2013 Wind Technologies Market Report

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Lawrence Berkeley National Laboratory

Report Summary
August 2014
2013 Wind Technologies Market Report

Purpose, Scope, and Data:

• Publicly available annual report summarizing key trends in the U.S. wind power market, with a focus on 2013
• Scope primarily includes wind turbines over 100 kW in size
• Separate DOE-funded annual reports on distributed and offshore wind
• Data sources include AWEA, EIA, FERC, SEC, etc. (see full report)

Report Authors:

• Primary authors: Ryan Wiser and Mark Bolinger, Berkeley Lab
• Contributions from others at Berkeley Lab, Exeter Associates, NREL

Funded by: U.S. DOE Wind & Water Power Technologies Office

Available at: http://energy.gov/eere/wind/wind-program
Report Contents

• Installation trends
• Industry trends
• Technology trends
• Performance trends
• Cost trends
• Wind power price trends
• Policy & market drivers
• Future outlook
New to the Current Edition of the Report

• New chapter on technology trends, including the expanded use of turbines originally designed for lower wind speed sites

• Comparison of wind power sales prices to projections of future natural gas prices

• Expansion and refinement of manufacturing, supply chain, and domestic content assessments
Key Findings

• Annual wind additions were modest in 2013, but signals point to more-robust growth in 2014/15

• Notwithstanding 2013, wind has been a significant source of new generation in the U.S. since 2007

• Supply chain has been under duress, but domestic manufacturing content for nacelle assembly, blades, and towers is strong

• Turbine scaling is boosting expected wind project performance, while the installed cost of wind is on the decline

• Trends are enabling very aggressive wind power pricing and solid economics in many regions despite low natural gas prices

• Growth after 2015 remains uncertain, dictated in part by future natural gas prices, fossil plant retirements, and policy decisions, though technological advancements and recent declines in the price of wind energy have boosted future growth prospects
Installation Trends
Wind Power Additions Stalled in 2013, with only 1,087 MW of New Capacity Added

- Capacity additions in 2013 were just 8% of 2012 additions
- $1.8 billion invested in wind power project additions
- Cumulative wind capacity up by less than 2%, bringing total to 61 GW
Wind Represented 7% of Electric-Generating Capacity Additions in 2013

But… from 2007-2013, wind represented 33% of capacity additions nationwide, and a much higher proportion in some regions.
The U.S. Fell to 6th Place in Annual Wind Power Capacity Additions

<table>
<thead>
<tr>
<th></th>
<th>Annual Capacity (2013, MW)</th>
<th>Cumulative Capacity (end of 2013, MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>16,088</td>
<td>China</td>
</tr>
<tr>
<td>Germany</td>
<td>3,237</td>
<td>Germany</td>
</tr>
<tr>
<td>India</td>
<td>1,987</td>
<td>United States</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1,833</td>
<td>Spain</td>
</tr>
<tr>
<td>Canada</td>
<td>1,599</td>
<td>India</td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td><strong>1,087</strong></td>
<td><strong>United Kingdom</strong></td>
</tr>
<tr>
<td>Brazil</td>
<td>948</td>
<td>Italy</td>
</tr>
<tr>
<td>Poland</td>
<td>894</td>
<td>France</td>
</tr>
<tr>
<td>Sweden</td>
<td>724</td>
<td>Canada</td>
</tr>
<tr>
<td>Romania</td>
<td>695</td>
<td>Denmark</td>
</tr>
<tr>
<td><strong>Rest of World</strong></td>
<td><strong>7,045</strong></td>
<td><strong>Rest of World</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>36,137</strong></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

Source: Navigant; AWEA project database for U.S. capacity

- Led by decline in U.S. market, global additions 20% lower in 2013
- U.S. remains a distant second to China in cumulative capacity
U.S. Lagging Other Countries in Wind As a Percentage of Electricity Consumption

Note: Figure only includes the countries with the most installed wind power capacity at the end of 2012
Geographic Spread of Wind Power Projects in the United States Is Reasonably Broad

Note: Numbers within states represent cumulative installed wind capacity and, in brackets, annual additions in 2013.
California Installed the Most Capacity in 2013; 9 States Exceed 12% Wind Energy

