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CrossMark

Wind Vision: A New Era for Wind Power in the United States

Despite near- to medium-term cost barriers, a future U.S. electricity system in which wind plays a major role is technically feasible; could result in enduring benefits globally, nationally, and locally; and could result in consumer and system cost savings in the long term.

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I. Introduction

Wind power is one of the fastest-growing sources of new electricity supply and the largest source of new renewable power generation added in the United States since 2000. Wind power has abundant resource potential; competitive, long-term, stable pricing; and favorable environmental attributes. At the same time, low natural gas prices, low wholesale electricity prices, and low electricity demand growth since 2008 are impacting investments for all new electric generation. Annual U.S. wind capacity additions have varied dramatically owing to these factors as well as trends in wind power costs and federal and state policy.

In this context, the U.S. Department of Energy (DOE) initiated the *Wind Vision* study to inform a broad range of stakeholders about wind power's potential and to quantify the costs and benefits of continued wind investments (DOE, 2015). The study evaluates an ambitious but credible scenario in which wind energy serves 10 percent of the nation's end-use electricity demand by 2020, 20 percent by

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2030, and 35 percent by 2050. This scenario is not a prediction but a framework for evaluating the impacts of expanded wind deployment. The *Wind Vision* study updates and elaborates on an earlier DOE report, *20% Wind Energy by 2030* (DOE, 2008).

The *Wind Vision* study resulted from a collaborative effort. Under the leadership of the Wind and Water Power Technologies Office in DOE's Office of Energy Efficiency and Renewable Energy, the study drew on a diverse group of more than 250 energy experts, including representatives from grid operators, the wind industry, science-based organizations, academia, governmental agencies, national laboratories, and environmental-stewardship organizations. This ensures that the *Wind Vision* analysis, modeling inputs, and conclusions are based on the best available information from the fields of science, technology, economics, finance, and engineering.

This article highlights key findings and conclusions from the *Wind Vision* study. After describing recent progress and trends in the U.S. wind industry, it introduces the analytical scenarios and sums up the impacts of achieving the *Vision* scenario. The final sections summarize a roadmap for continued wind growth and offer conclusions about the opportunities and challenges associated with U.S. wind power.

II. U.S. Wind Industry Progress and Trends

At the end of 2013, U.S. wind capacity totaled more than 61 GW across 39 states, and wind supplied 4.5 percent of the nation's electricity demand—a significant expansion since 2008, when wind met 1.5 percent of U.S. demand (EIA, 2014a). Annual deployment increased from 2 GW in 2006, to 8 GW in 2008, to peak annual installations of 13 GW in 2012. Large amounts of wind power have been reliably integrated into electric power systems. Two states, Iowa and South Dakota, exceeded 25 percent of in-state generation from wind in 2013, and seven other states operated with greater than 12 percent of their generation from wind (AWEA, 2014a). Power system operators experienced with wind now view its use routinely as a dependable component in the portfolio of generating options.

Two states, Iowa and South Dakota, exceeded 25 percent of in-state generation from wind in 2013.

Technological advancements and declining wind power costs have facilitated this recent growth. The levelized cost of energy (LCOE) from wind in good to excellent resource sites declined by more than one-third from 2008 to 2013, from $71/megawatt-hour (MWh) to $45/MWh, and recent long-term power purchase agreements for wind energy have (with the benefit of federal tax incentives) regularly been signed at just $20–25/MWh (Wiser and Bolinger, 2014).[1] In some regions, especially with federal tax incentives, wind power prices are competitive with wholesale power prices and other sources of generation. Continued advancements and scale-up of turbine technology, such as longer blades and taller towers, have helped reduce wind power costs and enable broader geographic deployment.

The U.S. supply chain has grown to meet the increased demand for wind power. New investments in U.S. wind plants averaged $13 billion/year between 2008 and 2013. Domestic manufacturing content for some large, key components, such as blades and towers, ranged between 50 percent and 80 percent in 2012. Domestic content for nacelle components was significantly lower. In total, the domestic share of total wind project costs (considering turbines and balance of plant) was approximately 60 percent in 2012 (Wiser and Bolinger, 2014). Moreover, in 2013, the wind supply chain included more than 560 facilities across 43 states

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