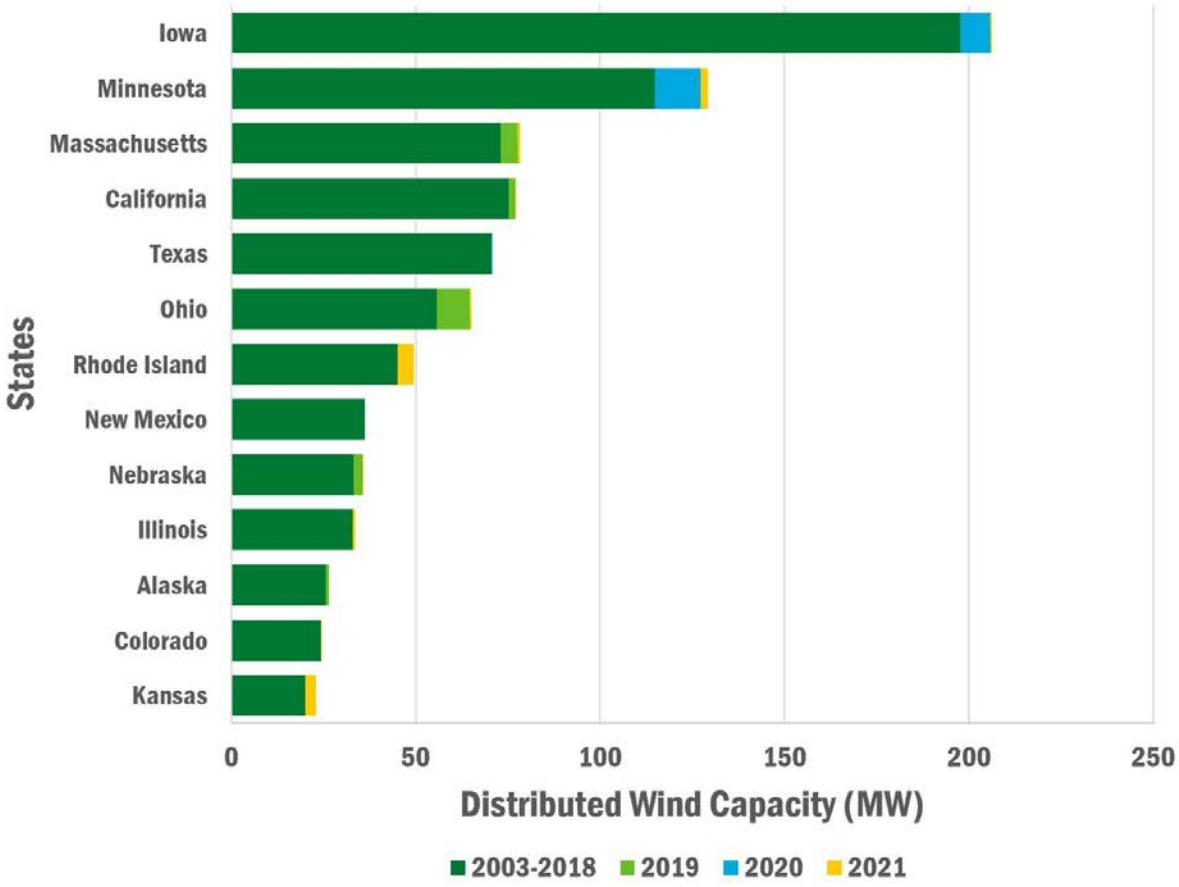
California	Nebraska
Colorado	New York
Illinois	Ohio
Iowa	Rhode Island
Kansas	Utah
Massachusetts	Vermont
Michigan	Wisconsin
Minnesota	



U.S. cumulative (2003–2021) capacity and 2021 capacity additions for distributed wind by state

Iowa and Minnesota are the top states for cumulative distributed wind capacity

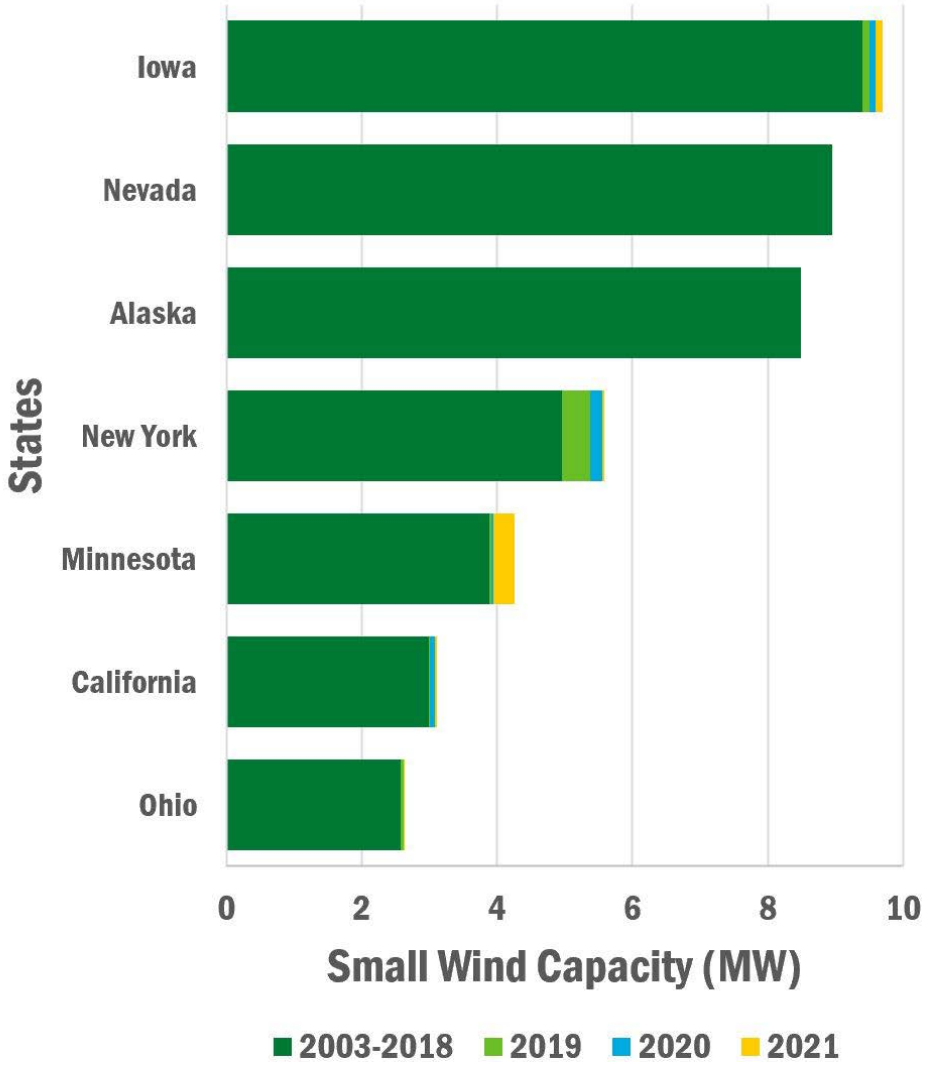
- Iowa and Minnesota have strong wind resources, active project developers, and have historically received a significant number of U.S. Department of Agriculture Rural Energy for America Program wind grants.



States with distributed wind capacity greater than 20 MW, 2003–2021

Iowa, Nevada, and Alaska are the top three states for cumulative small wind capacity

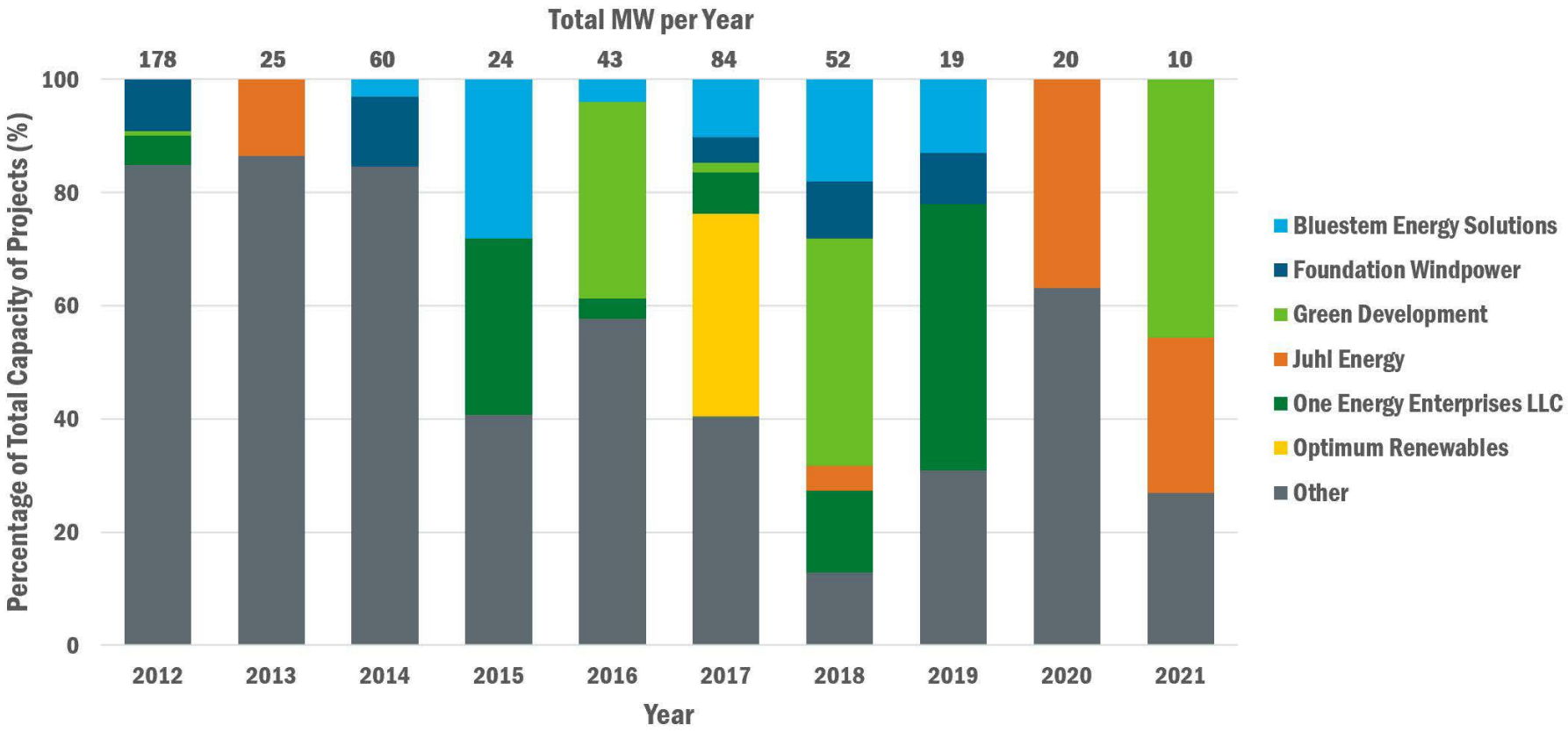
- Minnesota had the most small wind capacity additions in 2021 because of a focus by manufacturer Eocycle on the agricultural market there.
- New York led in annual small wind capacity additions from 2017 through 2020, but installations have declined there following the discontinuation of the New York State Energy and Research Development Authority Small Wind Turbine Incentive Program.



