U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Land-Based Wind Market Report: 2021 Edition

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Land-Based Wind Market Report: 2021 Edition

Purpose and Scope:

- Summarize data on key trends in the U.S. wind power sector
- Focus on land-based wind turbines over 100 kW in size
  - Separate DOE-funded data collection efforts on distributed and offshore wind
- Focus on historical data, with some emphasis on the previous year

Funding:

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

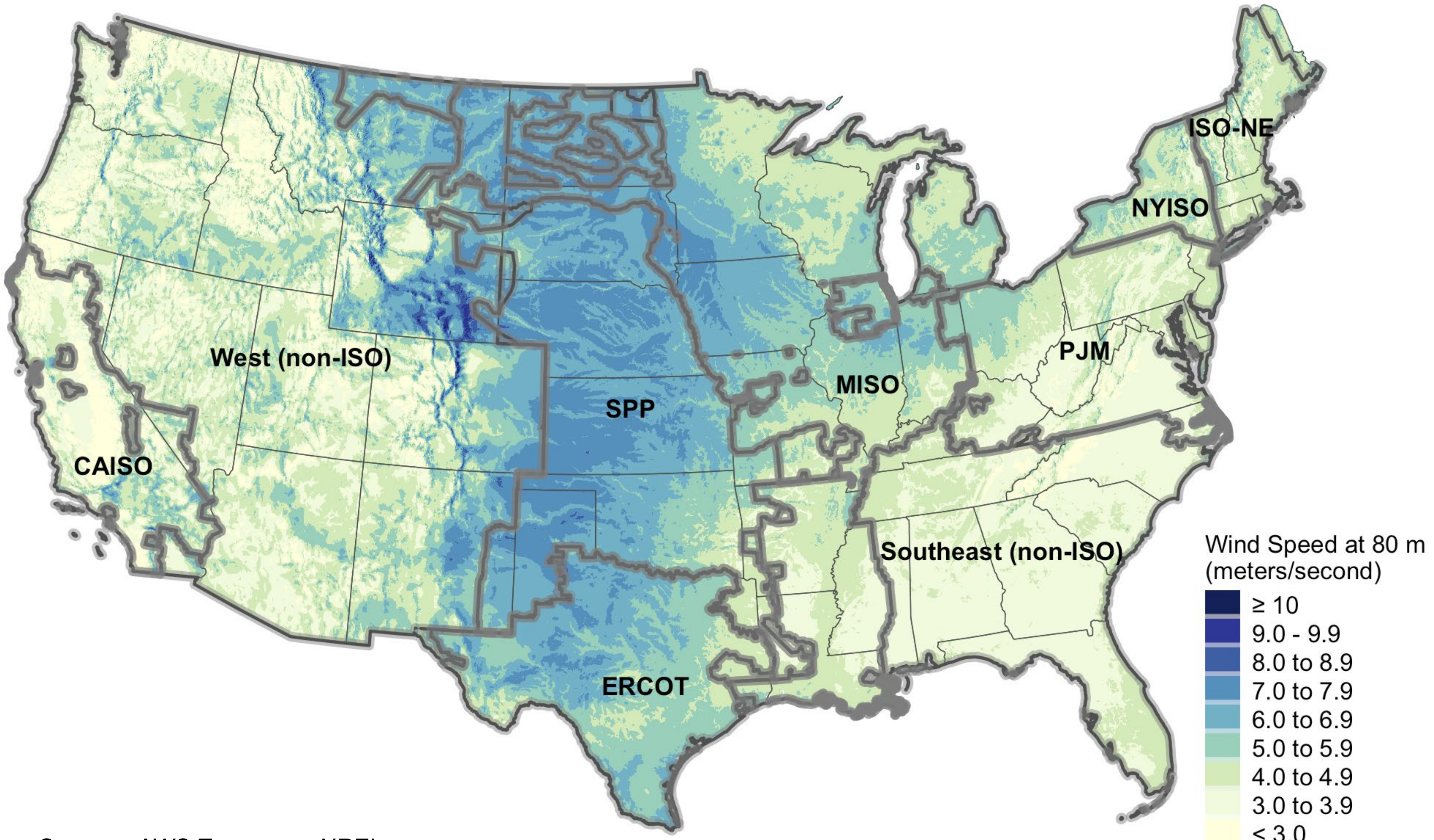
Products and Availability:

- This briefing is complemented with underlying report, data file, and visualizations
- All products available at: windreport.lbl.gov

Presentation Contents

- Installation trends
- Industry trends
- Technology trends
- Performance trends
- Cost trends
- Power sales price and levelized cost trends
- Cost and value comparisons
- Future outlook

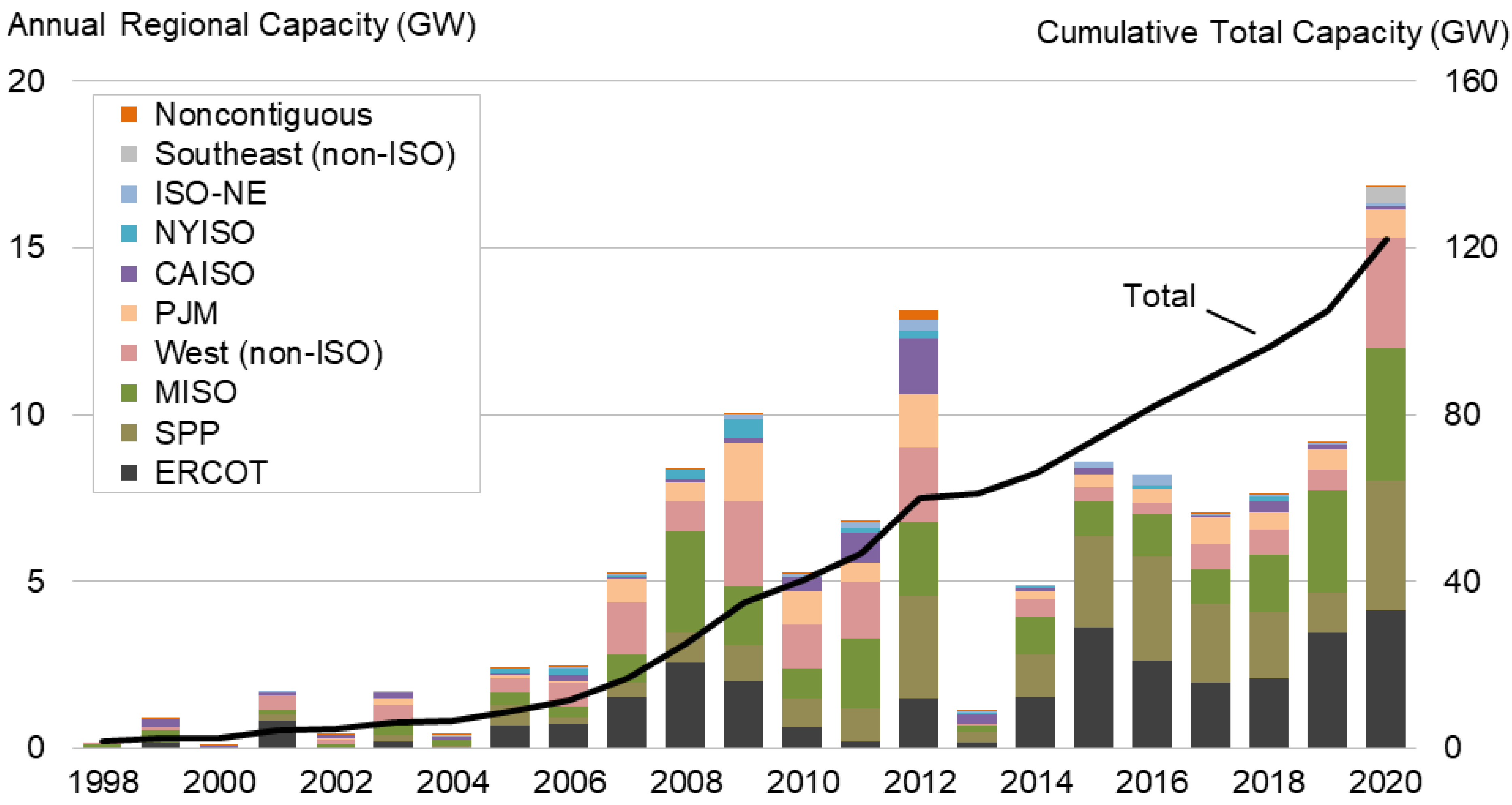
Regional boundaries applied in this analysis include the seven independent system operators (ISO) and two non-ISO regions



Sources: AWS Truepower, NREL

Installation Trends

Wind power capacity was added at a record pace in 2020, with 16,836 MW of new capacity added and $24.6 billion invested



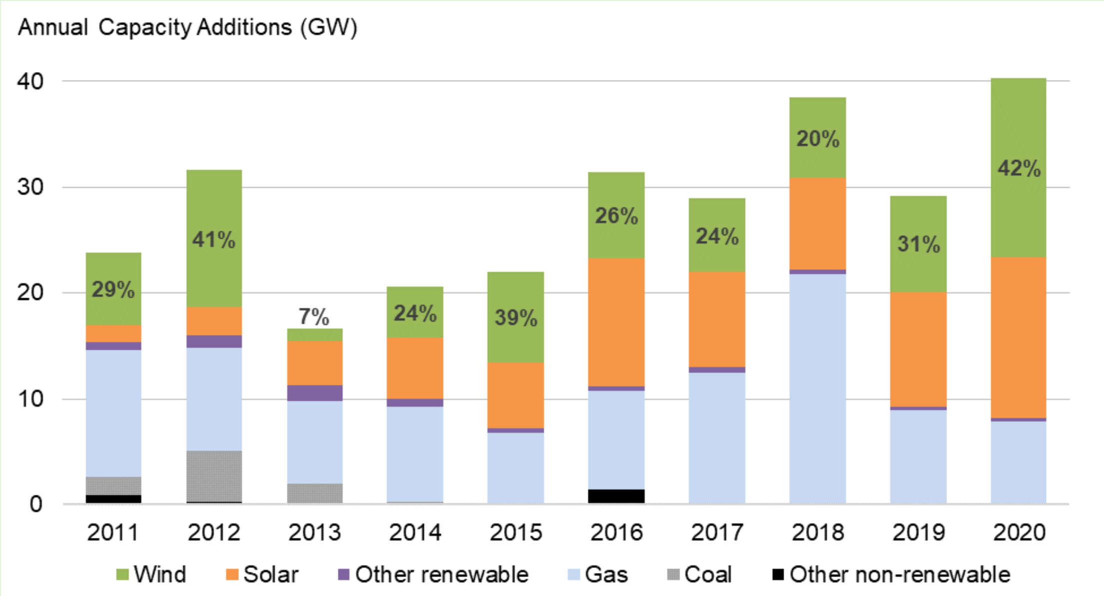
Source: ACP

- >70% of new capacity in ERCOT, MISO, SPP
- Partial repowering: 2,861 MW of turbines retrofitted in 2020

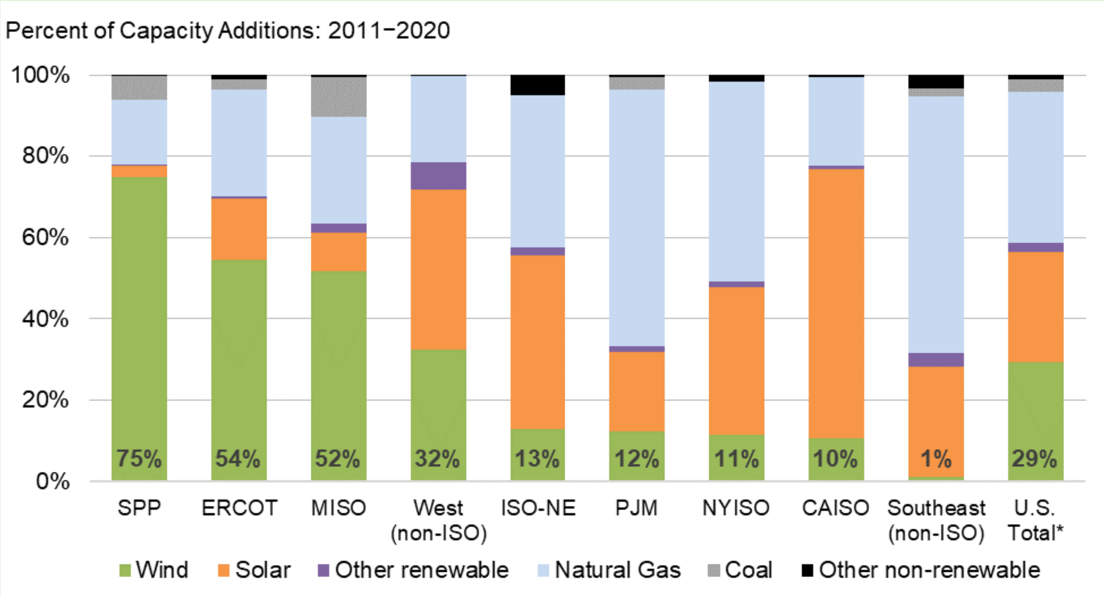
Interactive data visualization: https://emp.lbl.gov/wind-energy-growth

Wind power represented the largest source of U.S. electric-generating capacity additions in 2020

Relative contribution of generation types in annual capacity additions



Generation capacity additions by region: 2011-2020



Sources: ABB, ACP, Wood Mackenzie, Berkeley Lab

Over the last decade, wind has comprised 29% of total capacity additions, and a much higher proportion in SPP, ERCOT, and MISO

Globally, the United States ranked 2nd in annual and cumulative wind power capacity additions in 2020

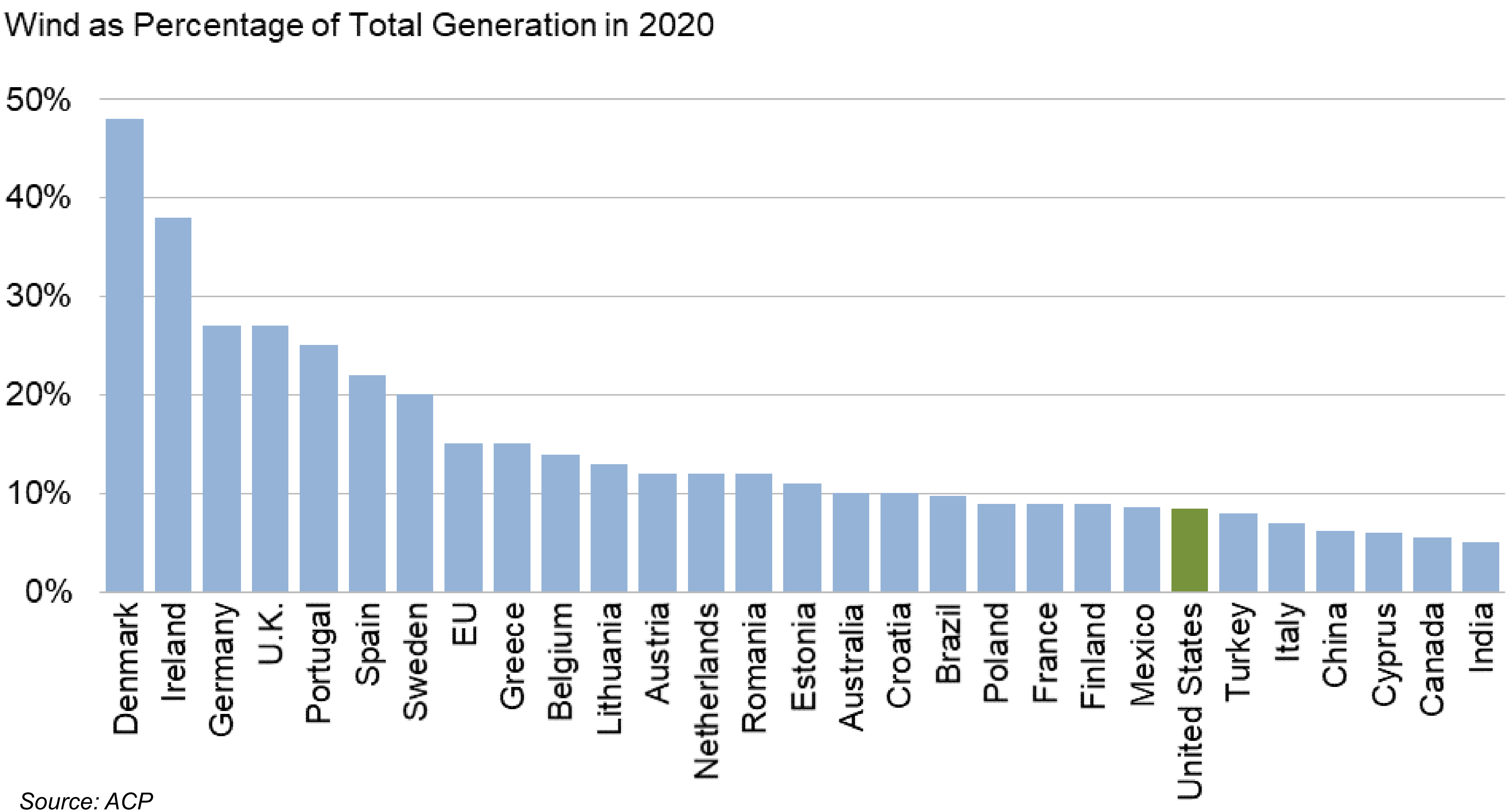
Annual Capacity (2020, MW)	
China	52,000
United States	**16,836**
Brazil	2,297
Netherlands	1,979
Germany	1,668
Norway	1,532
Spain	1,400
France	1,318
Turkey	1,224
India	1,119
Rest of World	11,538
TOTAL	**92,910**

Cumulative Capacity (end of 2020, MW)	
China	288,320
United States	**121,955**
Germany	62,850
India	38,625
Spain	27,250
United Kingdom	23,937
France	17,948
Brazil	17,750
Canada	13,578
Italy	10,543
Rest of World	119,572
TOTAL	**742,327**

Sources: GWEC, ACP

- Global wind additions hit a new record in 2020, with nearly 93 GW of newly added capacity
- U.S. remains a distant second to China in annual and cumulative capacity

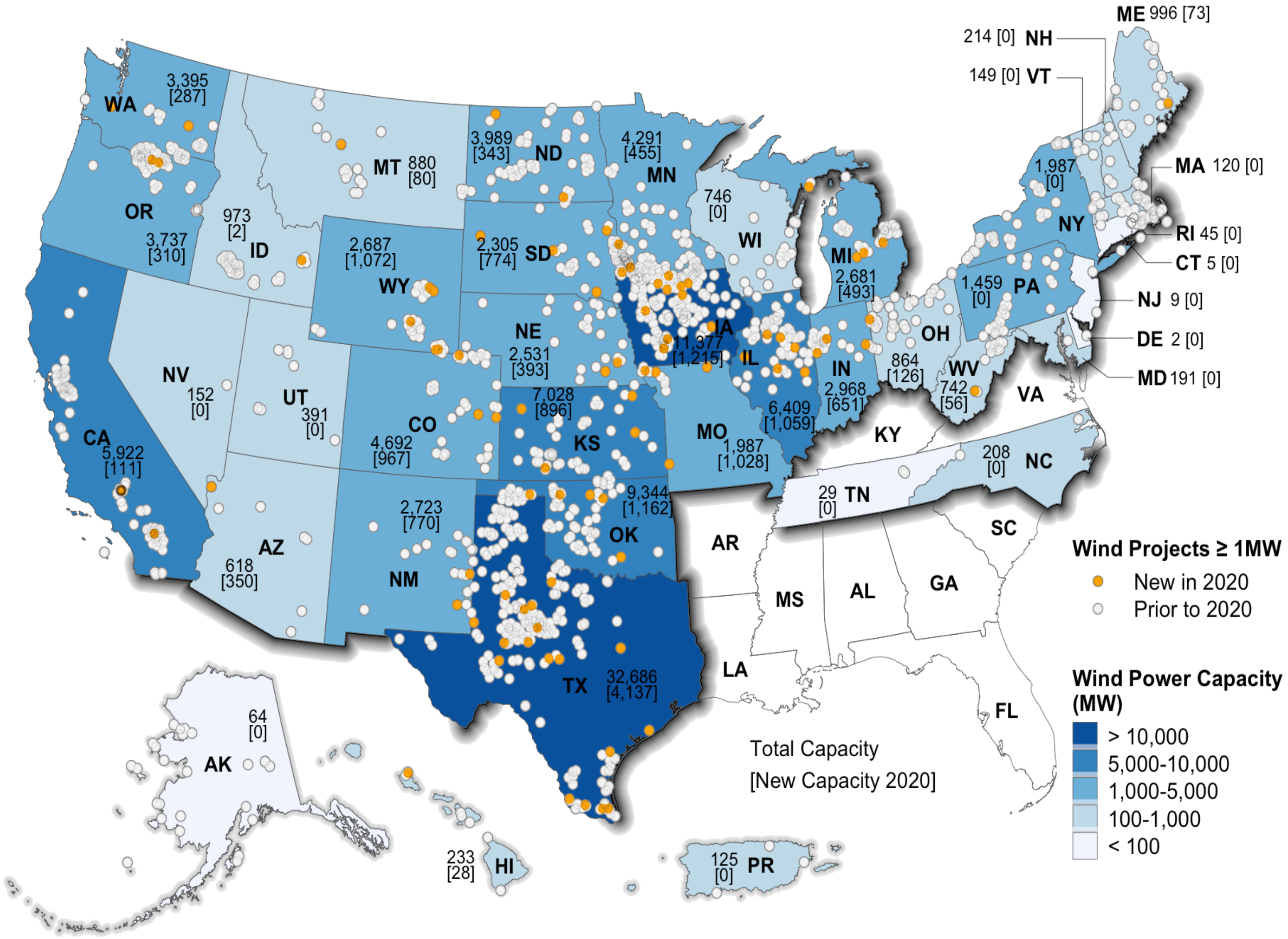
The United States ranks lower than many other countries in terms of wind energy as a share of total generation



Source: ACP

Note: Figure includes a subset of the top global wind markets

The geographic spread of wind power projects across the United States is broad, with the exception of the Southeast



Note: Numbers within states represent MegaWatts of cumulative installed wind capacity and, in brackets, annual additions in 2020.

Source: ACP, Berkeley Lab

Interactive data visualization:
https://emp.lbl.gov/wind-energy-growth

Texas installed the most wind power capacity in 2020; 16 States exceeded 10% wind as a fraction of in-state generation

Installed Capacity (MW)			
Annual (2020)		Cumulative (end of 2020)	
Texas	4,137	Texas	32,686
Iowa	1,215	Iowa	11,377
Oklahoma	1,162	Oklahoma	9,344
Wyoming	1,072	Kansas	7,028
Illinois	1,059	Illinois	6,409
Missouri	1,028	California	5,922
Colorado	967	Colorado	4,692
Kansas	896	Minnesota	4,291
South Dakota	774	North Dakota	3,989
New Mexico	770	Oregon	3,737
Indiana	651	Washington	3,395
Michigan	493	Indiana	2,968
Minnesota	455	New Mexico	2,723
Nebraska	393	Wyoming	2,687
Arizona	350	Michigan	2,681
North Dakota	343	Nebraska	2,531
Oregon	310	South Dakota	2,305
Washington	287	Missouri	1,987
Ohio	126	New York	1,987
California	111	Pennsylvania	1,459
Rest of U.S.	*238*	*Rest of U.S.*	*7,756*
Total	**16,836**	**Total**	**121,955**

2020 Wind Generation as a Percentage of:			
In-State Generation		In-State Sales	
Iowa	57.3%	Iowa	68.6%
Kansas	43.2%	North Dakota	61.7%
Oklahoma	35.4%	Kansas	61.2%
South Dakota	32.9%	Oklahoma	47.9%
North Dakota	30.8%	South Dakota	44.8%
Maine	23.8%	Wyoming	33.5%
Nebraska	23.6%	Nebraska	28.8%
Colorado	23.2%	New Mexico	28.6%
Minnesota	21.6%	Texas	22.7%
New Mexico	20.7%	Colorado	22.6%
Texas	19.5%	Maine	22.3%
Vermont	15.1%	Montana	20.8%
Idaho	14.1%	Minnesota	19.6%
Oregon	13.1%	Oregon	18.0%
Montana	12.6%	Illinois	13.0%
Wyoming	12.3%	Idaho	11.3%
Illinois	9.8%	Washington	9.8%
Washington	7.3%	Vermont	7.3%
Indiana	7.3%	Michigan	7.0%
California	6.4%	Indiana	7.0%
Rest of U.S.	*1.2%*	*Rest of U.S.*	*1.0%*
Total	**8.3%**	**Total**	**9.2%**

2020 Wind Penetration by ISO/RTO:

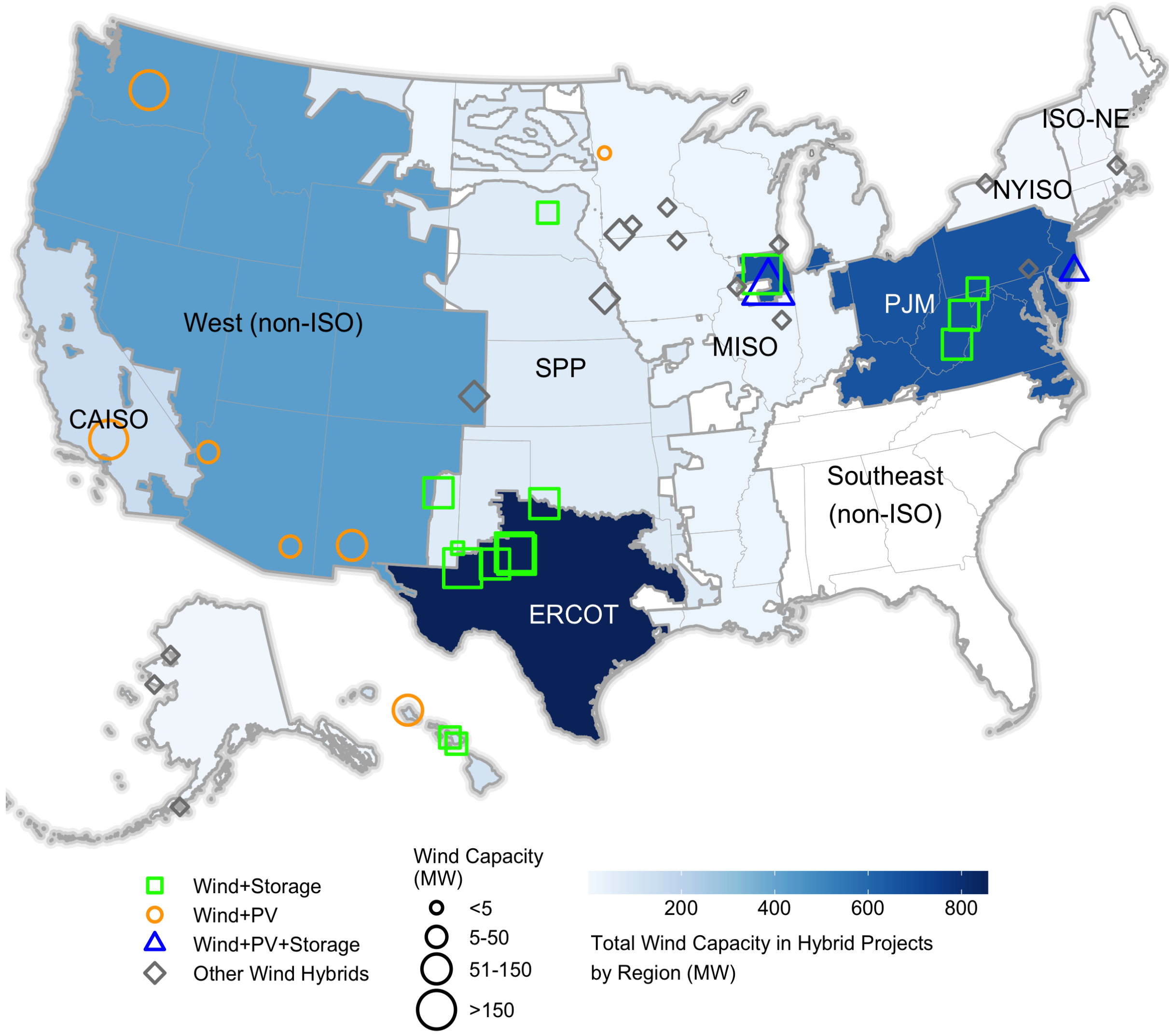
- SPP: 31.3%
- ERCOT: 22.7%
- MISO: 11.0%
- CAISO: 6.6%
- PJM: 3.4%
- ISO-NE: 3.0%
- NYISO: 2.9%

Interactive data visualization: https://emp.lbl.gov/wind-energy-growth

Source: ACP, EIA

A small but growing number of hybrid plants that pair wind with storage and other resources are operating in the United States

Online Wind Hybrid / Co-located Projects

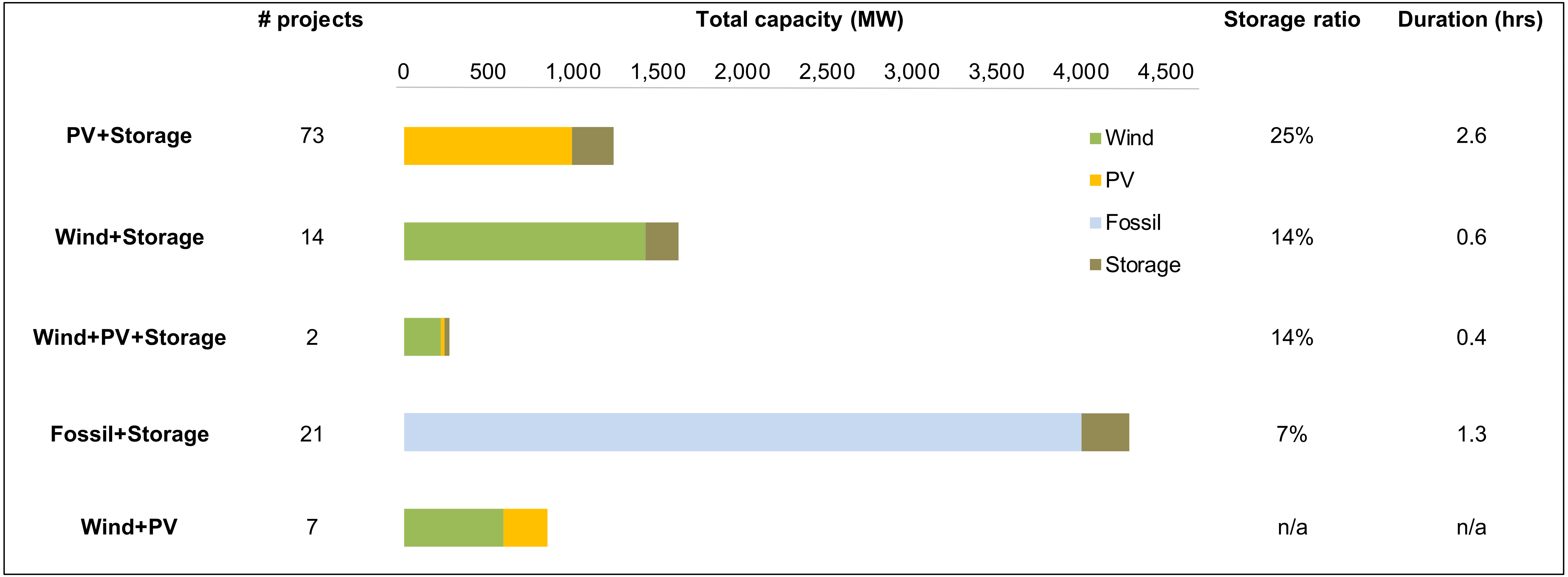


- 38 hybrid wind power plants in operation at the end of 2020
- Represent 2.3 GW of wind power and 0.9 GW of co-located resources
- Most common wind hybrid project combines wind+storage; other combinations include wind+PV; wind+PV+storage; wind+fossil
- ERCOT, PJM, non-ISO West host largest amount of wind hybrid capacity

Interactive data visualization:
https://emp.lbl.gov/online-hybrid-and-energy-storage-projects

Sources: EIA-860 2020 Early Release, Berkeley Lab

Comparing the frequency and design of a subset of the hybrid / co-located project configurations: end of 2020



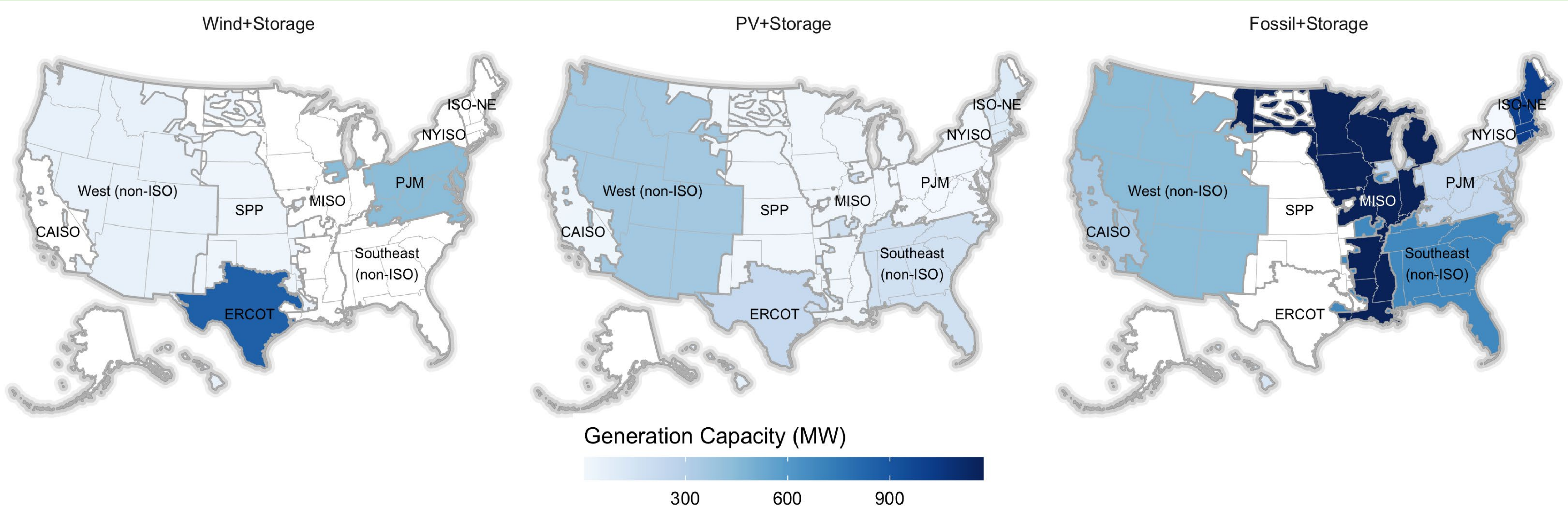
Notes: Not included in the figure are 111 other hybrid / co-located projects with other configurations. Storage ratio is defined as storage capacity divided by total generator capacity.

