



# **U.S. Renewable Electricity: How Does the Production Tax Credit (PTC) Impact Wind Markets?**

**Phillip Brown**  
Specialist in Energy Policy

June 20, 2012

**Congressional Research Service**

7-5700

[www.crs.gov](http://www.crs.gov)

R42576

## Summary

U.S. wind projects that use large turbines—greater than 100 kilowatts (kW)—are eligible to receive federal tax incentives in the form of production tax credits (PTC) and accelerated depreciation. Originally established in 1992, the PTC has played a role in the evolution and growth of the U.S. wind industry. Under existing law, wind projects placed in service on or after January 1, 2013, will not be eligible to receive the PTC incentive. Industry proponents are advocating for an extension of PTC availability, citing employment, economic development, and other considerations as justification for the extension. While a PTC extension may improve the prospects for U.S. wind development and manufacturing next year and beyond, the wind industry is influenced by a number of other factors. It is uncertain how the near- or long-term availability of the PTC incentive—in isolation of changes to other market factors—would either grow or sustain current wind development and manufacturing levels.

For 2012, the pending expiration of the wind PTC is actually creating a short-term surge in wind project development and related investment and employment. Wind installations in 2012 are expected to range somewhere between 10 to 12 gigawatts (GW)—a record year for the industry. However, market estimates for new installations in 2013 range from 1-2 GW if the PTC expires and 2-4 GW if the PTC is extended. Limited market activity in 2013 is partially explained by the uncertain nature of the PTC, which results in reduced manufacturing orders and development activity as developers and investors wait for official policy direction. Wind installation projections for 2014 and beyond vary with the assumed availability, and duration, of PTC incentives. However, all projections reviewed for this report expect annual U.S. wind turbine demand to be less than the existing U.S. turbine manufacturing capacity—approximately 13 GW per year.

Other factors that can affect wind development include (1) state renewable portfolio standards (RPS), (2) U.S. electricity demand growth, and (3) the price of natural gas. State RPS policies have been the primary demand creator for wind projects, in most cases, by requiring certain utilities to source a percentage of their retail electricity sales from renewable generators. Market analysis indicates that incremental RPS-driven demand for all sources of renewable power is estimated to be 4 GW-5 GW annually until 2025. Additionally, U.S. electricity demand growth is expected to be modest for the foreseeable future, meaning that there will likely be modest demand for new electric power capacity. Finally, the price of natural gas can also influence wind markets. Low natural gas prices can erode the economic competitiveness of wind electricity, while high natural gas prices can result in opportunities for wind to compete economically without the PTC. Current estimates from the U.S. Energy Information Administration (EIA) project sustained low, but increasing, natural gas prices for the next several years.

By the end of 2012, Congress will either allow the PTC incentive to expire or it may choose to extend or modify the incentive. Should Congress decide to extend the availability of wind PTC incentives, the duration (e.g., two years, four years, permanent) of such an extension will likely be part of the policy debate. Generally, the shorter the extension the greater the short-term economic and employment activity as developers and investors accelerate development plans in order to qualify for the PTC incentive. However, this development acceleration is likely to reduce future RPS-driven demand. A permanent PTC is also a policy option that may be considered, and EIA estimates indicate that such a policy may actually reduce near-term wind capacity additions, with annual installations peaking at 4 GW in the 2030 timeframe. Higher natural gas prices, more aggressive RPS policies, and increased U.S. electricity demand could change this outlook.

## Contents

Background.....	1
Impact of Current PTC Expiration.....	3
Potential Impact of Extending the PTC .....	3
Wind Installations.....	4
Wind Turbine Manufacturing .....	5
Short-Term versus Long-Term PTC Extension .....	5
Other Factors that Affect U.S. Wind Development .....	7
State Renewable Portfolio Standards.....	7
U.S. Electricity Demand Growth.....	9
Natural Gas Price.....	10
Example 1: Markets Coordinated by a Regional Transmission Organization.....	11
Example 2: California RPS Cost Containment Approach.....	13
Policy Discussion.....	13
Allow the PTC to Expire .....	14
Extend the PTC Incentive.....	14
Phase-Out of the PTC.....	15

## Figures

Figure 1. Annual U.S. Wind Power Capacity Additions.....	2
Figure 2. Estimated U.S. Wind Installations, With and Without a PTC Extension .....	4
Figure 3. EIA Estimates for Annual Wind Capacity Installations: Long-Term PTC.....	6
Figure 4. Projected U.S. Electricity Demand Growth .....	9
Figure 5. U.S. and Chinese Projected Electricity Demand Growth.....	10
Figure 6. Simplified Electricity Dispatch Curve for Wholesale Power.....	12