<table>
<thead>
<tr>
<th>State</th>
<th>Installed Capacity (MW)</th>
<th>Percentage of In-State Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>269</td>
<td>Texas 12,354</td>
</tr>
<tr>
<td>Kansas</td>
<td>254</td>
<td>California 5,829</td>
</tr>
<tr>
<td>Michigan</td>
<td>175</td>
<td>Iowa 5,177</td>
</tr>
<tr>
<td>Texas</td>
<td>141</td>
<td>Illinois 3,568</td>
</tr>
<tr>
<td>New York</td>
<td>84</td>
<td>Oregon 3,153</td>
</tr>
<tr>
<td>Nebraska</td>
<td>75</td>
<td>Oklahoma 3,134</td>
</tr>
<tr>
<td>Iowa</td>
<td>45</td>
<td>Minnesota 2,987</td>
</tr>
<tr>
<td>Colorado</td>
<td>32</td>
<td>Kansas 2,967</td>
</tr>
<tr>
<td>Ohio</td>
<td>3</td>
<td>Washington 2,808</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>3</td>
<td>Colorado 2,332</td>
</tr>
<tr>
<td>Alaska</td>
<td>3</td>
<td>New York 1,722</td>
</tr>
<tr>
<td>North Dakota</td>
<td>2</td>
<td>North Dakota 1,681</td>
</tr>
<tr>
<td>Indiana</td>
<td>1</td>
<td>Indiana 1,544</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>1</td>
<td>Wyoming 1,410</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1</td>
<td>Michigan 1,163</td>
</tr>
<tr>
<td>Idaho</td>
<td>93</td>
<td>South Dakota 783</td>
</tr>
<tr>
<td>South Dakota</td>
<td>783</td>
<td>New Mexico 778</td>
</tr>
<tr>
<td>New Mexico</td>
<td>778</td>
<td>Montana 645</td>
</tr>
<tr>
<td>Montana</td>
<td>645</td>
<td>Rest of U.S. 4,762</td>
</tr>
<tr>
<td>Rest of U.S.</td>
<td>0</td>
<td>Rest of U.S. 4,762</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,087</td>
<td>TOTAL 61,110</td>
</tr>
</tbody>
</table>

- Texas has more than twice as much wind capacity as any other state
- 23 states had >500 MW of capacity at end of 2013 (16 > 1 GW, 10 > 2 GW)
- 2 states have >25% of total in-state generation from wind (9 states > 12%)

* Based on 2013 wind and total generation by state from EIA’s Electric Power Monthly.
Source: AWEA project database, EIA
No Commercial Offshore Turbines Commissioned in the U.S., but 15 Projects Totaling 5.1 GW Are Somewhat More Advanced in Development

- Two projects have power purchase agreements (PPAs):
  - Cape Wind (MA)
  - Deepwater Wind (RI)
- Three demonstration projects selected for deployment by DOE
- Scale model of floating turbine deployed in ME in June 2013
- MD established offshore wind set-aside within state’s RPS
- Fishermen (NJ), Baryonyx (TX), Statoil (ME) faced set-backs
Interconnection Queues Demonstrate that a Substantial Amount of Wind Is Under Consideration

Wind represented ~36% of capacity in sampled 37 queues. But… absolute amount of wind (and coal & nuclear) in sampled queues has declined in recent years whereas natural gas and solar capacity has increased.

Not all of this capacity will be built….

- AWEA reports >13 GW of capacity under construction after 1Q2014
95% of Wind Capacity Planned for Texas, Midwest, Southwest Power Pool, PJM, Northwest, Mountain Region, and California

Not all of this capacity will be built…. 
Industry Trends
GE Captured 90% of U.S. Wind Turbine Market Share in a Slow 2013

- Siemens came in a distant second, at 8% market share
- 2013 U.S. installations by Chinese and South Korean manufacturers only included Sany Electric (8 MW)
- Globally, Vestas recaptured the mantle as top supplier, with GE falling to 5th
Manufacturing Supply Chain Experienced Substantial Growing Pains

- Over last decade, foreign and domestic manufacturers have localized and expanded U.S. manufacturing presence
- 5 of 10 turbine OEMs with largest share of U.S. market through 2013 had manufacturing facilities in the U.S. at the end of 2013, compared to one in 2004
- Uncertain demand and growing global competition have created strain: general trend in 2013 was towards reduced workforce or closed facilities
- Only one facility opened in 2013, with a larger number closed or dormant
- Wind related jobs declined from 80,700 in 2012 to 50,500 in 2013
Domestic Manufacturing Capability for Nacelle Assembly, Towers and Blades Is Reasonably Well Balanced Against Near-Term Demand Forecasts
After a Number of Years in Decline, Turbine OEM Profitability Rebounded in 2013
Sharp Decline in Wind-Related Imports and Stable Exports in 2013