Sources: EIA 860 2020 Early Release, Berkeley Lab

Most wind hybrids are Wind+Storage, with limited storage duration to serve ancillary services markets

Interactive data visualization: https://emp.lbl.gov/online-hybrid-and-energy-storage-projects

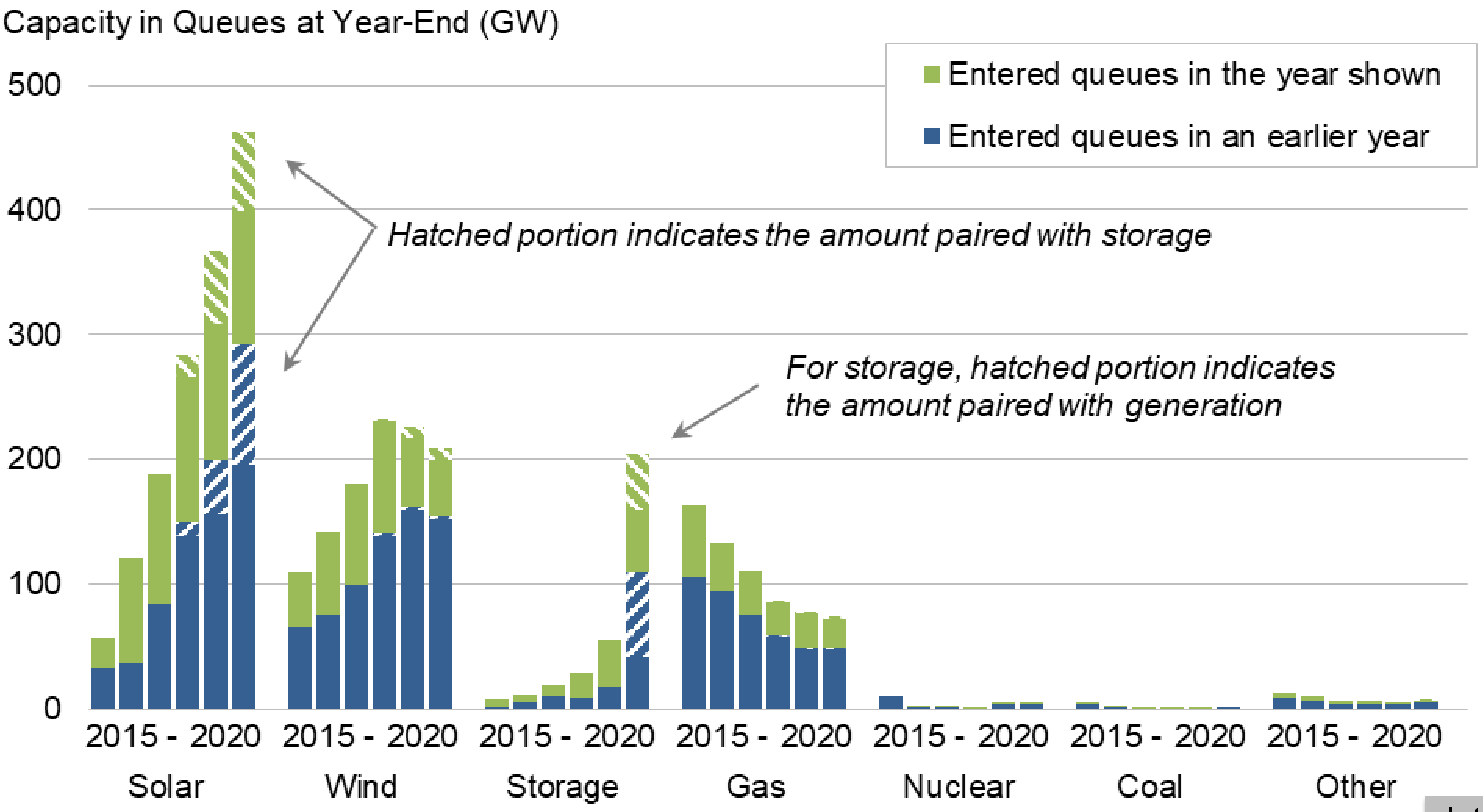
Generator + storage hybrid / co-located projects at end of 2020: wind+storage, PV+storage, fossil+storage



- Wind+storage plants located primarily in ERCOT and PJM so far
- PV+storage plants located primarily in non-ISO West, ERCOT, and Southeast
- Fossil+storage plants located primarily in MISO and ISO-NE

Interactive data visualization: https://emp.lbl.gov/online-hybrid-and-energy-storage-projects

Despite a slight contraction since 2018, 209 GW of wind power capacity exists in transmission interconnection queues



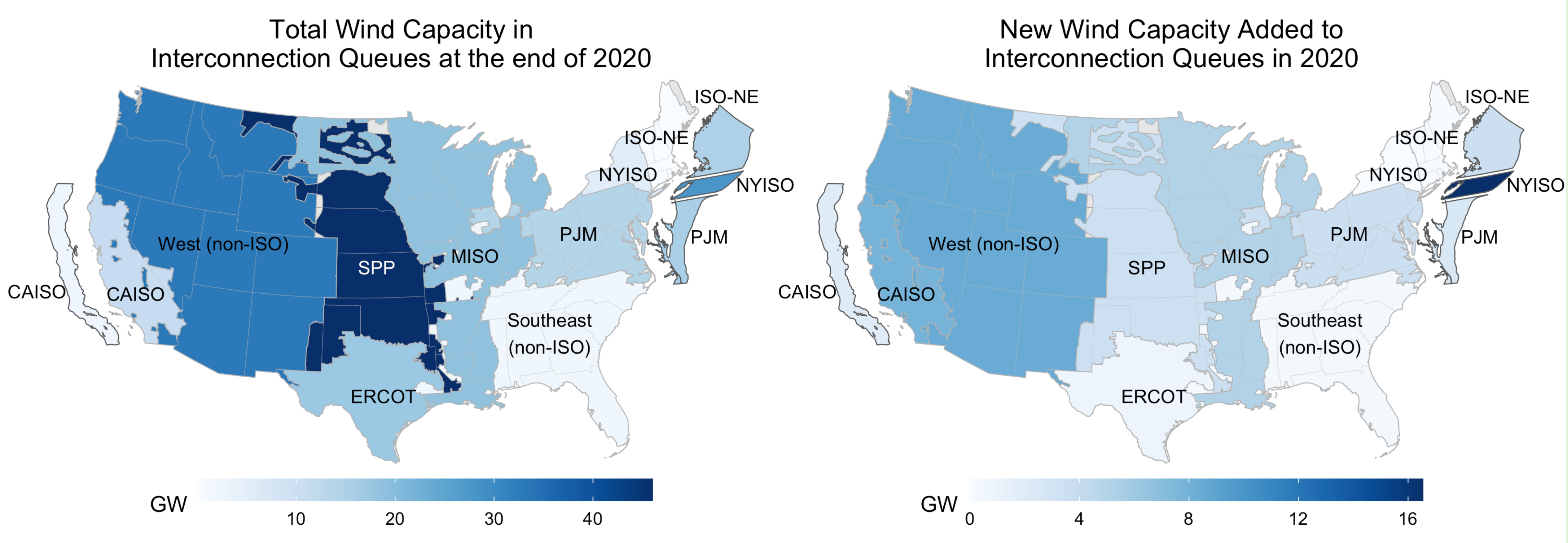
Note: Storage capacity in hybrids was not estimated for years prior to 2020.

Source: Berkeley Lab review of interconnection queues

Not all of this capacity will be built: ~25% completion rate

Interactive data visualization: https://emp.lbl.gov/generation-storage-and-hybrid-capacity

Larger amounts of wind capacity in SPP, NYISO, non-ISO West, and PJM queues; 29% (61 GW) of wind capacity in queues is offshore

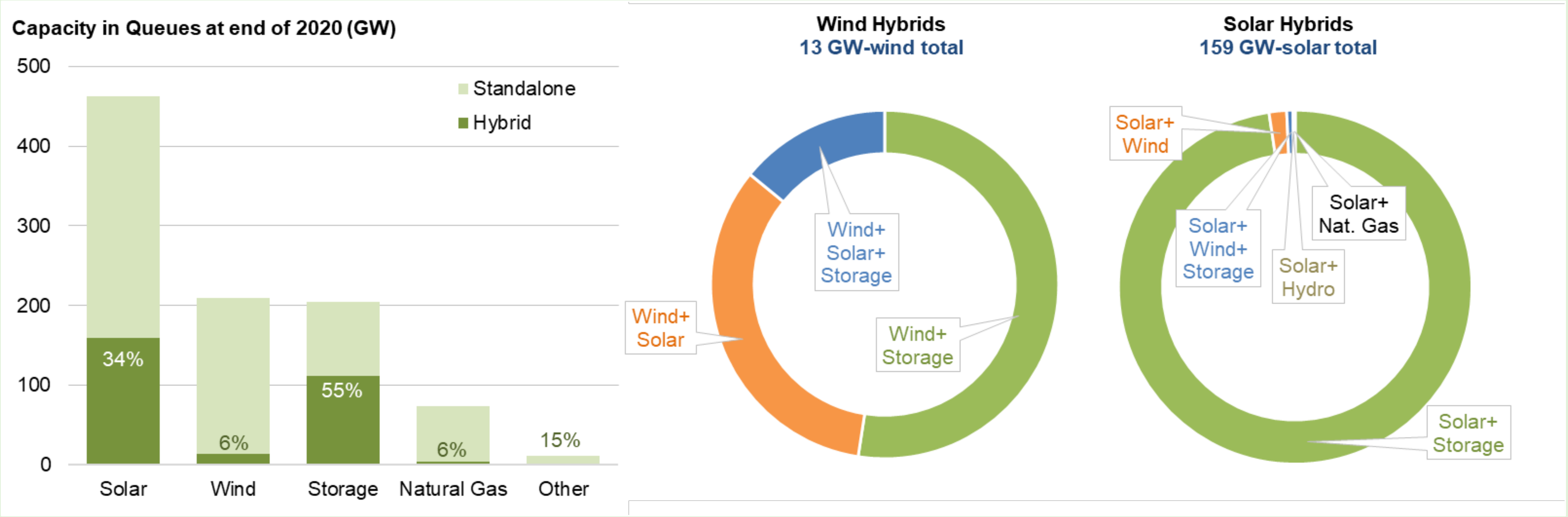


Source: Berkeley Lab review of interconnection queues

Note: Not all of this capacity will be built

Interactive data visualization: https://emp.lbl.gov/generation-storage-and-hybrid-capacity

Interest in hybrid plants has increased: 6% of wind proposed as hybrids (13 GW); 34% of solar proposed as hybrids (159 GW)

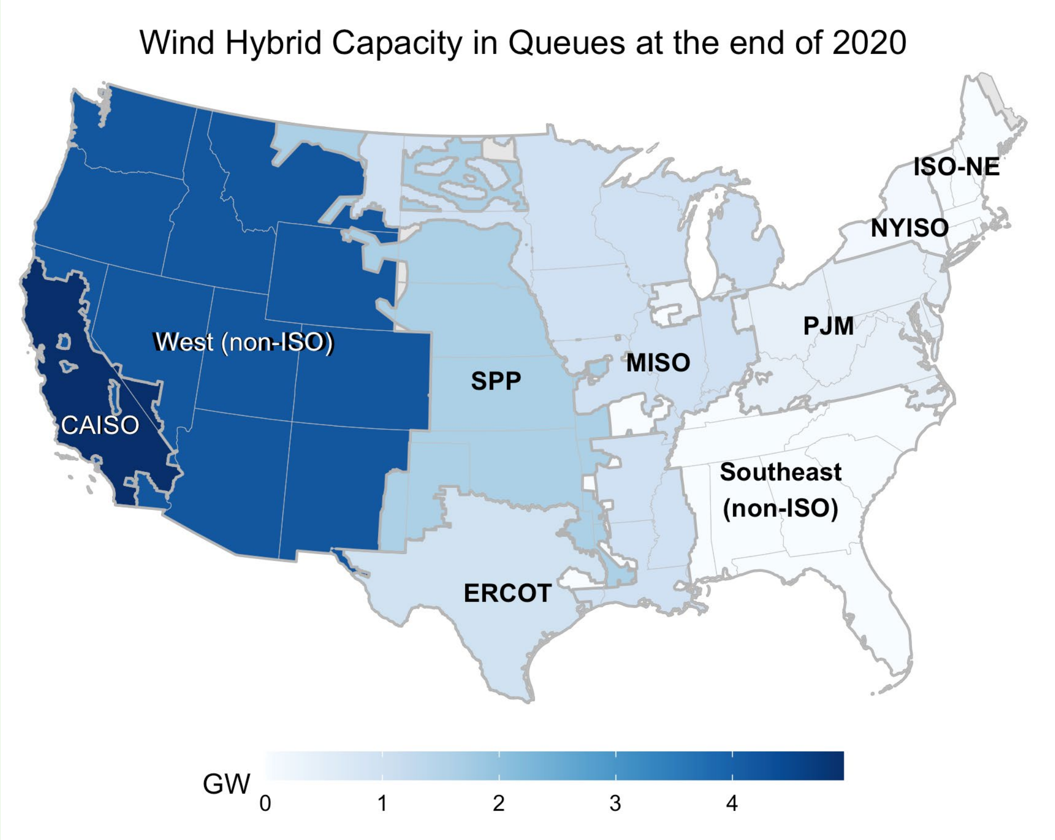


Source: Berkeley Lab review of interconnection queues

Notes: (1) Not all of this capacity will be built; (2) Hybrid plants involving multiple generator types (e.g., wind+PV+ storage, wind+PV) show up in all generator categories, presuming the capacity is known for each type.

Interactive data visualization: https://emp.lbl.gov/generation-storage-and-hybrid-capacity

Proposed wind hybrids are primarily located in California and the non-ISO Western regions



Region	% of Proposed Capacity Hybridizing in Each Region			
	Wind	Solar	Nat. Gas	Battery
CAISO	37%	89%	0%	64%
ERCOT	6%	21%	34%	37%
SPP	4%	22%	33%	38%
MISO	5%	18%	0%	n/a
PJM	1%	19%	1%	n/a
NYISO	0%	5%	6%	2%
ISO-NE	0%	12%	0%	n/a
West (non-ISO)	13%	67%	6%	n/a
Southeast (non-ISO)	0%	13%	1%	n/a
TOTAL	**6%**	**34%**	**6%**	**n/a**

Source: Berkeley Lab review of interconnection queues

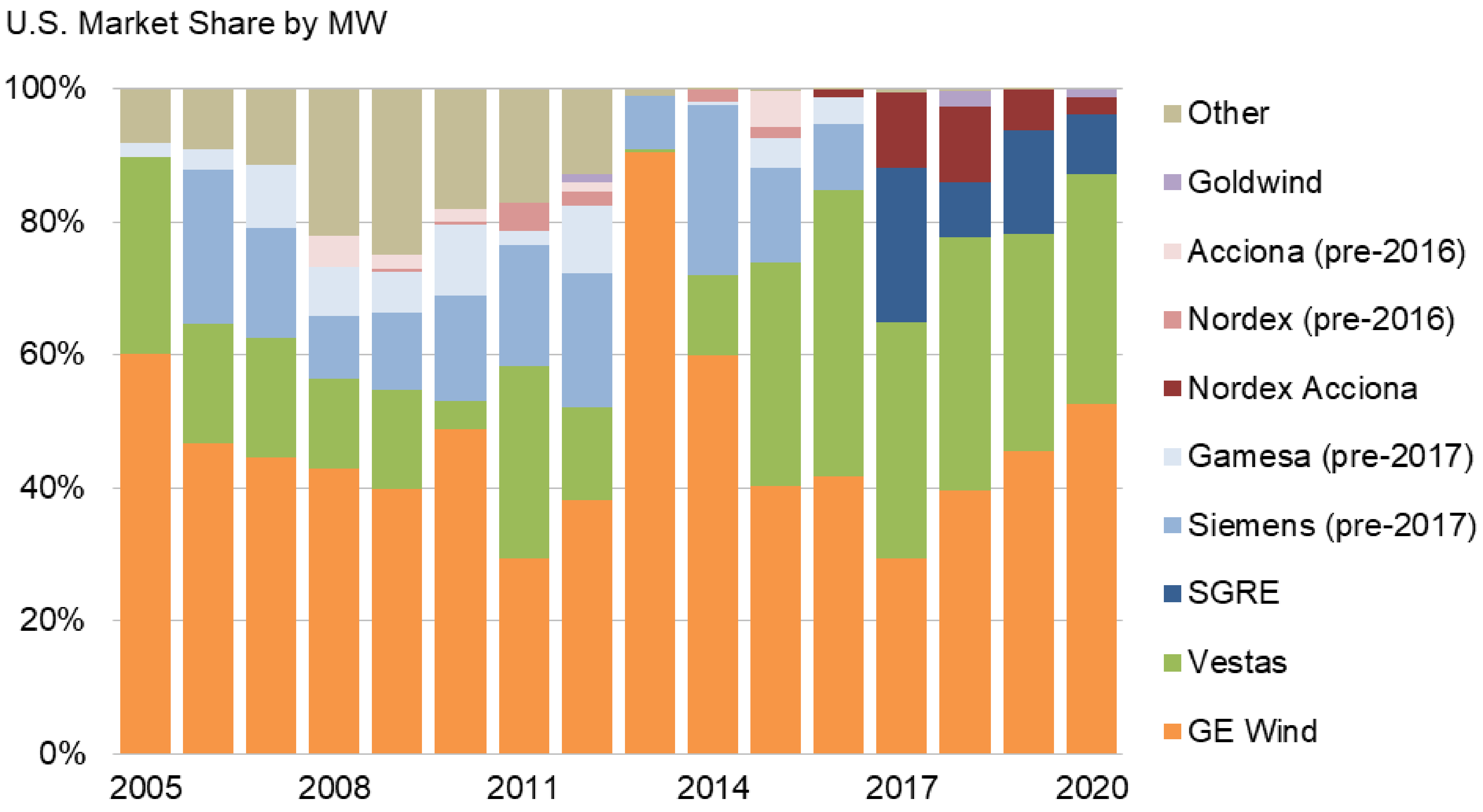
Notes: (1) Not all of this capacity will be built; (2) Hybrid plants involving multiple generator types (e.g., wind+PV+ storage, wind+PV) show up in all generator categories, presuming the capacity is known for each type..

Interactive data visualization: https://emp.lbl.gov/generation-storage-and-hybrid-capacity

Industry Trends

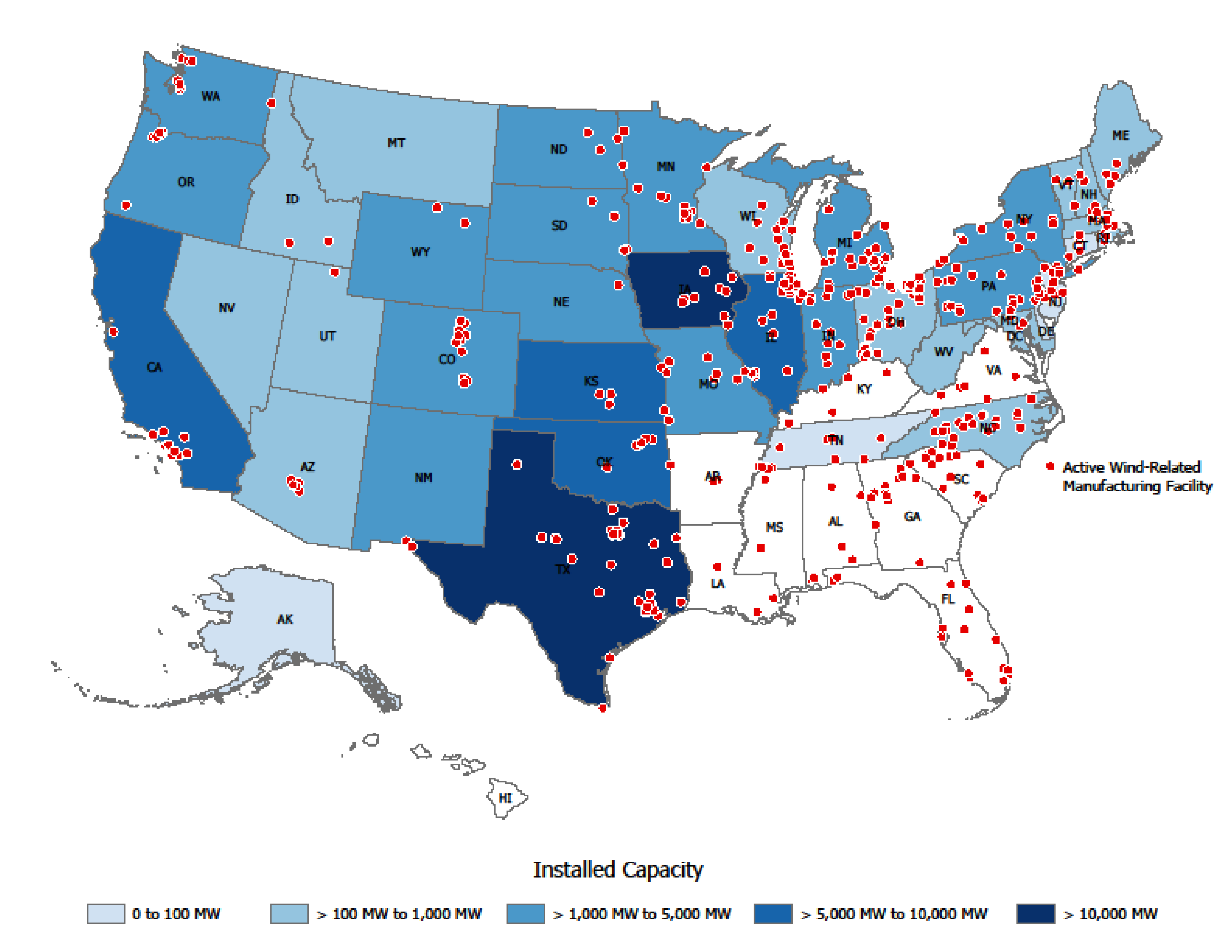
Industry Trends

GE and Vestas accounted for 87% of the U.S. wind market in 2020



Source: ACP

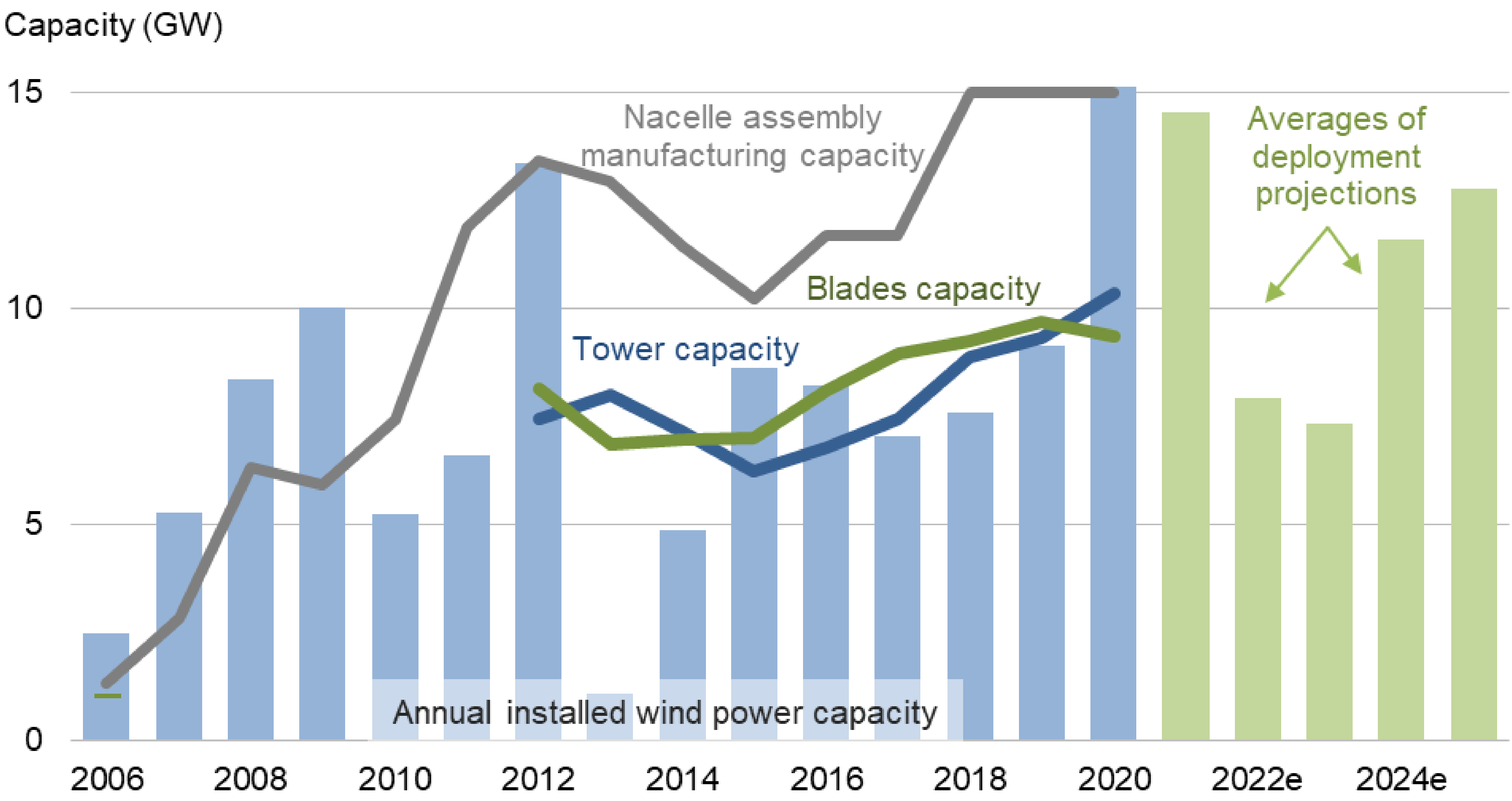
The domestic supply chain for wind equipment is diverse, with manufacturing facilities located in all regions of the country



Source: ACP

- Despite COVID-19, with record growth in wind installations, wind-related job totals in the United States increased by 1.8% in 2020, to 116,800 full-time workers
- These jobs include, among others, those in construction (42,300) and manufacturing (23,900)

Domestic manufacturing capability for nacelle assembly, towers, and blades has been reasonably well balanced against historical demand

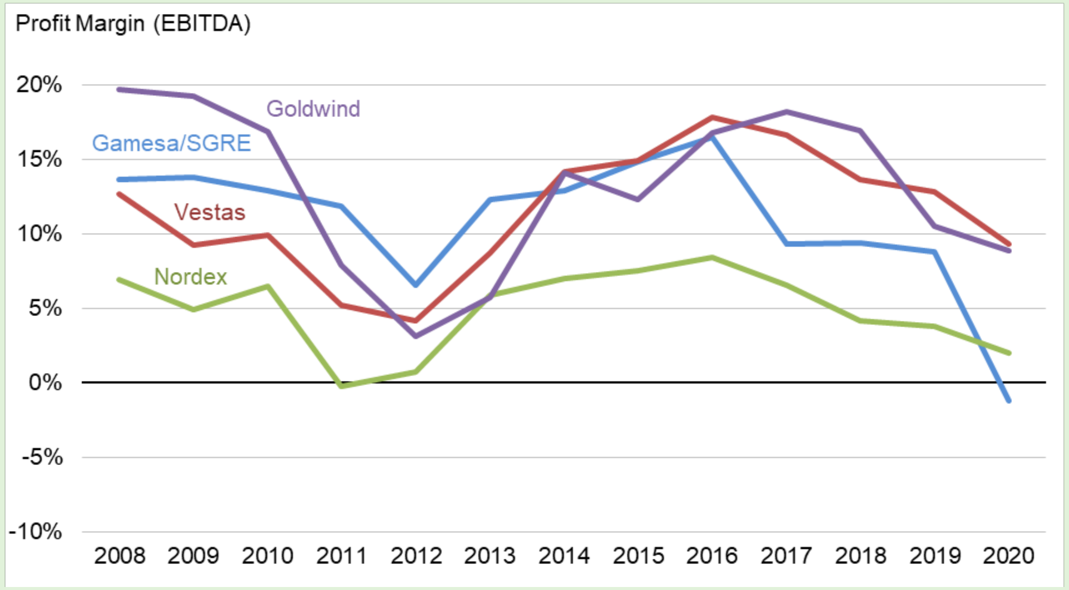


Sources: ACP, independent analyst projections, Berkeley Lab

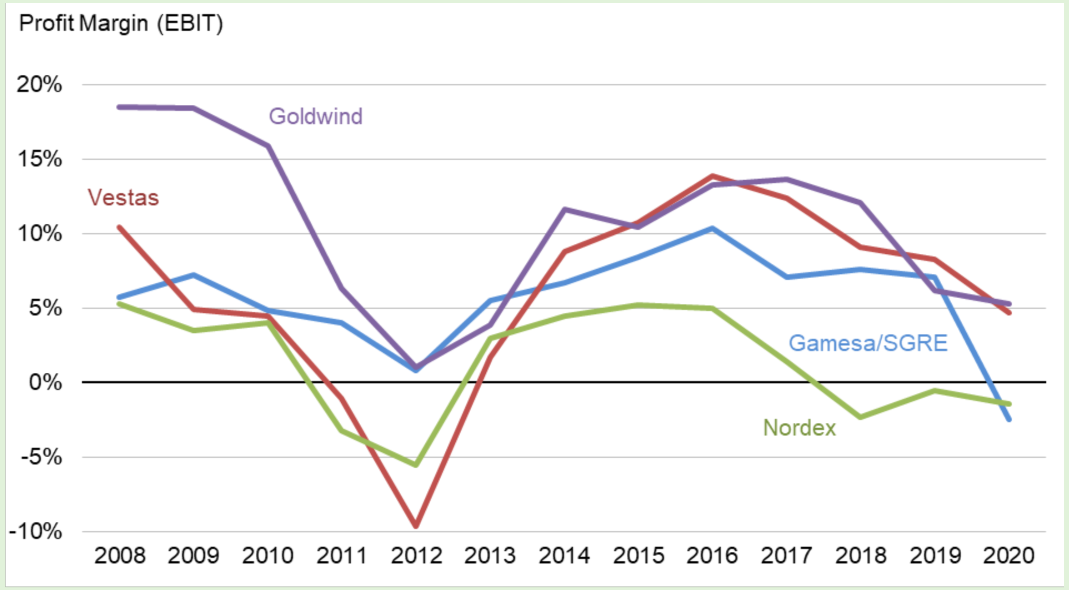
Note: Actual nacelle assembly, tower production, and blades production would be expected to be below maximum production capacity.