## Tables

Table 1. Selected Bills Introduced to Extend Wind PTC Incentives .....	14
--	----

## Contacts

Author Contact Information.....	15
---------------------------------	----

## Background

Federal incentives for operational renewable electricity projects have generally been in the form of tax benefits, including production tax credits (PTC), investment tax credits (ITC), and accelerated depreciation.<sup>1</sup> Renewable energy production tax credits were first introduced in the Energy Policy Act of 1992.<sup>2</sup> Section 45 of the Internal Revenue Code (IRC) outlines production tax credit incentives for wind, biomass, geothermal, landfill gas, trash, qualified hydropower, and marine and hydrokinetic projects that generate electricity. Under current law, the production tax credit for new wind projects will no longer be available as of January 1, 2013.<sup>3</sup> For all other eligible renewable energy projects, the PTC is available to projects placed in service before January 1, 2014.<sup>4</sup>

PTC policies provide incentives for electricity projects by providing a tax credit for each kilowatt-hour of electricity produced by a qualified project during the first 10 years of operation. Currently, the tax credit for wind projects is 2.2 cents (\$0.022) per kilowatt-hour.<sup>5</sup> The PTC incentive is annually adjusted for inflation.

To date, the wind industry has been the largest beneficiary of federal production tax credits. The industry has experienced substantial growth over the last several years, with annual capacity installations generally increasing since 2005 (see **Figure 1**). As of the end of March 2012, cumulative U.S. wind power capacity was 48,611 megawatts, equal to approximately 4% of total U.S. generation capacity.<sup>6</sup> In 2011 wind was the largest source of non-hydro renewable electricity generation, providing approximately 120 million megawatt-hours, roughly 3% of total U.S. generation.<sup>7</sup>

---

<sup>1</sup> For additional background on U.S. energy tax policy and the production tax credit for renewable energy projects, see CRS Report R41227, *Energy Tax Policy: Historical Perspectives on and Current Status of Energy Tax Expenditures*, by Molly F. Sherlock.

<sup>2</sup> Ibid.

<sup>3</sup> Production tax credits for wind power projects are for those that use wind turbines larger than 100 kilowatts (the majority of current installed capacity). For wind projects that use 100 kilowatt and smaller wind turbines, a 30% investment tax credit is available until January 1, 2017.

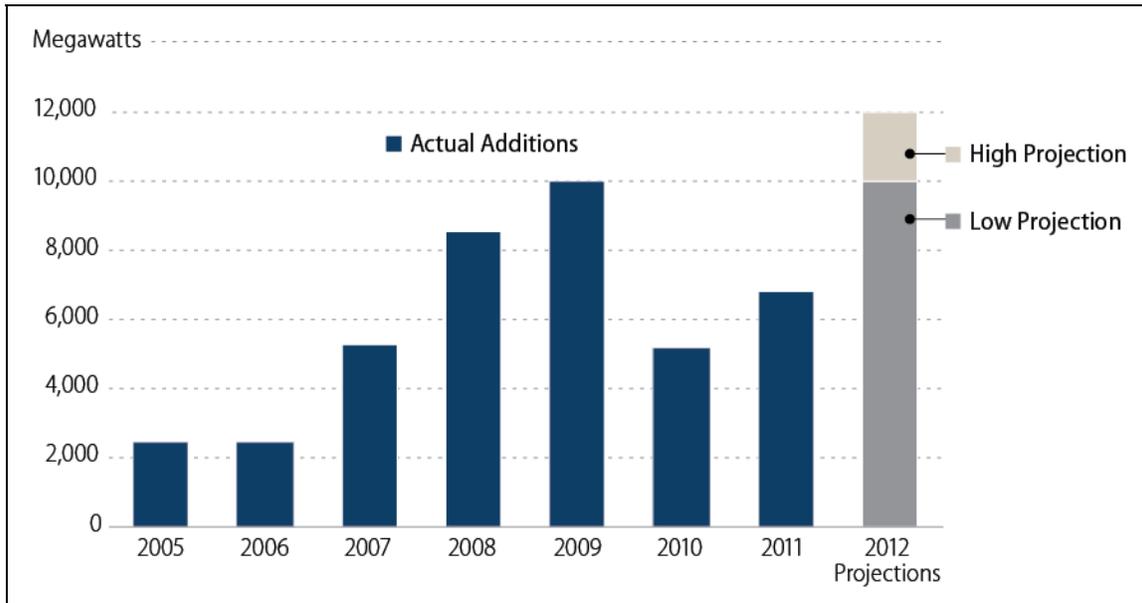
<sup>4</sup> For more information see IRC §45.

