U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

2014 Wind Technologies Market Report Highlights

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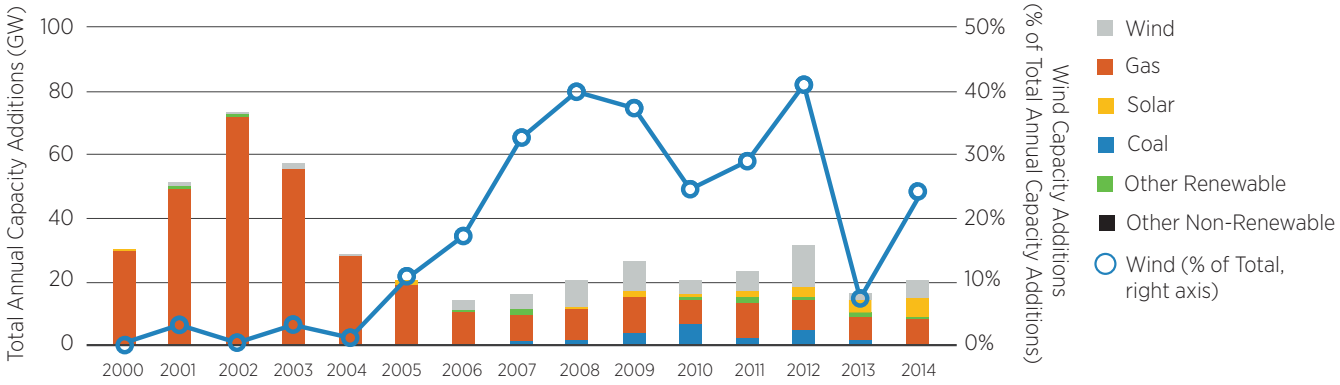
Introduction

The United States remains a top installer of wind energy capacity. Wind power additions rebounded in 2014, with 4,854 megawatts (MW) of new capacity added in the United States representing $8.3 billion in new investments. In total, the wind industry grew to 65.9 gigawatts (GW) of total installed wind capacity, which is roughly an 8% growth over 2013. The United States now has enough installed wind energy capacity to power over 17.5 million homes.

Wind power represented 24% of U.S. electric-generating capacity additions in 2014 and accounted for 4.9% of end-use electricity demand. Since 2007, wind power has represented 33% of all U.S. capacity additions. With utility-scale wind energy projects installed in 39 States and Puerto Rico, the U.S. wind sector supports more than 73,000 jobs, representing a 30% job market increase over 2013. Additionally, 2014 ushered in some of the lowest wind energy prices ever, falling to 2.35 cents per kilowatt hour (kWh) for Power Purchase Agreements (PPAs), which accounts for a 66% decline since 2009, when prices topped out at nearly 7 cents per kWh.



Wind Represented 24% of U.S. Electric-Generating Capacity Additions in 2014

Wind power was the third-largest source of newly installed generating capacity in the United States in 2014. While the United States is the world's number one producer of wind energy, in terms of total installed capacity, the United States remains second to China.