U.S. is a net importer of wind equipment

Exports of wind-powered generating sets increased modestly in 2013 to $421 billion; no ability to track other wind-specific exports, but total tower exports equalled $129 million

* estimated imports

Figure only includes selected, tracked trade categories; misses other wind-related imports

See full report for the many assumptions used to generate this figure
WIND AND WATER POWER PROGRAM

Tracked Wind Equipment Imports in 2013
Mostly from Asia, the Americas, and Europe

Note: Tracked wind-specific equipment includes: wind-powered generating sets, towers, hubs and blades, wind generators and parts.
Source Markets for Imports Vary Over Time, and By Type of Wind Equipment

- Considering total 2013 imports in these selected trade categories: 45% from Asia, 38% Americas, 16% from Europe
- Majority of wind-powered generating sets from home countries of OEMs, but share from Europe in recent decline
- Majority of tower imports from Asia (less from North America), but tariff measures largely stopped imports from China and Vietnam in 2013
- Most imports of blades & hubs from Brazil and China in 2013
- Globally diverse sourcing strategy for generators & parts, with increase from Asia in 2013
Despite Supply Chain Challenges, a Growing Amount of the Equipment Used in U.S. Wind Projects Has Been Sourced Domestically since 2006-07

When presented as a fraction of equipment-related turbine costs, the combined import share of tracked wind equipment (i.e., blades, towers, generators, gearboxes, and wind-powered generating sets) has declined from nearly 80% in 2006-2007 to ~30% in 2012-2013.

See report for the assumptions used to generate these figures.

Because imports occur in untracked trade categories, including many nacelle internals, overall import (domestic) content is higher (lower) than suggested here: in 2012, overall domestic content estimated at ~40%
The Project Finance Environment Held Steady in 2013

- Notable events included the launch of several renewable energy “yieldcos”
- Tax equity and term debt yields held relatively steady in 2013
- Project sponsors raised $3.1 billion of tax equity and $2.4 billion of debt
IPPs Own 95% of the New Wind Capacity Installed in 2013

New utility ownership continued to languish for the second year in a row, at just 4% of the 2013 wind capacity additions.
Long-Term Contracted Sales to Utilities Remained the Most Common Off-Take Arrangement, but Merchant Projects Have Regained some Favor, at Least in Texas
Technology Trends
Turbine Nameplate Capacity, Hub Height, and Rotor Diameter Have All Increased Significantly Over the Long Term
Growth in Rotor Diameter Has Outpaced Growth in Nameplate Capacity and Hub Height in Recent Years

**Nameplate Capacity**

**Rotor Diameter**

**Hub Height**
Turbines Originally Designed for Lower Wind Speed Sites Have Rapidly Gained Market Share
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

By Region

- **Hub Height**: Red: ≤100 m, Blue: ≥90-100 m
- **Specific Power**: Red: 200-220 W/m², Blue: 220-300 W/m²
- **IEC Class**: Red: Class 3, Blue: Class 2/3

By Wind Resource Quality

- **Hub Height**: Red: ≤100 m, Blue: ≥90-100 m
- **Specific Power**: Red: 200-220 W/m², Blue: 220-300 W/m²
- **IEC Class**: Red: Class 3, Blue: Class 2/3

*Estimated Wind Resource Quality at 80 Meters*
Performance Trends
The wind resource index is compiled from NextEra Energy Resources reports. The pre-2007 portion of the index is adjusted to approximate the conversion from wind speed to generation (this adjustment is unnecessary starting in 2007).
Wind Curtailment Is Substantial, but Has Generally Declined in Recent Years

Estimated Wind Curtailment (GWh and % of potential wind generation)