States with small wind capacity greater than 2 MW, 2003–2021

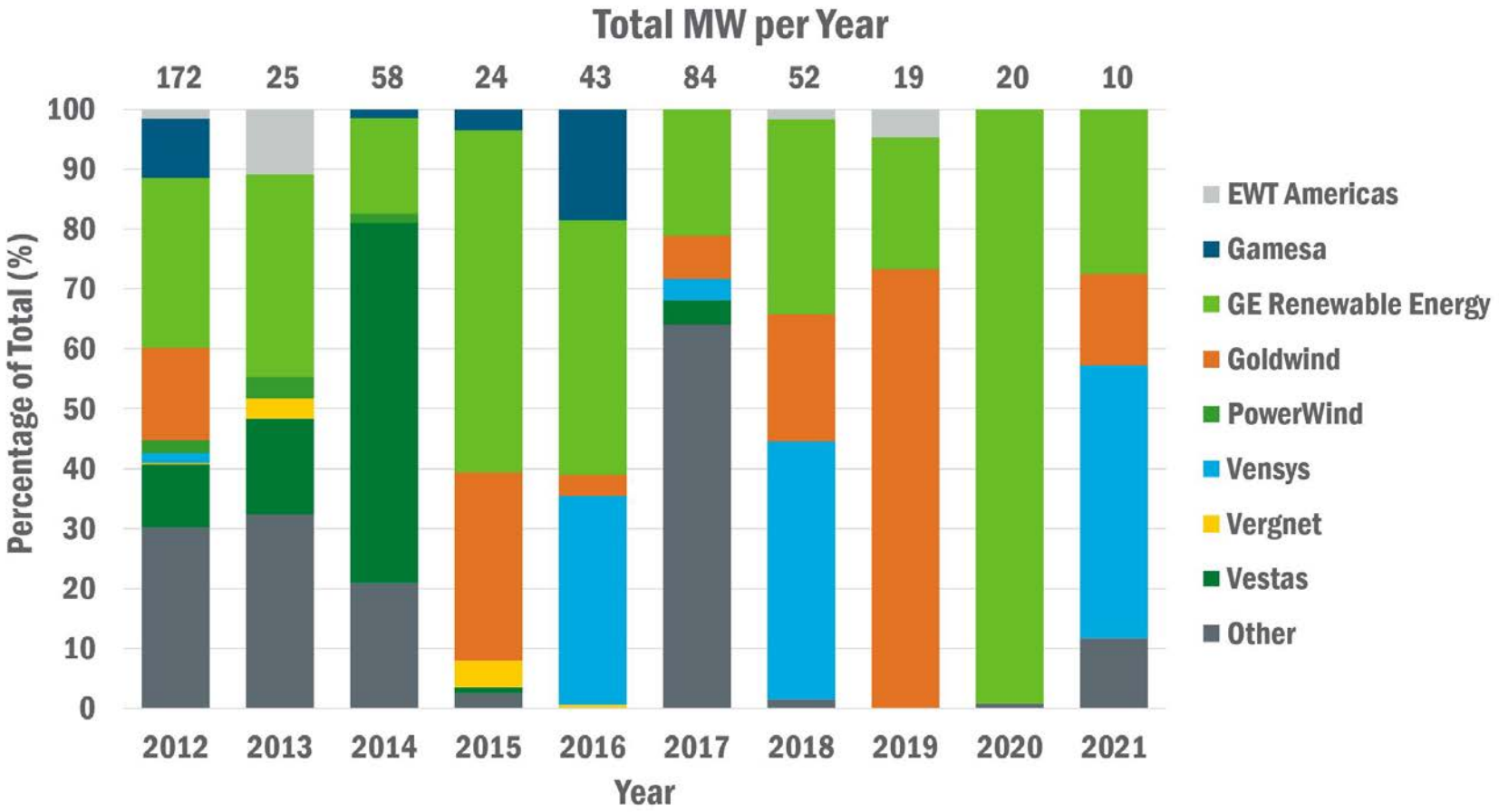
U.S. Distributed Wind Projects and Sales

Six developers have accounted for 40+% of distributed wind capacity from projects using 100+ kW turbines since 2015



Project developers using turbines greater than 100 kW, 2012–2021

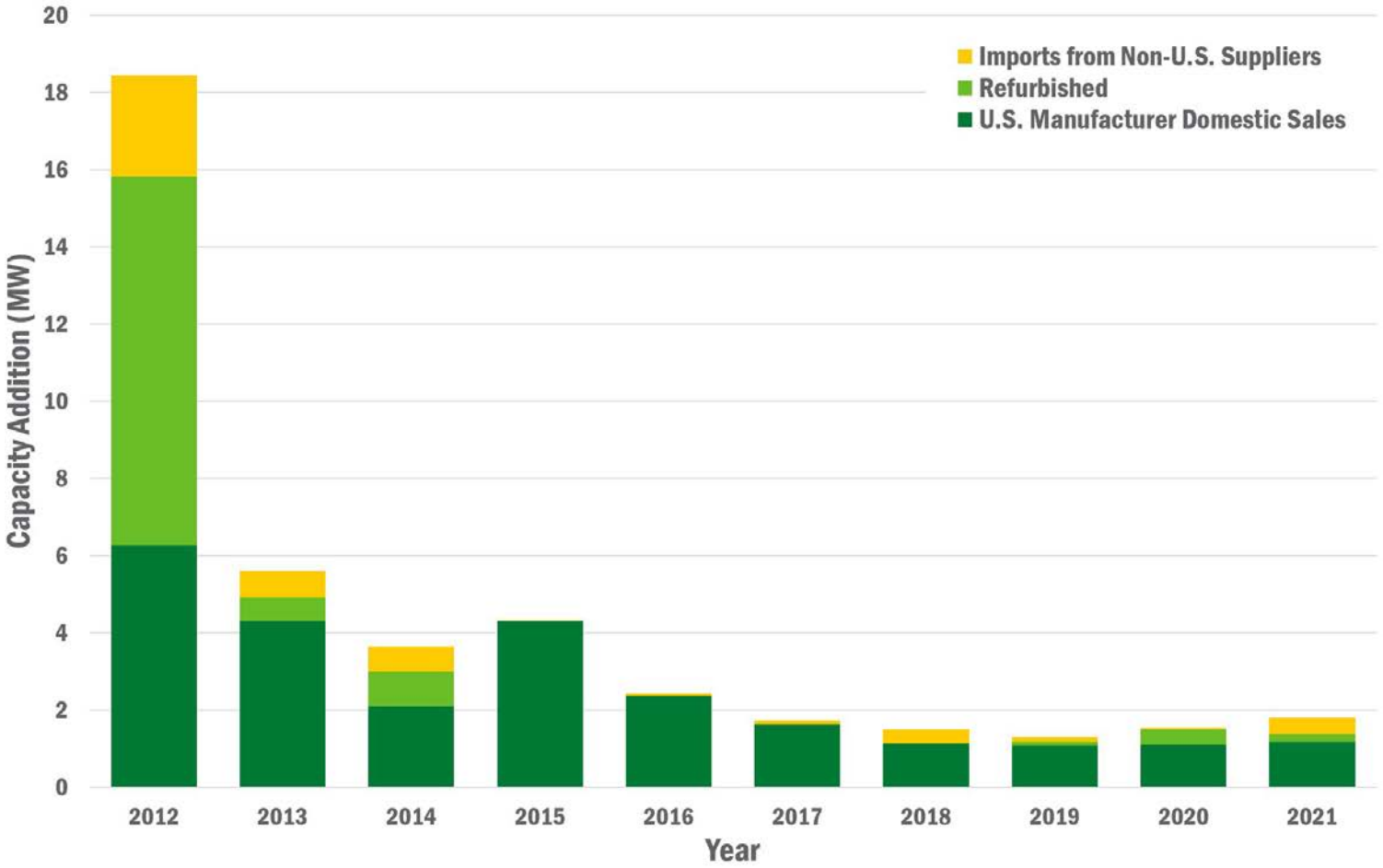
Distributed wind manufacturer representation was greater in 2021 than in 2019 and 2020



Wind turbine manufacturers of turbines greater than 100 kW with a U.S. sales presence, 2012–2021

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

Small wind sales from both U.S.-based and non-U.S. manufacturers increased slightly in 2021



U.S. small wind turbine sales, 2012–2021

- U.S.-based manufacturers of new small wind turbines accounted for 65% of the small wind sales capacity in 2021.