The profitability of global wind turbine manufacturers has generally declined over the last several years

Earnings before interest, taxes, depreciation, amortization (EBITDA)

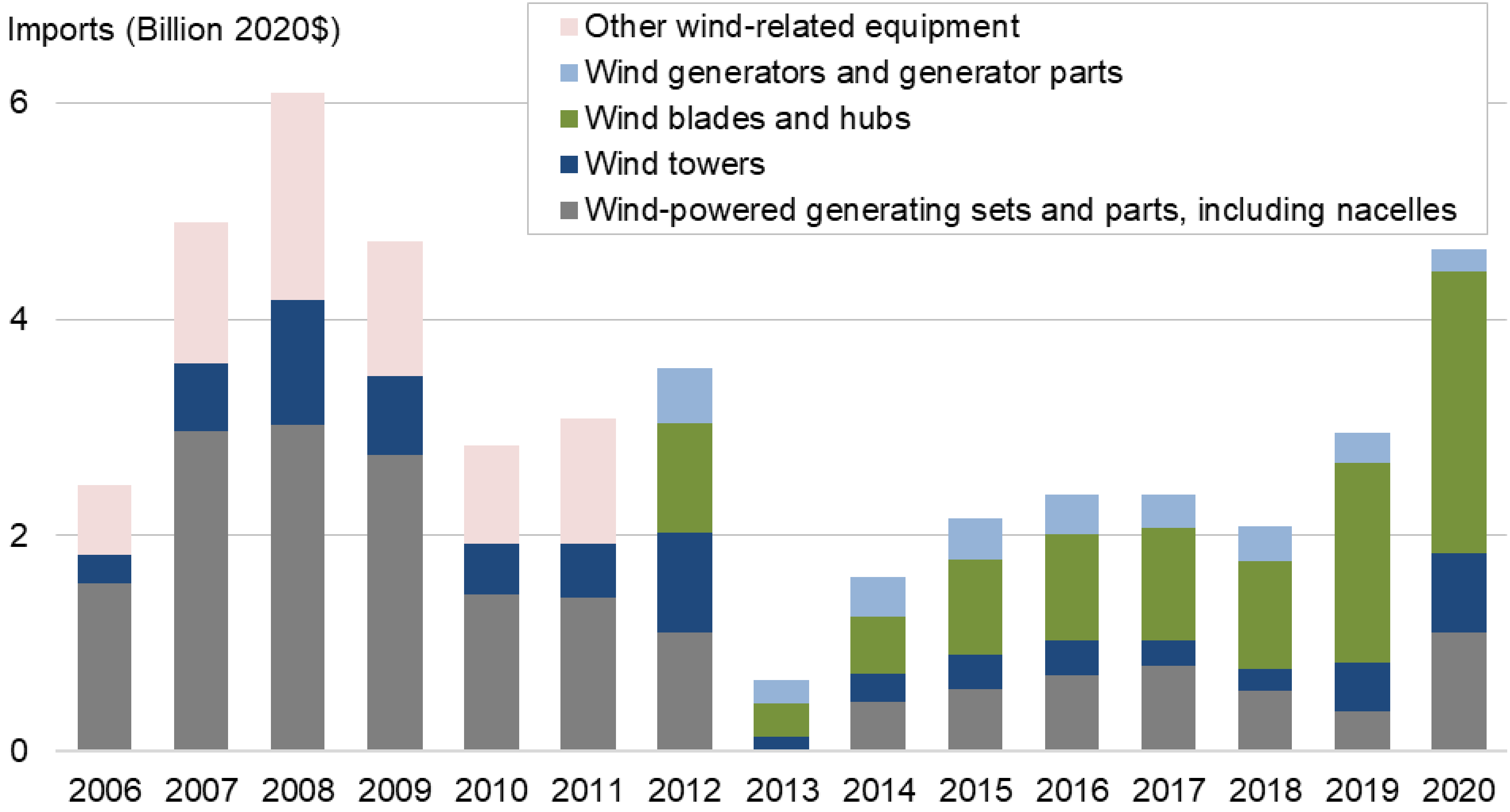


Earnings before interest and taxes (EBIT)



Sources: OEM annual reports and financial statements

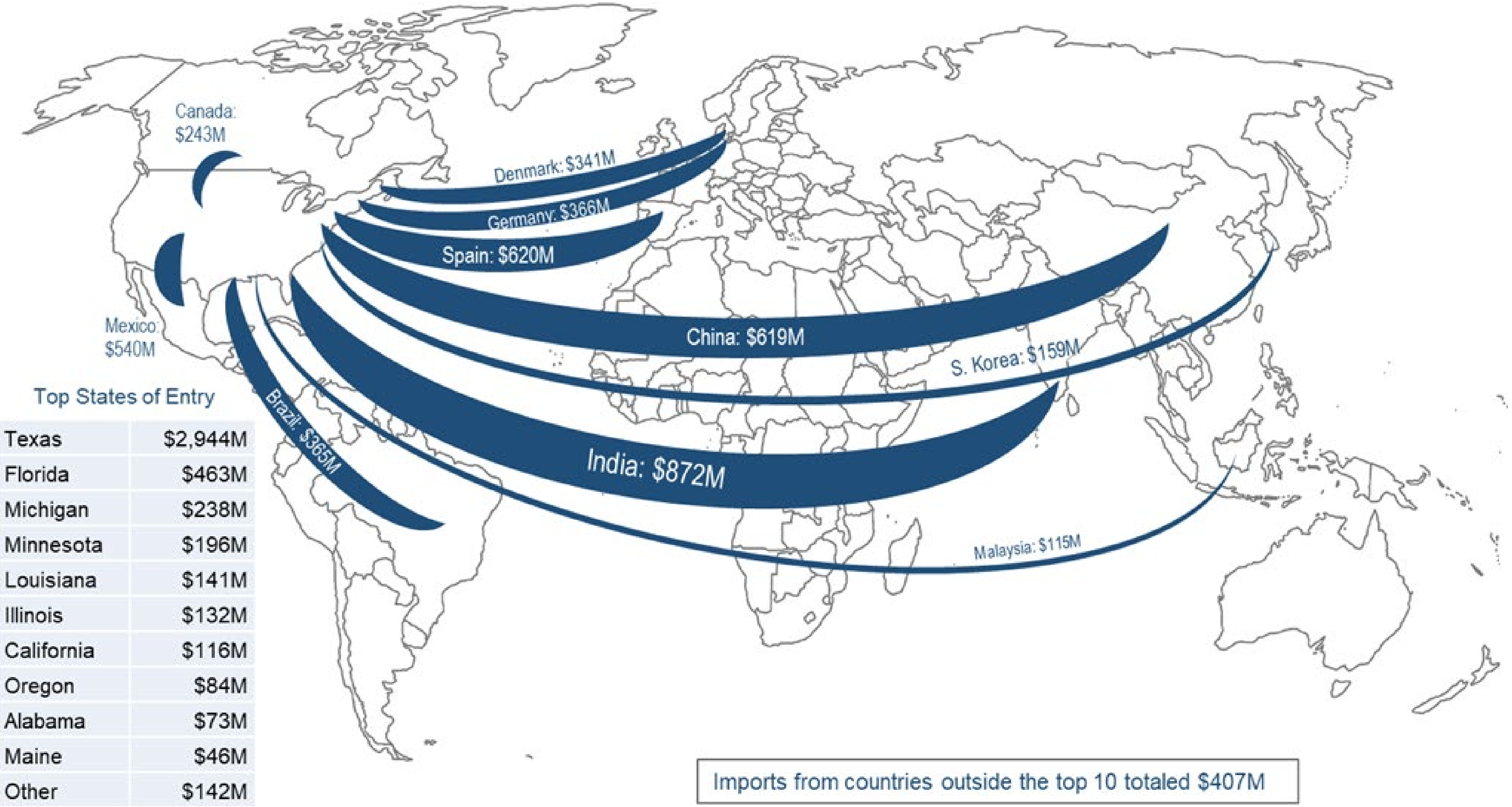
Imports of wind equipment into the United States are sizable



Source: Berkeley Lab analysis of data from USA Trade Online, https://usatrade.census.gov

Notes: Figure only includes tracked trade categories, misses other wind-related imports; wind-related trade codes and definitions are not consistent over the full time period; see full report for the assumptions used to generate the figure.

Tracked wind equipment imports into the United States in 2020 came from multiple regions of the world



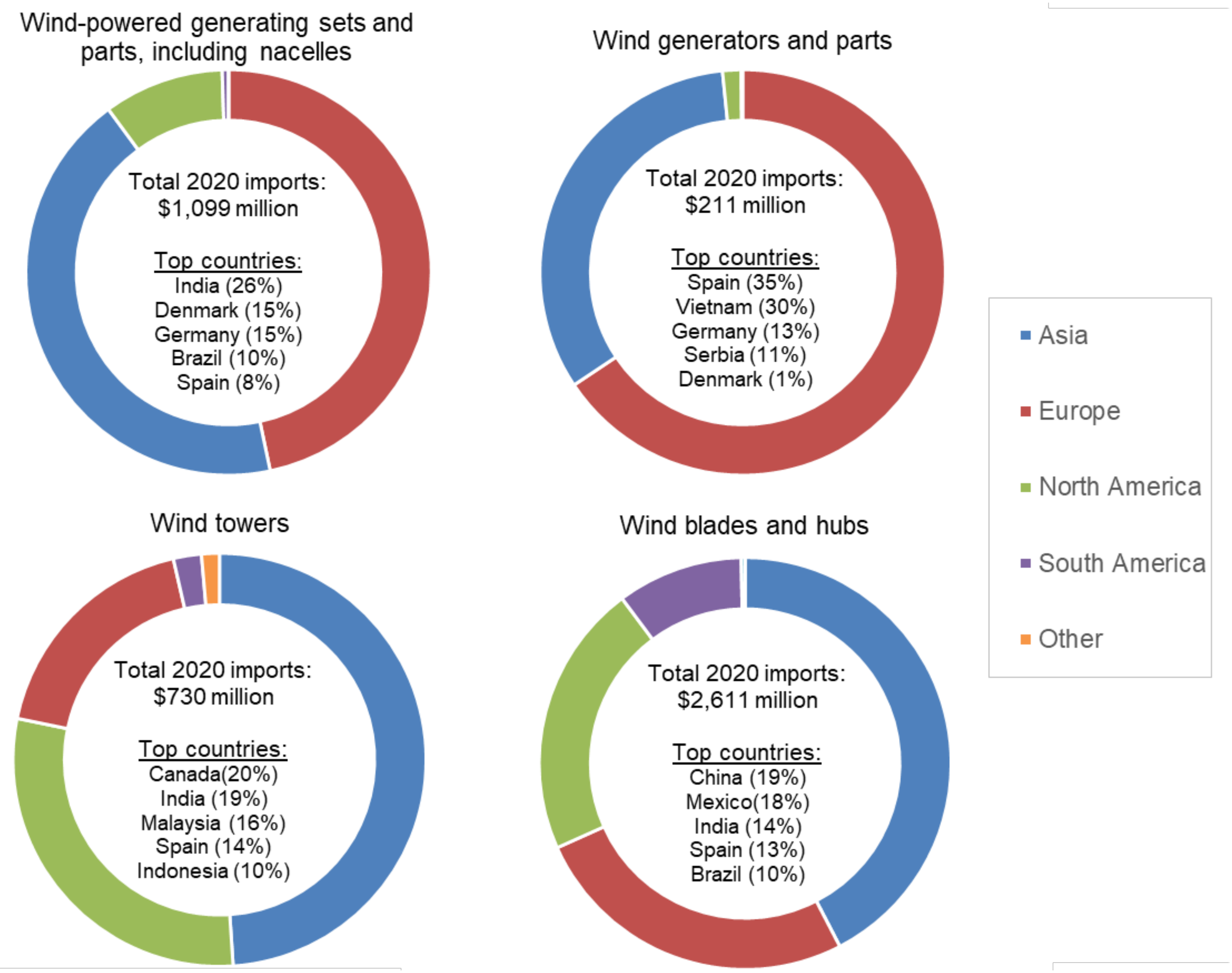
Top States of Entry

Texas	$2,944M
Florida	$463M
Michigan	$238M
Minnesota	$196M
Louisiana	$141M
Illinois	$132M
California	$116M
Oregon	$84M
Alabama	$73M
Maine	$46M
Other	$142M

Source: Berkeley Lab analysis of data from USA Trade Online, https://usatrade.census.gov

Notes: Line widths are proportional to amount of imports, by country. Figure does not intend to depict the destination of these imports, by state. Tracked wind-specific equipment includes: wind-powered generating sets and parts, towers, generators and generator parts, blades and hubs, and nacelles

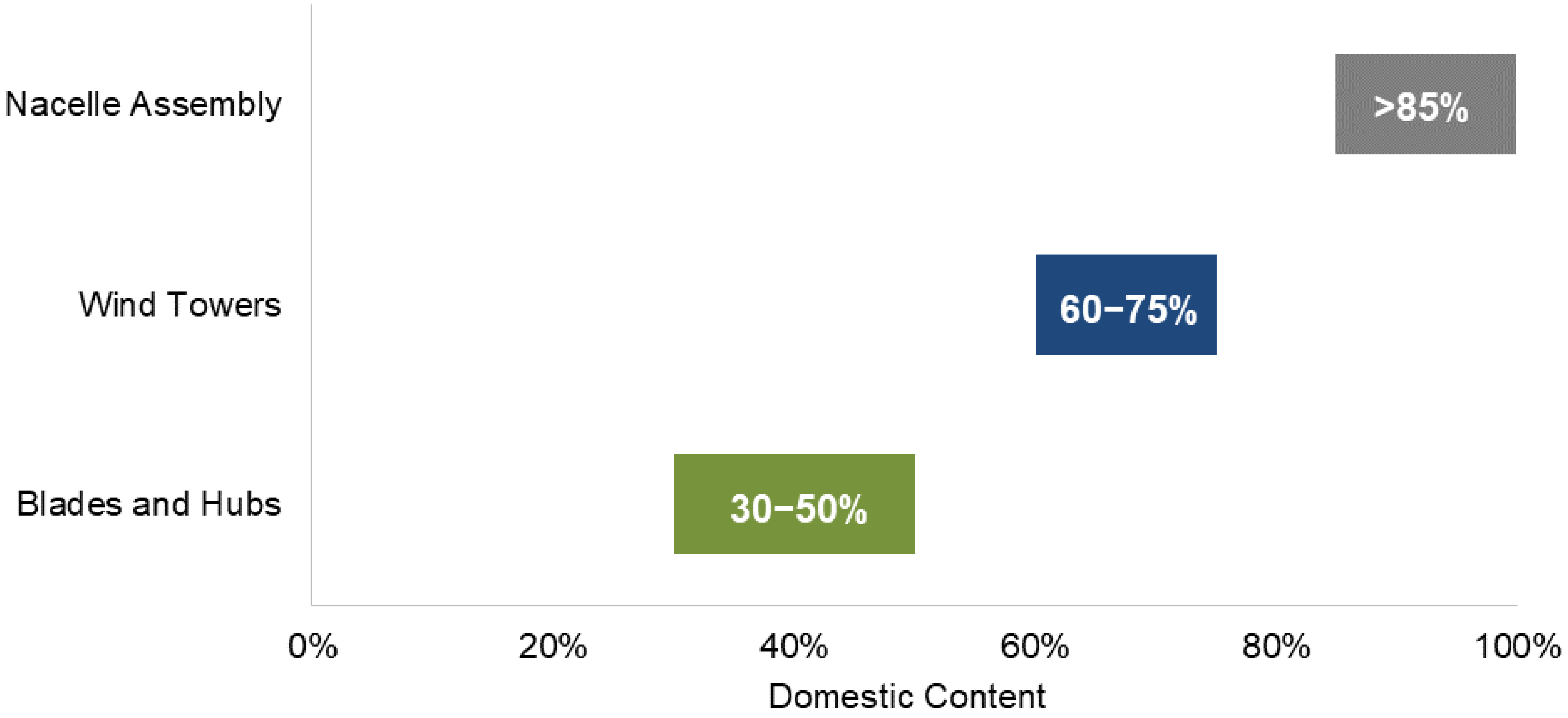
Source markets for 2020 wind equipment imports vary by type of wind equipment



- India, followed by Denmark, Germany, Brazil, and Spain, were the primary source markets for wind-powered generating sets and nacelles in 2020
- Tower imports came from a mix of countries near and far—Canada, India, Malaysia, Spain, and Indonesia
- With regard to blades and hubs, China, Mexico, India, Spain and Brazil topped the charts in 2020
- Wind-related generators and generator parts primarily came from Spain, Vietnam, Germany and Serbia

Source: Berkeley Lab analysis of data from USA Trade Online, https://usatrade.census.gov

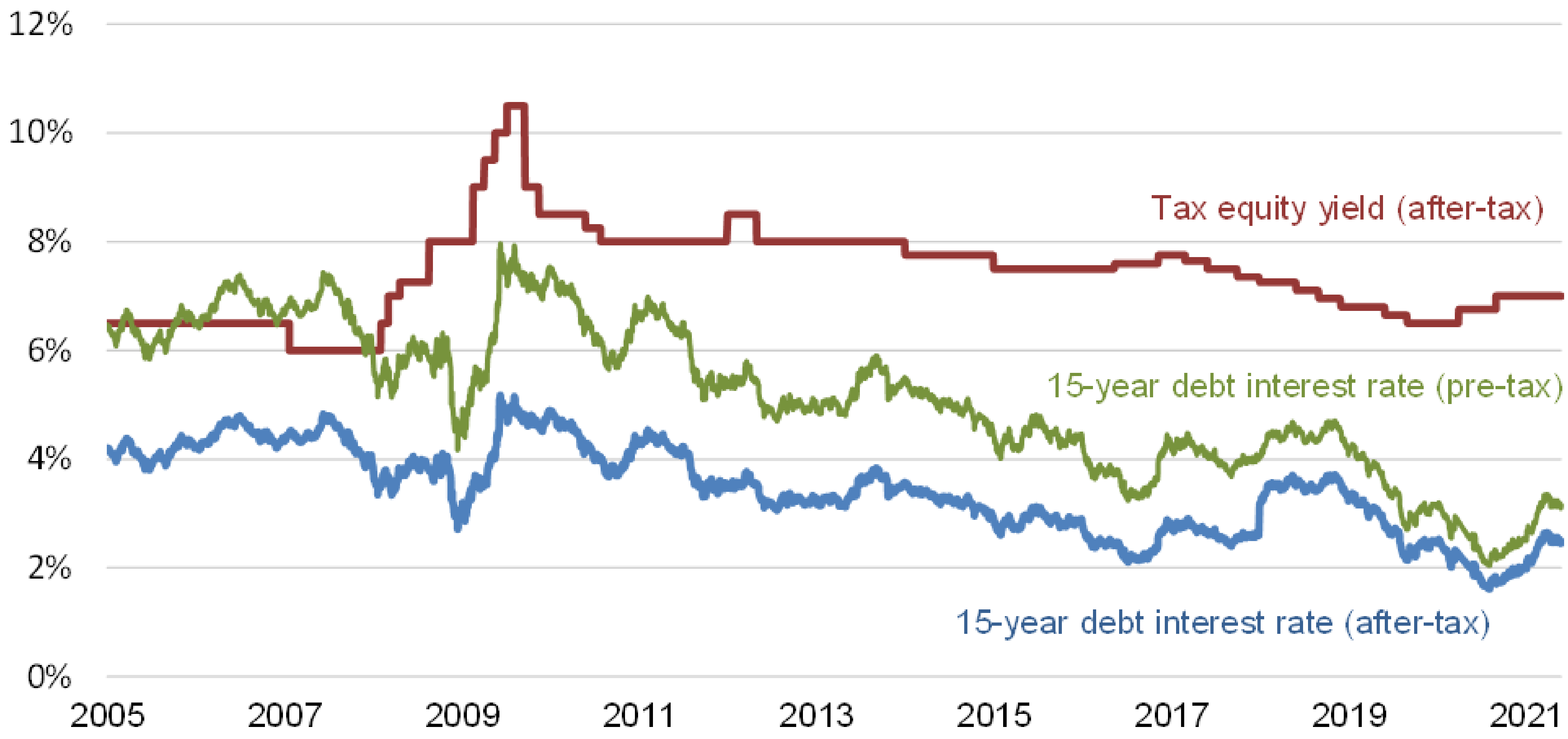
Domestic manufacturing content in 2020 was relatively strong for nacelle assembly, towers, and blades



Source: Berkeley Lab

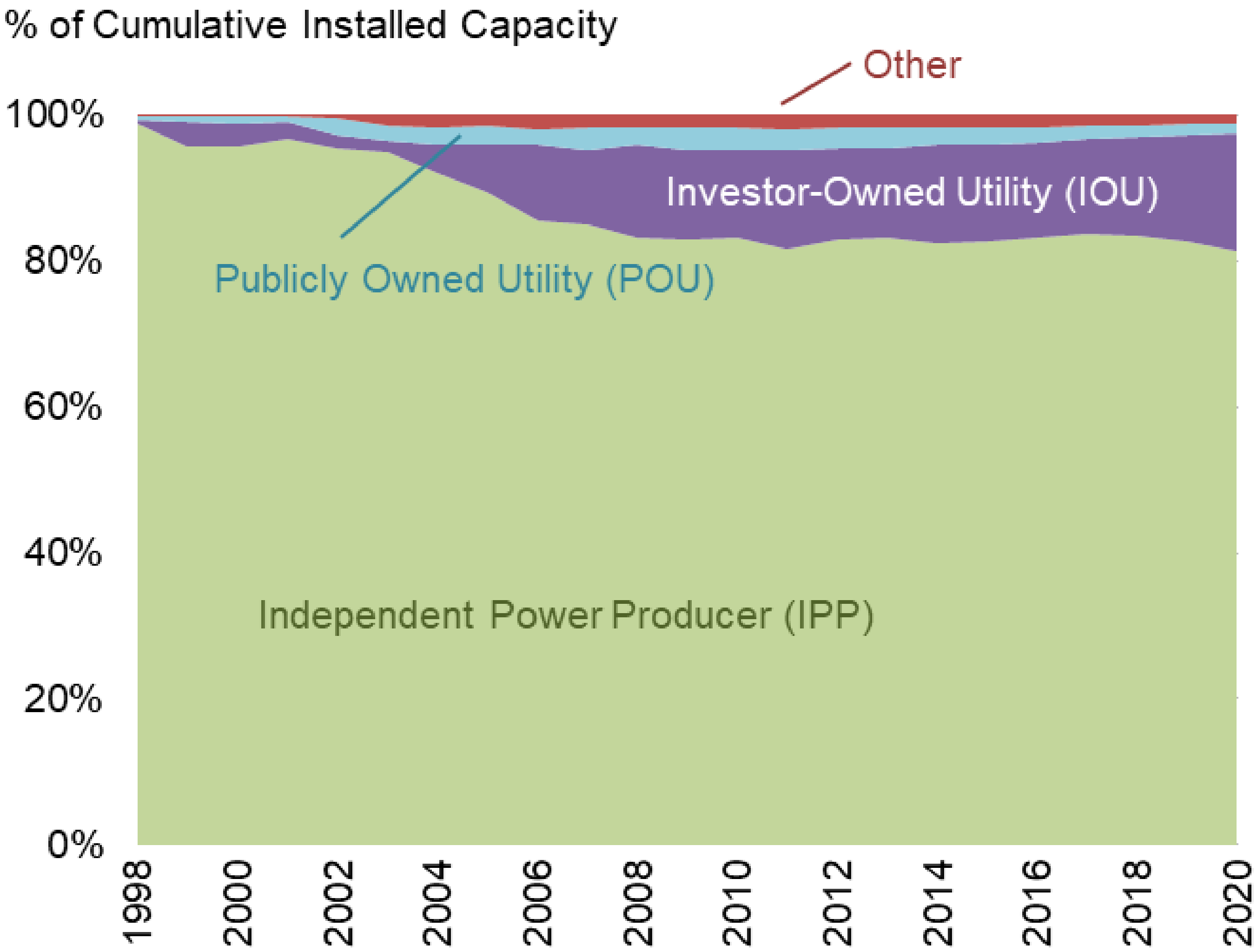
Imports occur in untracked trade categories not included above, including many nacelle internals. Blade domestic content has declined in recent years. BloombergNEF (2021) has recently estimated that a typical onshore wind project in the U.S. sources 57% of its components (by dollar value) domestically.

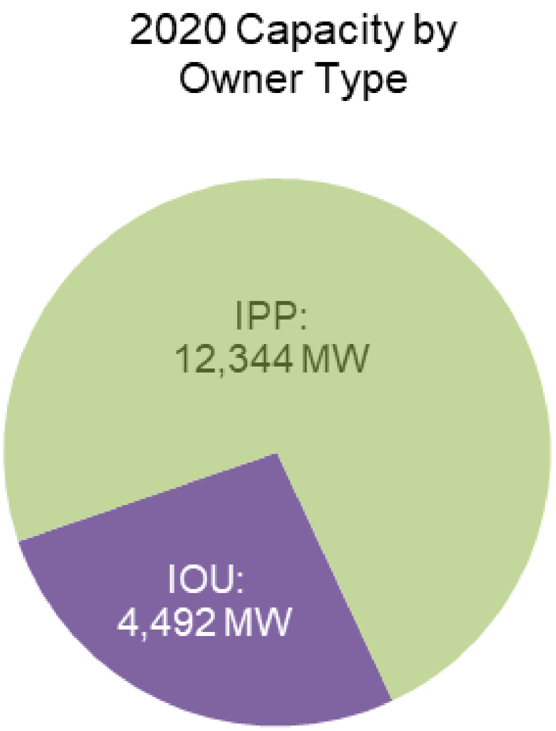
Project finance was volatile in 2020



Sources: Intercontinental Exchange Benchmark Administration, BNEF, Norton Rose Fulbright

Independent Power Producers own the majority of wind assets built in 2020, but Investor-Owned Utilities own a sizable share

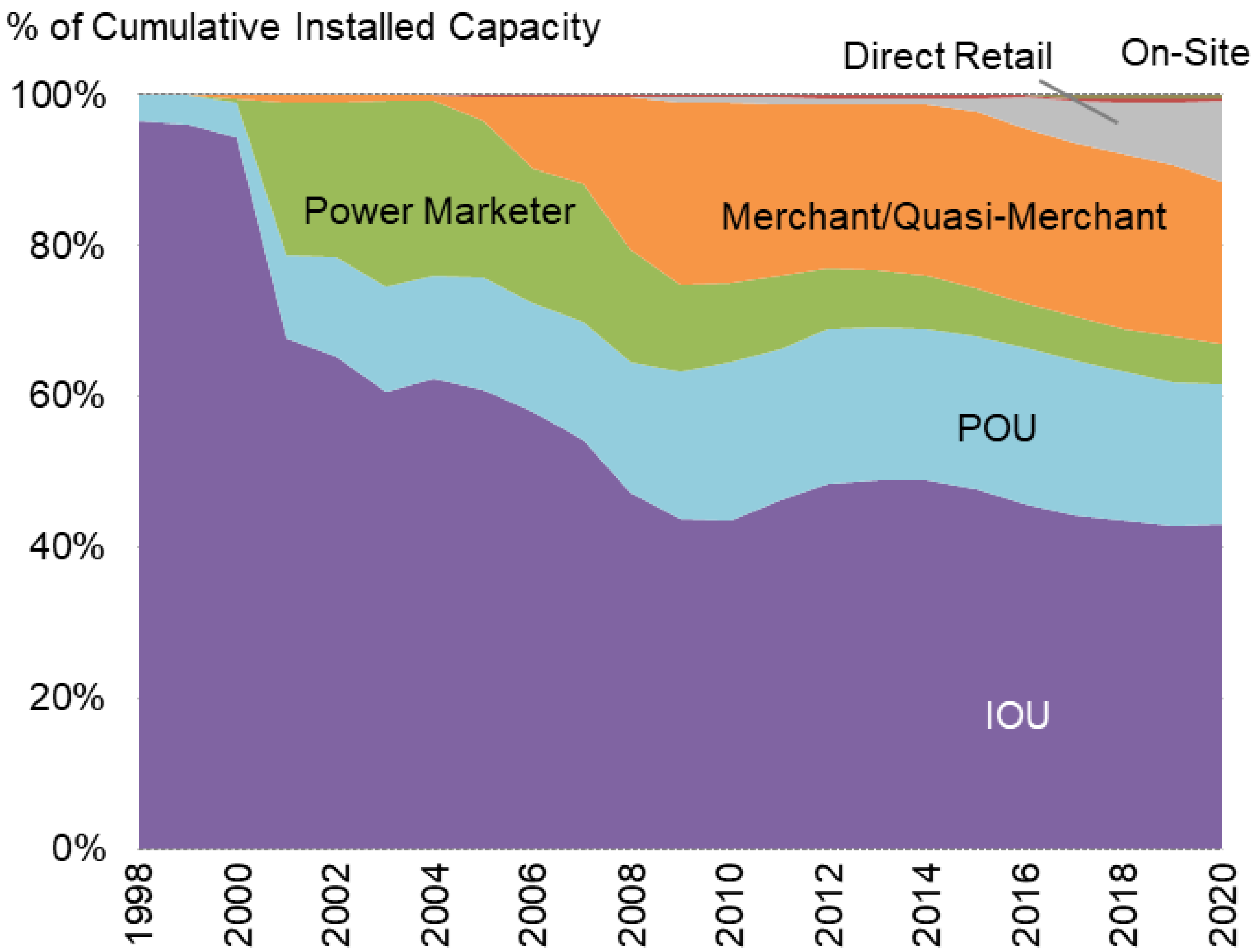


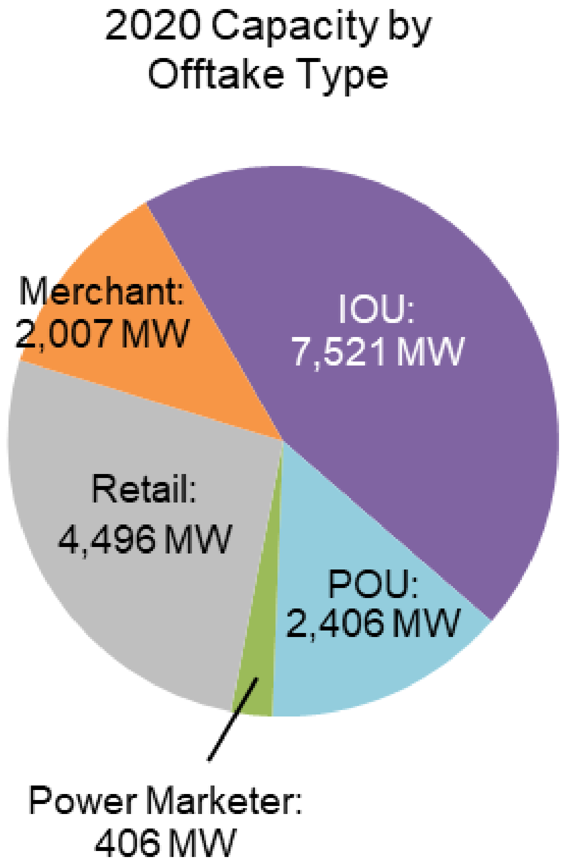


Source: Berkeley Lab estimates based on ACP

Note: Graphic on left shows distribution among growing cumulative fleet of projects installed. Pie chart shows distribution only among those projects built in 2020.