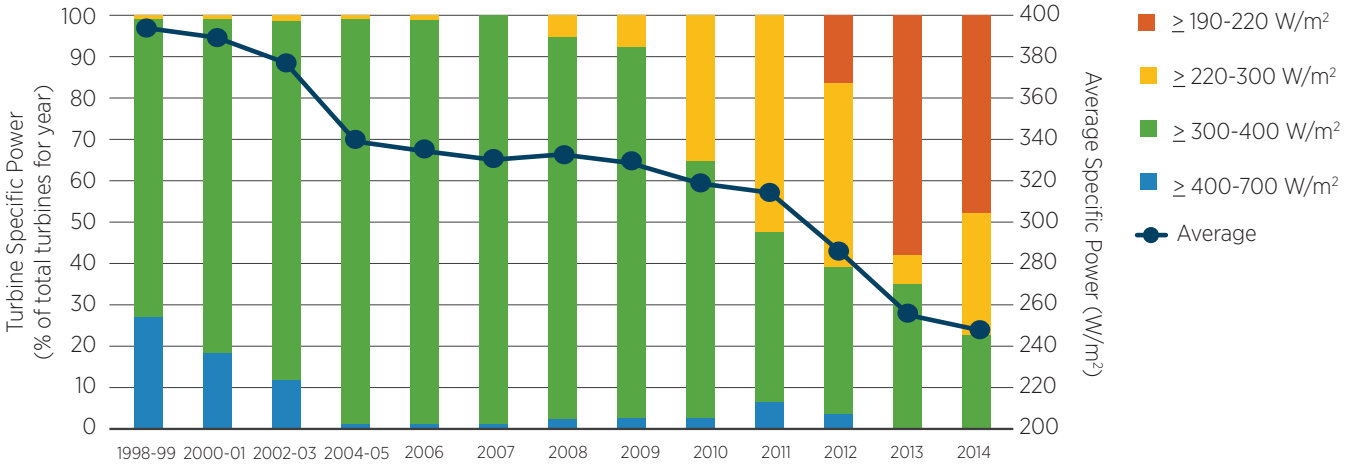
Annual Capacity (2014, in MW)	
China	23,300
Germany	5,119
United States	**4,854**
Brazil	2,783
India	2,315
Canada	1,871
United Kingdom	1,467
Sweden	1,050
France	1,042
Turkey	804
Rest of World	6,625
TOTAL	**51,230**

Cumulative Capacity (end of 2014, in MW)	
China	114,760
United States	**65,877**
Germany	39,223
India	22,904
Spain	22,665
United Kingdom	12,413
Canada	9,684
France	9,170
Italy	8,556
Brazil	6,652
Rest of World	60,208
TOTAL	**372,112**

The United States Placed Third in Annual Wind Power Capacity Additions in 2014
Source: Navigant; AWEA project database for U.S. capacity

Wind Technology

Wind turbines originally designed for lower wind speed sites have rapidly gained market share. With growth in average swept rotor area outpacing growth in average nameplate capacity, there has been a decline in the average "specific power" (in W/m^2) over time, from 394 W/m^2 among projects installed in 1998–1999 to 249 W/m^2 among projects installed in 2014. A wind turbine's specific power is the ratio of its nameplate capacity rating to its rotor-swept area. All else equal, a lower specific power will boost capacity factors because there is more swept rotor area available (resulting in greater energy capture) for each watt of rated turbine capacity, meaning that the generator is likely to run closer to or at its rated capacity more often.