Small Wind Certification

Seven small wind turbines are certified to American Wind Energy Association 9.1.2009 or IEC 61400-1, -2, -11 standards

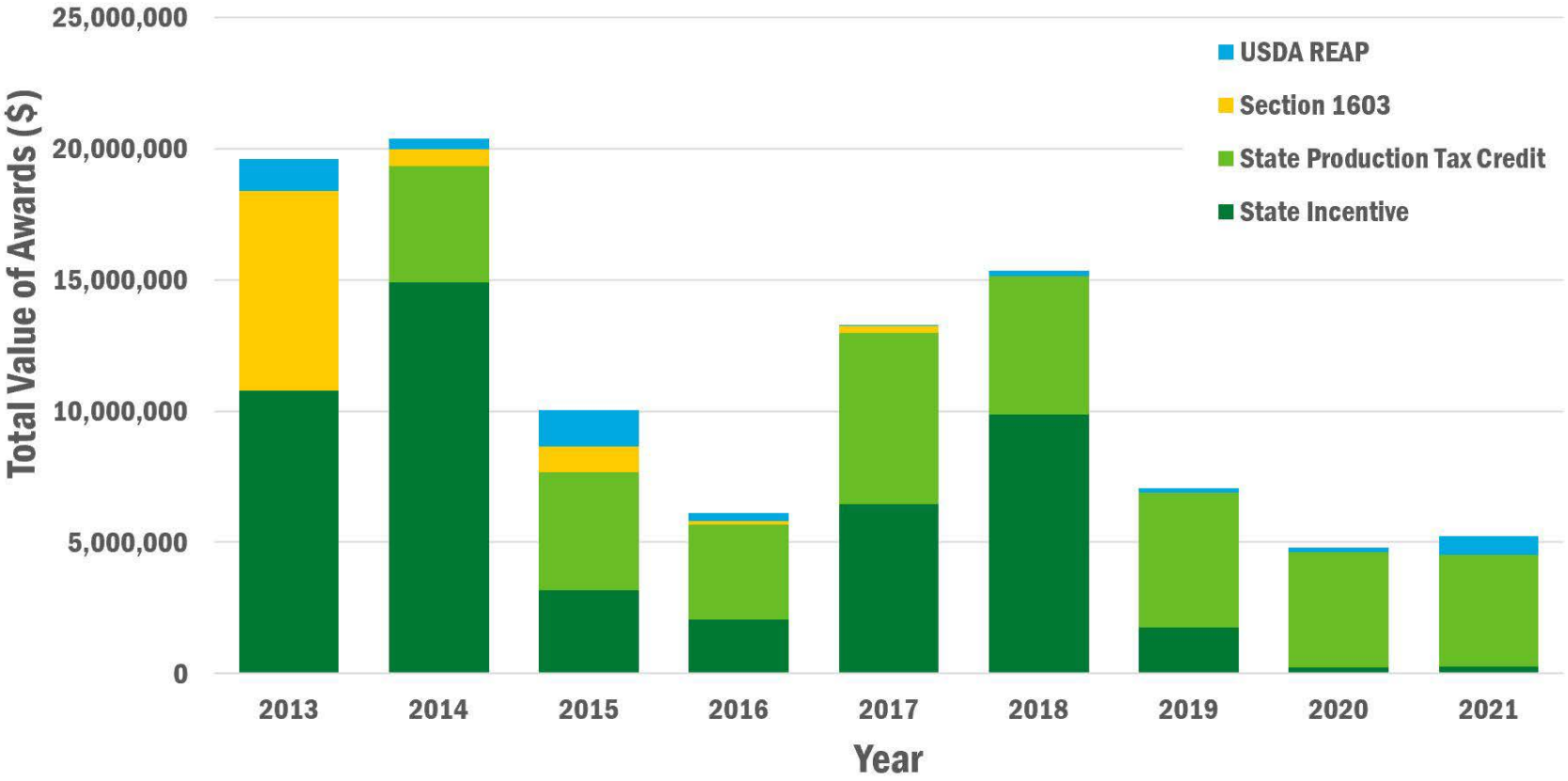
Certified Small Wind Turbines (as of July 31st , 2022)

Applicant	Turbine Model	Date of Initial Certification	Certified Power Rating @ 11 m/s (kW)	Certification Standard
Bergey WindPower	Excel 10	11/16/2011	8.9	AWEA 9.1
Bergey WindPower	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.	E020/E025	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

- The American Clean Power Association (ACP) has developed a new standard to facilitate easier certification compliance. The forthcoming ACP 101-1 standard defines small wind turbines as having a peak power of 150 kW or less and microturbines as having a peak power up to 1 kW. The industry expects that new turbine models will be certified to this standard in the future.

Policies, Incentives, and Market Insights

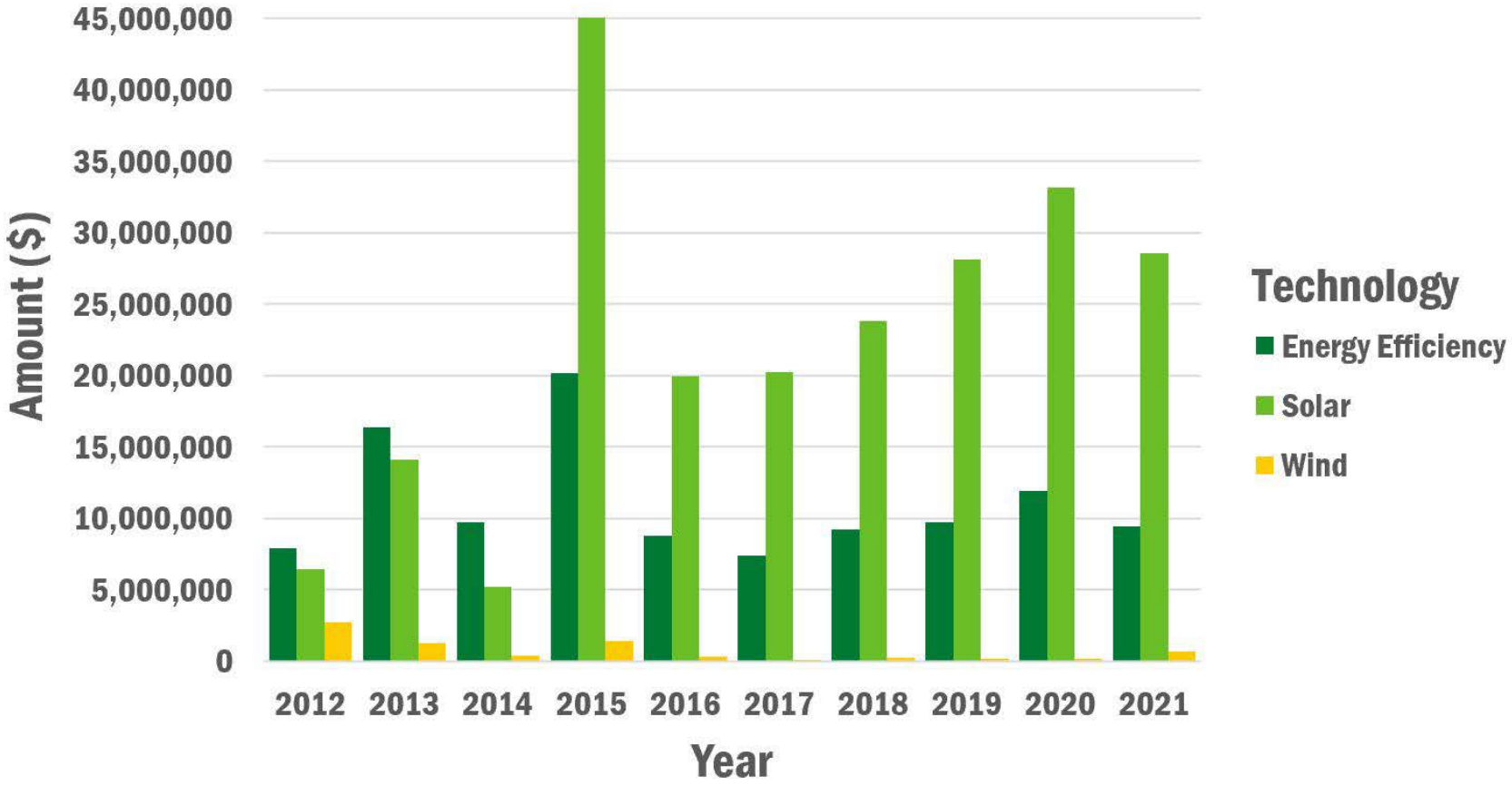
The combined value of incentives given to distributed wind projects in 2021 was $5.2 million across eight states