Utilities remained the most common offtaker (through ownership and purchases), but retail sales and merchant were also very significant



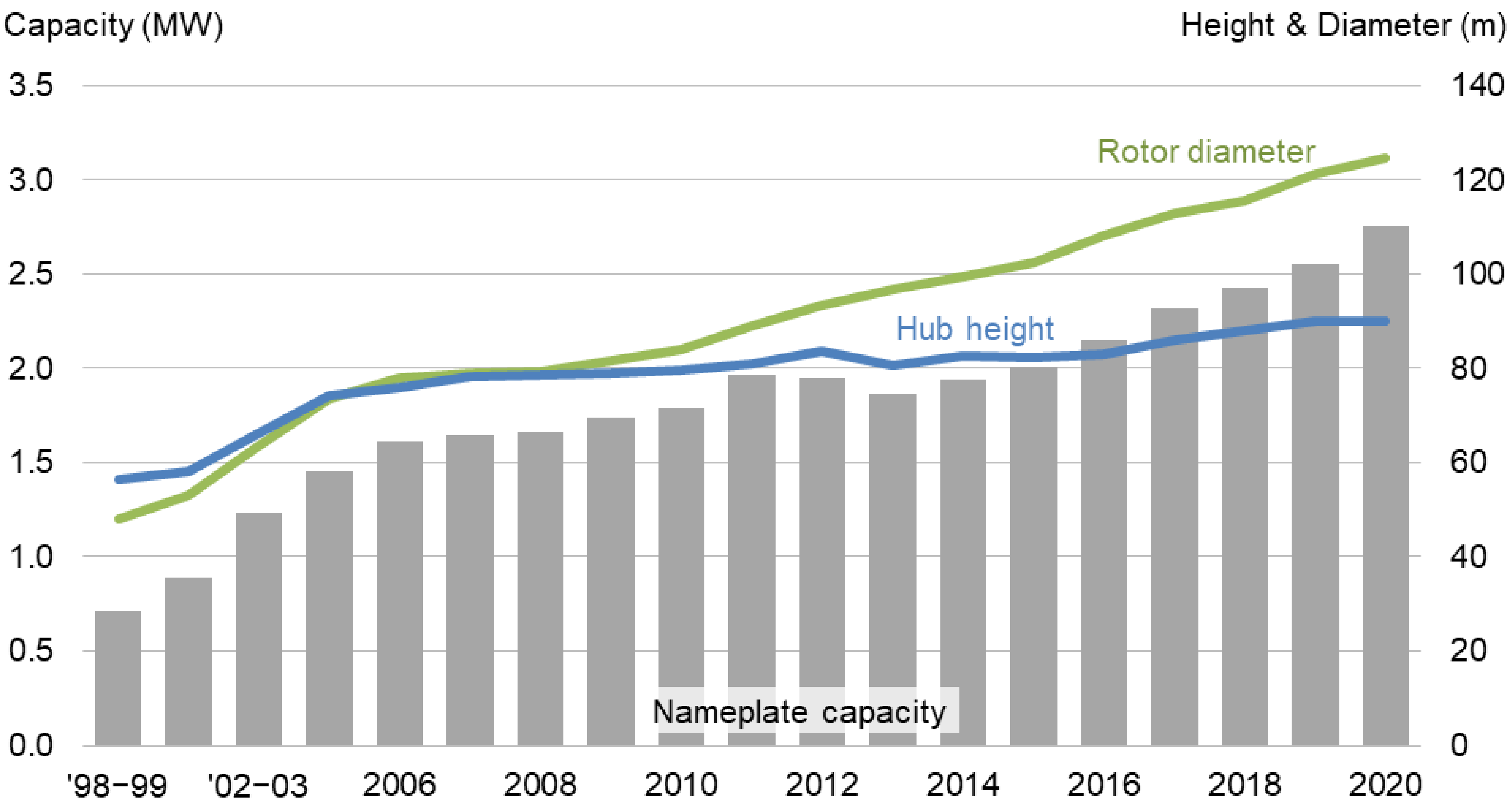


Source: Berkeley Lab estimates based on ACP

Note: Graphic on left shows distribution among growing cumulative fleet of projects installed. Pie chart shows distribution only among those projects built in 2020.

Technology Trends

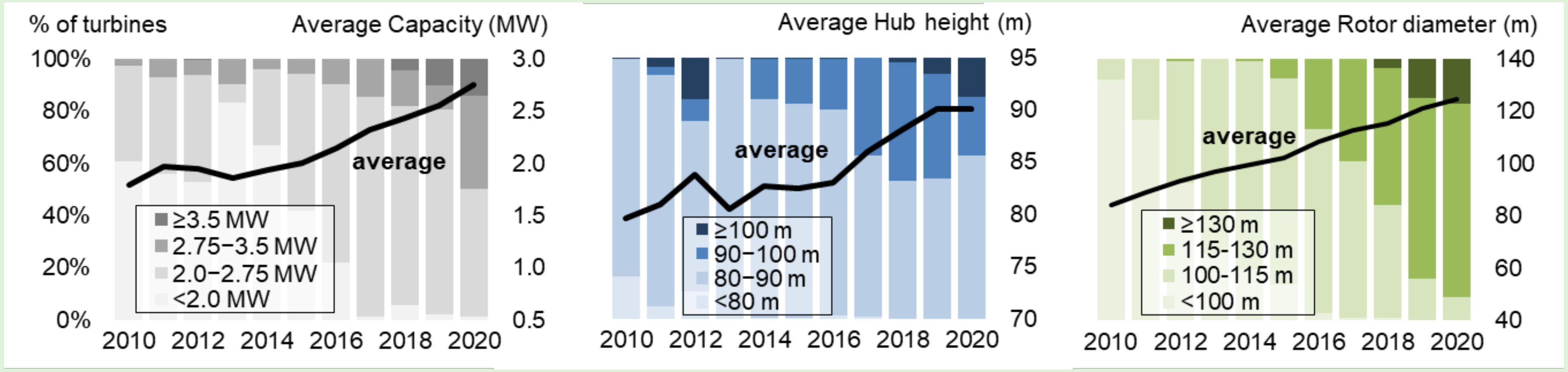
Turbine capacity, rotor diameter, and hub height have all increased significantly over the long term



Sources: ACP, Berkeley Lab

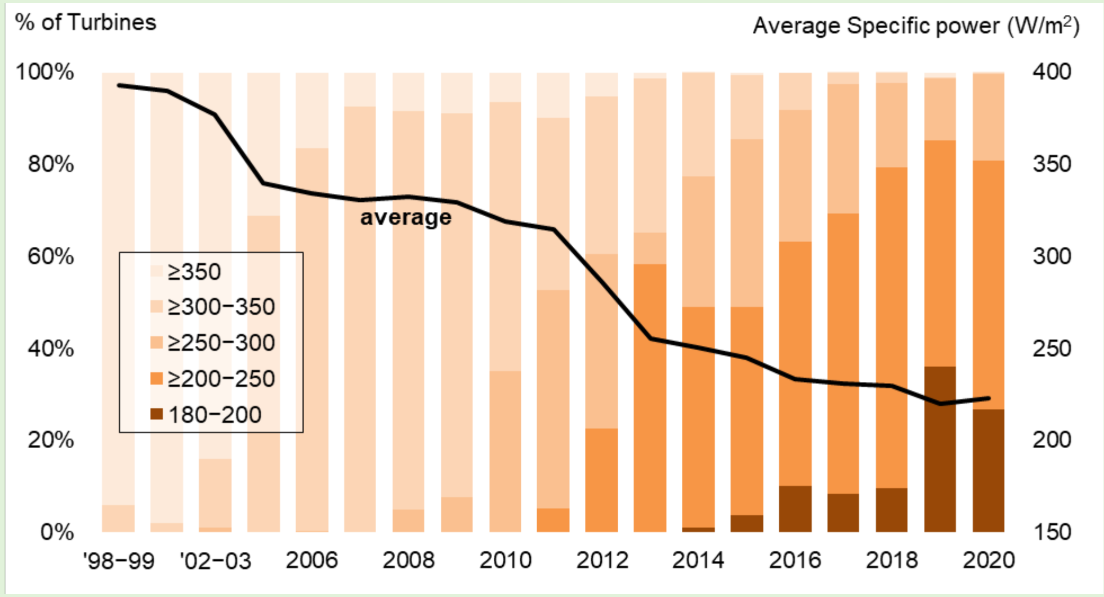
Interactive data visualization: https://emp.lbl.gov/wind-power-technology-trends

Turbine size maintains upward trajectory; turbines originally designed for lower wind speeds dominate the market



Specific power: turbine capacity divided by swept rotor area; lower specific power leads to higher capacity factors, as shown later

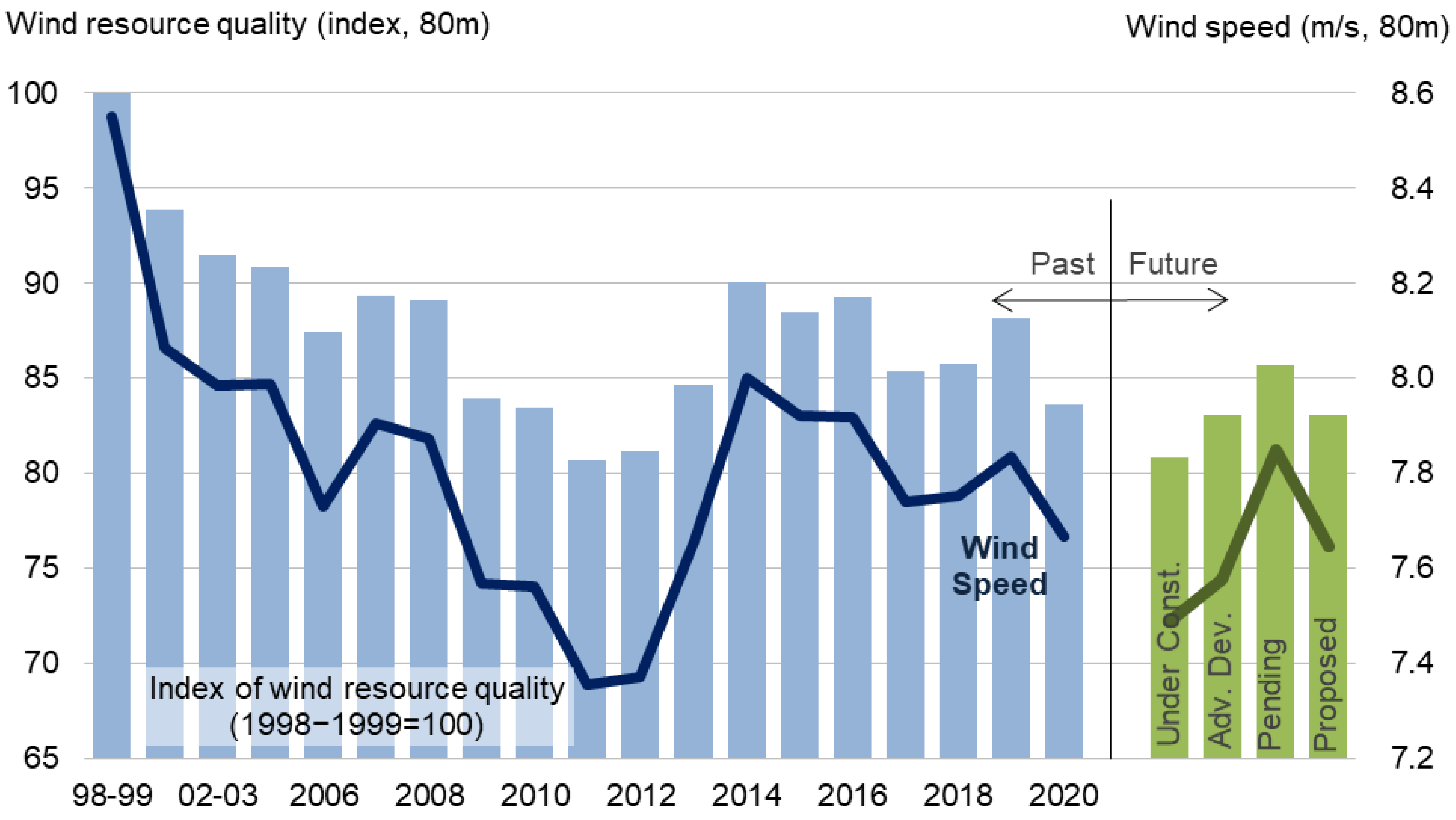
2020 average = 223 W/m^2



Sources: ACP, Berkeley Lab

Interactive data visualization: https://emp.lbl.gov/specific-power

Wind turbines were deployed in somewhat lower wind speed sites in 2020 than in the previous seven years

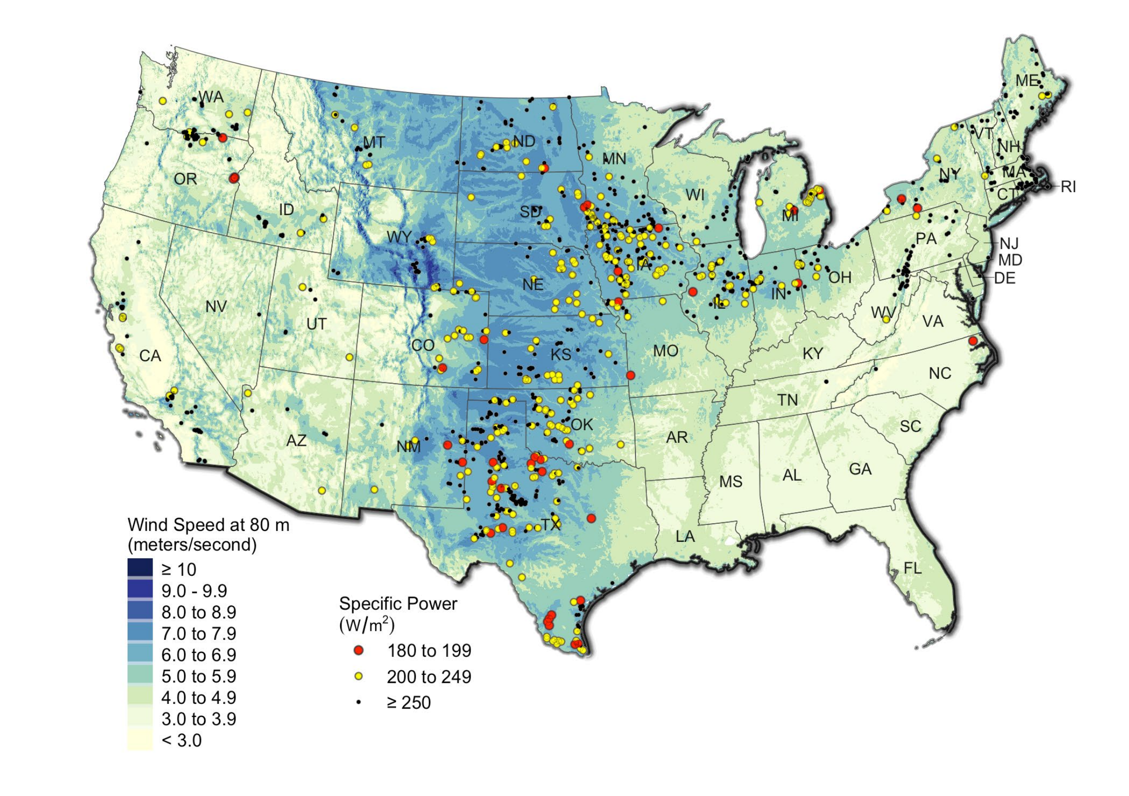


Sources: ACP, Berkeley Lab, AWS Truepower, FAA files

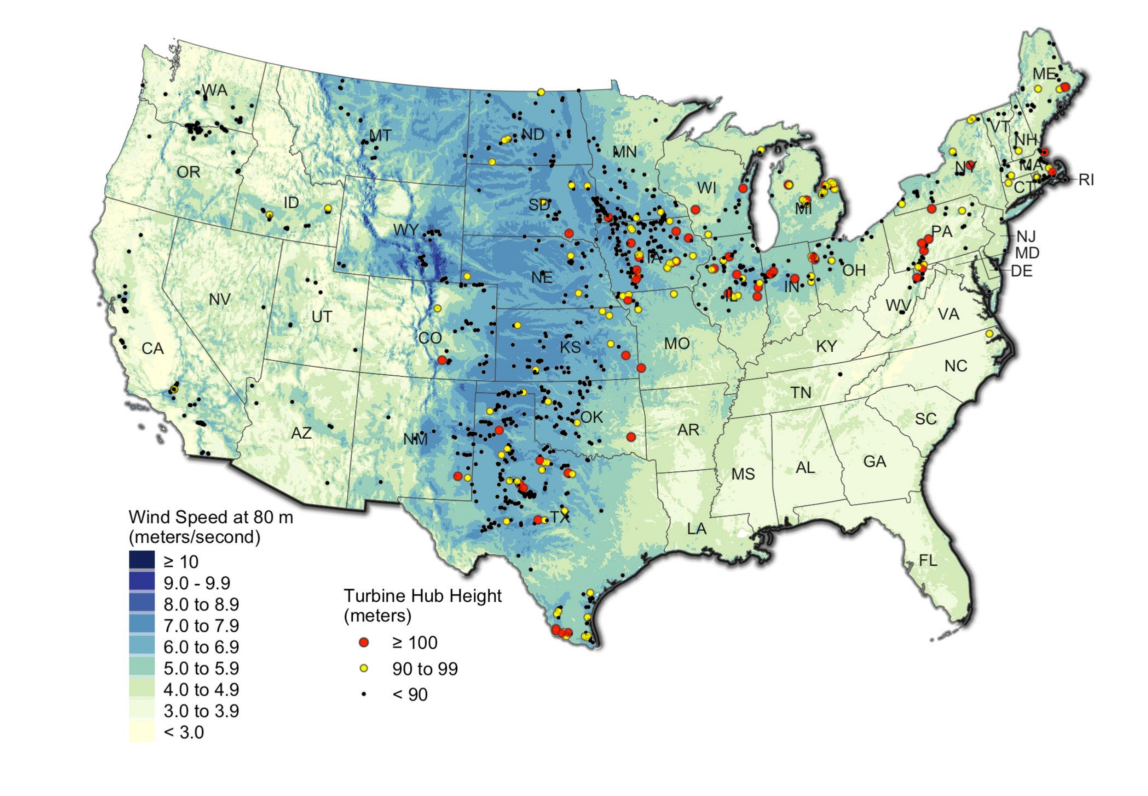
Note: Wind resource quality index is based on site estimates of gross capacity factor at 80 meters by AWS Truepower. A single, common wind-turbine power curve is used across all sites and timeframes, and no losses are assumed. Values are indexed to those projects built in 1998—1999.

Low specific power turbines are deployed on widespread basis; taller towers are seeing increased use in wider variety of sites

Specific Power



Hub Height

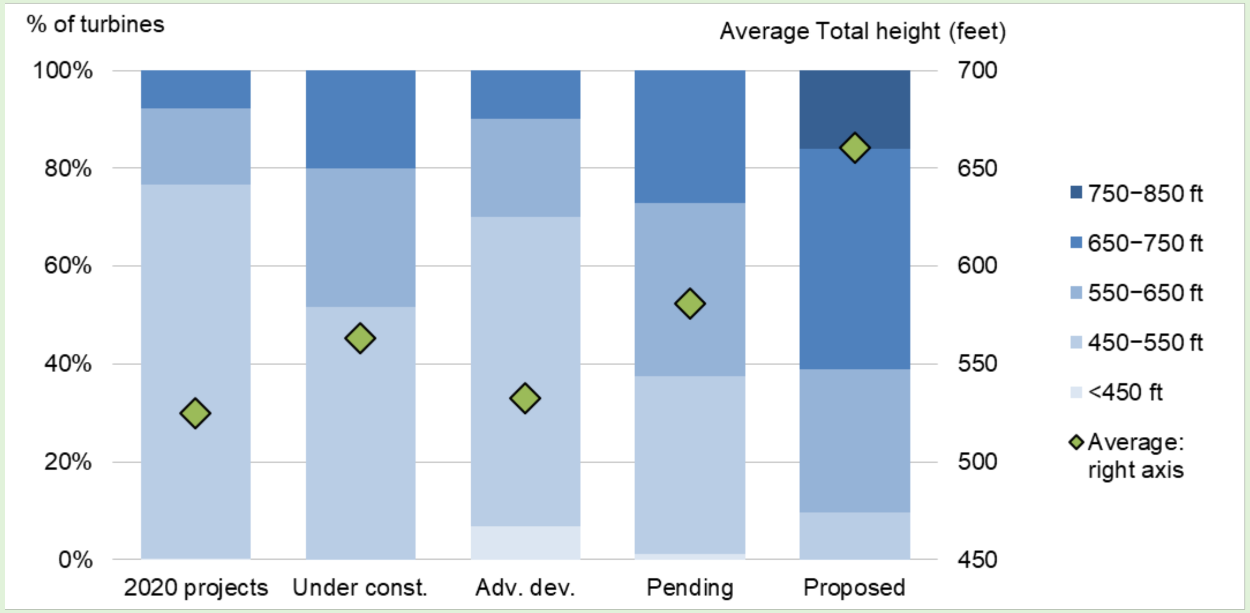


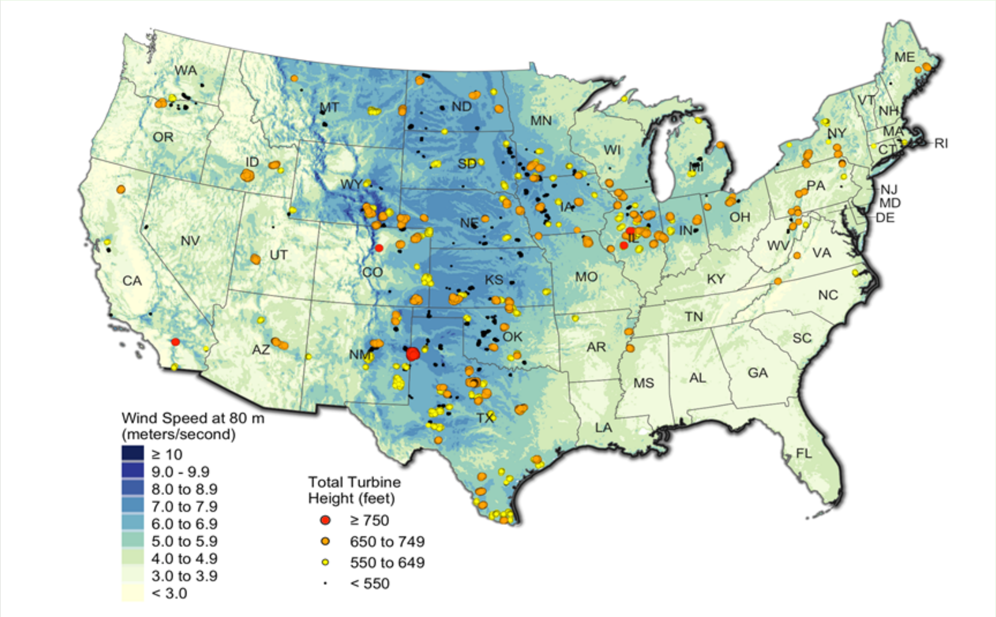
Sources: ACP, U.S. Wind Turbine Database, AWS Truepower, Berkeley Lab

Interactive data visualization: https://emp.lbl.gov/wind-power-technology-trends

Wind projects planned for the near future are poised to continue the trend of ever-taller turbines

Proposed turbines show significant growth in total turbine height, compared to 2020 projects

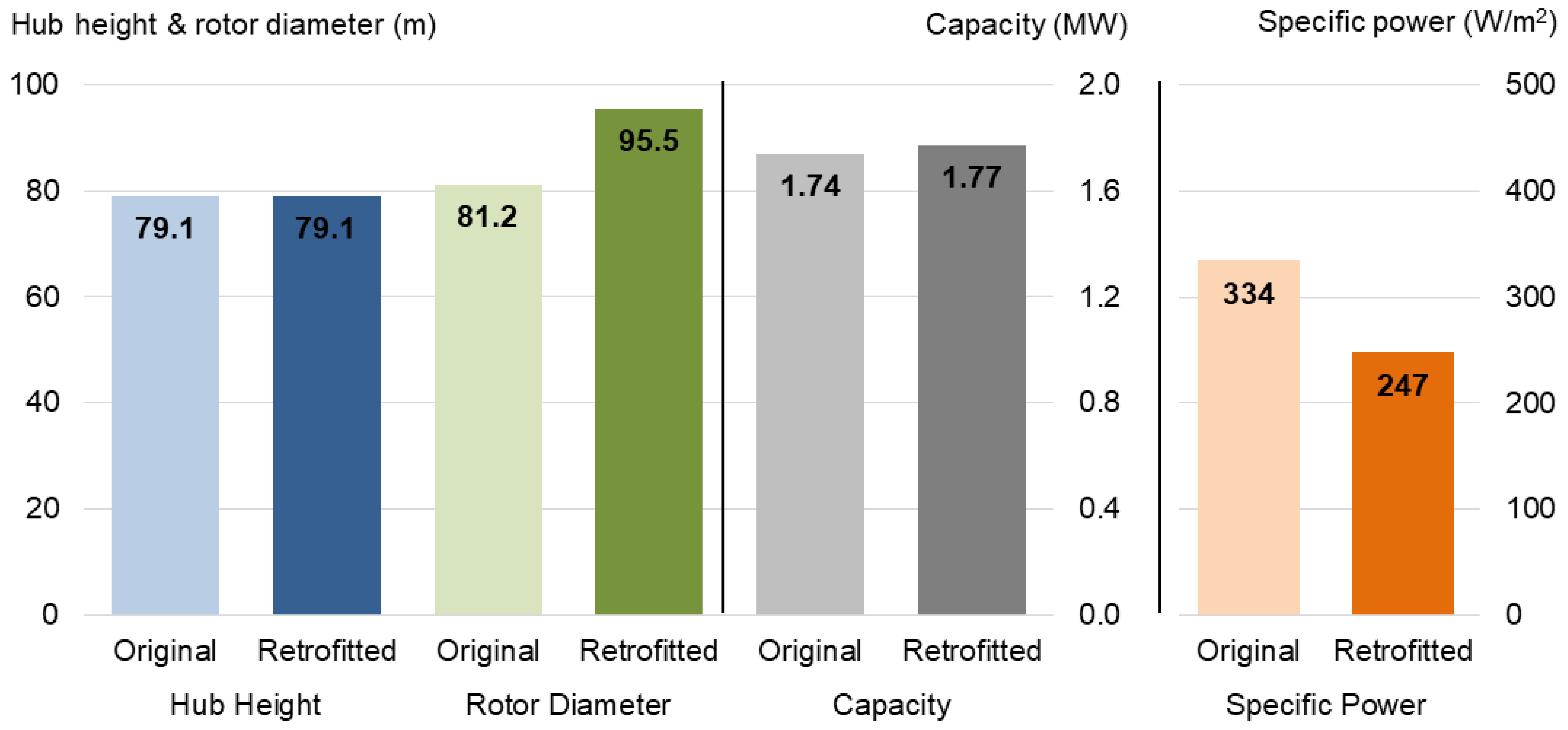




FAA = Federal Aviation Administration

Sources: ACP, FAA files, AWS Truepower, Berkeley Lab

In 2020, 29 wind projects were partially repowered, most of which now feature significantly larger rotors and lower specific power ratings