<sup>5</sup> “Credit for Renewable Electricity Production, Refined Coal Production, and Indian Coal Production, and Publication of Inflation Adjustment Factors and Reference Prices for Calendar Year 2012,” Department of the Treasury: Internal Revenue Service, Federal Register Vol. 77, No. 70, p. 21835, April 11, 2012.

<sup>6</sup> *AWEA U.S. Wind Industry First Quarter 2012 Market Report*, American Wind Energy Association, 2012, available at [http://www.awea.org/learnabout/publications/reports/upload/AWEA\\_First\\_Quarter\\_2012\\_Market\\_Report\\_Public.pdf](http://www.awea.org/learnabout/publications/reports/upload/AWEA_First_Quarter_2012_Market_Report_Public.pdf).

<sup>7</sup> *Electric Power Monthly*, U.S. Energy Information Administration, March 2012.

**Figure 1. Annual U.S. Wind Power Capacity Additions**  
(2005-2012)



**Source:** American Wind Energy Association (AWEA) annual and quarterly reports. 2012 projections from Bloomberg New Energy Finance and CRS conversations with various wind market analysts.

In response to U.S. wind market growth, a number of manufacturing and assembly facilities were established to supply wind turbine components and systems. In 2012, the U.S. wind manufacturing sector is estimated to have the capacity to produce approximately 13 gigawatts (GW) of wind turbines annually.<sup>8</sup> Industry estimates indicate that approximately 470 facilities in the United States provide various products (e.g., towers, turbines, gear boxes) for the wind turbine manufacturing supply chain.<sup>9</sup> In 2011, the wind industry reported that these facilities supported approximately 30,000 jobs.<sup>10</sup>

There are many arguments both for and against tax incentives for renewable electricity generation. Proponents of extending the wind PTC point to the potential loss of manufacturing and construction jobs that will result if the tax incentive is allowed to expire, the environmental benefits of U.S. wind development, and the potential to re-establish the United States as a global leader in an emerging industry. Opponents of a wind PTC extension argue that all electricity generators should be subject to market-based competition, wind electricity generation has been incentivized for a long enough period of time, and wind projects should compete on their own economic and environmental merits without the support of federal financial incentives.

This report examines how the production tax credit and its impending expiration impact the wind industry, and how other factors influence market demand for wind power projects.

<sup>8</sup> Zindler, Ethan. “Clean Energy Market Trends: US House Renewable Energy and Energy Efficiency Caucus.” *Bloomberg New Energy Finance*, May 9, 2012.

<sup>9</sup> *AWEA U.S. Wind Industry Annual Market Report: Year Ending 2011*, American Wind Energy Association, 2012. Also, for more information about U.S. wind manufacturing, see CRS Report R42023, *U.S. Wind Turbine Manufacturing: Federal Support for an Emerging Industry*, by Michaela D. Platzer.

<sup>10</sup> *Ibid.*

## **Impact of Current PTC Expiration**

U.S. wind installations are expected to reach record levels in 2012, with industry analysts estimating between 10 GW and 12 GW of total installations by the end of the year.<sup>11</sup> As a result, related economic development, employment, and manufacturing activities needed to support 2012 wind installations are likely to be at record levels. Wind developers, utility companies, and investors are accelerating their planned wind projects in order to qualify for tax credit incentives that might not be available in 2013 and beyond.

In essence, the pending PTC expiration at the end of 2012 has actually created a short-term surge in wind-related manufacturing and employment. Due to lead times—generally 12 to 18 months—required to fully develop wind projects, most manufacturing activities supporting 2012 wind capacity additions likely occurred either in 2011 or during the first quarter of 2012. Wind-related employment and economic development activity in the second half of 2012 will be primarily focused on construction, installation, and commissioning activities for projects in development. Based on current market conditions and other factors, it is unlikely that 2012 wind development levels can be sustained in either the near or long term, regardless of PTC availability.

Accelerated wind development in anticipation of the PTC expiring can create a severe market downturn in the year following PTC expiration. The wind PTC has expired three times since 2000 (in 2000, 2002, and 2004), and the wind industry experienced precipitous drops in annual wind capacity installations in each of those years.<sup>12</sup> One market estimate projects that 2013 wind capacity additions may drop to as low as 1 GW in 2013, if the PTC is not extended.<sup>13</sup>

## **Potential Impact of Extending the PTC**

Production tax credits for wind-generated electricity provide a financial incentive for project developers and investors to install wind projects in the United States. However, the PTC incentive is only one of several factors that influence wind development, and a PTC extension, in isolation of other market factors, may not result in ever-larger levels of wind deployment. Other important factors for project development include state renewable portfolio standards, electricity demand growth, and natural gas prices. Each of these factors is discussed in more detail below. The following sections provide some background on how a PTC extension might impact U.S. wind project installations and manufacturing. A brief discussion of the potential impact of a short-term versus long-term PTC extension is also provided.