U.S. distributed wind incentive awards, 2013–2021

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

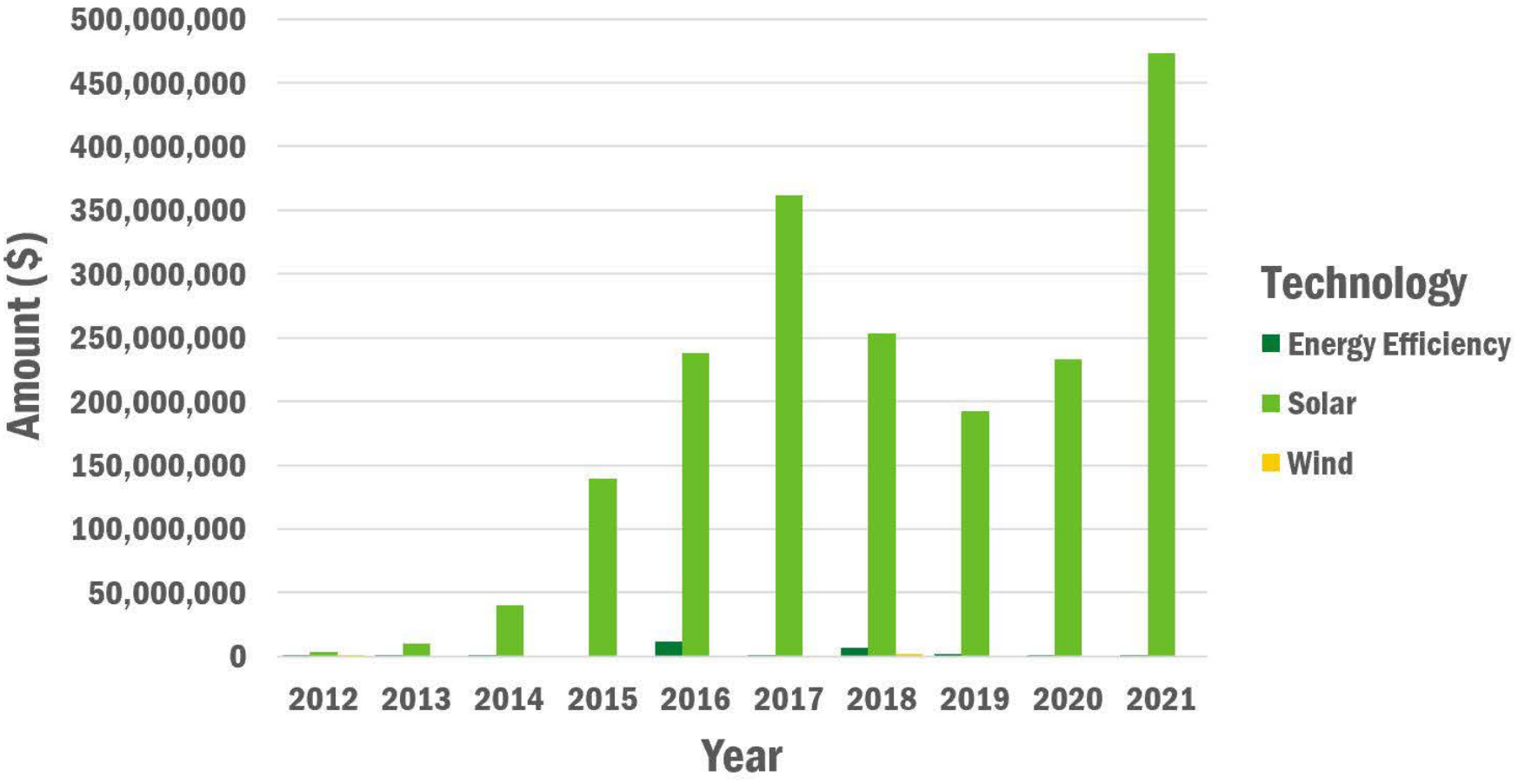
In 2021, a total of $696,964 in USDA REAP grants was awarded to 22 wind projects



USDA REAP grants by technology, 2012–2021

- Since 2003, USDA has awarded over $73 million in REAP wind grants. These wind grants have decreased significantly since 2012, while awards to solar PV projects have increased.

There have been just two USDA REAP wind loans in the past 10 years in 2012 and 2018, while solar loans have increased



USDA REAP loans by technology, 2012–2021

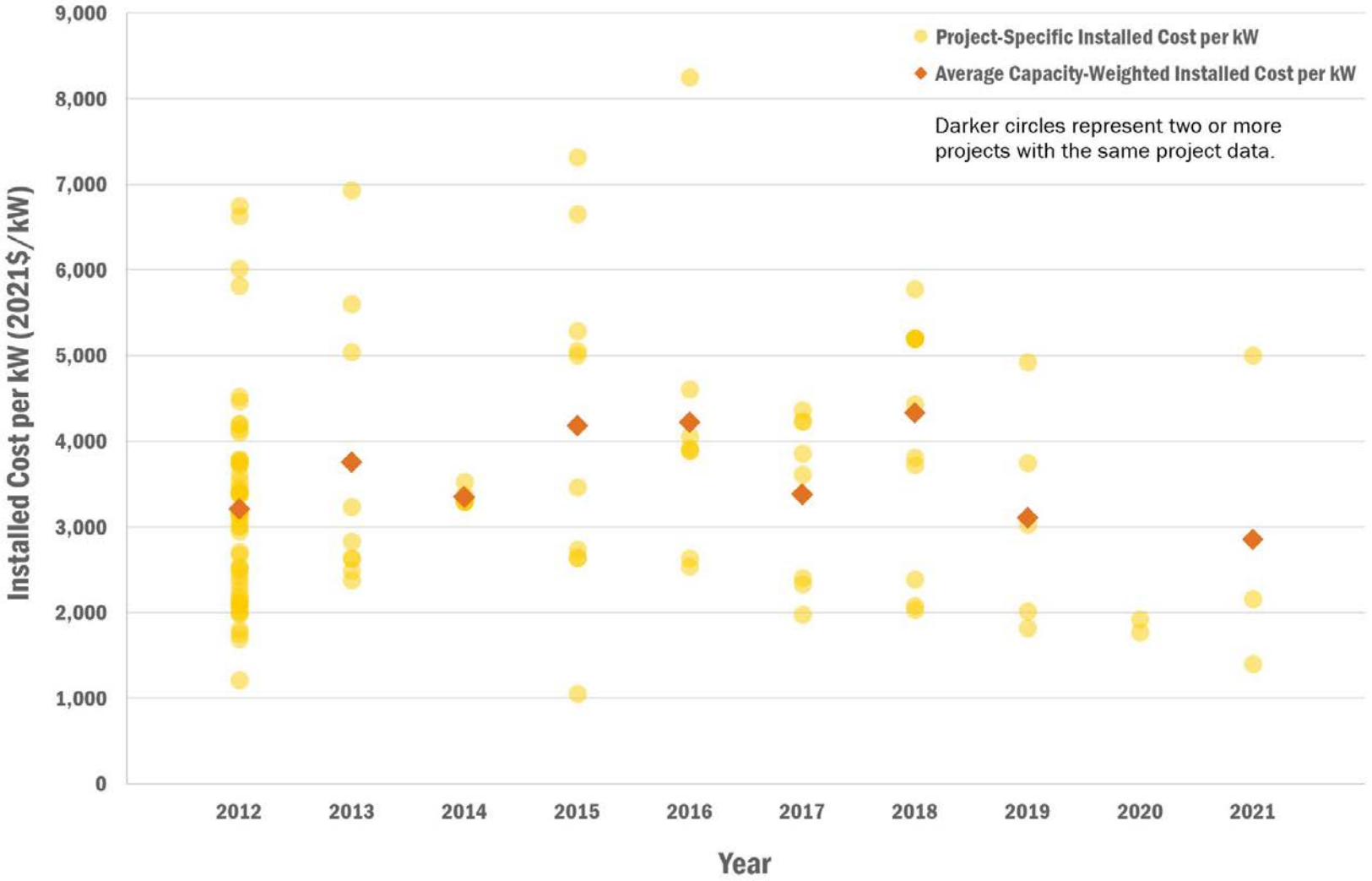
Distributed Wind Cost Trends

The average capacity-weighted installed cost for new small wind projects in 2021 was $5,120/kW

Average and project-specific U.S. new and retrofit small wind installed project costs, 2012–2021

- The average capacity-weighted installed cost for small wind retrofit projects in 2021 was approximately $3,400/kW. Retrofit projects using refurbished turbines represent the low-end of the retrofit installed cost range.

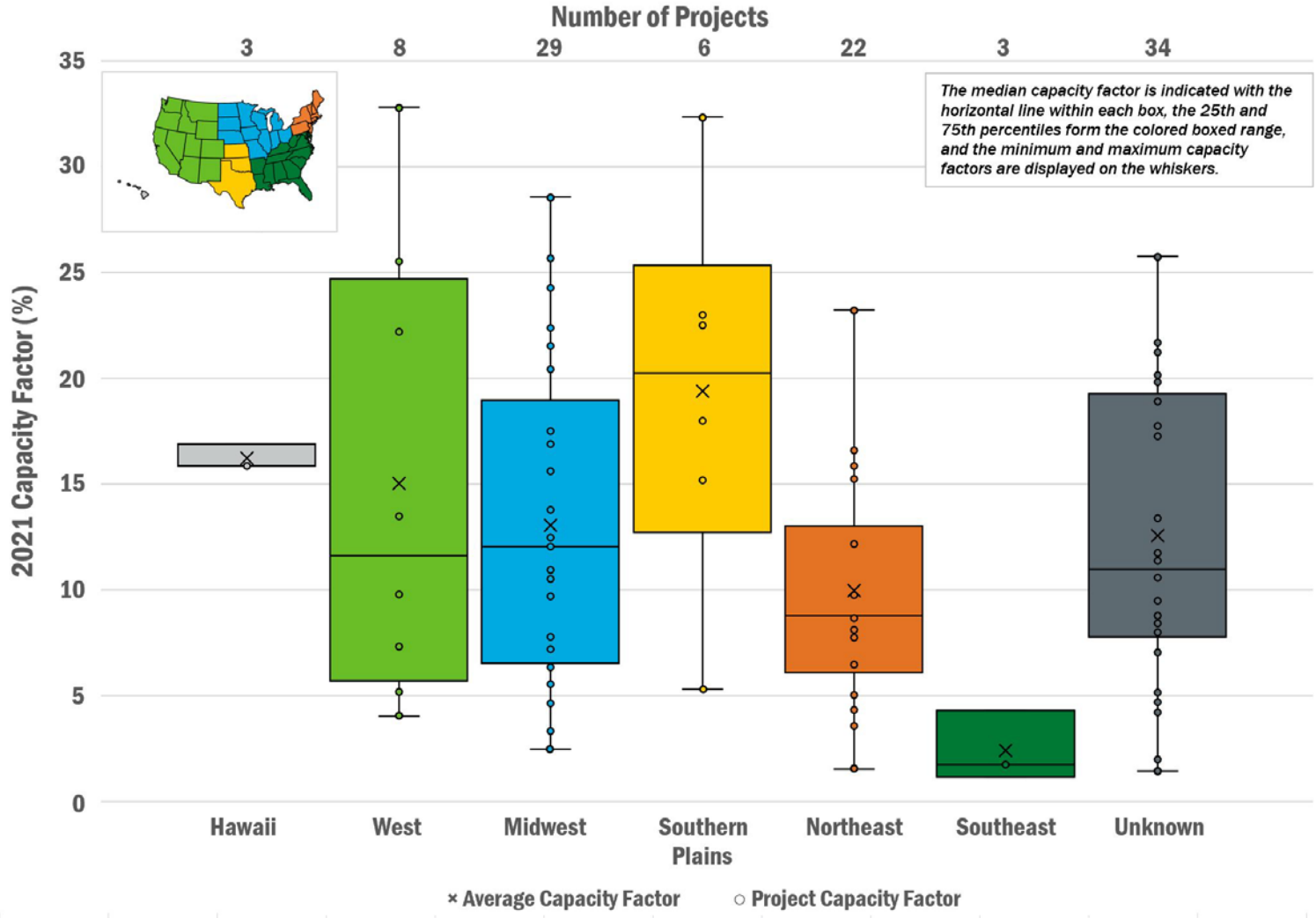
The average capacity-weighted installed cost for projects using turbines greater than 100 kW in 2021 was $2,900/kW