<table>
<thead>
<tr>
<th>Area</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Reliability Council of Texas (ERCOT)</td>
<td>109 (1.2%)</td>
<td>1,417 (8.4%)</td>
<td>3,872 (17.1%)</td>
<td>2,067 (7.7%)</td>
<td>2,622 (8.5%)</td>
<td>1,175 (3.8%)</td>
<td>363 (1.2%)</td>
</tr>
<tr>
<td>Southwestern Public Service Company (SPS)</td>
<td>N/A</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0.9 (0.0%)</td>
<td>0.5 (0.0%)</td>
<td>N/A**</td>
<td>N/A**</td>
</tr>
<tr>
<td>Public Service Company of Colorado (PSCo)</td>
<td>N/A</td>
<td>2 (0.1%)</td>
<td>19 (0.6%)</td>
<td>82 (2.2%)</td>
<td>64 (1.4%)</td>
<td>115(e)</td>
<td>112(e)</td>
</tr>
<tr>
<td>Northern States Power Company (NSP)</td>
<td>N/A</td>
<td>25 (0.9%)</td>
<td>42 (1.7%)</td>
<td>44 (1.7%)</td>
<td>59 (1.6%)</td>
<td>125 (3.0%)</td>
<td>284 (5.9%)</td>
</tr>
<tr>
<td>Midwest Independent System Operator (MISO), less NSP</td>
<td>N/A</td>
<td>N/A</td>
<td>250 (2.0%)</td>
<td>780 (4.2%)</td>
<td>792 (3.4%)</td>
<td>724 (2.5%)</td>
<td>1,470 (4.6%)</td>
</tr>
<tr>
<td>Bonneville Power Administration (BPA)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5* (0.1%)</td>
<td>129* (1.4%)</td>
<td>71* (0.7%)</td>
<td>6* (0.1%)</td>
</tr>
<tr>
<td>New York Independent System Operator (NYISO)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9 (0.3%)</td>
<td>50 (1.4%)</td>
</tr>
<tr>
<td>PJM</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>125* (2.0%)</td>
<td>284 (1.9%)</td>
</tr>
<tr>
<td>Total Across These Eight Areas:</td>
<td>109 (1.2%)</td>
<td>1,444 (5.7%)</td>
<td>4,183 (9.7%)</td>
<td>2,978 (4.9%)</td>
<td>3,665 (5.0%)</td>
<td>2,345 (2.6%)</td>
<td>2,569 (2.5%)</td>
</tr>
</tbody>
</table>

MISO, ERCOT, NYISO, and PJM track both forced and economic curtailment, while BPA, NSP, PSCo, and SPS likely only capture forced curtailment

In areas where curtailment has been particularly problematic in the past – principally in Texas – steps taken to address the issue have born fruit.
Even Controlling for These Factors, Average Capacity Factors for Projects Built After 2005 Have Been Stagnant

Sample includes 582 projects totaling 57.2 GW

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</thead>
<tbody>
<tr>
<td># projects:</td>
<td>25</td>
<td>27</td>
<td>38</td>
<td>28</td>
<td>22</td>
<td>38</td>
<td>80</td>
<td>95</td>
<td>48</td>
<td>66</td>
<td>115</td>
</tr>
<tr>
<td># MW:</td>
<td>921</td>
<td>1,765</td>
<td>1,988</td>
<td>3,651</td>
<td>1,739</td>
<td>5,284</td>
<td>8,522</td>
<td>9,426</td>
<td>4,733</td>
<td>5,760</td>
<td>13,368</td>
</tr>
</tbody>
</table>
Trends Explained by Competing Influence of Lower Specific Power and Build-Out of Lower Quality Wind Resource Sites

All else equal:
- Drop in average specific power will boost capacity factors
- Building projects in lower wind resource sites will hurt capacity factors
Controlling for Wind Resource Quality and Specific Power Demonstrates Impact of Turbine Evolution

Notwithstanding build-out of lower-quality wind resource sites, turbine design changes are driving capacity factors higher for projects located in given wind resource regimes.
Controlling for Wind Resource Quality and Commercial Operation Date Demonstrates Impact of Turbine Evolution

Notwithstanding build-out of lower-quality wind resource sites, turbine design changes are driving capacity factors higher for projects located in given wind resource regimes.
Regional Variations in Capacity Factors Reflect the Strength of the Wind Resource and Adoption of New Turbine Technology

Sample includes 113 projects built in 2012 and totaling 13.2 GW
Cost Trends
Wind Turbine Prices Remained Well Below the Levels Seen Several Years Ago

- Recent turbine orders reportedly in the range of $900-1,300/kW, with more-favorable terms for buyers and improved technology

Figure depicts reported transaction prices from 112 U.S. wind turbine orders totaling 29 GW

• Recent turbine orders reportedly in the range of $900-1,300/kW, with more-favorable terms for buyers and improved technology
Reported Installed Project Costs Continued to Trend Lower in 2013