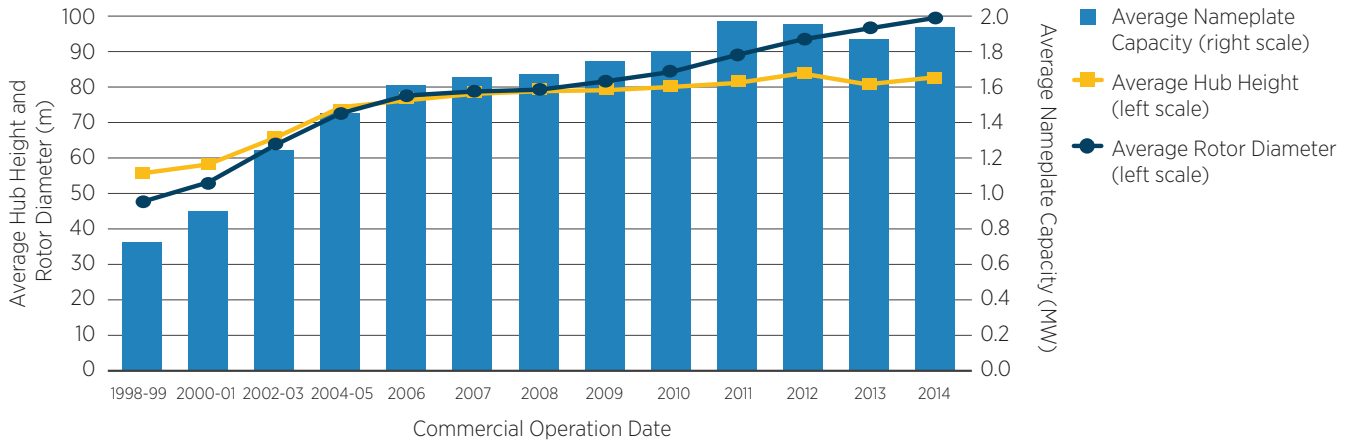


United States Increases Use of Turbines with Low Specific Power

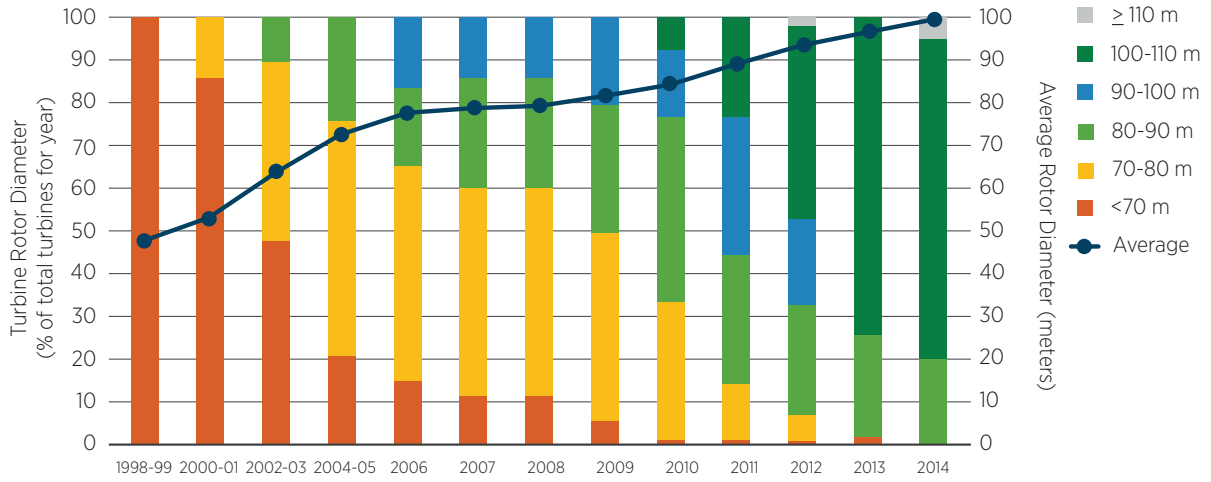
Technology Trends

Along with growing rotor diameters, turbine nameplate capacity and hub height have also increased significantly over the long term. With capacity factors now averaging 33%, up from 30% in 2000, wind turbines are converting a higher amount of wind into wind energy at a lower price. The average nameplate capacity of newly installed wind turbines in the United States in 2014 was 1.9 MW, up 172% since 1998–1999.

The average hub height of newly installed wind turbines in 2014 was 82.7 meters (m), up 48% since 1998–1999, while the average rotor diameter was 99.4 m, up 108% since 1998–1999. Rotor scaling has been especially significant in recent years, and more so than increases in nameplate capacity and hub heights, both of which have seen a stabilization of the long-term trend in recent years. In 2008, no turbines employed rotors that were 100 m in diameter or larger; by 2014, that percentage was 80%.