Average annual and project-specific installed costs for projects using turbines greater than 100 kW, 2012–2021

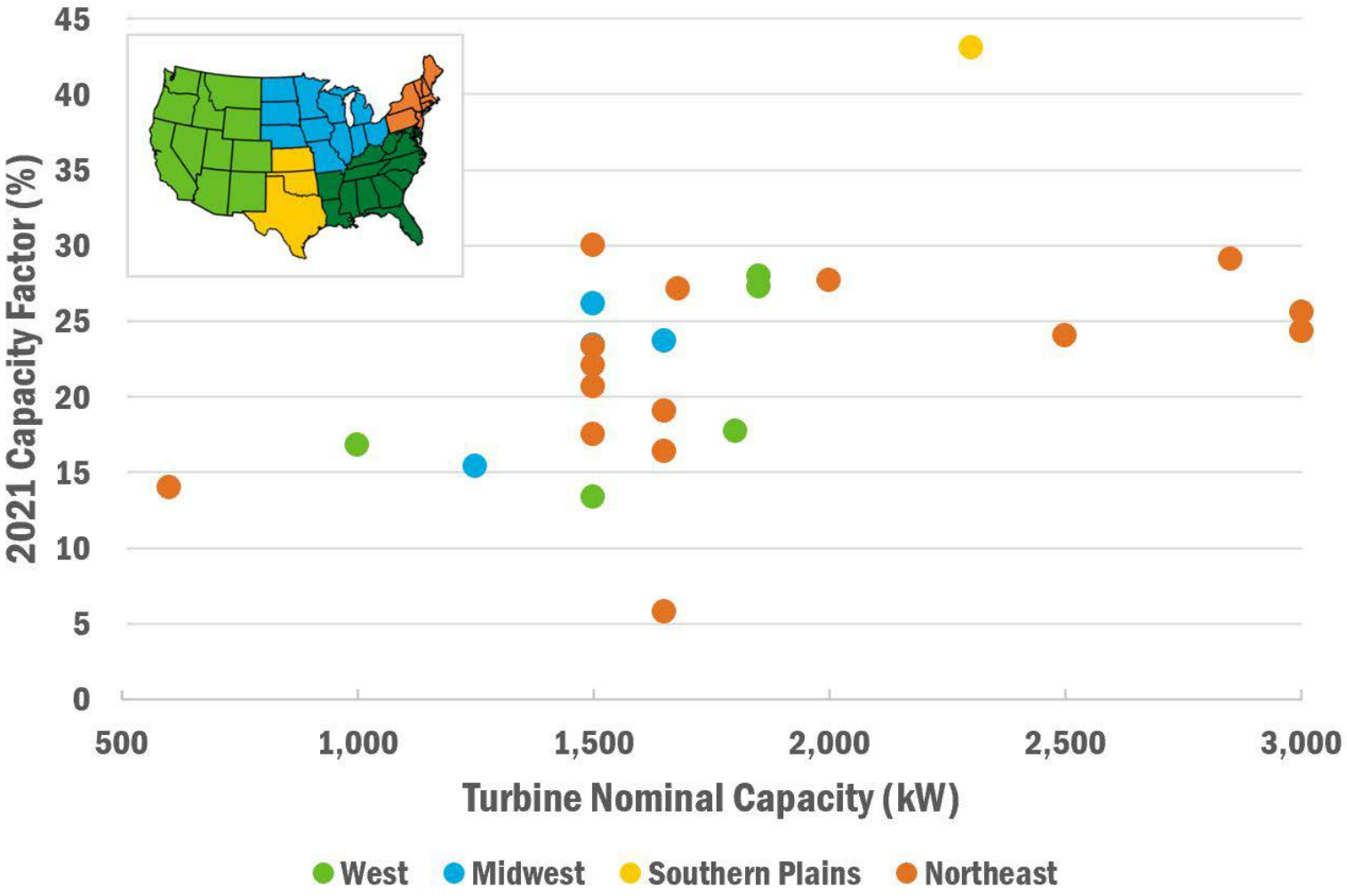
Distributed Wind Performance

The small wind average capacity factor from a sample of projects that generated energy in 2021 was 13%



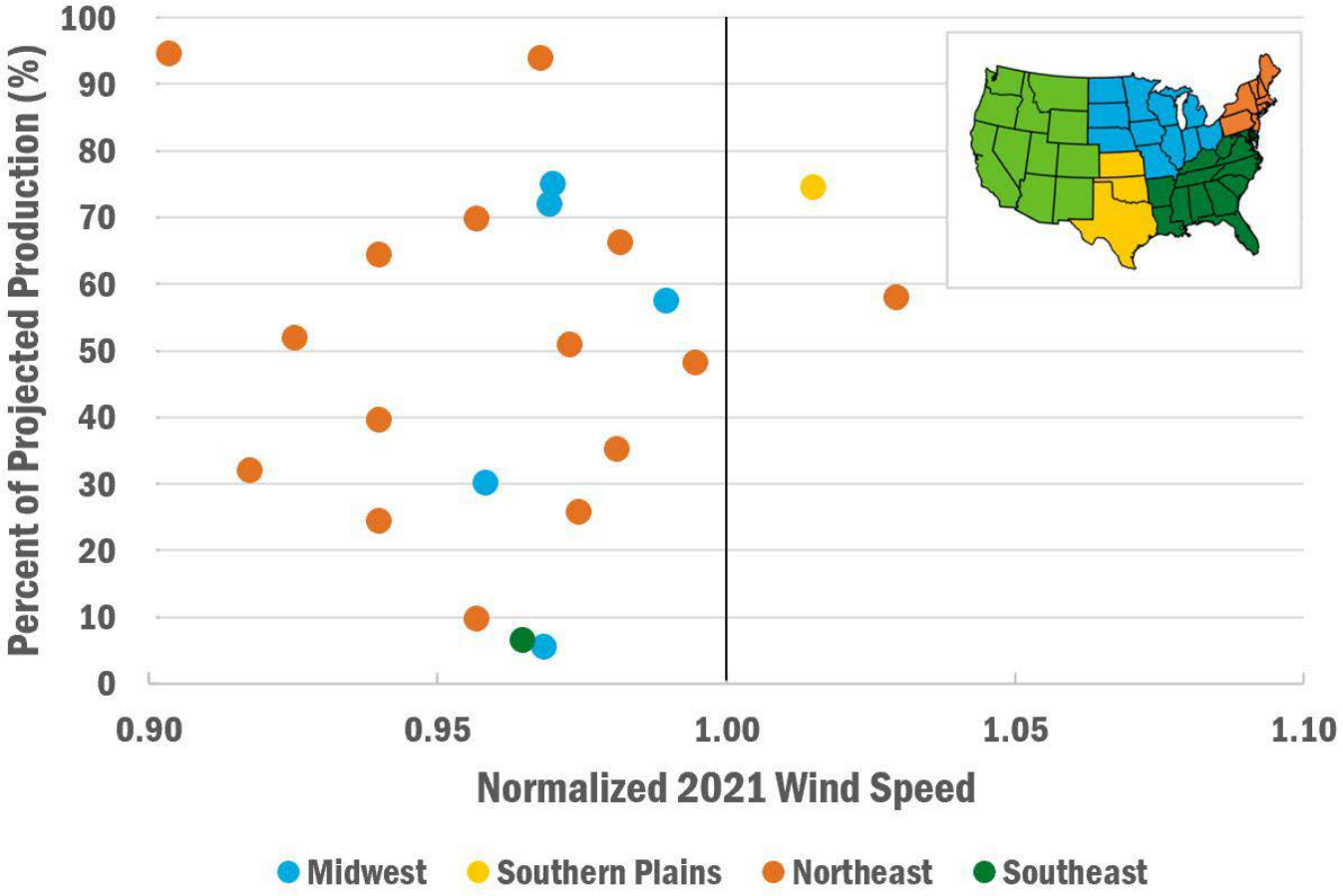
Small wind capacity factors

The average capacity factor for a sample of distributed wind projects using turbines greater than 100 kW in 2021 was 22%



Capacity factors for projects using turbines greater than 100 kW

For a sample of small wind projects, actual energy production in 2021 was less than initial estimates provided to customers