---

<sup>11</sup> Bloomberg New Energy Finance estimates 2012 wind installations to be approximately 10.5 gigawatts; see Zindler, Ethan, “Clean Energy Market Trends: US House Renewable Energy and Energy Efficiency Caucus,” *Bloomberg New Energy Finance*, May 9, 2012. CRS conversations with other market analysts indicate that 10 GW to 12 GW in 2012 is a general range for wind capacity installations.

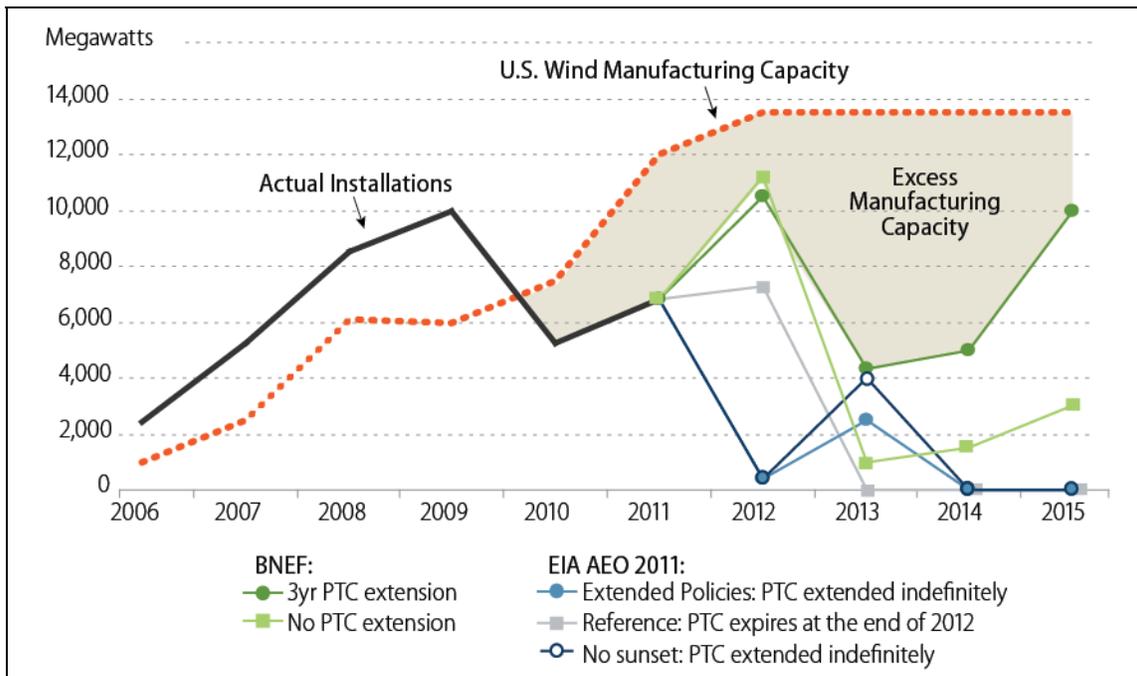
<sup>12</sup> Federal Production Tax Credit for Wind Energy: The American Wind Industry Urges Congress to Take Immediate Action to Pass an Extension of the PTC, American Wind Energy Association, available at [http://www.awea.org/issues/federal\\_policy/upload/PTC-Fact-Sheet.pdf](http://www.awea.org/issues/federal_policy/upload/PTC-Fact-Sheet.pdf).

<sup>13</sup> Zindler, op. cit.

## Wind Installations

Various organizations have estimated the amount of wind project development under scenarios in which the PTC is either extended or is not extended. CRS obtained forecast information from the U.S. Energy Information Administration (EIA) and from Bloomberg New Energy Finance (BNEF) that estimates the amount of wind capacity (megawatts) expected to be installed under different PTC availability scenarios. **Figure 2** compares estimated wind installations with existing U.S. wind turbine manufacturing capacity.

**Figure 2. Estimated U.S. Wind Installations, With and Without a PTC Extension (2006-2015)**



**Source:** Zindler, Ethan, “Clean Energy Market Trends: U.S. House Renewable Energy and Energy Efficiency Caucus,” *Bloomberg New Energy Finance*, May 9, 2012; and, U.S. Energy Information Administration, *Annual Energy Outlook 2011*, AEO Table Browser, May 24, 2012, available at <http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=10-AEO2011&table=16-AEO2011&region=0-0&cases=nosunset-d030711a,extended-d031011a,ref2011-d020911a>.