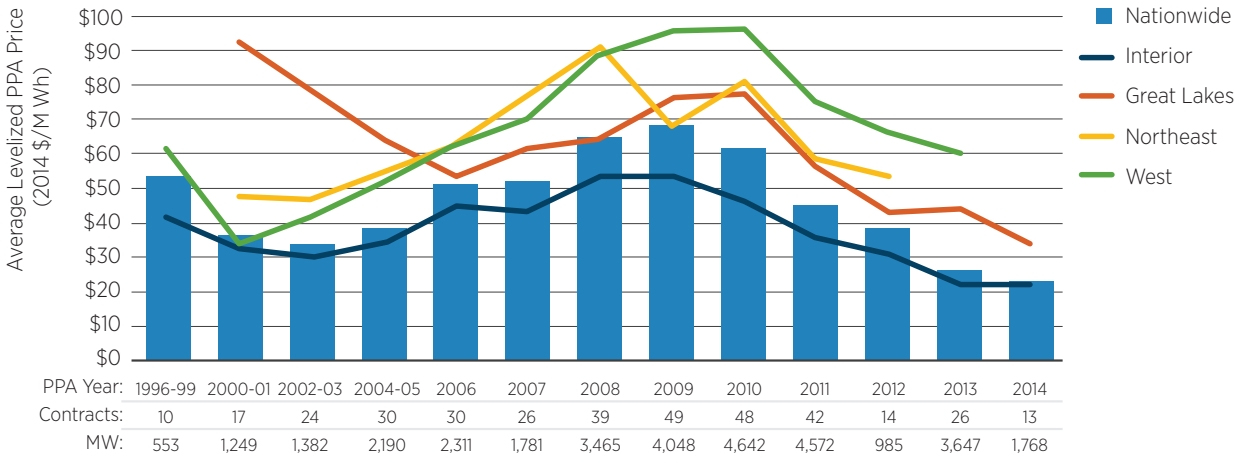
Turbines and Turbine Components Increase in Size and Efficiency



Trends in Turbine Rotor Diameter

Pricing Trends

The project finance environment remained strong in 2014. Spurred on by the safe harbor deadline to achieve commercial operations by 2015 to qualify for the PTC (later extended through 2016), the U.S. wind market raised $5.8 billion of new tax equity in 2014—the largest single-year amount on record. Debt finance increased slightly to $2.7 billion, with plenty of additional availability. Tax equity yields held steady at around 8% (in unlevered, after-tax terms), while debt interest rates fell by roughly 100 basis points (i.e., an absolute decrease of 1%) throughout 2014 as debt availability remained high. Looking ahead, 2015 should be another busy year, given the extension of the safe harbor guidance through 2016.

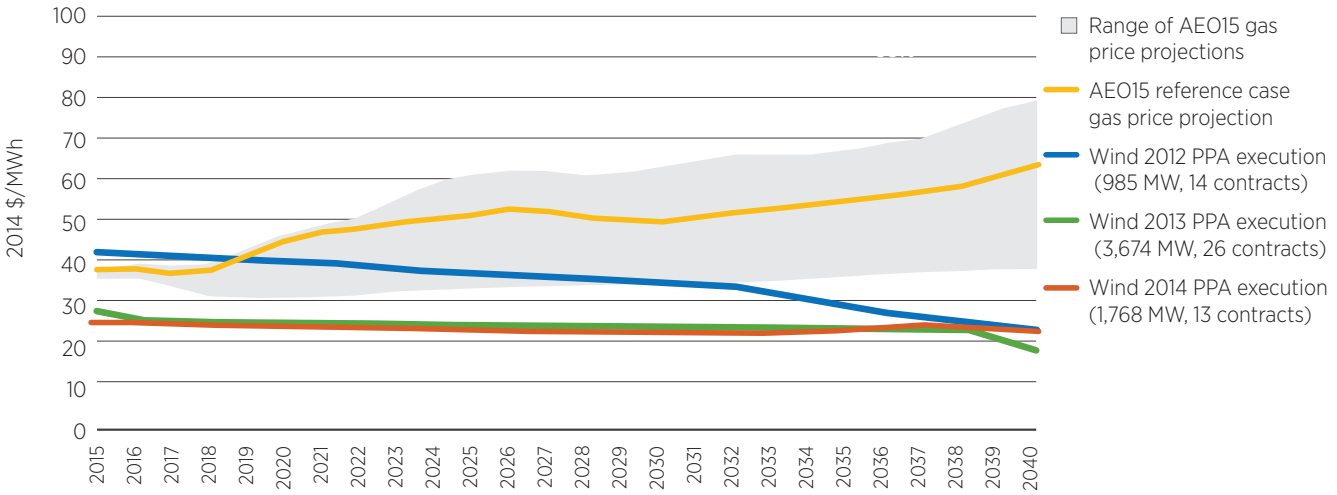


Market Prices Decline in All Regions across the United States

Wind PPA prices have reached all-time lows. After topping out at nearly 7 cents per KWh for PPAs executed in 2009, the national average levelized price of wind PPAs that were signed in 2014 fell to around 2.35 cents per KWh nationwide, driven largely by prices in the central part of the country. Wind turbine prices have dropped substantially, despite increases in hub heights and larger rotor diameters. Recently announced transactions feature pricing in the $850–$1,250/kW range. These price reductions, coupled with improved turbine technology, have exerted downward pressure on project costs and wind power prices.