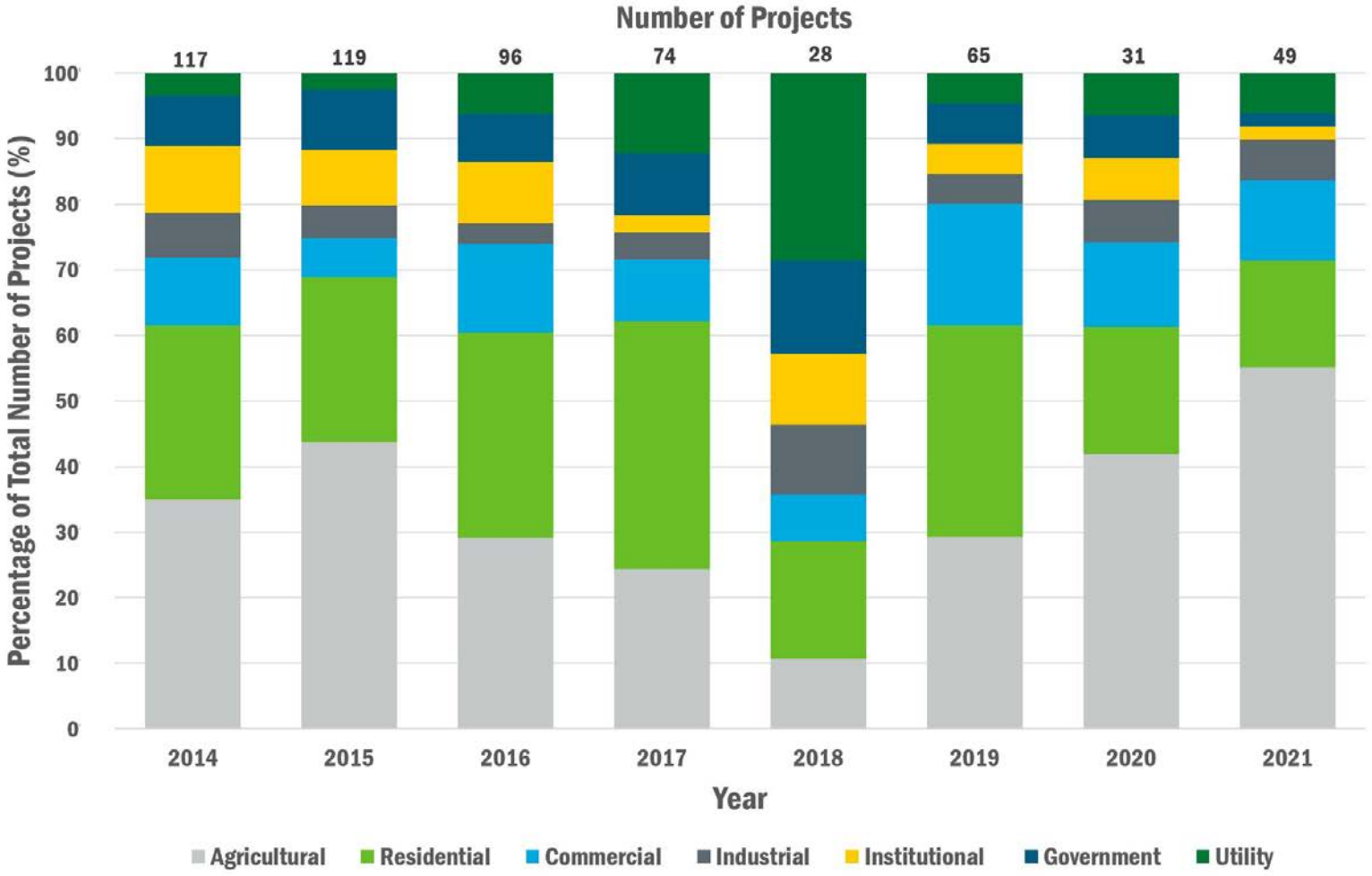


Actual and estimated performance for select small wind projects

- Historical data indicates that 2021 was a below average wind resource year for most projects (as indicated by the 2021 normalized wind speed) and that is one contributing factor to the low turbine performance recorded in 2021 relative to expectations.

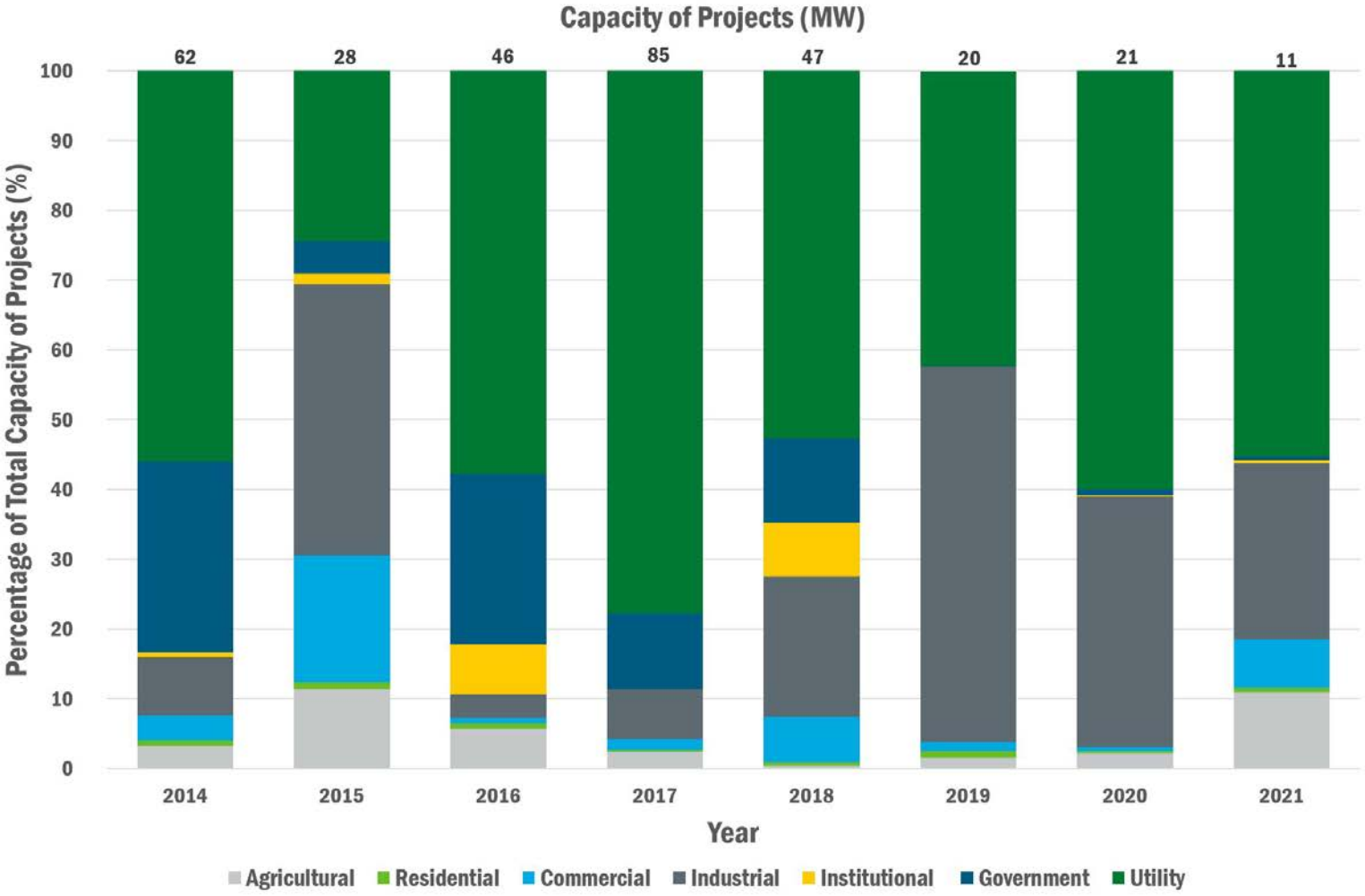
Distributed Wind Markets

Agricultural customers had 55% of the number of all projects installed in 2021, followed by residential customers at 16%



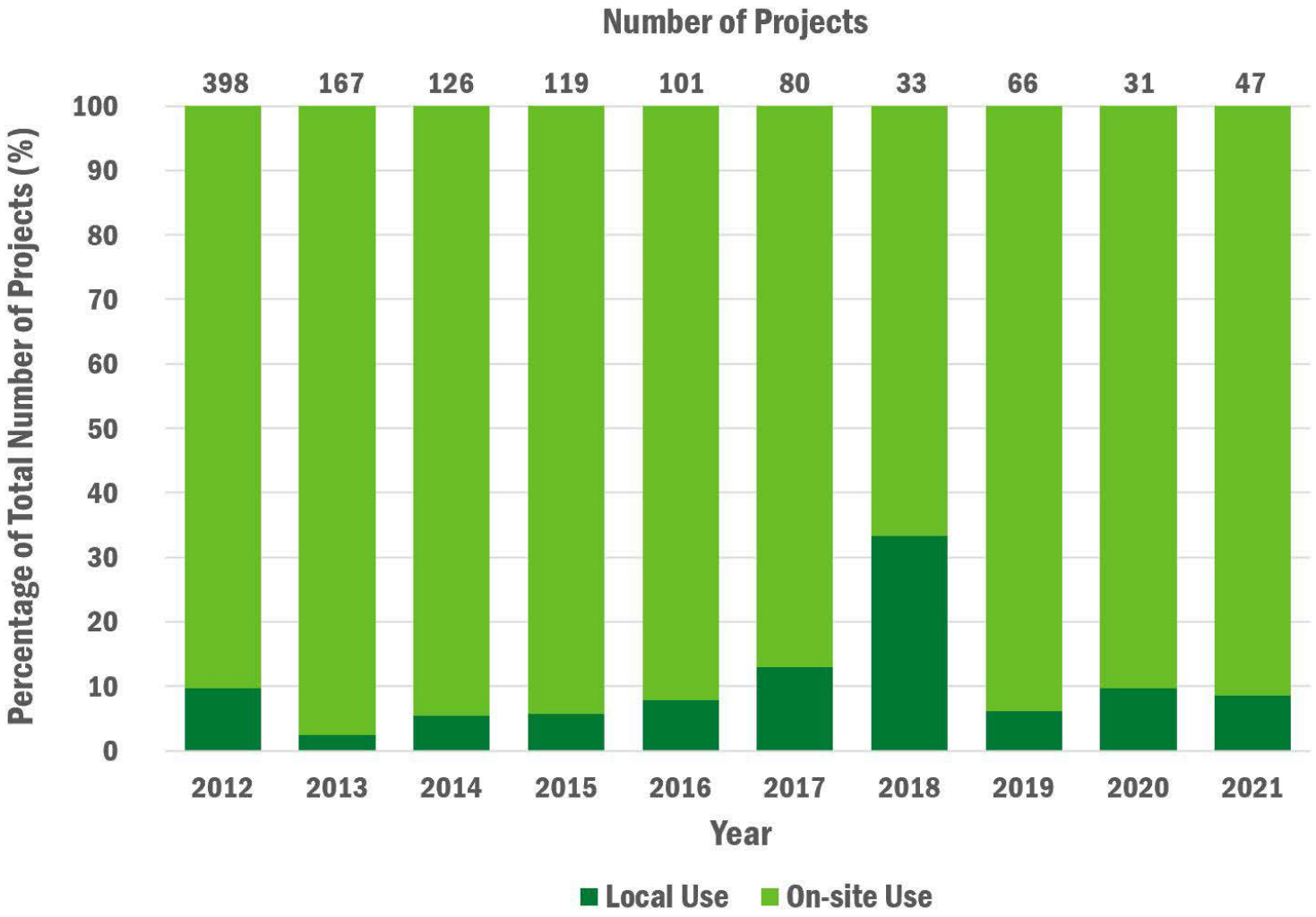
Distributed wind end-use customer types by number of projects, 2014–2021