**Notes:** The BNEF “3yr PTC extension” case shows a large capacity addition increase from 2014 to 2015. This is likely explained by the expiring nature of the three-year extension and the expectation that developers would accelerate their projects in order to qualify for the PTC incentive before the deadline. Unlike the BNEF three-year extension scenario, EIA estimates wind capacity additions for two scenarios that assume indefinite availability of the PTC. As indicated in the figure, the long-term PTC extension actually results in less near-term development activity since there is no expiration date motivating developers to accelerate project development timelines. For background information about EIA’s model and analysis results, see the “notes” section in **Figure 3**. EIA’s “Extended Policies” and “No sunset” scenarios both assume an indefinite extension of PTC incentives, but annual capacity estimates are different for each scenario. In addition to the indefinite availability of PTC incentives, the “Extended Policies” scenario also includes assumptions for energy efficiency policies that are extended over longer periods of time. These energy efficiency measures effectively reduce U.S. electricity demand, and therefore reduce the amount of additional wind capacity needed to comply with RPS policies.

As indicated in **Figure 2**, both BNEF and EIA forecast levels of wind development in 2013 and 2014 that are much less than development activity expected in 2012. As a result, levels of

investment, manufacturing, and employment activity will be commensurately lower in the near term, even with a PTC extension. However, a short-term PTC extension may result in higher near-term levels of development activity when compared to scenarios without a PTC extension.

## **Wind Turbine Manufacturing**

Neither BNEF nor EIA estimate a scenario where wind installations meet or exceed existing U.S. wind turbine manufacturing capacity (see **Figure 2**). As a result, a PTC extension is unlikely to result in stimulating additional wind manufacturing facilities in the United States. Estimated wind installations in 2013 and 2014 are expected to drop to levels much lower than existing U.S. manufacturing capacity, including PTC extension scenarios. Whether the PTC expires or is extended, U.S. wind manufacturing utilization levels will likely be less than levels needed to support the wind market in 2012. Therefore, some U.S. wind manufacturing facilities could reduce operations or even completely shut down in 2013 and beyond.

Much like the U.S. wind market, there is excess capacity in the global wind turbine manufacturing sector.<sup>14</sup> The competitive global market for wind generating equipment is one factor that may limit U.S. wind turbine manufacturing export opportunities.<sup>15</sup> Other factors affecting U.S. wind exports may include logistic and transportation costs associated with exporting large wind turbine equipment and certain local-content policies within global markets that may require co-locating manufacturing capability within a geographical market area. However, excess wind turbine manufacturing capacity will likely result in wind turbine price decreases as manufacturers improve their cost and technology performance. Wind turbine price declines would contribute to new wind projects becoming more economically competitive with other sources of electricity generation on an unsubsidized basis.

## **Short-Term versus Long-Term PTC Extension**

Some advocates for extending the availability of the PTC for wind projects argue that a long-term extension is needed to provide stable incentives that will result in certainty within the wind industry and may stimulate growth. The American Wind Energy Association (AWEA) states the following:

The wind industry seeks long-term tax policies, lasting more than just a few years, to provide consistency and market certainty.<sup>16</sup>

AWEA and other proponents of extending the availability of the PTC incentive argue that the expiring nature of production tax credits has created a volatile U.S. wind market with new installations ramping up just before the credits expire, and the following year having very little new wind development.<sup>17</sup> It is possible that such uncertainty could reduce investment, research,

---

<sup>14</sup> “Q1 2012 Clean Energy Policy & Market Briefing: Policy pullbacks, weak economies, market oversupply slow Q1 investment,” *Bloomberg New Energy Finance*, April 18, 2012.

<sup>15</sup> According to the Global Trade Information Service, U.S. wind power generating set (HS 8502.31) exports were approximately \$255 million in 2011.

<sup>16</sup> American Wind Energy Association website, June 4, 2012, [http://www.awea.org/issues/federal\\_policy/index.cfm](http://www.awea.org/issues/federal_policy/index.cfm).