The relative economic competitiveness of wind power improved in 2014. The continued decline in average levelized wind PPA prices, along with a continued rebound in wholesale power prices, left average wind PPA prices signed in 2014 below the bottom of the range of nationwide wholesale power prices. Based on the 2014 analysis, wind PPA prices are most competitive

with wholesale power prices in the Interior region. The average price stream of wind PPAs executed in 2014 also compares favorably to a range of projections of the fuel costs of gas-fired generation extending out through 2040.



Average Long-Term Wind PPA Prices vs. Natural Gas Fuel Cost Projections

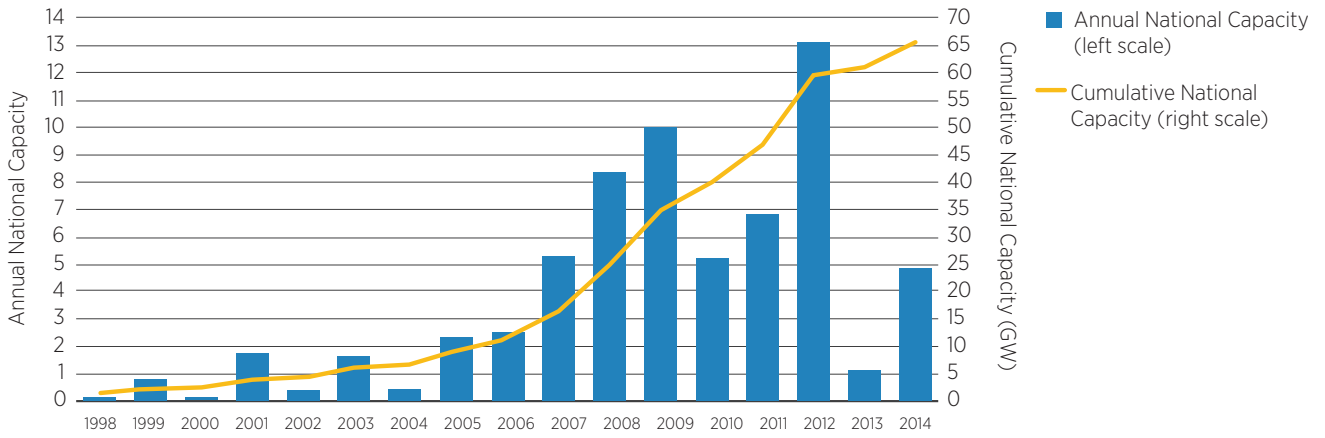
Manufacturing and Jobs

The manufacturing supply chain continued to adjust to swings in domestic demand for wind equipment. Wind sector employment increased from 50,500 at end of 2013 to 73,000 at end of 2014, resulting in a 30% increase in the job market. More than half of the content used to build turbines domestically is built in the United States. Domestic nacelle assembly capability stood at roughly 9 GW in 2014, and the United States also had the capability of producing approximately 7 GW of blades and 7 GW of towers annually.

General Electric (GE), Siemens, and Vestas captured 98% of the United States market in 2014. GE captured 60% of U.S. market share, followed by Siemens (26%) and Vestas (12%). Globally, Vestas remained the top supplier, followed by Siemens, GE, and Goldwind. Exports of wind-powered generating sets from the United States have risen from $16 million in 2007 to $488 million in 2014. Tower exports equated to $116 million in 2014.

Installation Trends

New utility-scale wind turbines were installed in 19 states in 2014, adding 4,854 MW of new capacity, and bringing the U.S.' total installed wind capacity to 65.9 GW. Additionally, one-third of U.S. electric generating capacity installed since 2007 comes from newly-installed wind capacity.