Utility customers, who typically use large-scale turbines, had 56% of the total distributed wind capacity installed in 2021



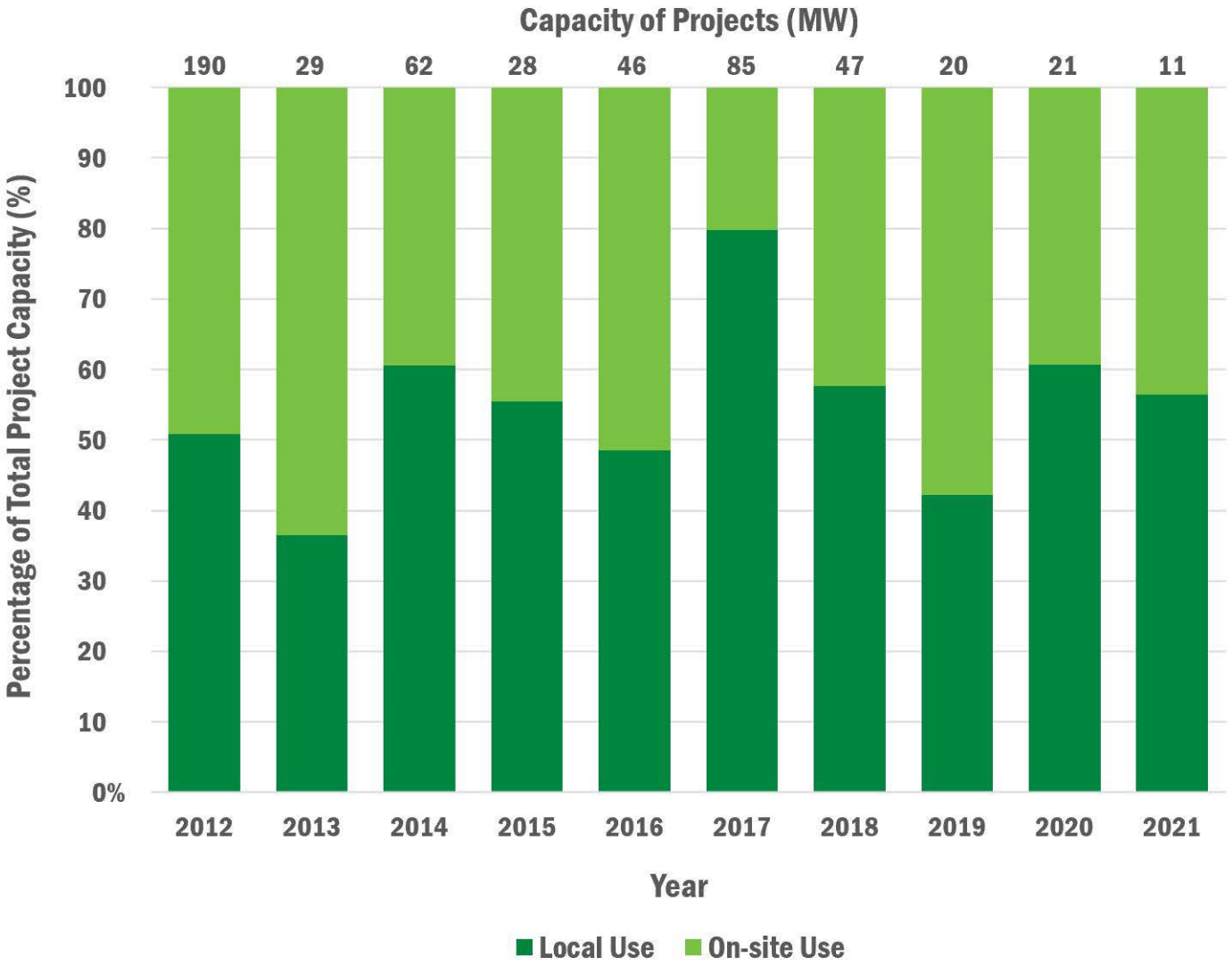
Distributed wind end-use customer types by capacity of projects, 2014–2021

From 2012 through 2021, 90% of all distributed wind projects, on average, were interconnected for on-site use



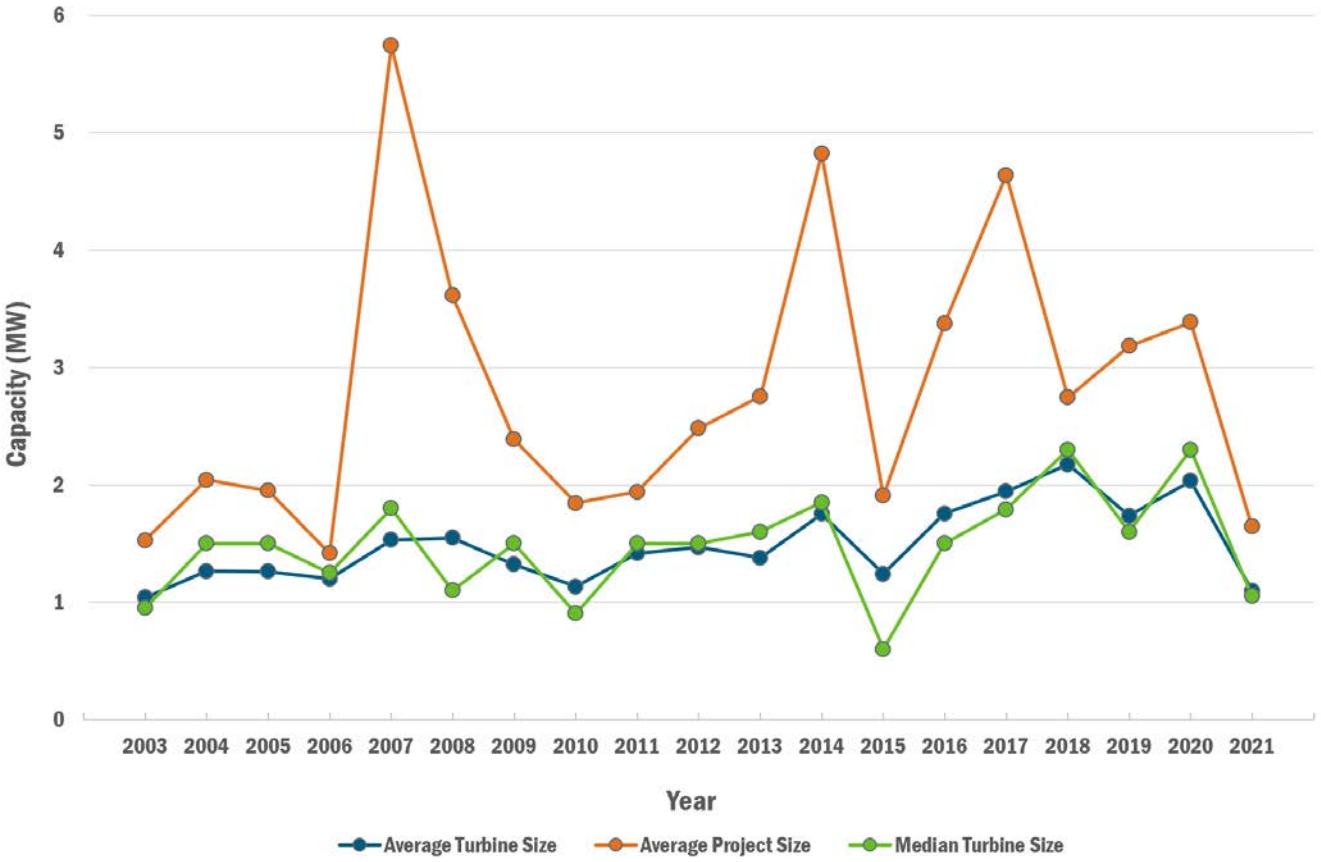
Distributed wind for on-site use and local loads by number of projects, 2012–2021

From 2012 through 2021, 55% of total distributed wind capacity served local loads, while 45% was for on-site use



Distributed wind for on-site use and local loads by capacity of projects, 2012–2021