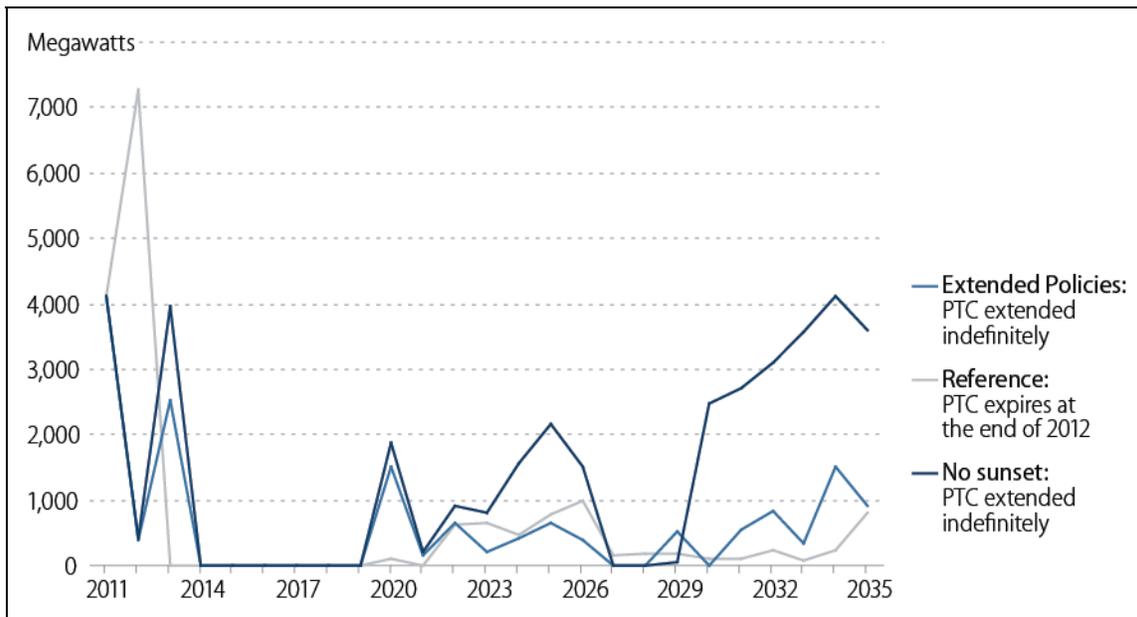
<sup>17</sup> Federal Production Tax Credit for Wind Energy: The American Wind Industry Urges Congress to Take Immediate Action to Pass an Extension of the PTC, American Wind Energy Association, available at [http://www.awea.org/issues/federal\\_policy/upload/PTC-Fact-Sheet.pdf](http://www.awea.org/issues/federal_policy/upload/PTC-Fact-Sheet.pdf).

and employment in the wind industry. Going forward, an element of the PTC debate may include the duration of PTC availability. If the PTC is extended, should it be a short-term, long-term, or indefinite extension?

Short-term PTC extensions generally result in short-term manufacturing, development, and employment activity as project developers and investors seek to capture the value of tax credit incentives during their availability window. However, since much of the demand for wind-generated electricity is a result of state-level renewable portfolio standards (discussed in more detail below), a short-term PTC extension would likely result in accelerating wind deployments needed to comply with state RPS requirements. This acceleration scenario is illustrated by the BNEF three-year PTC extension forecast (dark green line) in **Figure 2**, where annual installations reach 4 GW in 2013, 5 GW in 2014, and then ramp up to approximately 10 GW in 2015, when the credit extension would end. As a result, RPS-related demand in later years would likely decline and any future PTC extensions may or may not provide enough incentive to stimulate additional development activity.

Alternatively, a stable and long-term PTC incentive would provide manufacturers and developers with known incentive levels over an established period of time. However, a long-term or permanent PTC may not stimulate market activity comparable to levels observed between 2010 and 2012. EIA forecasts indicate that an indefinite PTC extension could result in more total wind capacity installations over the projection period (see **Figure 3**) when compared to a reference case scenario. However, annual capacity installations in the long-term extension scenario are relatively modest (in some years zero) and peak at around 4 GW. These annual installation levels are much lower than the existing 13 GW of U.S. wind turbine assembly capacity.

**Figure 3. EIA Estimates for Annual Wind Capacity Installations: Long-Term PTC (2011-2035)**



**Source:** U.S. Energy Information Administration, *Annual Energy Outlook 2011*, AEO Table Browser, May 24, 2012, available at <http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=10-AEO2011&table=16-AEO2011&region=0-0&cases=nosunset-d030711a,extended-d031011a,ref2011-d020911a>.

**Notes:** EIA uses its National Energy Modeling System (NEMS) to make annual projections for the U.S. energy sector. Annually installed wind capacity, as indicated in this figure, is one of several outputs from the NEMS model. NEMS includes several modules. One module is the Electricity Market module, which is used to calculate the projections provided in this figure. The Electricity Market module evaluates the U.S. electricity market based on different regions and considers future wind capacity additions based on regional economic and policy conditions. Generally, wind capacity is added based on federal policy, market economics, and as needed in order to comply with state RPS requirements. With respect to state RPS requirements, NEMS considers the amount of renewable electricity capacity in the various regions and the amount of renewable electricity required to comply with state RPS policies. NEMS does not, however, consider every policy design element included in each state RPS, such as credit sale limitations, credit banking, or credit borrowing.