- The limited sample of 2013 projects had an average cost of $1,630/kW, down substantially from previous years.
- Larger sample of under-construction projects average $1,750/kW.
Economies of Scale Evident, Especially at Lower End of Project & Turbine Size Range
Some Regional Differences in Average Wind Power Project Costs Are Apparent

Different permitting/development costs may play a role at both ends of spectrum: it’s easier/cheaper to build in the US interior and harder/more expensive along the coasts.
Operations and Maintenance Costs Varied By Project Age and Commercial Operations Date

Capacity-weighted average 2000-13 O&M costs for projects built in the 1980s equal $34/MWh, dropping to $23/MWh for projects built in 1990s, to $10/MWh for projects built in the 2000s, and to $9/MWh for projects built since 2010.

Note: Sample is limited, and consists of 152 wind projects totaling 10,679 MW; few projects in sample have complete records of O&M costs from 2000-13; O&M costs reported here DO NOT include all operating costs.
Operations and Maintenance Costs Varied By Project Age and Commercial Operations Date

O&M reported in figure does not include all operating costs: Statements from public companies with large U.S. wind asset bases report total operating costs in 2013 for projects built in the 2000s of ~$24/MWh

Note: Sample size is extremely limited
Wind Power Price Trends
Sample of Wind Power Prices

- Berkeley Lab collects data on historical wind power sales prices, and long-term PPA prices
- PPA sample includes 343 contracts totaling 29,632 MW from projects built from 1998-2013, or planned for installation in 2014 or 2015
- Prices reflect the bundled price of electricity and RECs as sold by the project owner under a power purchase agreement
  - Dataset excludes merchant plants and projects that sell renewable energy certificates (RECs) separately
  - Prices reflect receipt of state and federal incentives (e.g., the PTC or Treasury grant), as well as various local policy and market influences; as a result, prices do not reflect wind energy generation costs
Wind PPA Prices Have Reached All-Time Lows

Levelized PPA Price (2013 $/MWh)

- **Interior** (18,178 MW, 192 contracts)
- **West** (7,124 MW, 72 contracts)
- **Great Lakes** (3,044 MW, 42 contracts)
- **Northeast** (1,018 MW, 25 contracts)
- **Southeast** (268 MW, 6 contracts)

PPA Execution Date

- 50 MW
- 150 MW
- 75 MW
A Smoother Look at the Time Trend Shows Steep Recent Decline in Pricing; Especially Low Pricing in Interior Region
Relative Competitiveness of Wind Improved in 2013: Comparison to Wholesale Prices

- Wholesale price range reflects flat block of power across 23 pricing nodes across the U.S.
- Recent wholesale prices reflect low natural gas prices, driven by weak economy and shale gas
- Price comparison shown here is far from perfect – see full report for caveats
Comparison Between Wholesale Prices and Wind PPA Prices Varies by Region

Wind PPA prices most competitive with wholesale prices in the Interior region

Notes: Wind PPAs included are those signed from 2011-2013. Within a region there are a range of wholesale prices because multiple price hubs exist in each area; price comparison shown here is far from perfect – see full report for caveats

Wind project sample includes projects with PPAs signed in 2011-2013

- **Interior**: 44 projects (5,648 MW)
- **Great Lakes**: 11 projects (809 MW)
- **Northeast**: 3 projects (210 MW)
- **West**: 11 projects (1,044 MW)
- **Total US**: 69 projects (7,711 MW)

Average 2013 Wholesale Power Price Range
- Individual Project Levelized Wind PPA Price
- Generation-Weighted Average Levelized Wind PPA Price
Recent Wind Prices Are Hard to Beat: Competitive with Expected Future Cost of Burning Fuel in Natural Gas Plants

Price comparison shown here is far from perfect – see full report for caveats.
Renewable Energy Certificate (REC) Prices Remain High in Northeast

REC prices vary by: market type (compliance vs. voluntary); geographic region; specific design of state RPS policies.
Policy and Market Drivers
Availability of Federal Incentives for Wind Projects Built in the Near Term Has Helped Restart the Domestic Market, but Policy Uncertainty Persists

• Near-term availability of the PTC/ITC for those projects that reached the “under construction” milestone by the end of 2013 has helped restart the domestic market and should enable solid growth at least through 2015