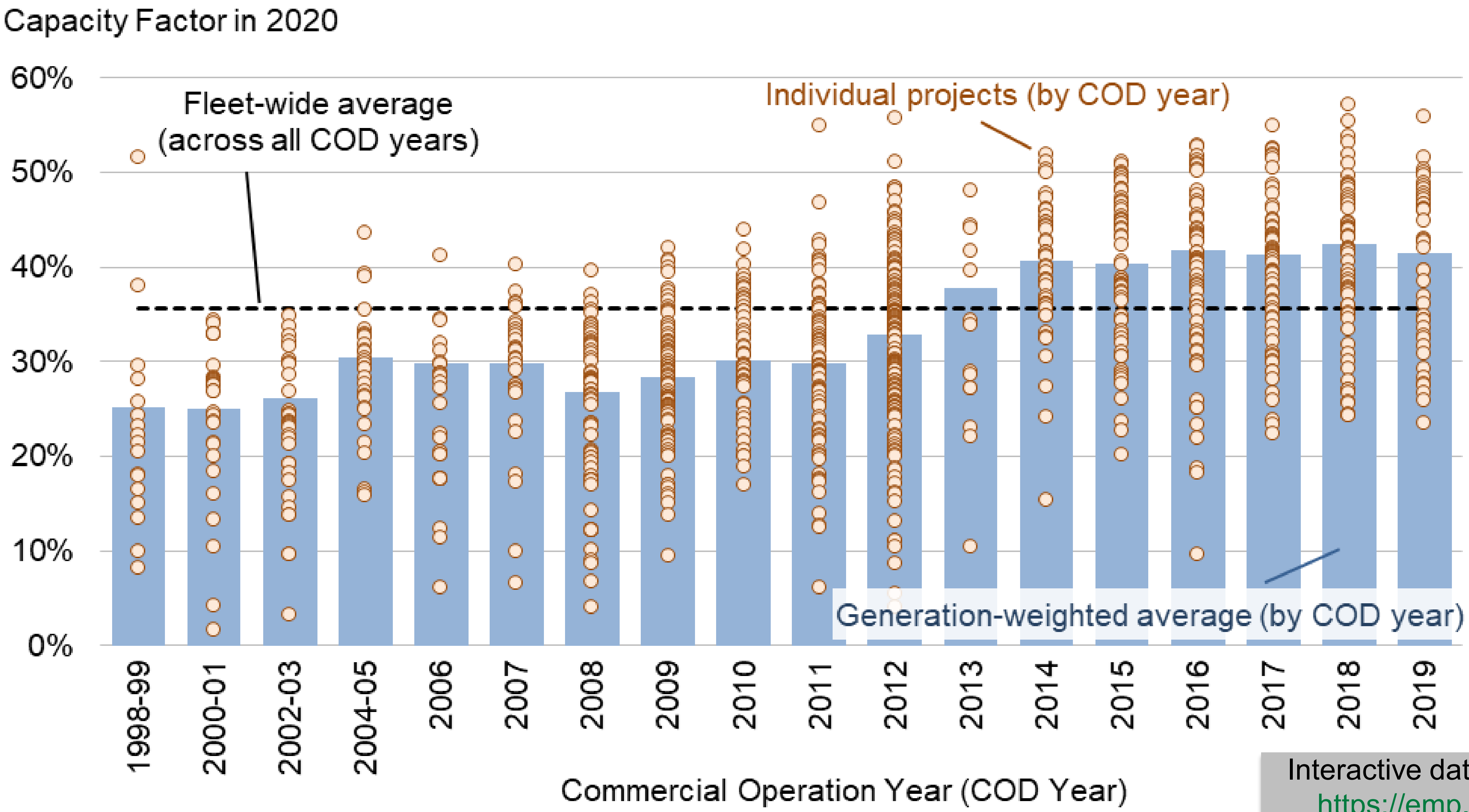


Sources: ACP, Berkeley Lab, turbine manufacturers

The mean age of turbines retrofitted in 2020 was just 12 years

Performance Trends

The average capacity factor in 2020 exceeded 40% among wind projects built in recent years, and reached 36% on a fleet-wide basis

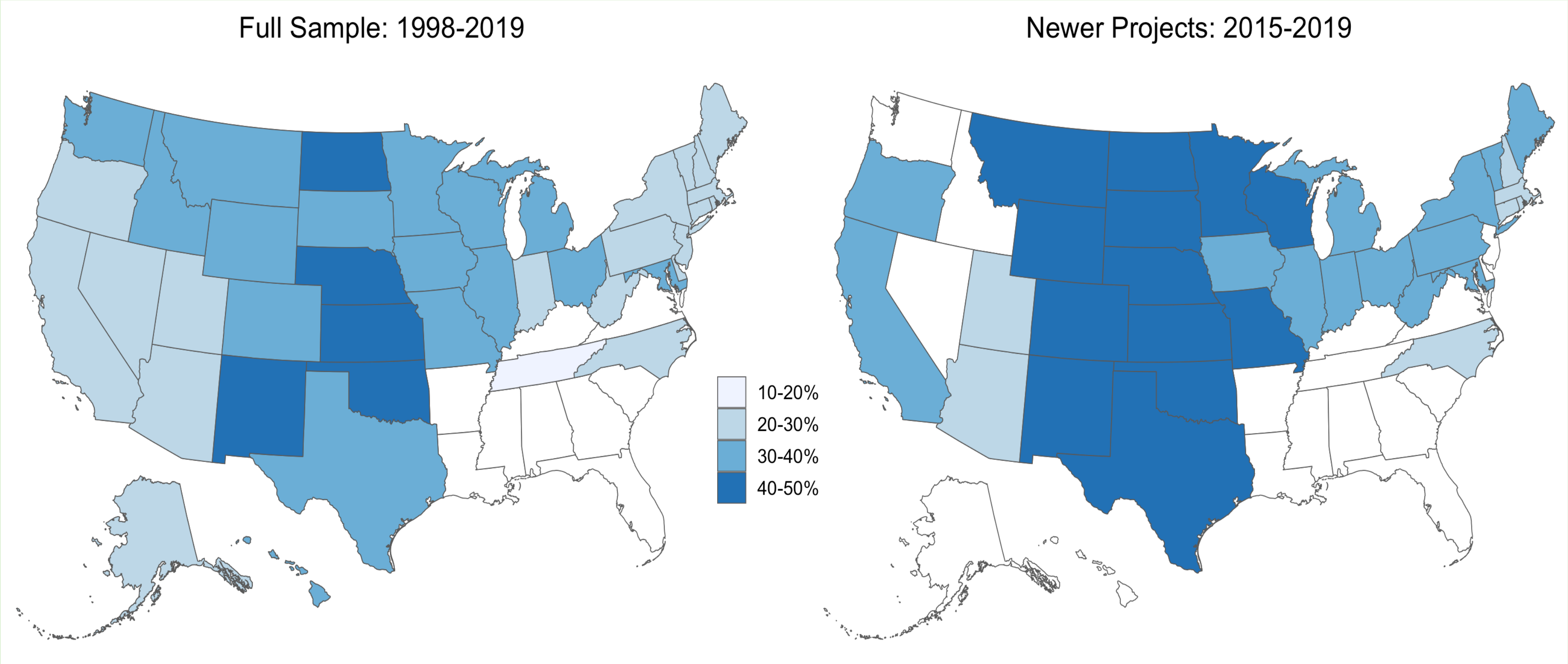


Source: EIA, FERC, Berkeley Lab

Interactive data visualization: https://emp.lbl.gov/wind-power-performance

The central part of the country features the highest capacity factors, in part reflecting the strength of the wind resource

Newer projects (right figure) have considerably higher capacity factors than the full sample of 1998—2019 projects (left figure)

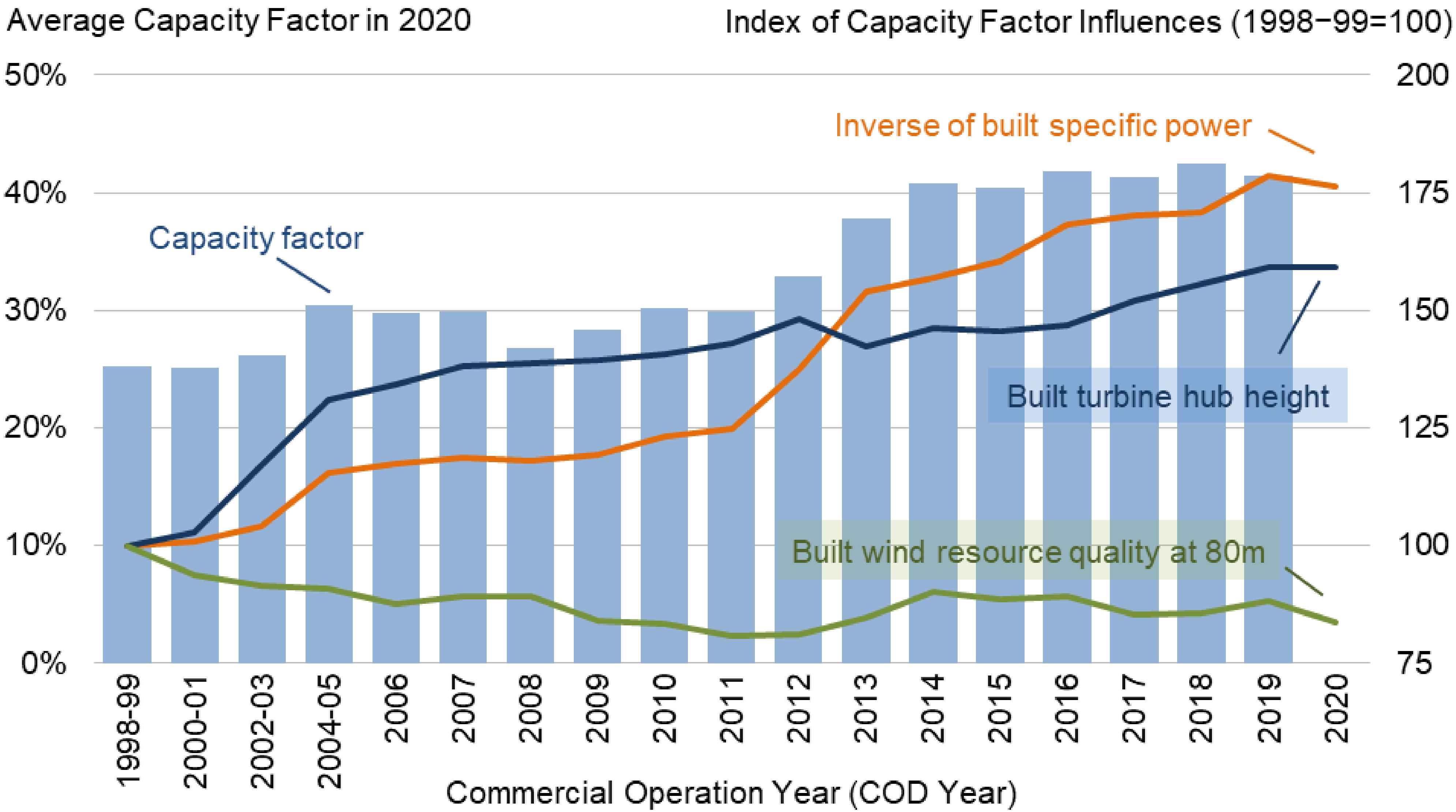


Source: EIA, FERC, Berkeley Lab

Note: States shaded in white have no projects in full sample (left) or in newer sample (right)

Interactive data visualization: https://emp.lbl.gov/wind-power-performance

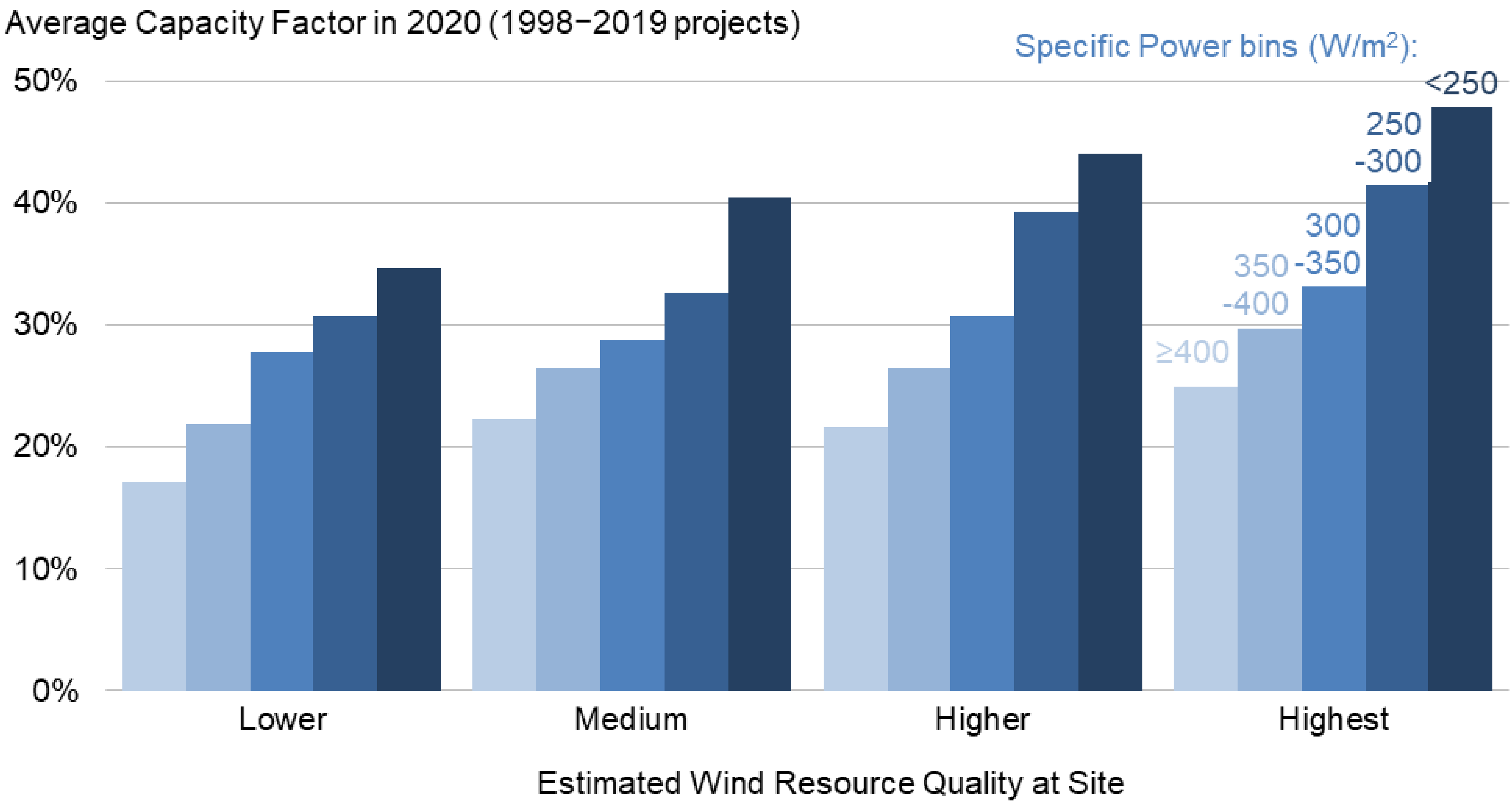
Turbine design and site characteristics influence performance, with declining specific power leading to sizable increases in capacity factor



Source: EIA, FERC, Berkeley Lab

Controlling for wind resource quality and specific power demonstrates impact of turbine evolution

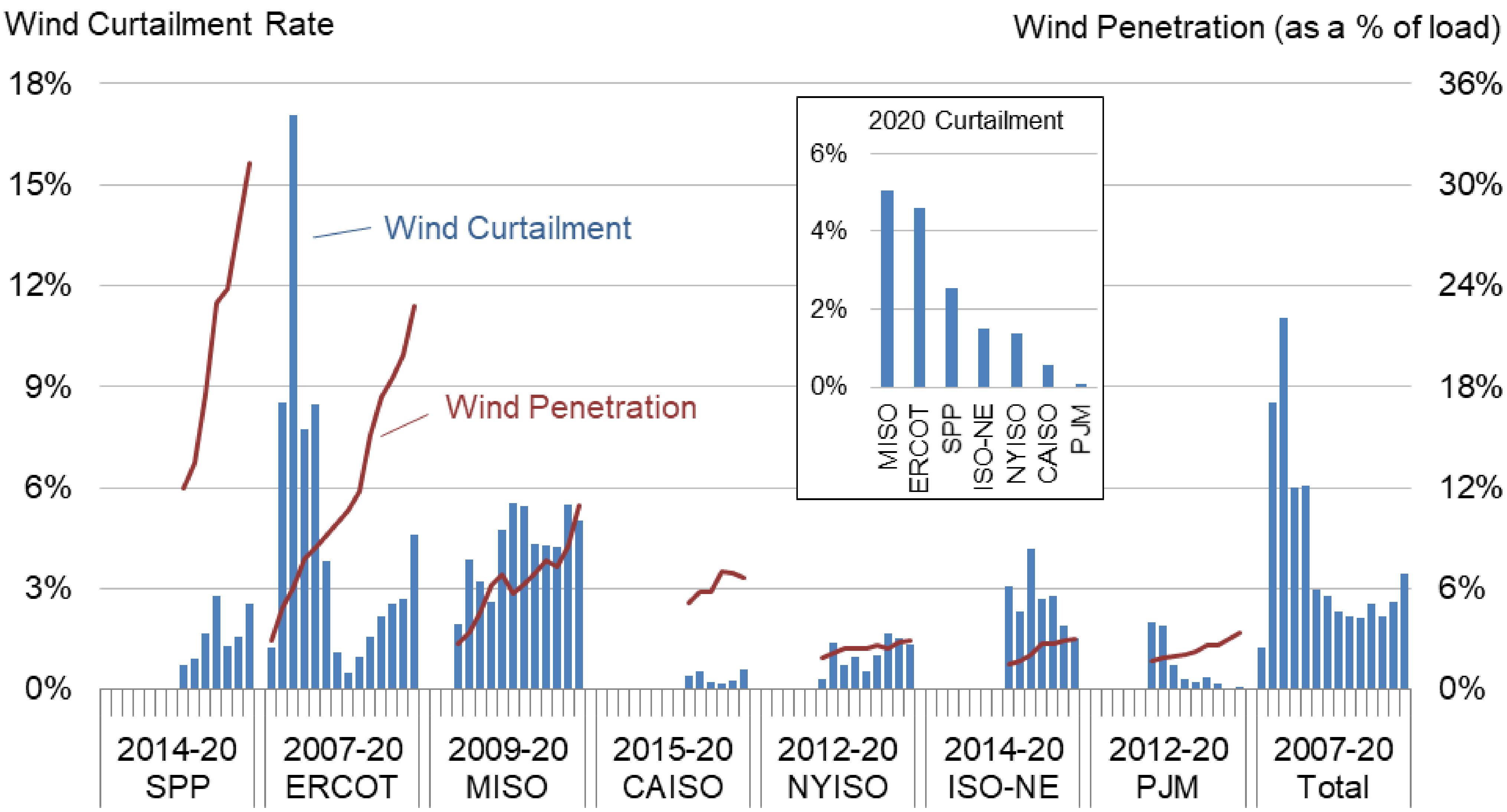
Low specific power turbines are driving capacity factors higher for projects located in given wind resource regimes



Note: Wind resource quality is based on site estimates of gross capacity factor at 80 meters by AWS Truepower, using a single, common wind-turbine power curve. The "lower" category includes all projects with an estimated gross capacity factor of less than 40%; "medium" corresponds to ≥40%–45%; "higher" ≥45%–50%; and "highest" ≥50%.

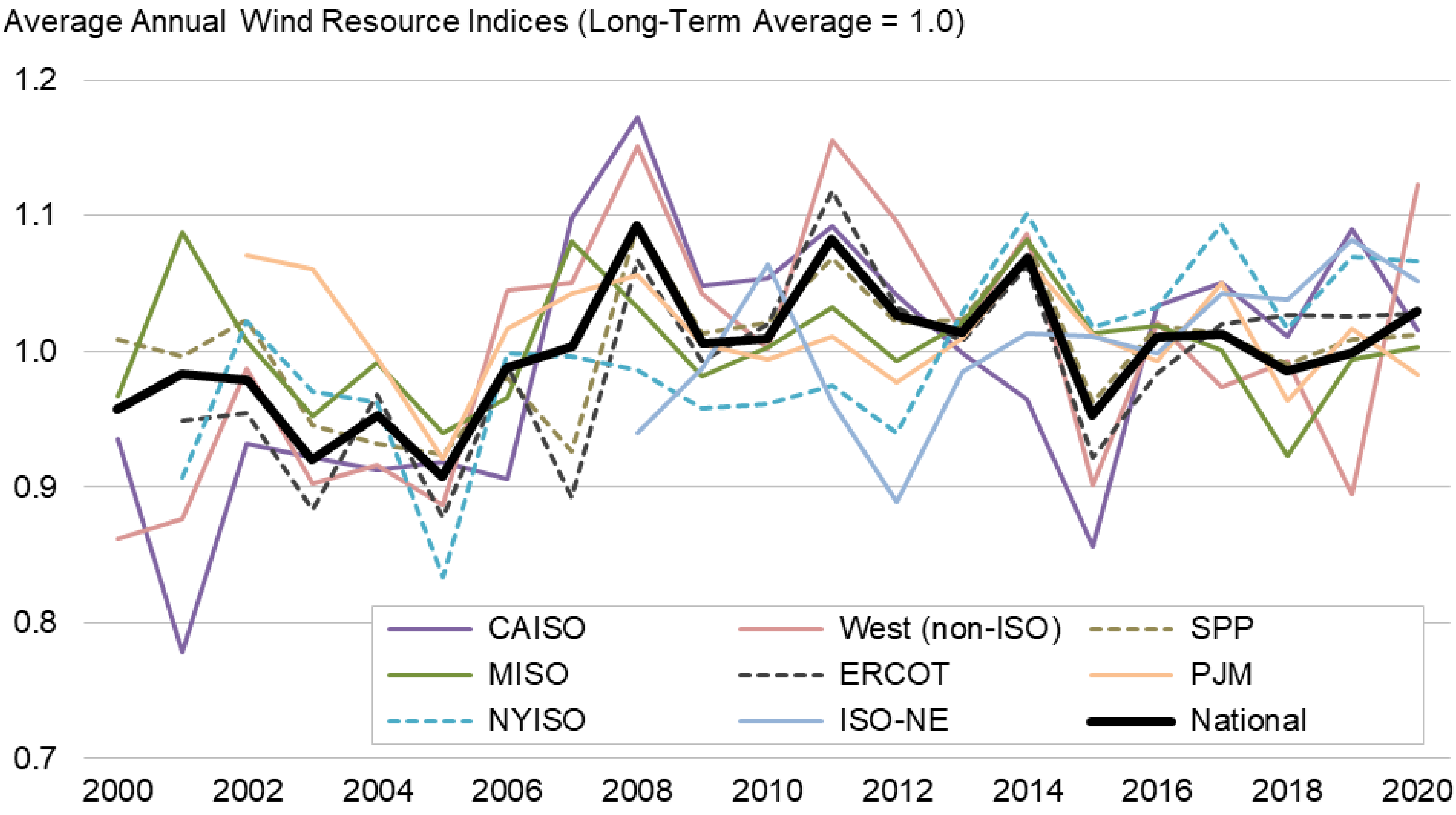
Source: EIA, FERC, Berkeley Lab

Wind curtailment impacts project performance; MISO and ERCOT experienced the highest levels of curtailment in 2020



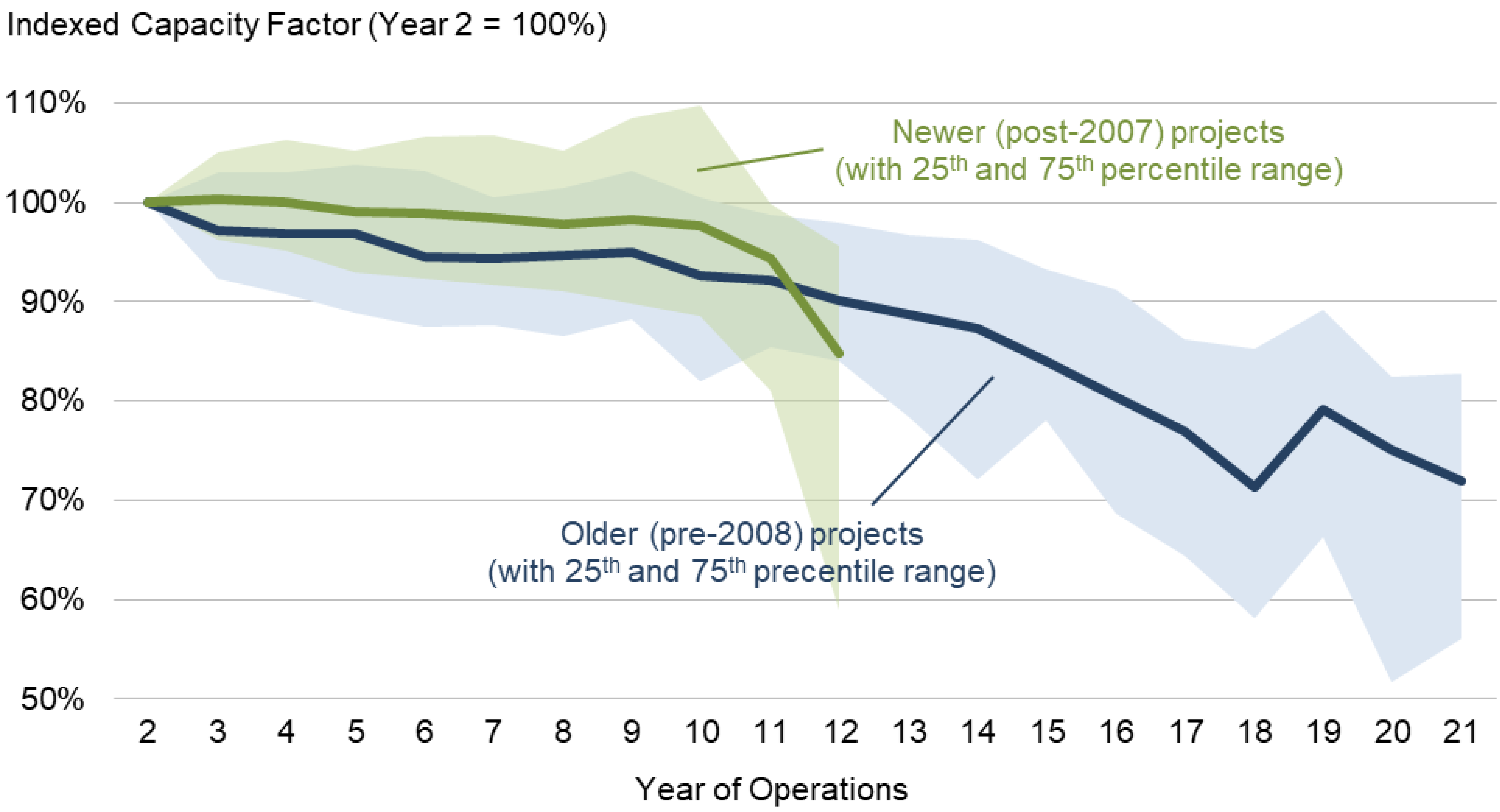
Sources: ERCOT, MISO, CAISO, NYISO, PJM, ISO-NE, SPP

Yearly variations in average wind speed impact project performance; 2020 wind speeds were slightly above the long-term average



Source: ERA, Berkeley Lab; methodology behind the index of inter-annual variability is explained in report appendix

Wind project performance degradation with project age also explains why older projects did not perform as well in 2020



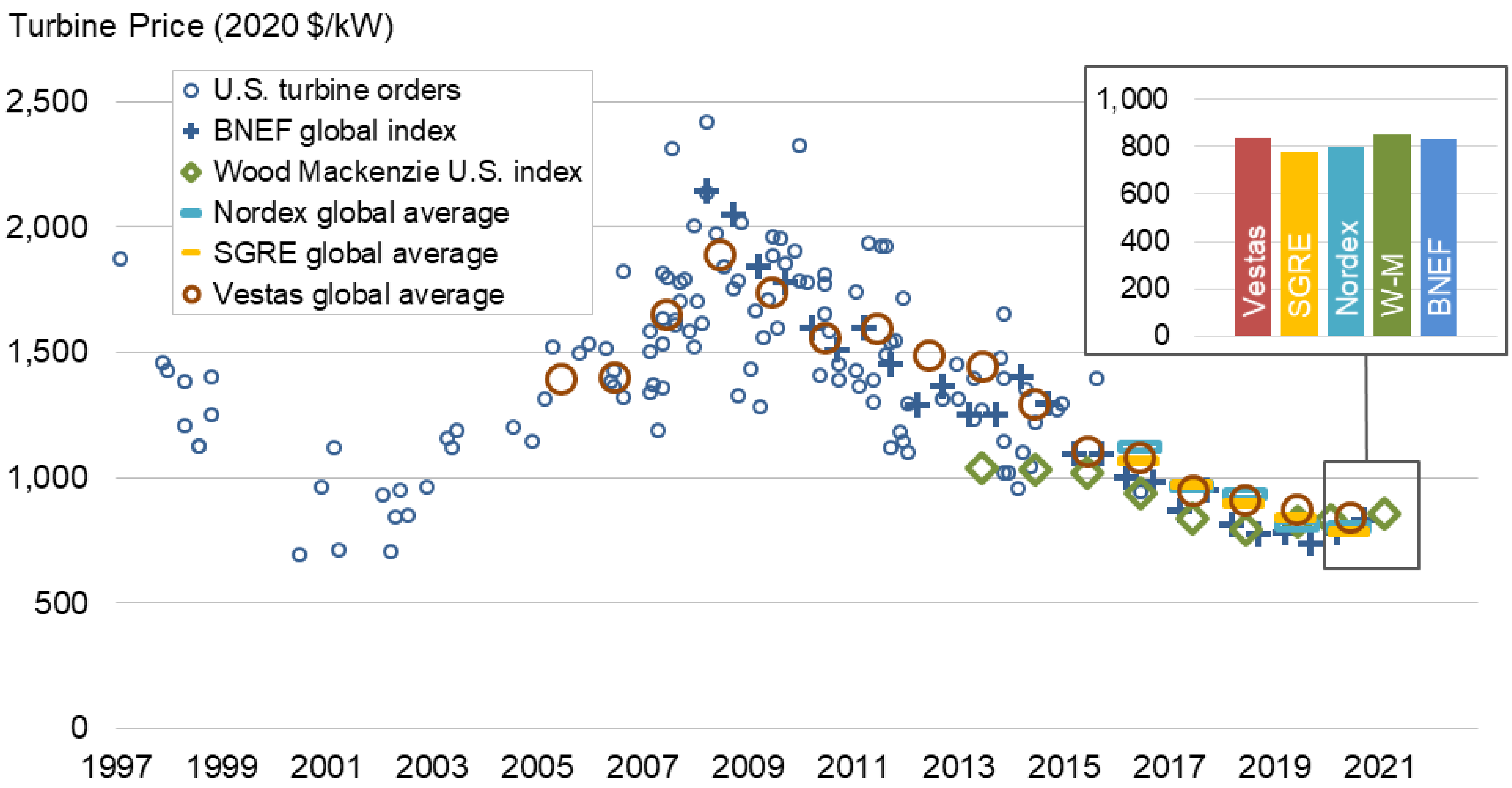
Performance decline after year 10 may, in part, reflect operational choices impacted by the federal PTC

Source: EIA, FERC, Berkeley Lab

For more analysis on wind project performance with plant age, see: https://emp.lbl.gov/publications/how-does-wind-project-performance