### **A Note About Market Forecasts and Analytical Models**

Market analysts have a difficult job in that they are required to predict the future in order to forecast expected market activity. Typically, market forecasts are estimated using a predictive numerical model that includes a number of assumptions about various factors that can significantly impact the forecasted results. Generally speaking, near-term forecasts have a higher degree of accuracy than long-term forecasts, simply because assumptions and variables that influence the model are more difficult to predict over longer time frames. Furthermore, forecasts will change over time as market conditions and other variables change.

Forecasts and predictions referenced in this report are no exception. Two different forecasting methodologies, with different assumptions, were used to derive the forecasts in this report, and results from each approach are obviously different. As a result, each estimate varies and neither forecast can be considered correct or incorrect. Additionally, estimates provided in this report are static as of the date they were released. In practice, market forecasts are typically updated periodically to reflect market, financial, and policy changes.

Market forecasts are valuable to policy makers, project developers, manufacturers, and other stakeholders since they allow for an assessment of expected market activity under certain assumptions. Furthermore, market forecasts can provide some perspective on the potential impact of market and policy changes. Nevertheless, it is important to recognize that models used to forecast the future have limits and reality will most likely differ from the projections provided in this report. Finally, the level of accuracy of market forecasts can only be determined by observing actual results in the future.

## **Other Factors that Affect U.S. Wind Development**

As briefly discussed above, availability of the federal production tax credit is one of several factors that impact the amount of wind development and deployment in the United States. Generally, state-level renewable portfolio standards (RPS) create a source of demand for wind projects. Overall U.S. electricity demand growth is also an important factor as it determines the total addressable market that wind projects can target. Low natural gas prices can create economic competitiveness pressure for wind projects but high natural gas prices can result in additional opportunities for the wind sector. While not an all-inclusive list of factors that affect wind development, the factors addressed below do represent some of the critical non-PTC factors that influence the U.S. wind industry. The following sections provide additional details about each factor.

### **State Renewable Portfolio Standards**

Generally, but not in all instances, a renewable portfolio standard is a policy that requires a certain percentage of electricity sold or generated within a defined geographical area be derived from qualified renewable energy sources.<sup>18</sup> As of May 2012, 29 states plus the District of

<sup>18</sup> The state of Texas is an exception to this generality. According to DSIRE (Database of State Incentives for Renewables & Efficiency, <http://www.dsireusa.org>), Texas has a renewable generation requirement that requires (continued...)

Columbia and Puerto Rico had binding RPS policies.<sup>19</sup> While the general concept of an RPS is the same for all states, each state typically has a unique design and implementation approach for its respective RPS policy. For example, the state of California requires that by 2020 its utility companies will have 33% of their retail electricity sales generated from renewable energy sources.<sup>20</sup>

State RPS policies are the primary renewable electricity demand driver, although demand for renewable power can also be encouraged by voluntary green power programs and fundamental economics.<sup>21</sup> Analysis by Lawrence Berkeley National Laboratory (LBNL) indicates that approximately 27 GW of non-hydro renewable electricity capacity was added in states with RPS policies in the years 1998-2010.<sup>22</sup> On a capacity basis, 92% of these renewable electricity additions were wind power projects.<sup>23</sup> From a generation perspective, the combination of mandated demand at the state level and federal financial incentives has created an environment that supports development of renewable electricity projects, most notably wind projects.

One typical compliance approach for RPS policies is submitting renewable energy certificates (RECs) to the appropriate state agency that manages RPS compliance.<sup>24</sup> RECs, each of which receives a unique tracking identification number, represent the renewable attributes of electricity generated from a qualified renewable power facility. One REC typically represents one megawatt-hour of renewable electricity. RECs can be obtained on either a bundled basis, where a utility company contracts to purchase both the electricity and associated RECs from a renewable generator, or an unbundled basis, in which case a utility company may purchase qualified RECs from other entities. RECs can potentially provide an additional revenue source for wind projects, although the value of RECs can vary depending on the supply/demand balance within certain markets.

Analysis of state RPS compliance indicates that existing renewable electricity capacity may be adequate to allow for RPS compliance over the next several years. Furthermore, future RPS-driven demand may not be large enough to stimulate substantial growth in the wind electricity sector. LBNL estimates that approximately 4 GW-5 GW of annual renewable electricity capacity additions between 2011 and 2025 would be required in order to meet state RPS requirements.<sup>25</sup>

---

(...continued)

5,880MW of installed renewable capacity by 2015.

<sup>19</sup> Database of State Incentives for Renewables & Efficiency, <http://www.dsireusa.org>. A summary map of state RPS policies is available at [http://www.dsireusa.org/documents/summarymaps/RPS\\_map.pdf](http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf).