Wind Power Additions (Added 4,854 NW of New Capacity in 2014)

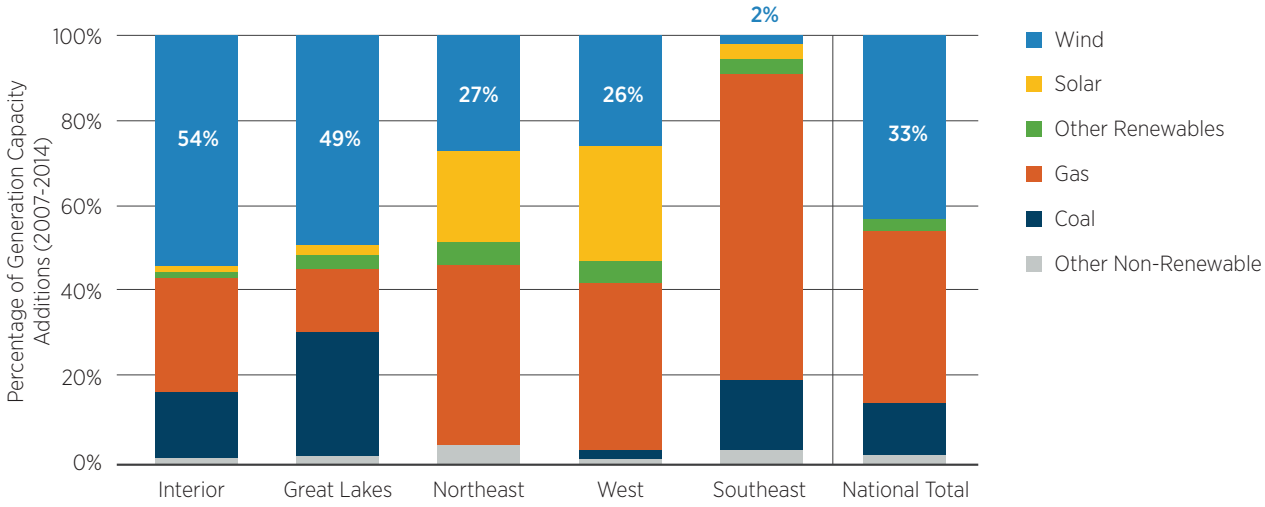
Wind power capacity additions in the United States rebounded in 2014, and continued near-term growth is anticipated. With the industry's primary federal support—the production tax credit (PTC)—only available for projects that had begun construction by the end of 2014, the next two years will see those projects commissioned.

Turbines originally designed for lower wind speeds are now regularly employed in both lower and higher wind speed sites, whereas taller towers predominate in lower wind speed sites. Low specific power and International Electrotechnical Commission (IEC)[a] Class 3 and 2/3 turbines are now regularly employed in all regions of the United States, and in both lower and higher wind speed sites. The tallest towers, on the other hand, have principally been deployed in lower wind resource areas, especially in the Great Lakes and Northeastern regions. Another indication of the increasing prevalence of lower wind speed turbines is that, in 2014, 94% of installations used IEC Class 3 and Class 2/3 turbines.

Regional Growth

Since 2007, wind power has represented 33% of all United States electric generating capacity additions, and an even larger fraction of new generation capacity in the Interior (54%) and Great Lakes (49%) regions. Wind energy's contribution to generation capacity growth over that period is somewhat smaller in the Northeast (27%) and West (26%), and considerably less in the Southeast (2%).

Regional variations in capacity factors reflect the strength of the wind resource and adoption of new turbine technology. Based on a sub-sample of wind projects built in 2012 and 2013, average capacity factors in 2014 were the highest in the Interior (41%) and the lowest in the West (27%). Not surprisingly, these regional rankings are roughly consistent with the relative quality of the wind resource in each region, but also reflect the degree to which each region has adopted new turbine design enhancements (e.g., turbines with a lower specific power, or taller towers) that can boost project capacity factors. For example, the Great Lakes (which ranks second among regions in terms of 2014 capacity factor) has thus far adopted these new designs to a much larger extent than has the West (which ranks last).