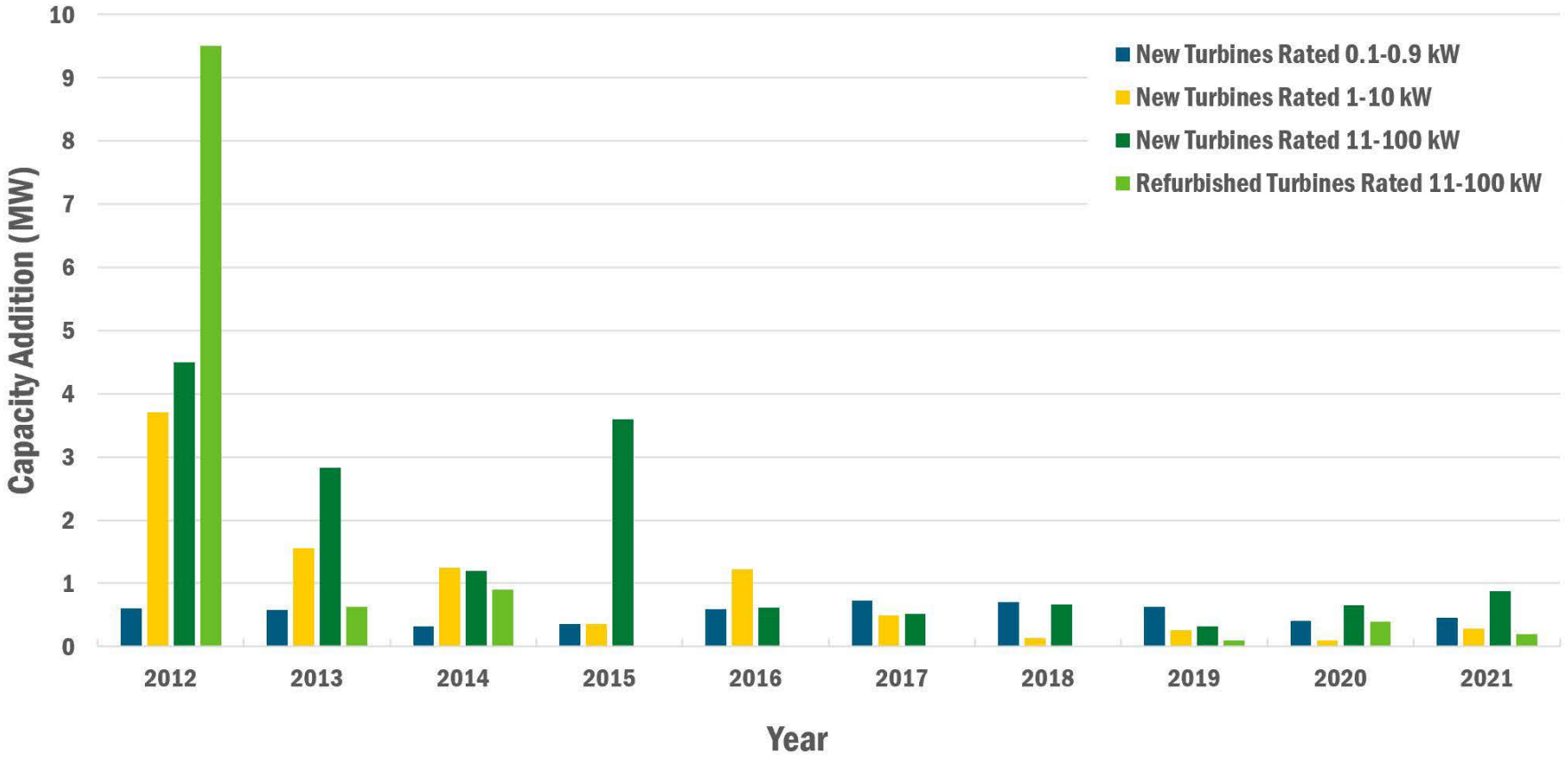
In 2021, the average capacity of turbines greater than 100 kW in distributed wind projects was 1.1 MW



Average size of turbines greater than 100 kW in distributed wind projects and average size of those projects, 2003–2021

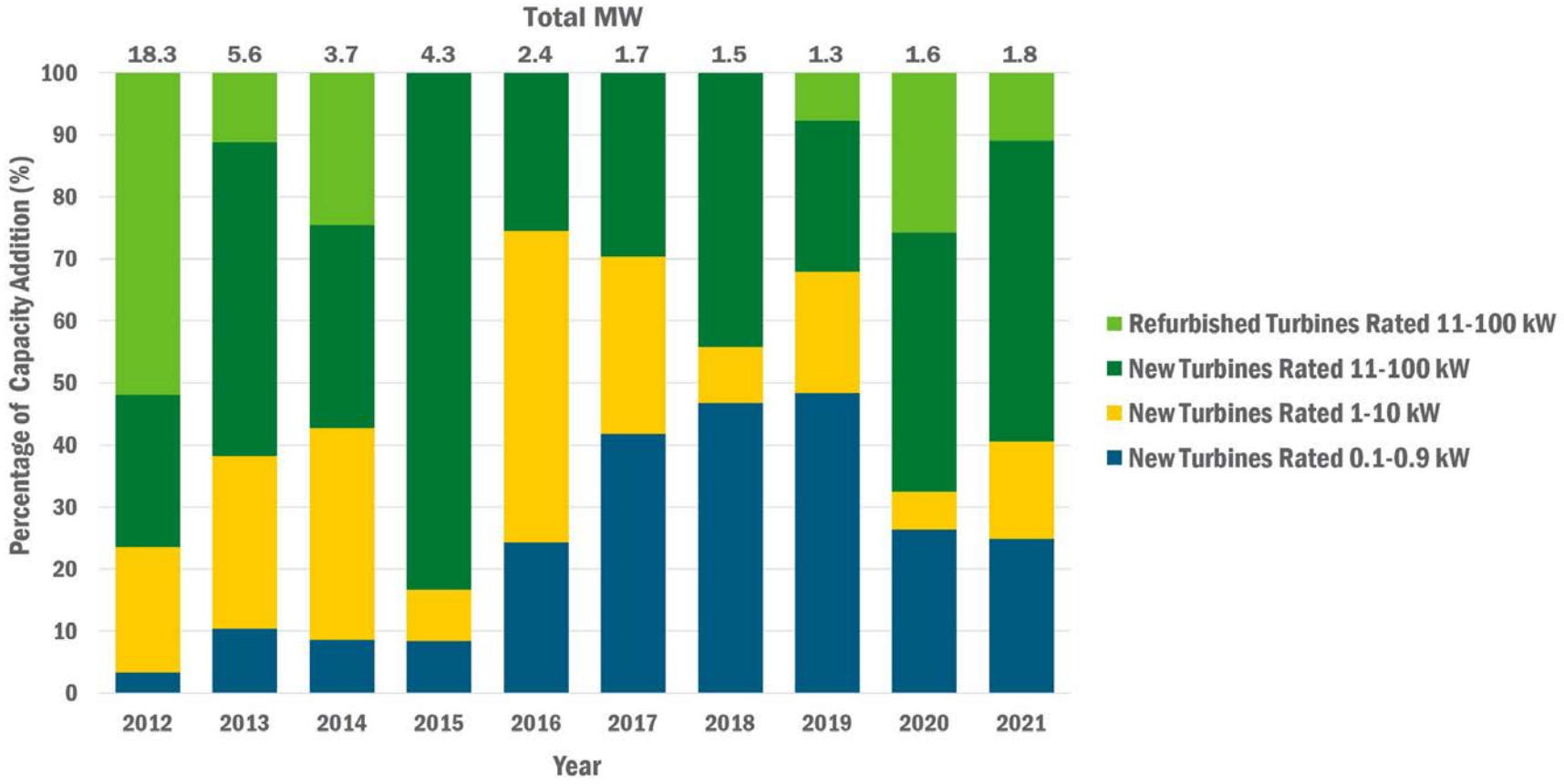
- The average turbine capacity was 2 MW in 2020. Similar drops in average turbine size (and average project size) can also be observed in years 2008, 2010, and 2015 when mid-size turbines accounted for more than 40% of the projects in those years.

New turbines in the size segment of 11 – 100 kW comprised the majority the small wind sales capacity in 2021



U.S. small wind sales capacity by turbine size, 2012–2021

The market share for new turbines 1 – 100 kW increased, while refurbished 11 – 100 kW and less-than-1-kW decreased



U.S. small wind sales percentage of capacity by turbine size, 2012–2021

Future Outlook, Market Potential, and Conclusions

Future Outlook and Market Potential

- The *Distributed Wind Energy Futures Study* determined there is economic potential for 919 GW of behind-the-meter installations and 474 GW of front-of-the-meter installations in a 2022 baseline scenario.
  - Economic potential is defined as having a positive rate of return
  - The projections increase substantially in a 2035 scenario that includes more policy support, namely the extension of the federal Investment Tax Credit and relaxed siting conditions.
- The Distributed Wind Energy Association's vision to achieve 35 GW of behind-the-meter distributed wind by 2035 requires the implementation of policy and program changes.
- One Energy Enterprise LLC estimates there is 36 GW of behind-the-meter distributed wind market potential for industrial customers.
- Although these studies have different focuses and assumptions, they all agree that there is significant market potential for distributed wind. However, based on current deployment levels, meeting these projections would require efforts that go beyond business as usual.

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.
    - Large-scale wind turbines continue to account for most of the distributed wind capacity additions; however, the total annual deployed capacity using large-scale turbines fluctuates year to year as these projects have longer project-development cycles than smaller distributed wind energy projects.
    - The use of mid-size turbines remains limited, but there is an upward trend in the number of projects using mid-sized turbines over the past three years.
    - The U.S. small wind market has been generally declining since a peak in 2012, but saw a slight increase in deployment in 2021.
- This variation is likely to continue considering the diverse ways in which distributed wind is able to be deployed.

Photo credit: Padma Kasthurirangan / Buffalo Renewables

See the full report for additional findings and details:

https://www.energy.gov/eere/wind/articles/distributed-wind-market-report-2022-edition

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For PNNL's Project Dataset, visit:

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

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