• Little action in 2013 on what are among the wind industry’s two highest priorities: a longer-term extension of federal tax incentives and passage of a federal renewable or clean energy portfolio standard

• Prospective impacts of more-stringent EPA environmental regulations, including those related to power-sector carbon emissions, may create new markets for wind energy
State Policies Help Direct the Location and Amount of Wind Development, but Current Policies Cannot Support Continued Growth at Recent Levels

- 29 states and D.C. have mandatory RPS
- State RPS’ can support ~3-4 GW/yr of renewable energy additions on average through 2025 (less for wind specifically)
Solid Progress on Overcoming Transmission Barriers Continued

- 3,500 circuit miles of new transmission built in 2013; completion of the Competitive Renewable Energy Zones project in Texas
- EEI has identified over 170 transmission projects in development, 76% of which would – at least in part – support the integration of renewable energy
- AWEA has identified 15 near-term transmission projects that – if all were completed – could carry almost 60 GW of additional wind power capacity
- FERC continued to implement Order 1000, requiring public utility transmission providers to improve planning processes and determine a cost allocation methodology for new transmission investments
System Operators Are Implementing Methods to Accommodate Increased Penetrations of Wind

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

Notes: Because methods vary and a consistent set of operational impacts has not been included in each study, results from the different analyses of integration costs are not fully comparable. There has been some recent literature questioning the methods used to estimate wind integration costs and the ability to disentangle those costs explicitly, while also highlighting the fact that other generating options also impose integration challenges and costs to electricity systems.
Future Outlook
Relatively Strong Wind Power Capacity Additions Anticipated for 2014 and 2015, then Uncertainty in 2016 and Beyond

Forecasts for Annual U.S. Wind Additions (MW)

<table>
<thead>
<tr>
<th>Source</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloomberg NEF (2014c)</td>
<td>6,000</td>
<td>9,000</td>
<td>3,600</td>
<td>Assumes no PTC extension beyond current law</td>
</tr>
<tr>
<td>IHS EER (2014)</td>
<td>4,800</td>
<td>7,300</td>
<td>8,400</td>
<td>Assumes one PTC extension for 2016</td>
</tr>
<tr>
<td>Navigant (2014)</td>
<td>6,300</td>
<td>6,000</td>
<td>2,800</td>
<td>Presumably assumes no PTC in 2016</td>
</tr>
<tr>
<td>MAKE Consulting (2014)</td>
<td>6,400</td>
<td>6,600</td>
<td>5,100</td>
<td>Assumes one PTC extension for 2016</td>
</tr>
<tr>
<td>EIA (2014b)</td>
<td>4,400</td>
<td>9,100</td>
<td>na</td>
<td>Assumes no PTC extension beyond current law</td>
</tr>
</tbody>
</table>

The upper end of the forecast range for 2014 and for 2015 does not approach the record build level achieved in 2012
Current Low Prices for Wind Energy, Future Technological Advancement and New EPA Regulations May Support Higher Growth in Future, but Headwinds Include…

- Lack of clarity about fate of federal tax incentives
- Continued low natural gas and wholesale electricity prices
- Modest electricity demand growth
- Limited near-term demand from state RPS policies
- Inadequate transmission infrastructure in some areas
- Growing competition from solar in some regions
U.S. Is on Early Trajectory that May Lead to 20% Wind; Projections for 2014-2016, However, Fall Short of Annual Growth Envisioned in 2008 20% Wind Report

Annual Capacity (GW)

Cumulative Capacity (GW)

range of annual projections

Deployment Path in 20% Wind Report (annual)
Actual Wind Installations (annual)
Deployment Path in 20% Wind Report (cumulative)
Actual Wind Installations (cumulative)
Conclusions

• Annual wind additions were modest in 2013, but signals point to more-robust growth in 2014/15
• Notwithstanding 2013, wind has been a significant source of new generation in the U.S. since 2007
• Supply chain has been under duress, but domestic manufacturing content for nacelle assembly, blades, and towers is strong
• Turbine scaling is boosting expected wind project performance, while the installed cost of wind is on the decline
• Trends are enabling very aggressive wind power pricing and solid economics in many regions despite low natural gas prices
• Growth after 2015 remains uncertain, dictated in part by future natural gas prices, fossil plant retirements, and policy decisions, though technological advancements and recent declines in the price of wind energy have boosted future growth prospects
For More Information...

See full report for additional findings, a discussion of the sources of data used, etc.


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