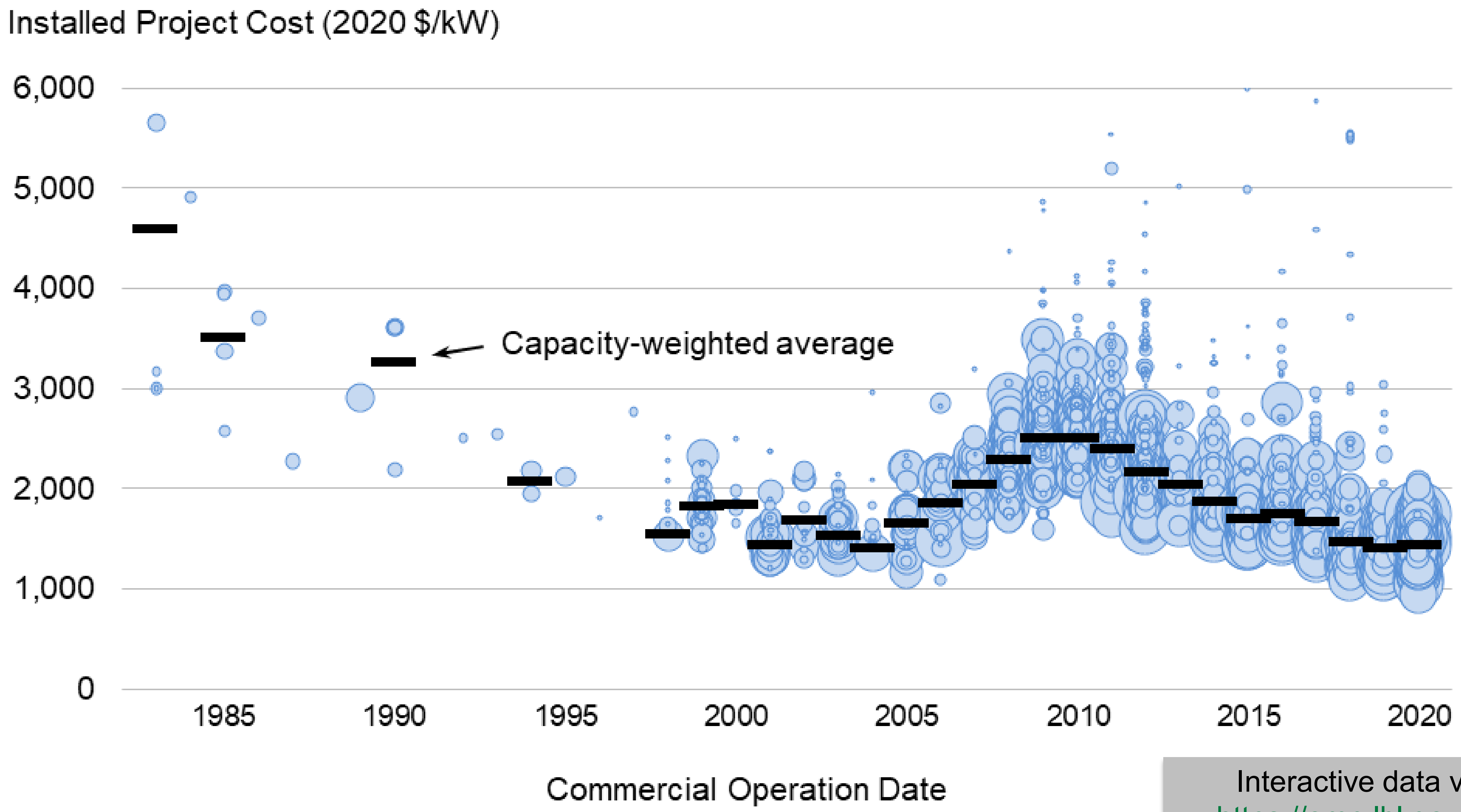
Cost Trends

Wind turbine prices remained well below the levels seen a decade ago: ~$775-850/kW in 2020



Sources: Berkeley Lab, annual financial reports, forecast providers

Lower turbine prices have driven reductions in total installed project costs: ~$1,460/kW average in 2020

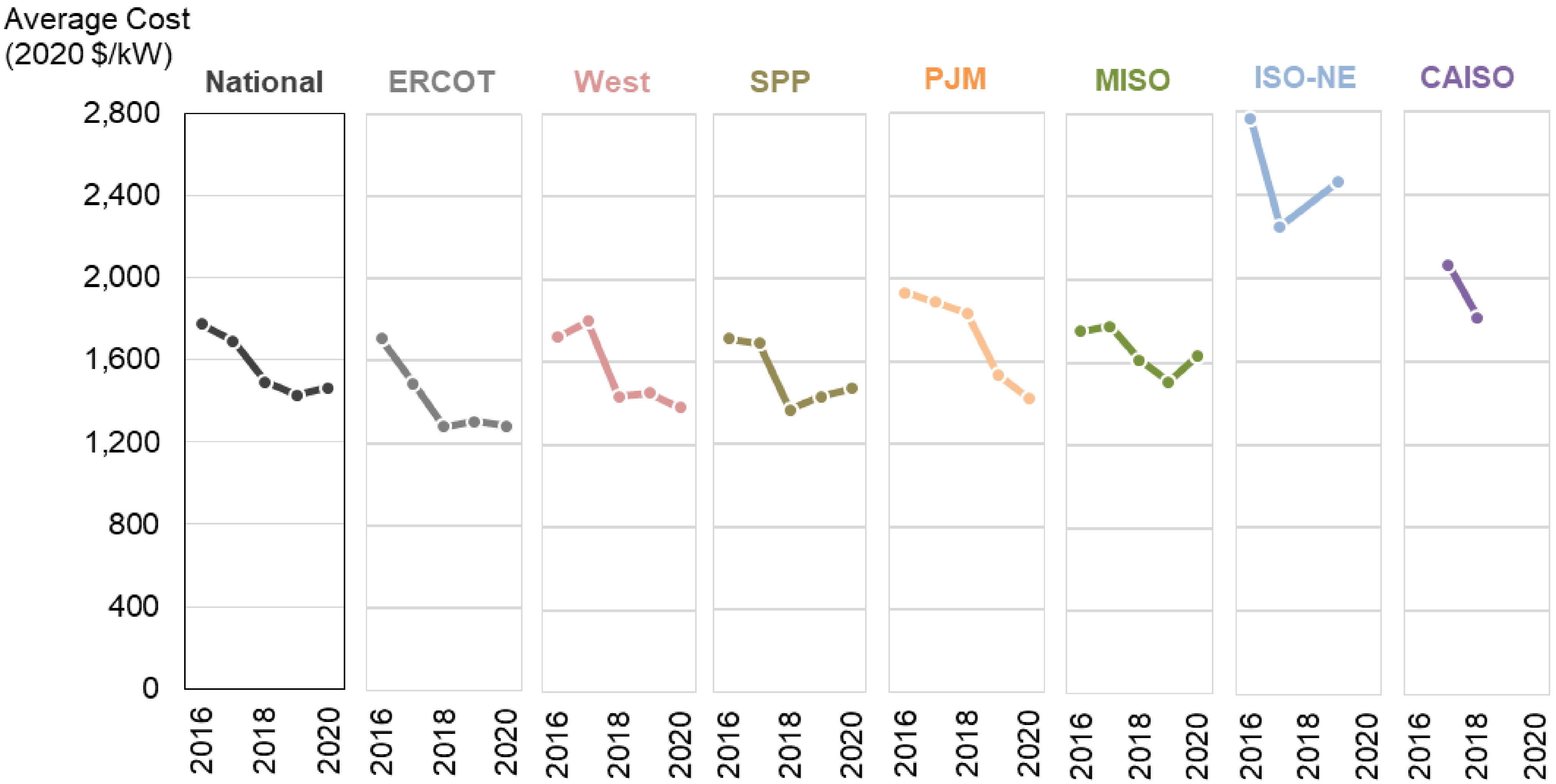


Note: Size of "bubble" reflects project capacity

Sources: Berkeley Lab, EIA (some data points suppressed to protect confidentiality)

Interactive data visualization: https://emp.lbl.gov/wind-energy-capital-expenditures-capex

General trend towards lower installed project costs exists across all regions of the United States

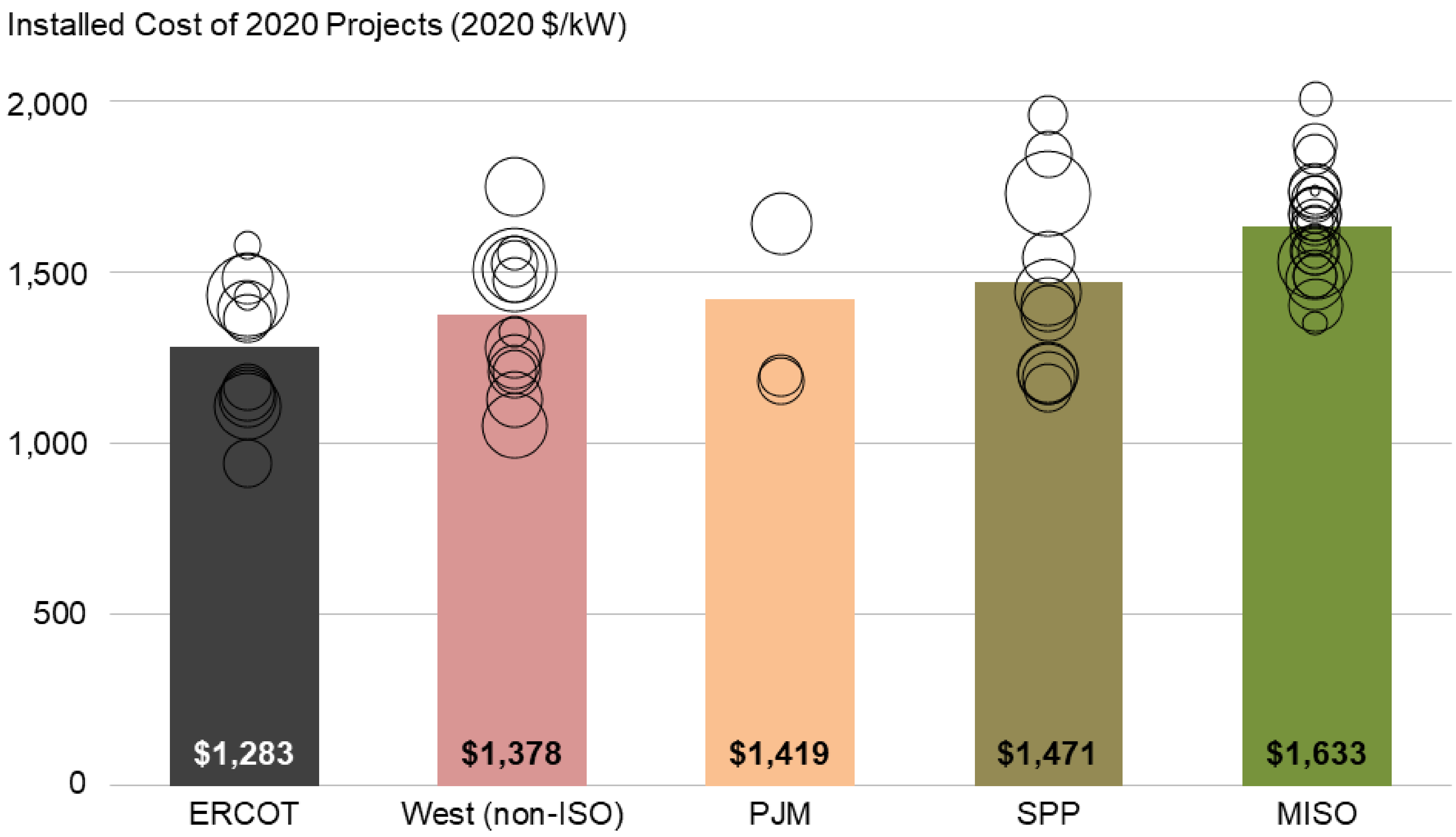


Sources: Berkeley Lab, EIA

Note: NYISO data are not available over this period. For other regions, data for specific years are missing.

Interactive data visualization: https://emp.lbl.gov/wind-energy-capital-expenditures-capex

Regional differences in average wind project costs in 2020 are apparent, but sample size is limited in some regions

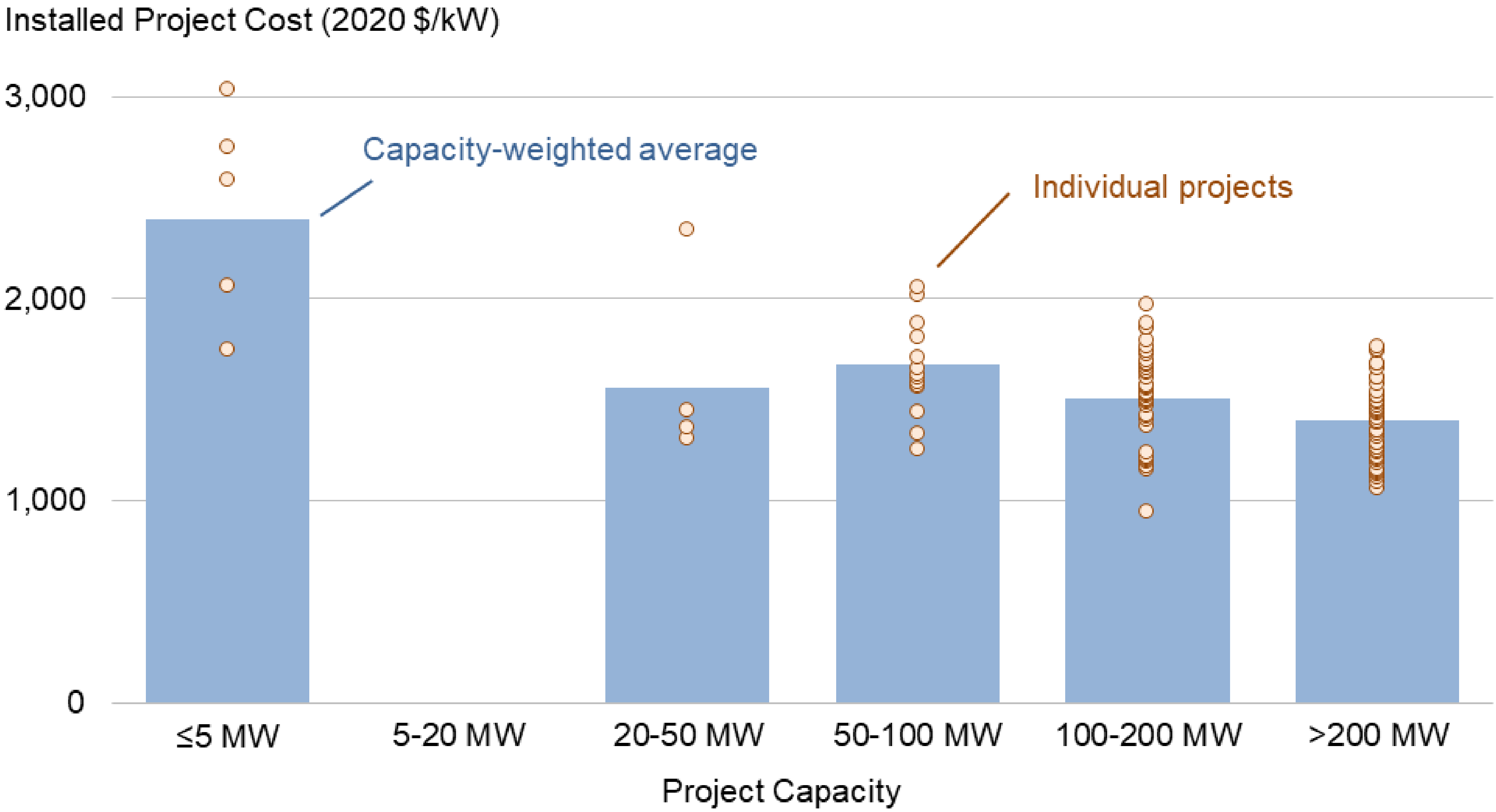


Interactive data visualization: https://emp.lbl.gov/wind-energy-capital-expenditures-capex

Note: Size of "bubble" reflects project capacity

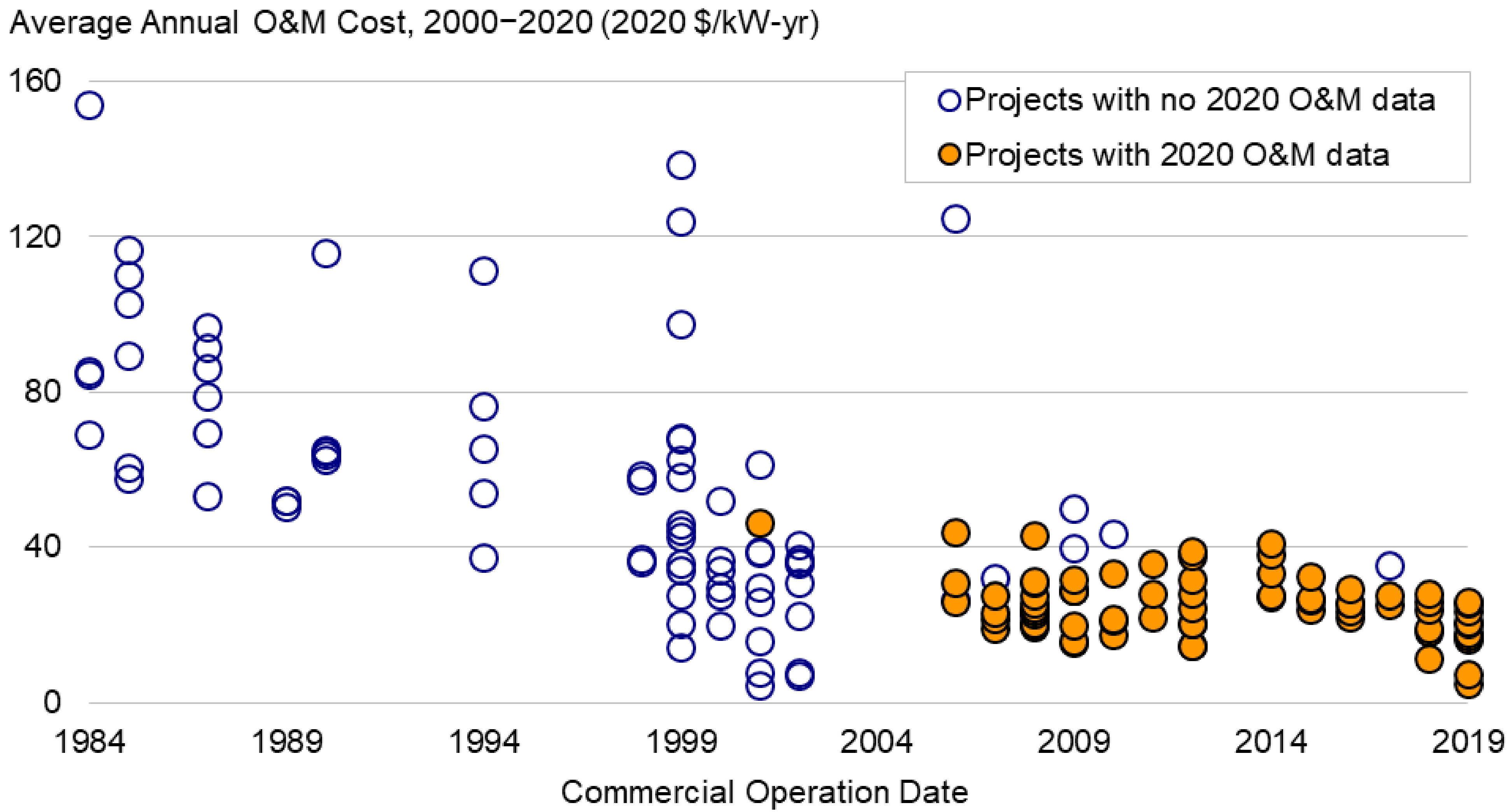
Source: Berkeley Lab

Economies of scale are evident, especially when moving from small- to medium-sized projects: 2019 and 2020 projects



Source: Berkeley Lab

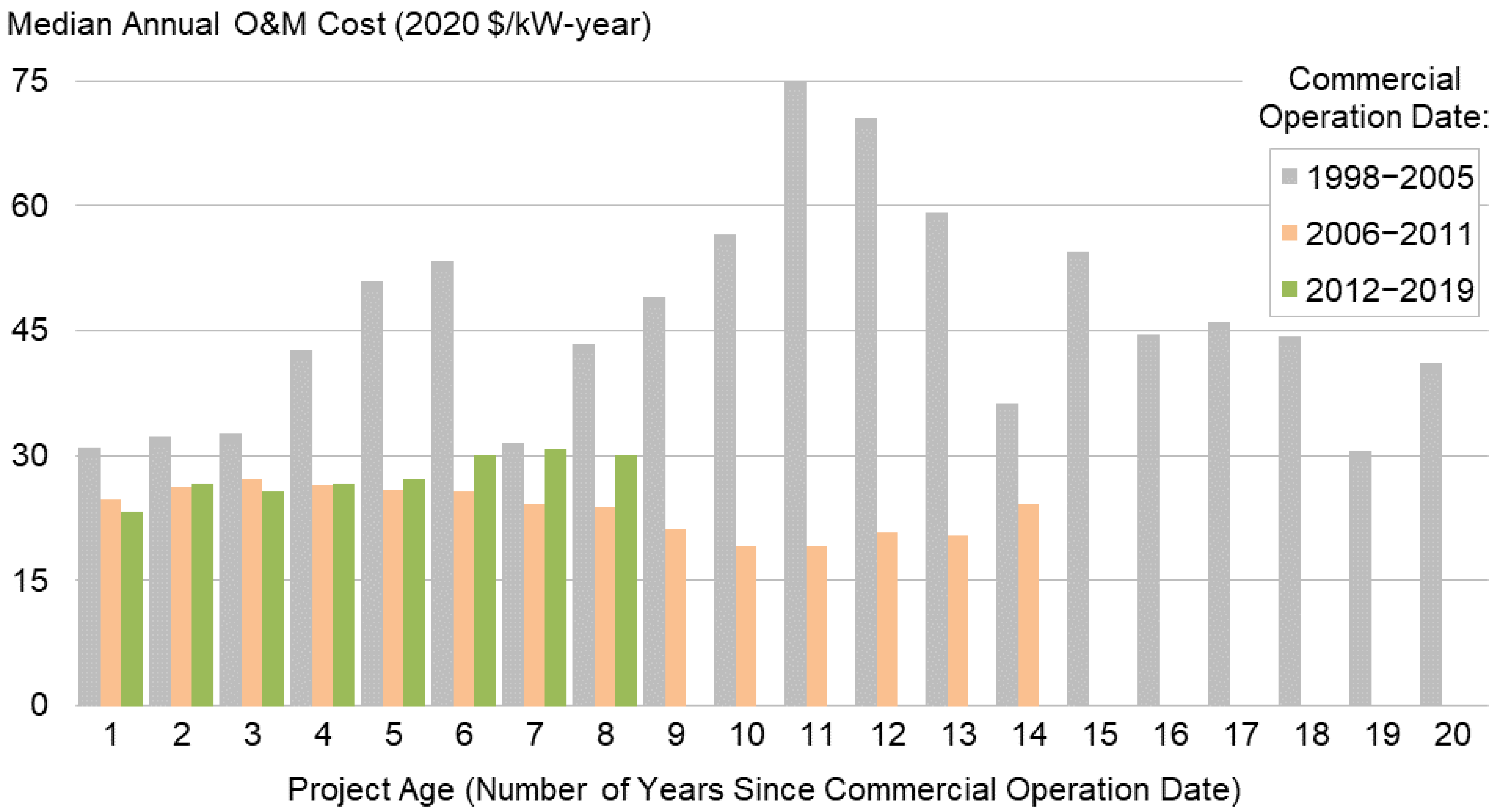
Operations and maintenance (O&M) costs vary by commercial operations date and project age



Source: Berkeley Lab; some data points suppressed to protect confidentiality

Note: Sample is limited; few projects in sample have complete records of O&M costs from 2000-20; O&M costs reported here do not include all operating costs.

O&M costs are lower for more-recently built projects, but cost trends as projects age do not follow consistent patterns



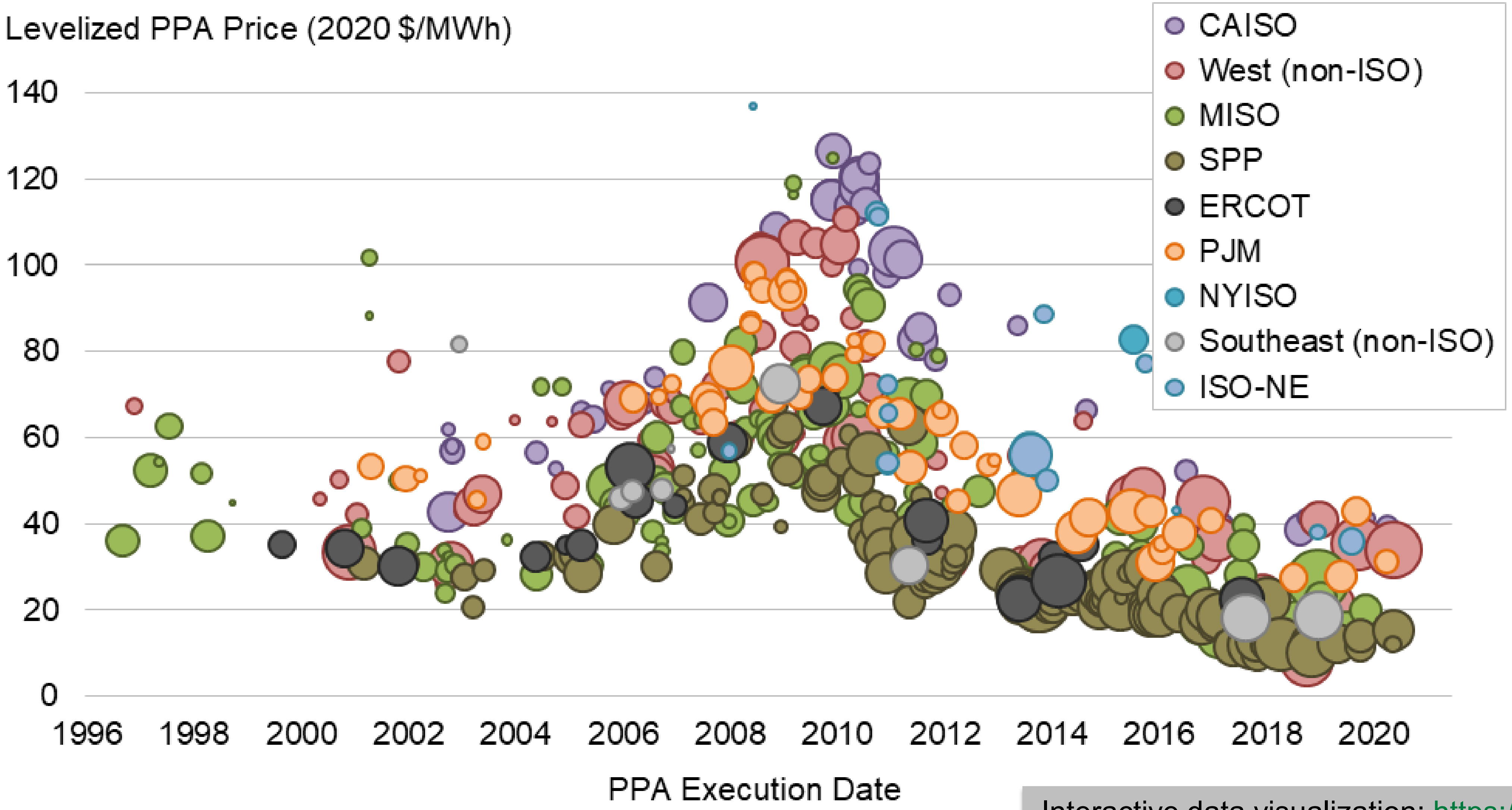
O&M reported here does not include all operating costs: all-in operating costs for the most recent wind projects average ~$44/kW-year

Source: Berkeley Lab; medians shown only for groups of two or more projects, and only projects >5 MW are included

Note: Sample size is limited, especially in years 15-20

Power Sales Price and Levelized Cost Trends

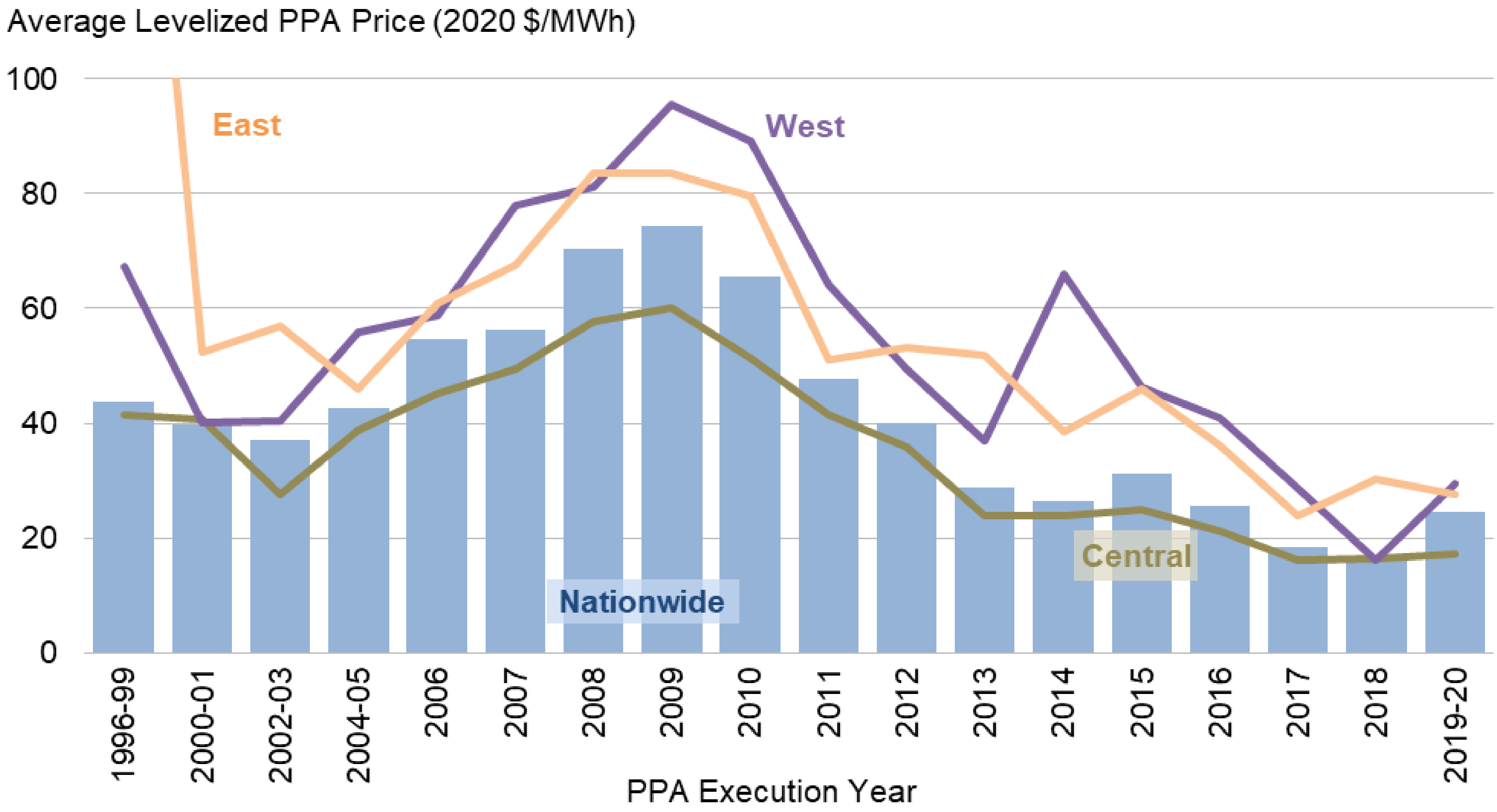
Wind power purchase agreement (PPA) prices remain low