From 2007-2014: Wind Comprised 33% of Capacity Additions Nationwide

State Specifics

New large-scale wind turbines were installed in 19 states in 2014. Notably, the wind power capacity installed in Iowa and South Dakota supplied more than 28% and 25%, respectively, of all in-state electricity generation in 2014, with Kansas close behind at nearly 22%. Texas, California, and Iowa each have more than 5 GW of total installed capacity. Nine states produced more than 12% of their total in-state generation from wind in 2014 and 17 states produced more than 6% of their electricity from wind.

[a] The IEC classification system considers multiple site characteristics, including wind speed, gusts, and turbulence. Class 3 turbines are generally designed for lower wind speed sites (7.5 m/s and below), Class 2 turbines for medium wind speed sites (up to 8.5 m/s), and Class 1 turbines for higher wind speed sites (up to 10 m/s). Some turbines are designed at the margins of two classifications, and are labeled as such (e.g., Class 2/3). Since 2009, there has been a substantial decline in the use of Class 2 turbines and an associated increasing market share of Class 3 and Class 2/3 turbines. In 2014, 68% of the newly installed turbines were Class 3 machines, with another 27% Class 2/3 machines; only 6% of turbines were Class 2 or lower.

Installed Capacity (MW)				Percentage of In-State Generation	
Annual (2014)		Cumulative (end of 2014)		Actual (2014)*	
Texas	1,811	Texas	14,098	Iowa	28.5%
Oklahoma	648	California	5,917	South Dakota	25.3%
Iowa	511	Iowa	5,688	Kansas	21.7%
Michigan	368	Oklahoma	3,782	Idaho	18.3%
Nebraska	277	Illinois	3,568	North Dakota	17.6%
Washington	267	Oregon	3,153	Oklahoma	16.9%
Colorado	261	Washington	3,075	Minnesota	15.9%
North Dakota	205	Minnesota	3,035	Colorado	13.6%
Indiana	201	Kansas	2,967	Oregon	12.7%
California	107	Colorado	2,593	Texas	9.0%
Minnesota	48	North Dakota	1,866	Wyoming	8.9%
Maryland	40	New York	1,748	Maine	8.3%
New Mexico	35	Indiana	1,745	New Mexico	7.0%
New York	26	Michigan	1,531	California	7.0%
Montana	20	Wyoming	1,410	Nebraska	6.9%
South Dakota	20	Pennsylvania	1,340	Montana	6.5%
Maine	9	Idaho	973	Washington	6.3%
Ohio	0.9	New Mexico	812	Hawaii	5.9%
Massachusetts	0.6	Nebraska	812	Illinois	5.0%
		South Dakota	803	Vermont	4.4%
Rest of United States	0	*Rest of United States*	4,941	*Rest of United States*	0.9%
TOTAL	**4,854**	**TOTAL**	**65,877**	**TOTAL**	**4.4%**

* Based on 2014 wind and total generation by state from EIAS's Electric Power Monthly. *Source: AWEA project database, EIA*

Transmission

Solid progress on overcoming transmission barriers continued in 2014. Approximately 2,000 miles of transmission lines came online. The wind industry has identified 18 near-term transmission projects that could carry 55-60 GW of additional wind capacity. At the end of 2014, there were 96 GW of wind power capacity within the transmission interconnection queues reviewed for this report. Wind power represented 30% of all generating capacity within these queues, higher than all other generating sources except natural gas.

Future Outlook

It is projected that near-term wind additions will be driven by the recent improvements in the cost and performance of wind power technologies, which have resulted in the lowest power sales prices ever seen in the U.S.wind sector, as well as growing corporate demand for wind energy and an array of state-level policies. In 2015, the U.S. Department of Energy published two new reports that take a comprehensive look at wind energy growth. The *Wind Vision Report* (which can be found at energy.gov/windvision) analyzed a scenario in which wind energy reaches 10%, 20%, and 35% of U.S. electric demand in 2020, 2030, and 2050, respectively. *Enabling Wind Power Nationwide* (which can be found at energy.gov/eere/wind/downloads/enabling-wind-power-nationwide) analyzes the potential for growth as wind turbines are scaled up to 110 and 140 meters. Quantified within these reports are the economic, environmental, and social benefits that can be achieved by continued wind energy development.

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