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2014 Wind Technologies Market Report

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Primary Authors

Ryan Wiser, Lawrence Berkeley National Laboratory
Mark Bolinger, Lawrence Berkeley National Laboratory

With Contributions From

Galen Barbose, Naïm Darghouth, Ben Hoen, Andrew Mills, Kristina Hamachi LaCommare,
Dev Millstein, Dana Hansen (Lawrence Berkeley National Laboratory)
Kevin Porter, Rebecca Widiss, Michael Buckley (Exeter Associates)
Frank Oteri, Aaron Smith, Suzanne Tegen (National Renewable Energy Laboratory)

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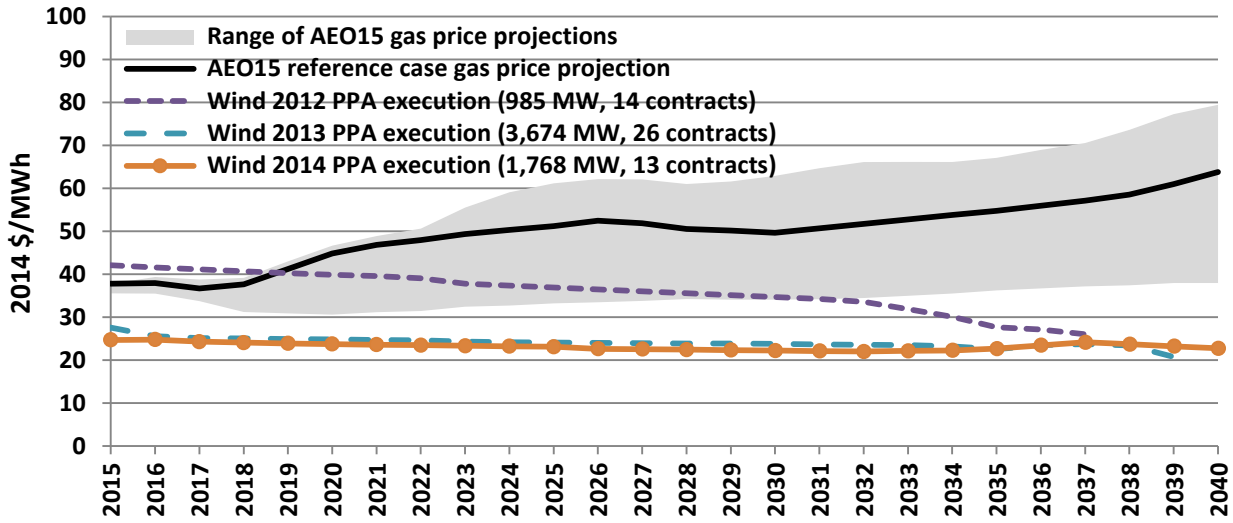
with the relative quality of the wind resource in each region, but also reflect the degree to which each region has adopted new turbine design enhancements (e.g., turbines with a lower specific power, or taller towers) that can boost project capacity factors. For example, the Great Lakes (which ranks 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).

Cost Trends

- **Wind turbine prices remained well below levels seen several years ago.** After hitting a low of roughly $750/kW from 2000 to 2002, average turbine prices increased to more than $1,500/kW by the end of 2008. Wind turbine prices have since dropped substantially, despite increases in hub heights and especially 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.
- **Lower turbine prices have driven reductions in reported installed project costs.** The capacity-weighted average installed project cost within our 2014 sample stood at roughly $1,710/kW—down $580/kW from the apparent peak in average reported costs in 2009 and 2010. Early indications from a preliminary sample of 17 projects totaling more than 2 GW that are currently under construction and anticipating completion in 2015 suggest no material change in installed costs in 2015.
- **Installed costs differed by project size, turbine size, and region.** Installed project costs exhibit some economies of scale, at least at the lower end of the project and turbine size range. Additionally, among projects built in 2014, the windy Interior region of the country was the lowest-cost region, with a capacity-weighted average cost of $1,640/kW.
- **Operations and maintenance costs varied by project age and commercial operations date.** Despite limited data availability, it appears that projects installed over the past decade have, on average, incurred lower operations and maintenance (O&M) costs than older projects in their first several years of operation, and that O&M costs increase as projects age.

Wind Power Price Trends

- **Wind PPA prices have reached all-time lows.** After topping out at nearly $70/MWh for PPAs executed in 2009, the national average levelized price of wind PPAs that were signed in 2014 (and that are within the Berkeley Lab sample) fell to around $23.5/MWh nationwide—a new low, but admittedly focused on a sample of projects that largely hail from the lowest-priced Interior region of the country. This new low average price level is notable given that installed project costs have not similarly broken through previous lows and that wind projects have, in recent years, been sited in somewhat lower-quality resource areas.
- **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 our sample, wind PPA prices are most competitive with wholesale power prices in the Interior region. The average price stream of wind PPAs executed in 2013 or 2014 also compares favorably to a range of projections of the fuel costs of gas-fired generation extending out through 2040.



Source: Berkeley Lab, EIA

Figure 49. Average long-term wind PPA prices (by vintage) and natural gas fuel cost projections over time

Figure 49 also hints at the long-term value that wind power can provide as a "hedge" against rising and/or uncertain natural gas prices. The average wind PPA prices that are shown have been contractually locked in, whereas the fuel cost projections to which they are compared are highly uncertain—actual fuel costs could end up being either lower or potentially much higher. Either way, as evidenced by the widening range of fuel cost projections over time, it becomes increasingly difficult to forecast fuel costs with any accuracy as the term of the forecast increases.

Important Note: Notwithstanding the comparisons made in this section, neither the wind nor wholesale electricity prices (nor fuel cost projections) reflect the full social costs of power generation and delivery. Specifically, the wind PPA prices are reduced by virtue of federal and, in some cases, state tax and financial incentives. Furthermore, these prices do not fully reflect integration, resource adequacy, or transmission costs. At the same time, wholesale electricity prices (or fuel cost projections) do not fully reflect transmission costs, may not fully reflect capital and fixed operating costs, and are reduced by virtue of any financial incentives provided to fossil-fueled generation and its fuel production cycle as well as by not fully accounting for the environmental and social costs of that generation. In addition, wind PPA prices—once established—are fixed and known, whereas wholesale electricity prices are short term and therefore subject to change over time (as shown in Figure 49, EIA and others project natural gas prices to rise, and therefore wholesale electricity prices to also increase, over time). Finally, the location of the wholesale electricity nodes and the assumption of a flat block of power are not perfectly consistent with the location and output profile of the sample of wind power projects.

In short, comparing levelized long-term wind PPA prices with either yearly wholesale electricity prices or forecasts of the fuel costs of natural gas-fired generation is not appropriate if one's goal is to account fully for the costs and benefits of wind energy relative to its competition. Nonetheless, these comparisons still provide some sense for the short-term competitive environment facing wind energy, and how that environment has shifted with time.