Note: Size of bubble reflects contract capacity
Source: Berkeley Lab, FERC

Interactive data visualization: https://emp.lbl.gov/wind-power-purchase-agreement-ppa-prices

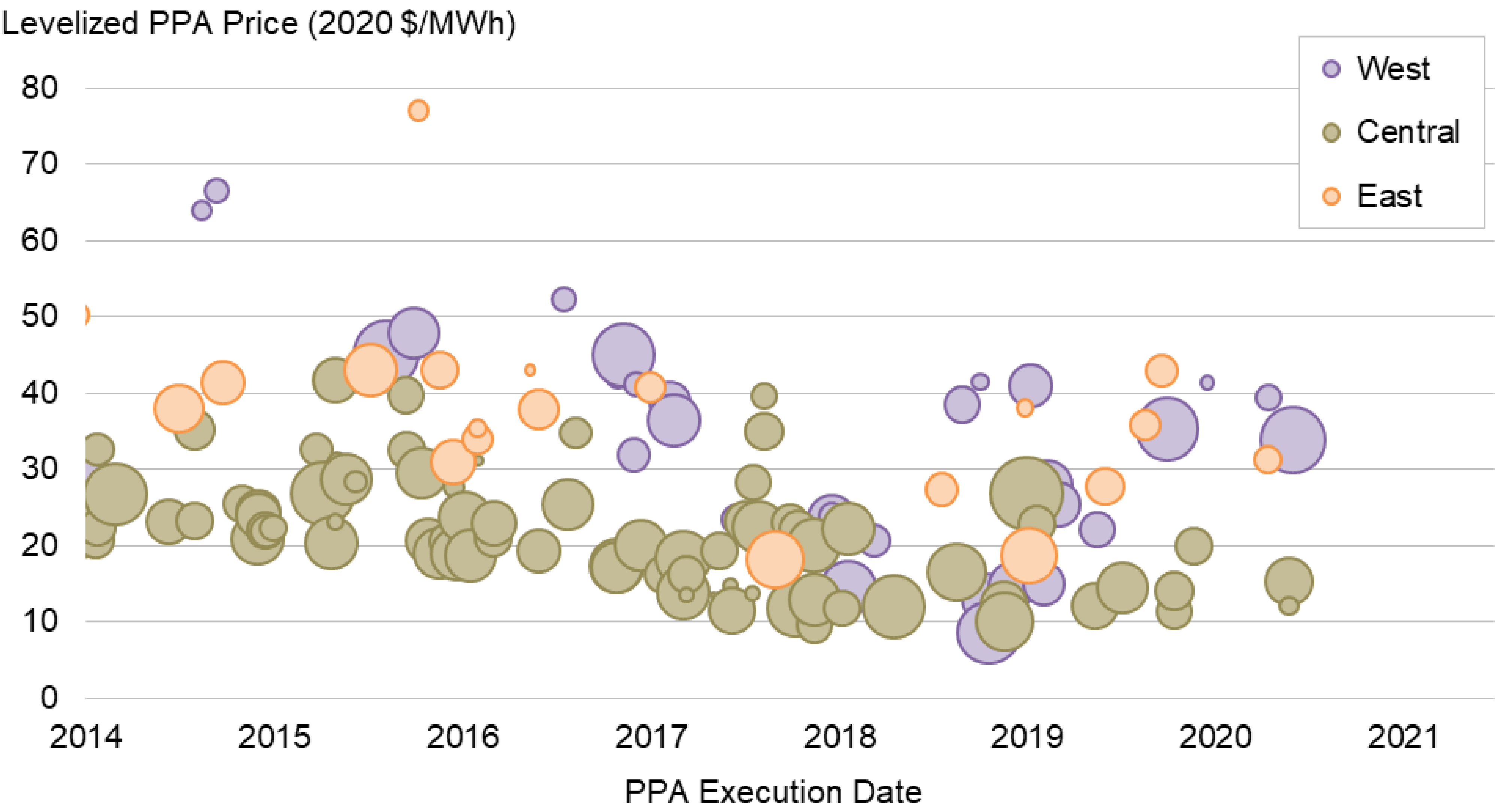
Average PPA prices have steeply declined since 2009; prices below $20/MWh in central region, but have been flat or risen in recent years



Source: Berkeley Lab, FERC

Note: West = CAISO, West (non-ISO); Central = MISO, SPP, ERCOT; East = PJM, NYISO, ISO-NE, Southeast (non-ISO)

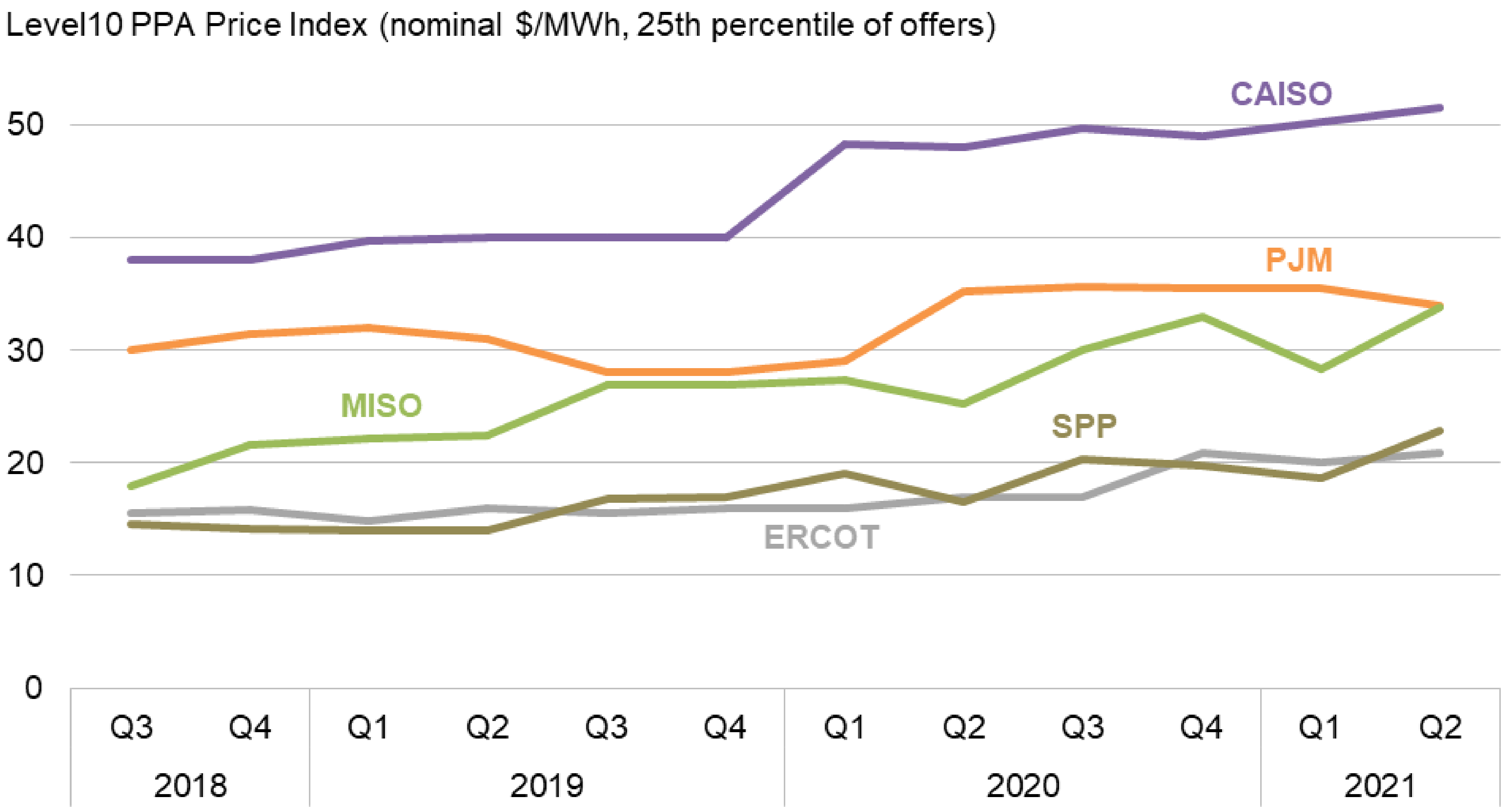
Recent wind power purchase agreements are priced in the mid-teens in some cases



Source: Berkeley Lab, FERC

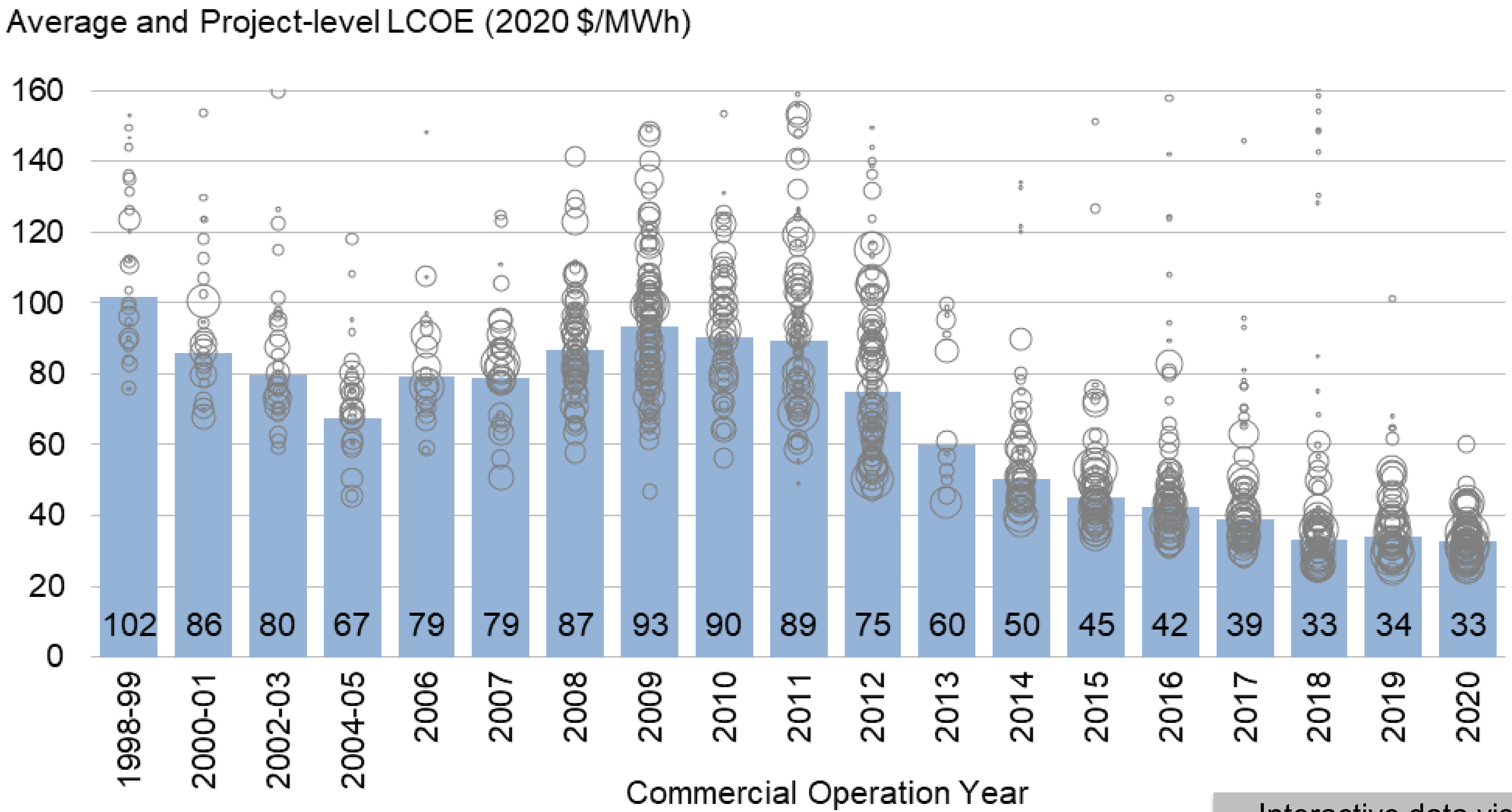
Interactive data visualization: https://emp.lbl.gov/wind-power-purchase-agreement-ppa-prices

LevelTen Energy price indices confirm low but rising PPA prices, and regional variations in wind energy prices



Source: LevelTen Energy

Levelized cost of wind energy (LCOE) has generally declined: nationwide average of $33/MWh for projects installed in 2020

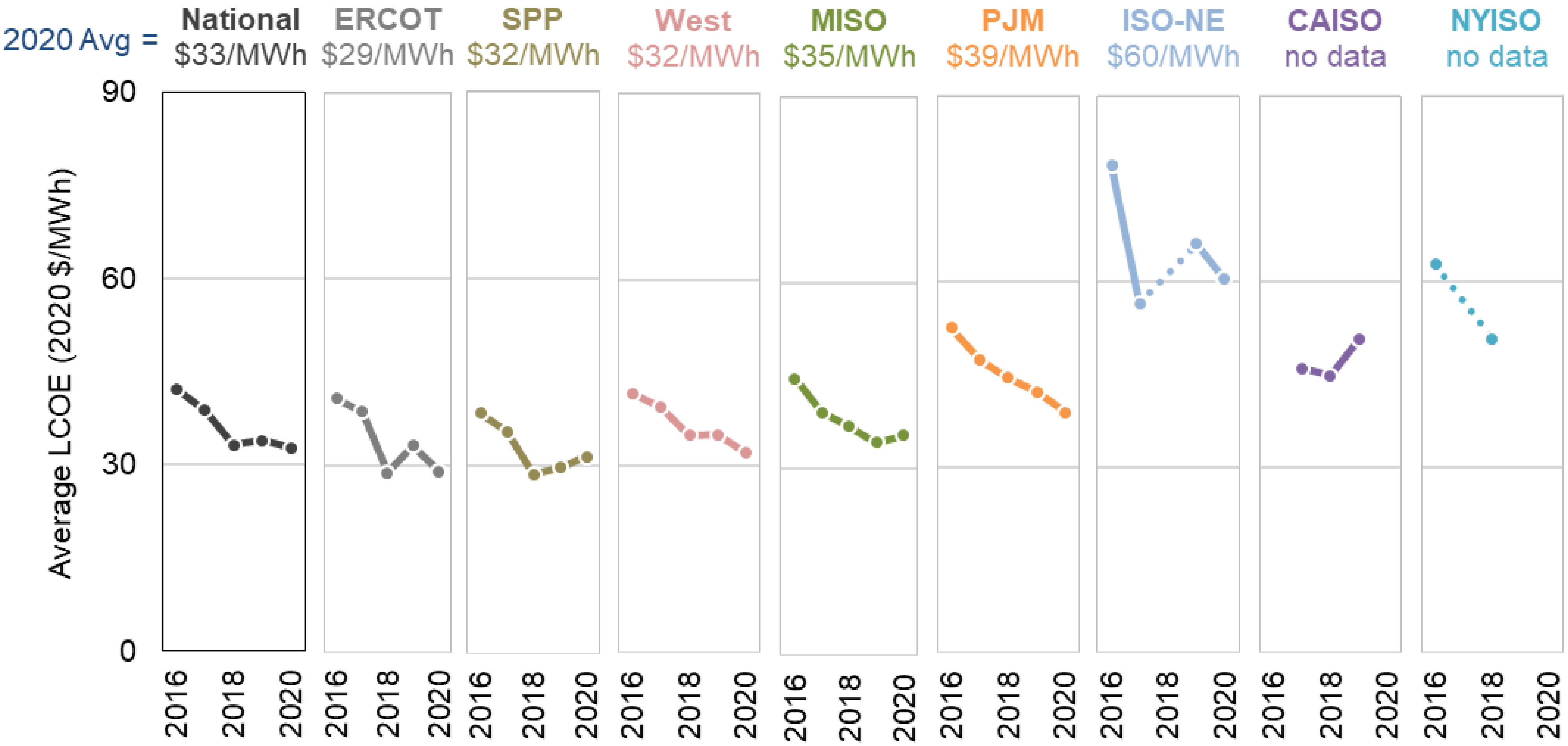


Source: Berkeley Lab

Note: Yearly estimates reflect variations in installed cost, capacity factors, operational costs, cost of financing, and project life; includes accelerated depreciation but exclude PTC. See full report for details.

Interactive data visualization: https://emp.lbl.gov/levelized-cost-wind-energy

Levelized costs vary by region, with the lowest costs in ERCOT, SPP, and the non-ISO West

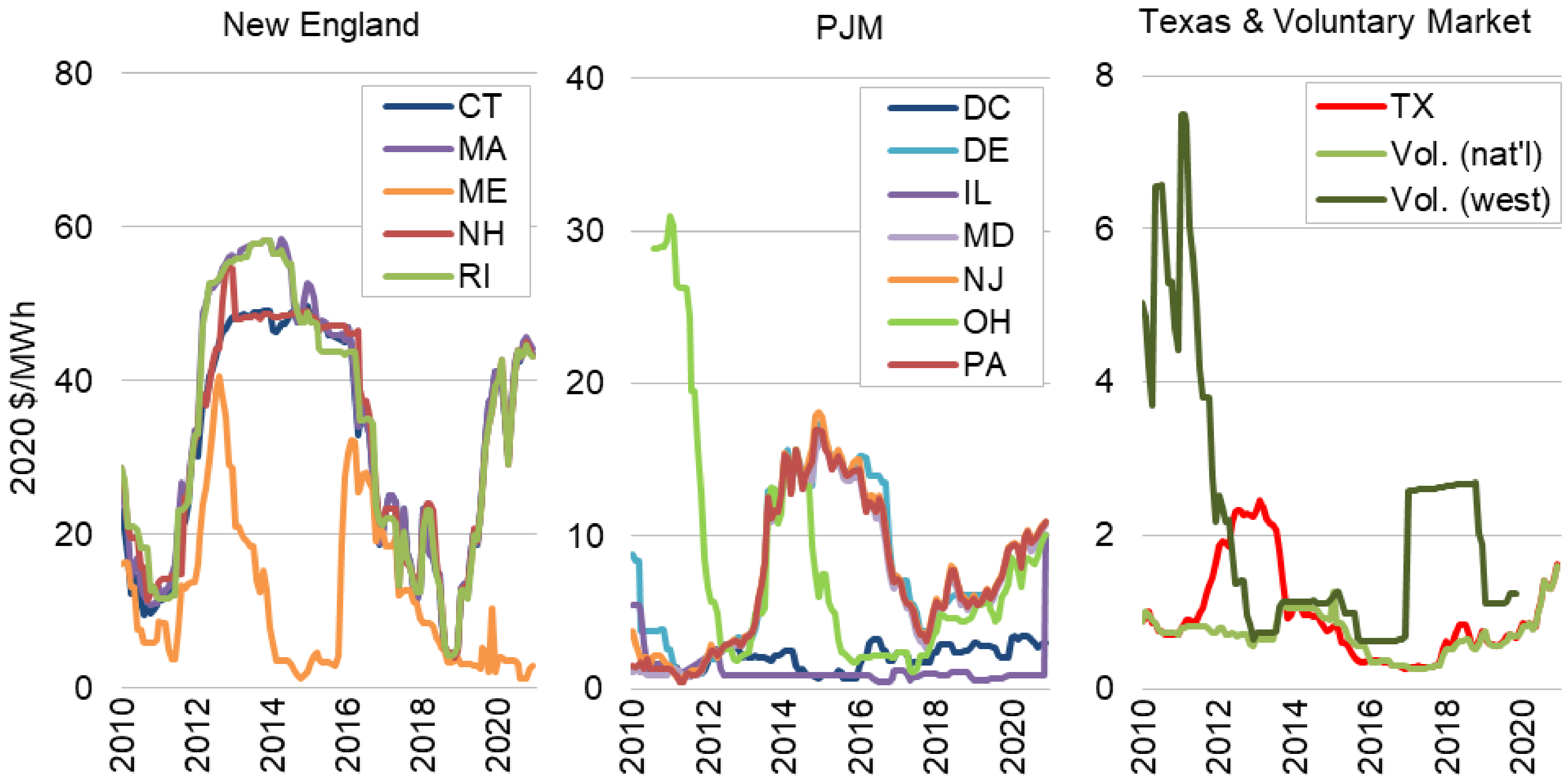


Source: Berkeley Lab

Note: Regional sample is limited in some regions and years

Interactive data visualization: https://emp.lbl.gov/levelized-cost-wind-energy

Renewable Energy Certificate (REC) prices continue to vary substantially across markets and time

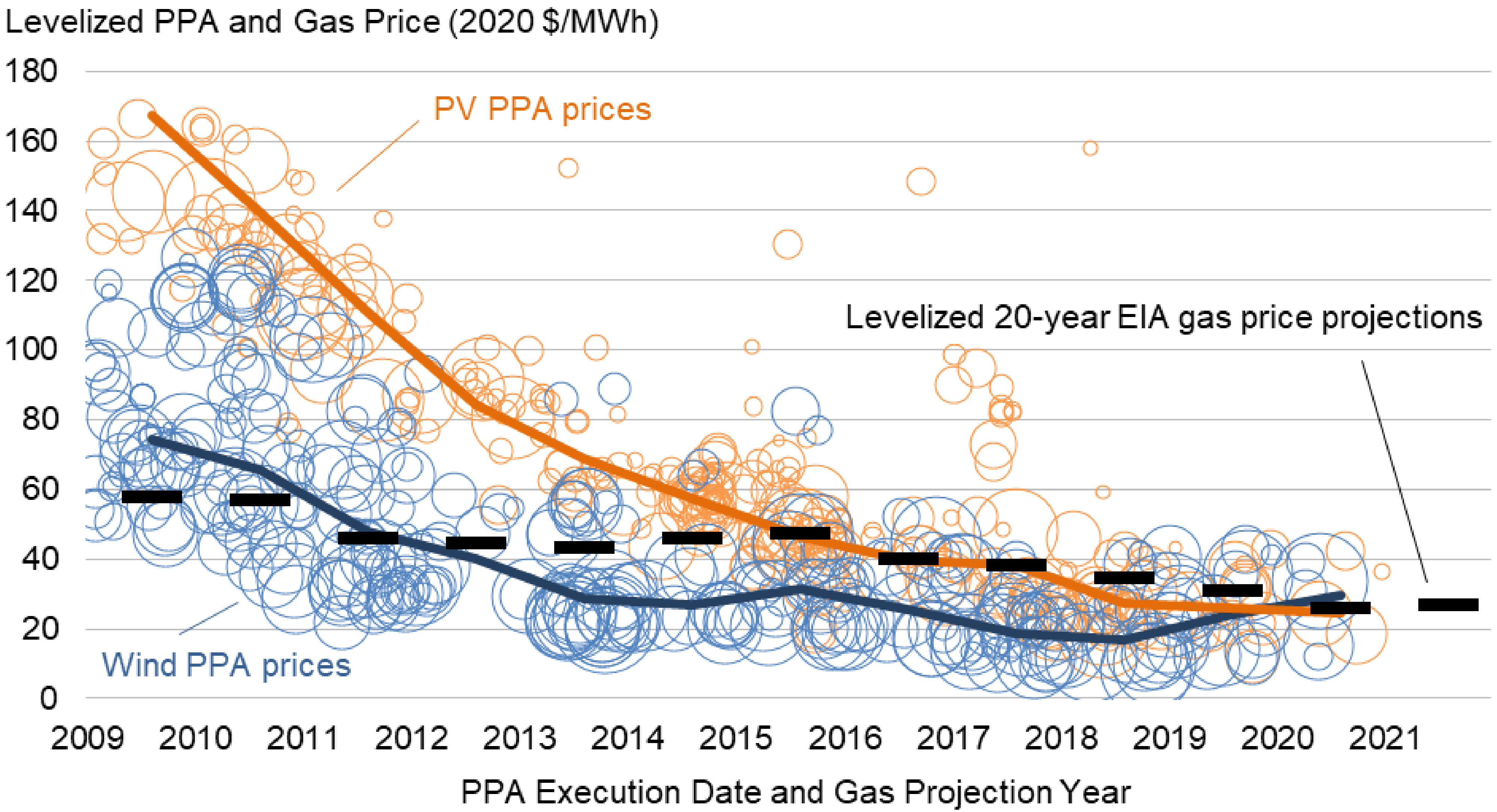


Source: Marex Spectron

REC prices vary by: market type (compliance vs. voluntary); geographic region; specific design of state RPS policies.

Cost and Value Comparisons

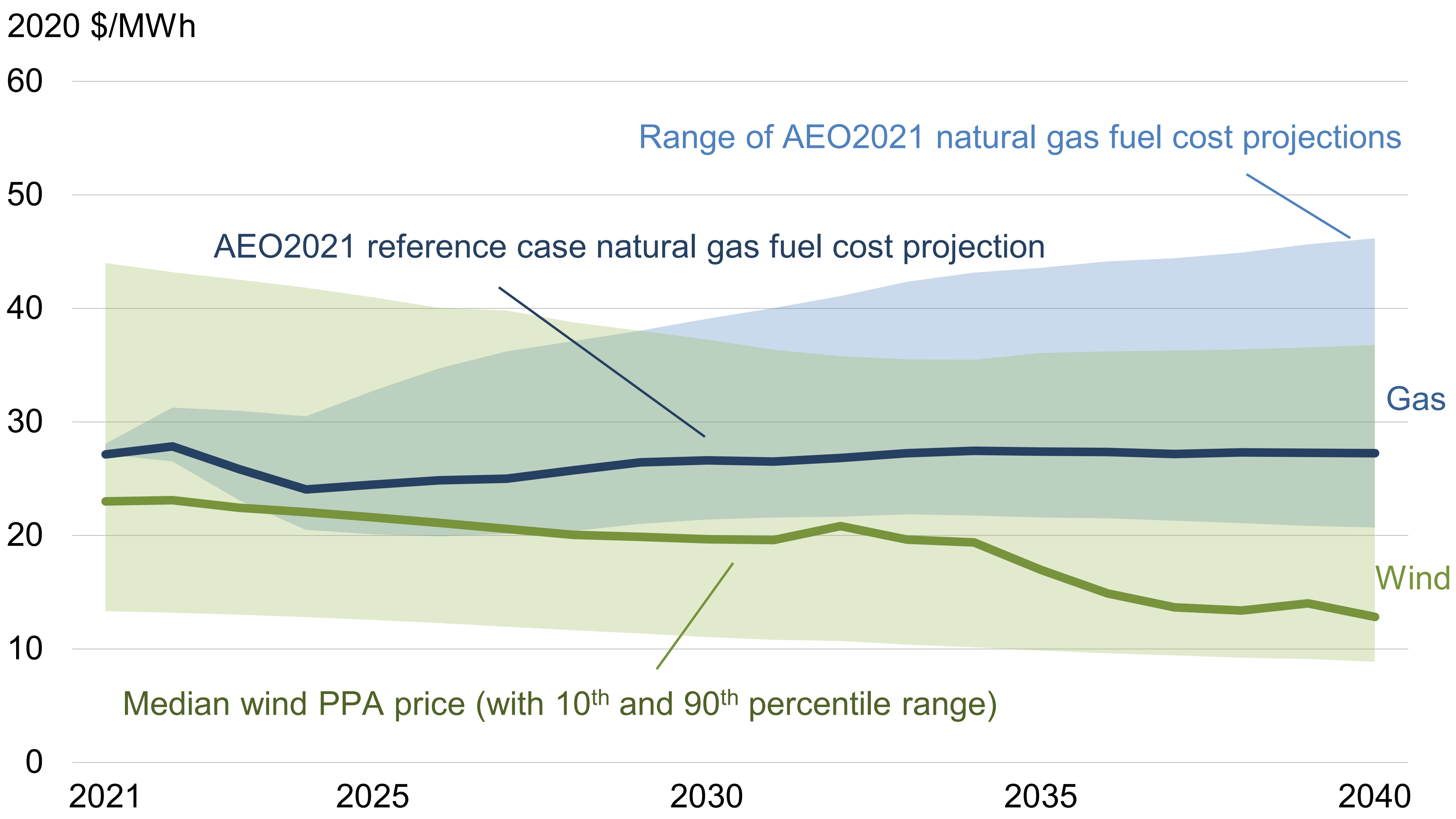
Despite recent low wind PPA prices, wind faces competition from solar and natural gas



Source: Berkeley Lab, FERC, EIA

Note: Smallest bubble sizes reflect smallest-volume PPAs (<5 MW), whereas largest reflect largest-volume PPAs (>500 MW).

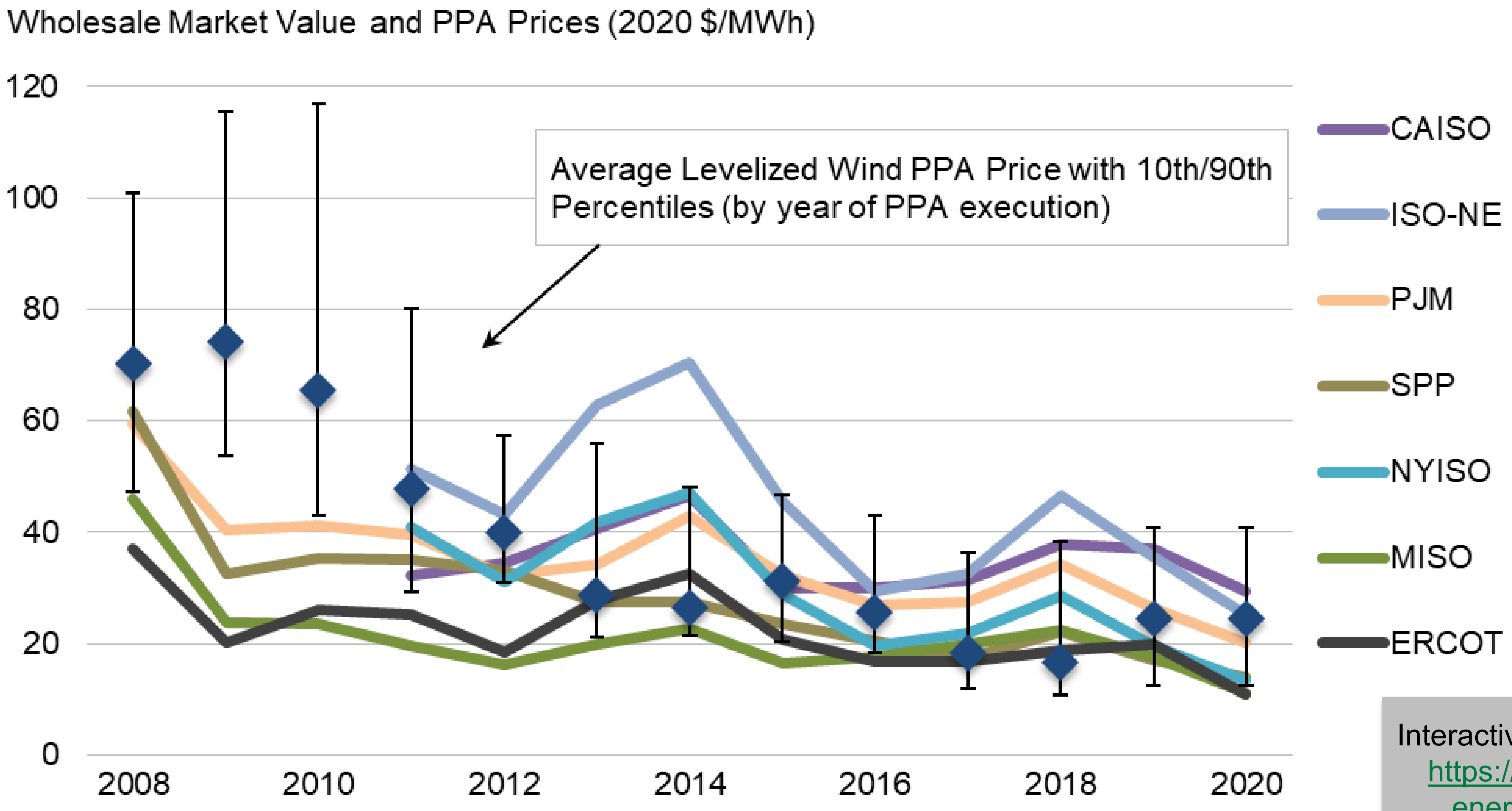
Recent wind prices are competitive with the expected future cost of burning fuel in natural gas plants



Source: Berkeley Lab, FERC, EIA

Notes: Price comparisons shown are far from perfect—see full report for details

Wind PPA prices have been broadly attractive compared to wind's grid-system value in wholesale power markets

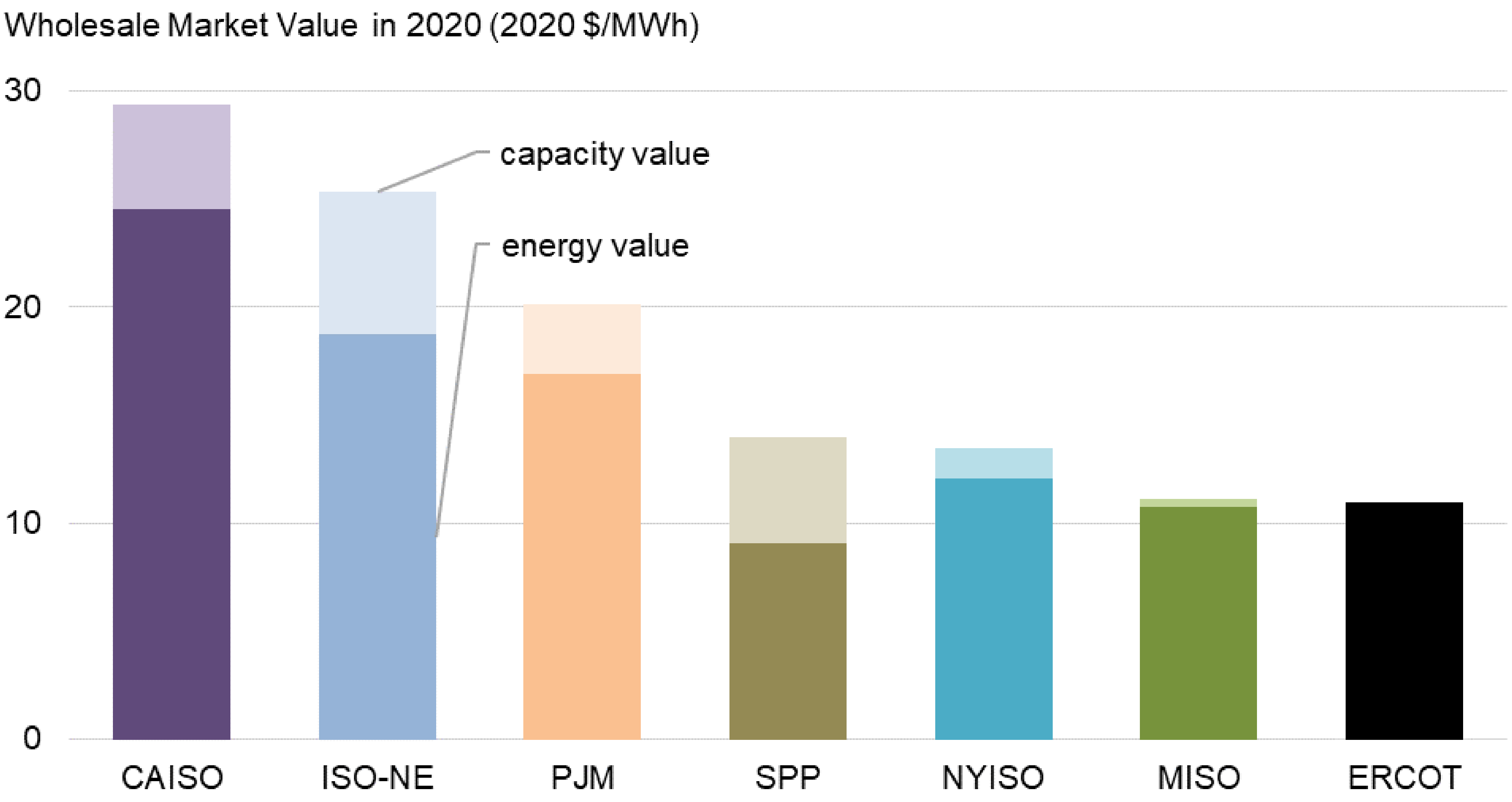


Sources: Berkeley Lab, ABB, ISOs

Wholesale market value considers hourly local wholesale energy price and hourly wind output, along with capacity value where available

Interactive data visualization: https://emp.lbl.gov/wind-energy-market-value

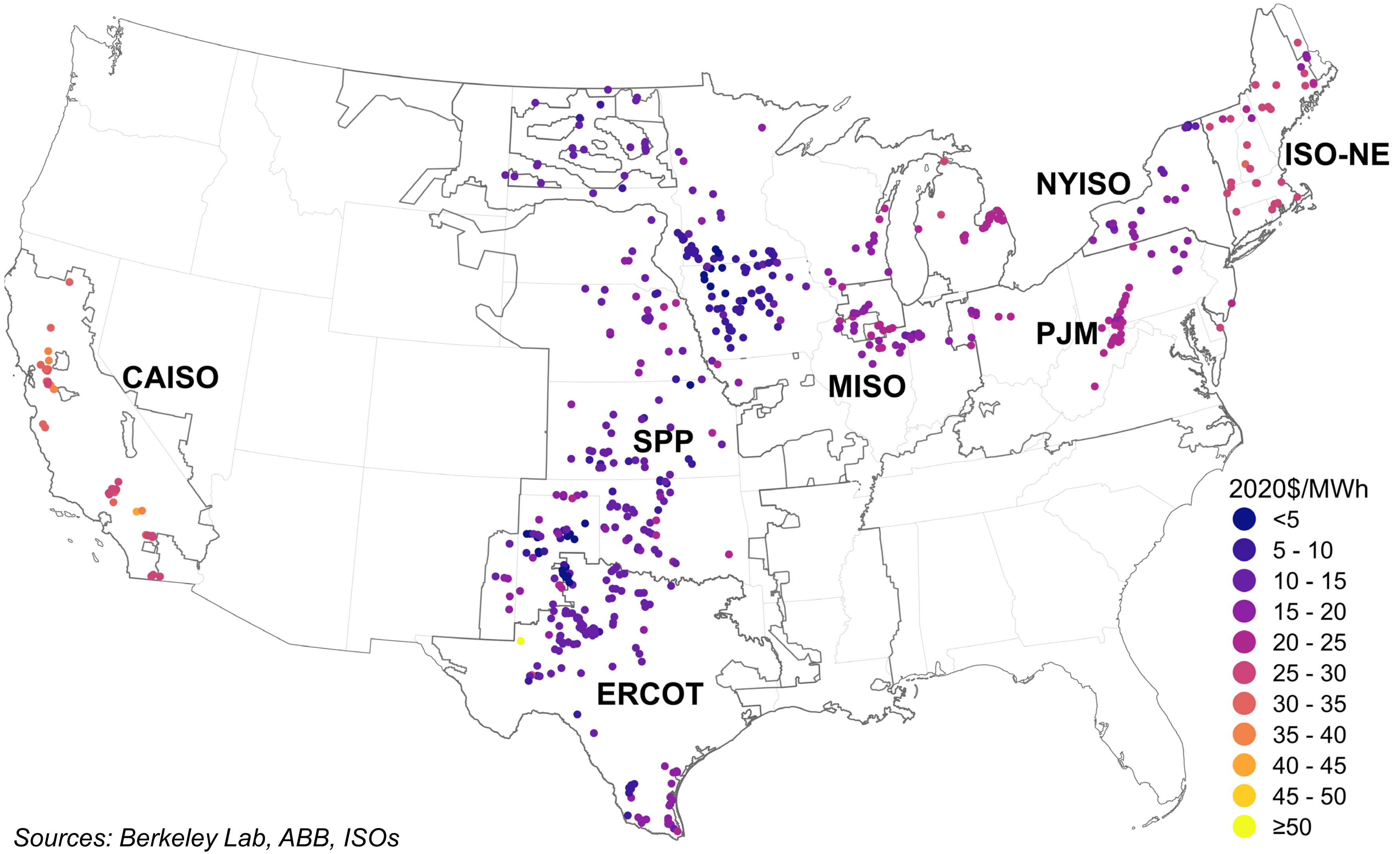
The wholesale market value of wind energy in 2020 varied by region: lowest in ERCOT, MISO, NYISO, SPP; highest in CAISO



Sources: Berkeley Lab, ABB, ISOs

Interactive data visualization: https://emp.lbl.gov/wind-energy-market-value

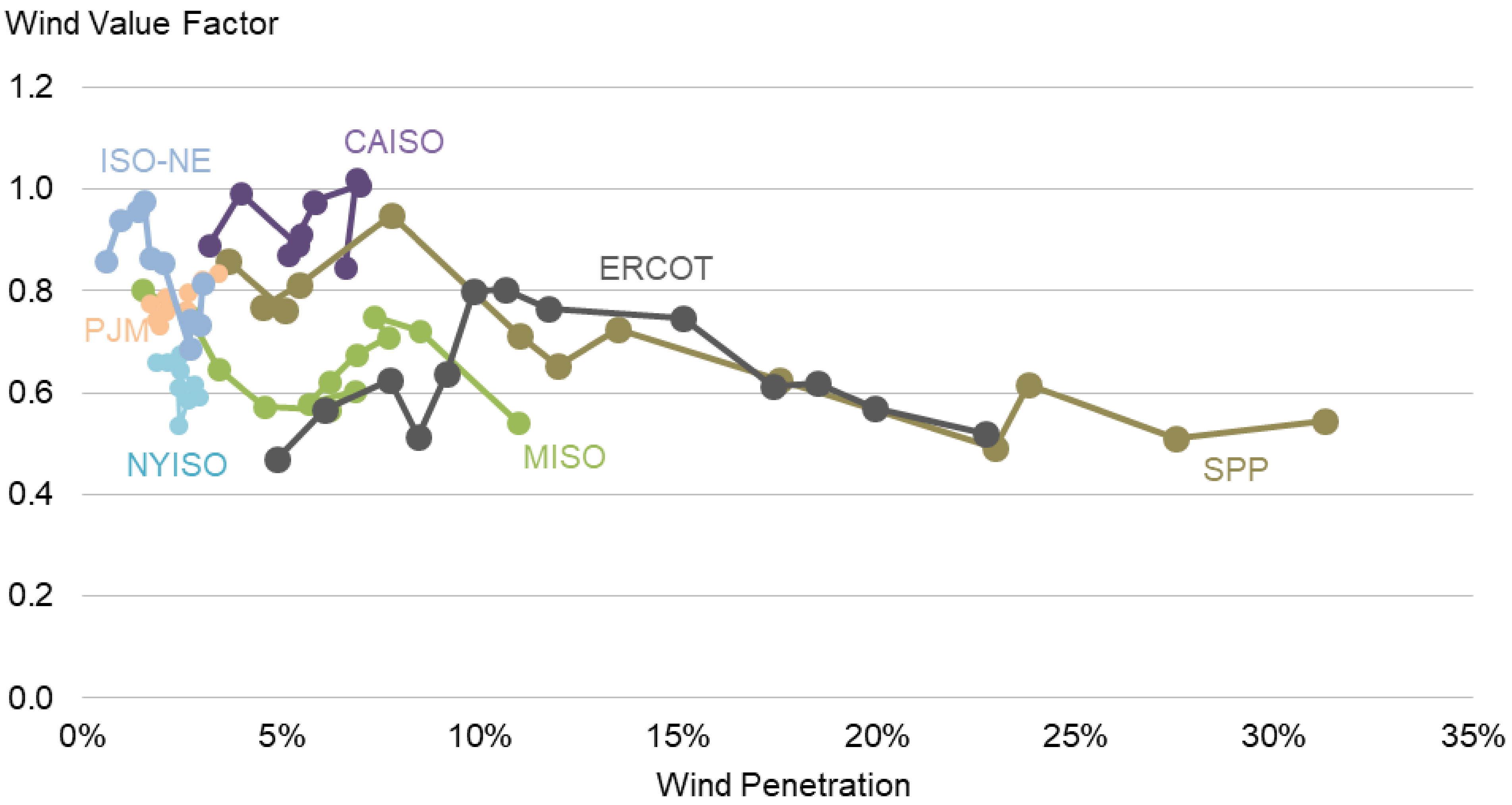
The grid-system market value of wind varies by project location



Sources: Berkeley Lab, ABB, ISOs

Interactive data visualization: https://emp.lbl.gov/wind-energy-market-value

Average "value factor" of wind (value relative to flat block) is highly variable across regions, tends to decline with penetration



Sources: Berkeley Lab, ABB, ISOs

Value factor = wholesale market value of wind relative to generalized flat block of power in region; generalized flat block is 24x7 average price across all pricing nodes in region

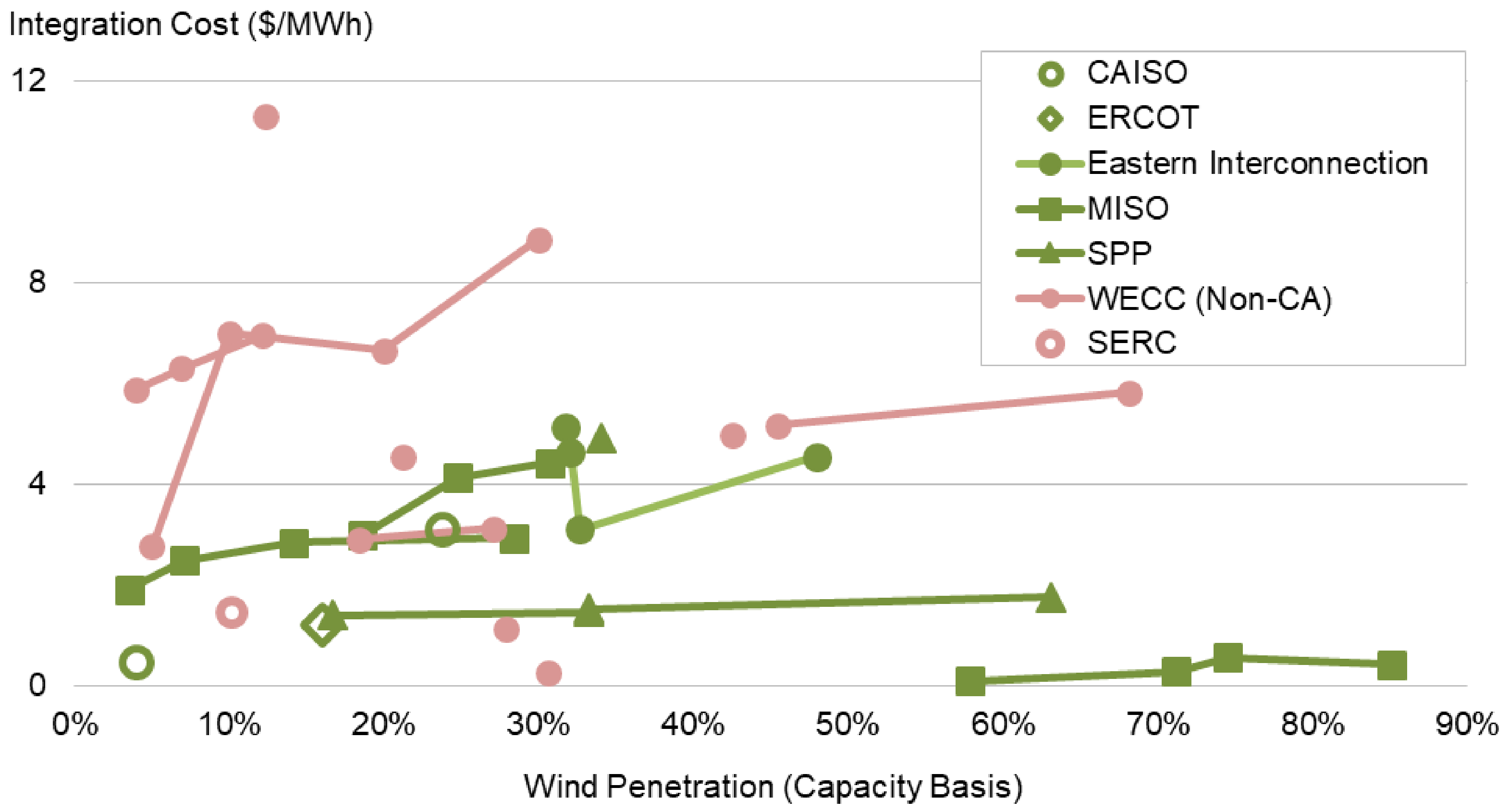
Grid-system market value of wind tends to decline with penetration, impacted by output profile, transmission congestion, and curtailment

Average market value de-rate of wind in 2020 relative to a flat block varied by region: dominated by wind's output profile in some regions (SPP, PJM, CAISO), and congestion in others (MISO, NYISO)

Sources: Berkeley Lab, ABB, ISOs

As a weather-driven resource, wind power impacts grid-system operations

Integrating wind energy into power systems is manageable, but not free of additional costs

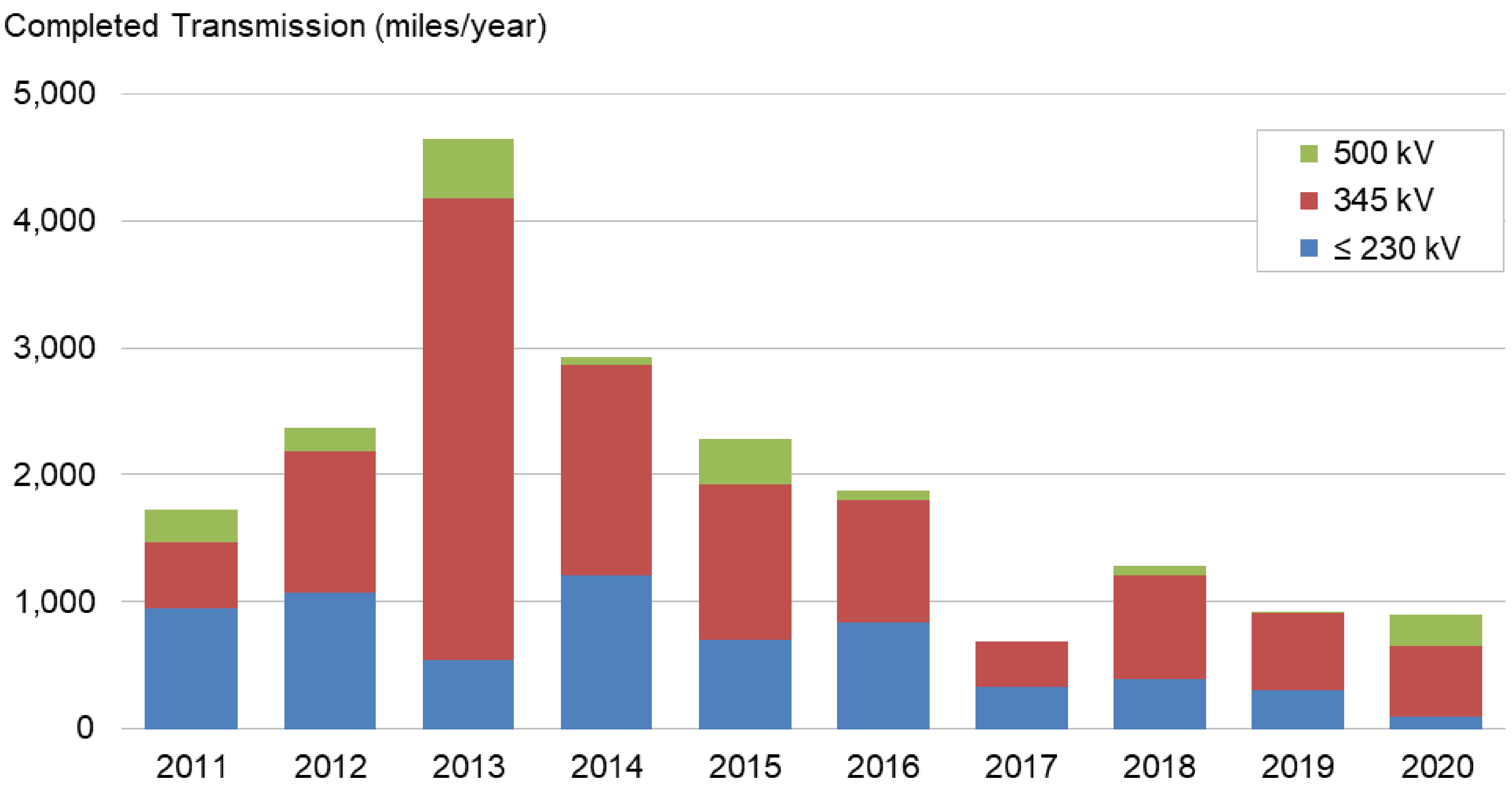


Sources: see data file for details

Note: Because methods vary and a consistent set of operational impacts has not been included in each study, results from the different analyses presented here are not fully comparable. Nonetheless, in general, the balancing costs included in the above graphic are often additional to the market value and value factor results presented in previous slides, as those earlier estimates focus on hourly trends in wind output whereas balancing costs often address forecast effort and sub-hourly output variations.

As a location-dependent resource, wind power often requires or benefits from new transmission

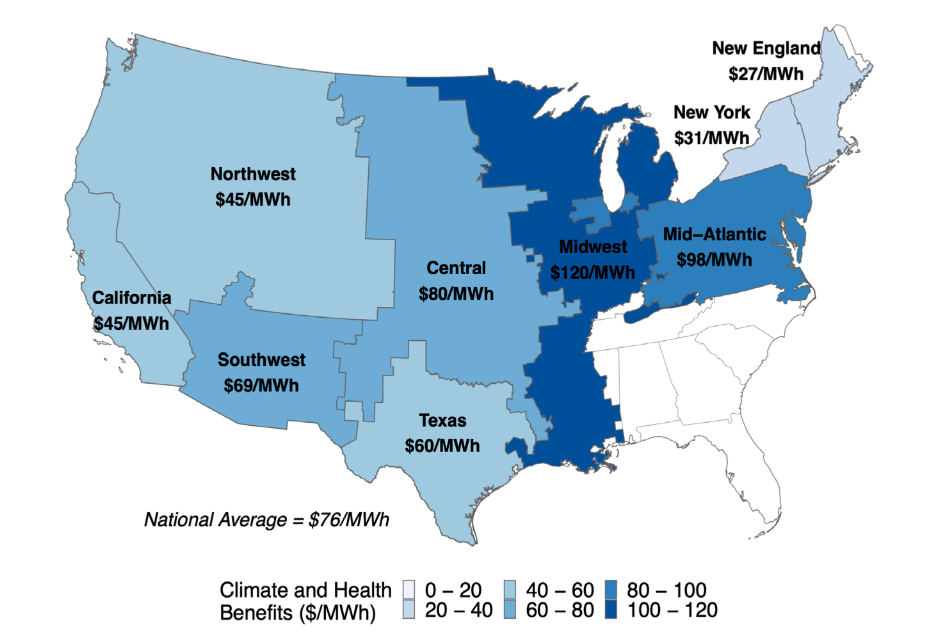
New transmission build has been relatively modest in recent years



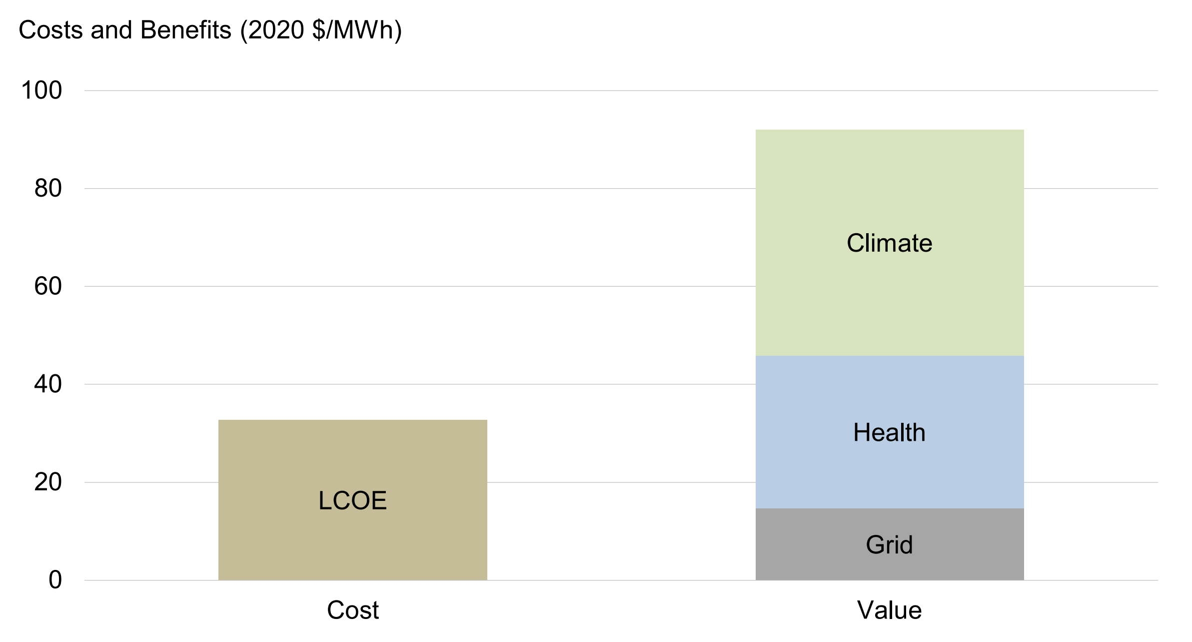
Source: FERC

The health and climate benefits of wind dwarf its grid-system value, and the combination of all three far exceeds the levelized cost of wind

Health and Climate Benefits of Wind in 2020 Vary Regionally, Average $76/MWh Nationally



Grid, Health, and Climate Benefits of New Wind Plants in 2020 Exceed LCOE

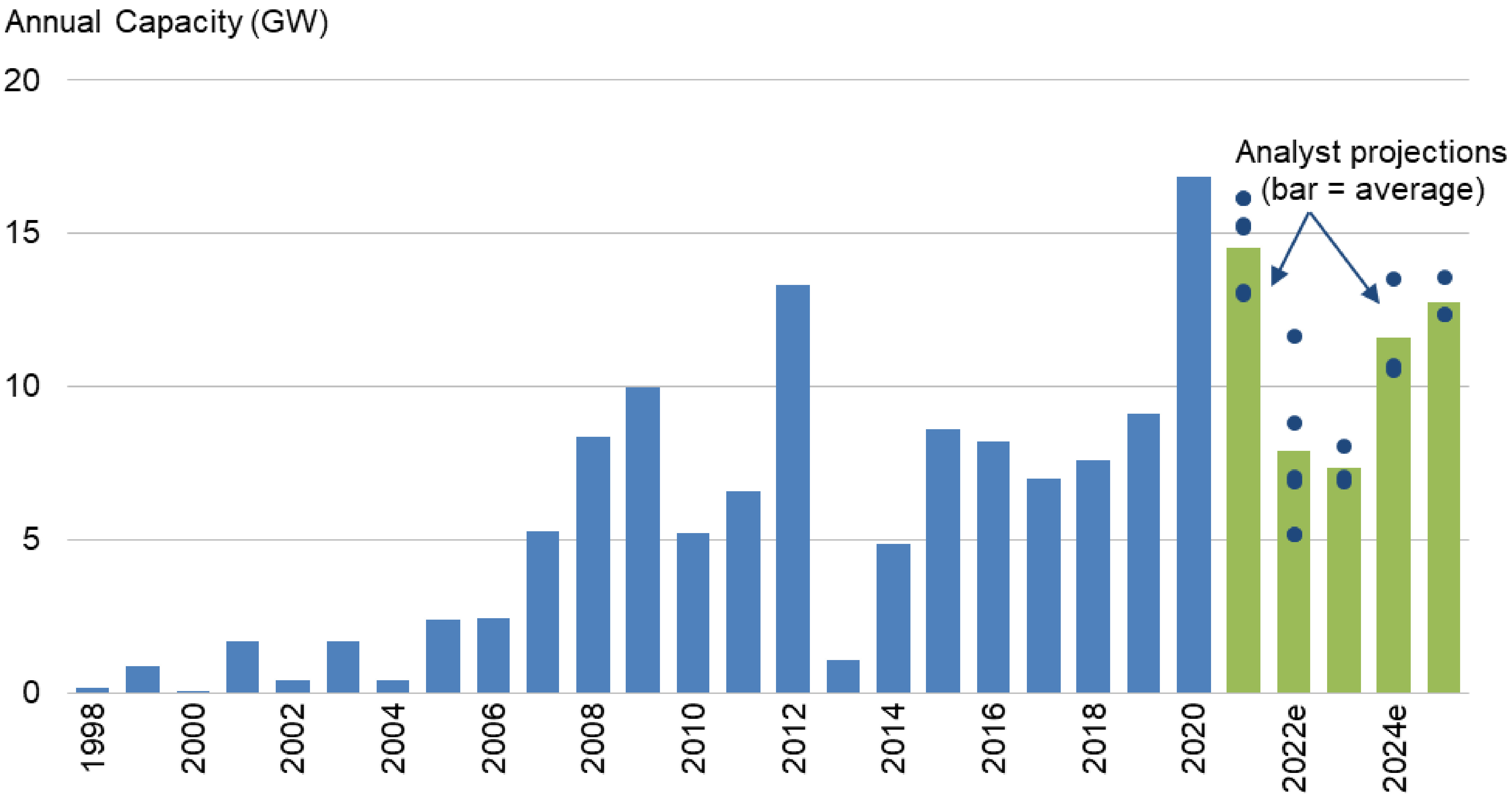


Note: Estimates not provided for Southeast due to small number of wind plants in that region.

Sources: Berkeley Lab, EIA Form 930, Fell and Johnson (2021)

Future Outlook

Independent analysts anticipate sizable wind additions in 2021 given tax incentives, but with a possible short-term downturn in 2022–2023



Sources: ACP, independent analyst projections

The underlying report, an accessible data file, and multiple visualizations can be found at:

- windreport.lbl.gov

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