<sup>20</sup> Database of State Incentives for Renewables & Efficiency, available at [http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=CA25R&re=1&ee=1](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA25R&re=1&ee=1).

<sup>21</sup> Voluntary green power markets are those in which consumers, businesses, and other entities purchase a certain amount of renewable energy on a voluntary basis. For more information on voluntary green power, see Jenny Heeter and Lori Bird, "Status and Trends in U.S. Compliance and Voluntary Renewable Energy Certificate Markets (2010 Data)," National Renewable Energy Laboratory, October 2011.

<sup>22</sup> Ryan Wisner and Galen Barbose, "The State of the States: Update on the Implementation of U.S. Renewable Portfolio Standards," Presentation at the 2011 National Summit on RPS, Lawrence Berkeley National Laboratory, October 26, 2011.

<sup>23</sup> Ibid.

<sup>24</sup> For additional background on RECs, see Holt, E., Sumner, J., and Bird, L., *Role of Renewable Energy Certificates in Developing New Renewable Energy Projects*, National Renewable Energy Laboratory, 2011, available at <http://www.nrel.gov/docs/fy11osti/51904.pdf>.

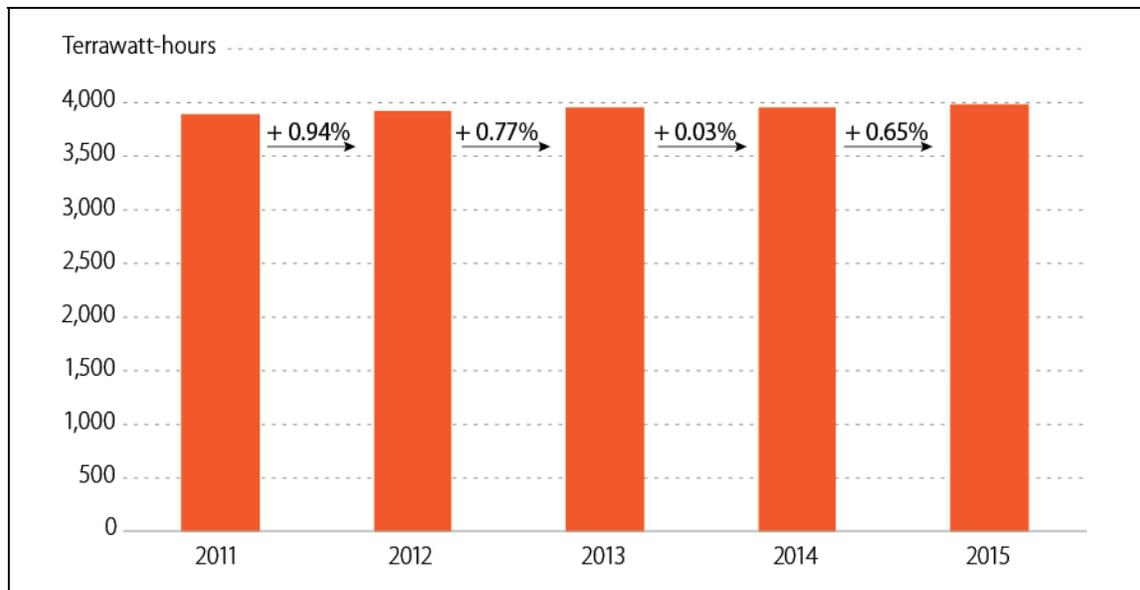
<sup>25</sup> Ryan Wisner and Galen Barbose, "The State of the States: Update on the Implementation of U.S. Renewable Portfolio Standards," Presentation at the 2011 National Summit on RPS, Lawrence Berkeley National Laboratory, October 26, (continued...)

This compares to 6 GW-11 GW of renewable capacity installed between 2008 and 2010.<sup>26</sup> RPS-driven renewable electricity demand, on its own, does not appear large enough to support annual wind industry growth going forward, and RPS policies may not provide enough demand to sustain annual wind capacity installations compared to levels installed in the years 2009 to 2012, or to match current U.S. manufacturing capacity.

## U.S. Electricity Demand Growth

Electricity demand growth is an important factor when considering opportunities for renewable electricity for two primary reasons. First, generally, the greater the annual demand growth the more new electricity capacity needed to satisfy that demand. Larger annual requirements for new electricity capacity create more opportunities for renewable electricity projects to compete. Second, large annual demand growth can result in a larger base of electricity to which RPS policies are applied. The larger the electricity base, the greater the amount of renewable electricity required to comply with state percentage-based RPS policies. However, EIA projects modest growth levels for U.S. electricity demand over the next several years (see **Figure 4**).

**Figure 4. Projected U.S. Electricity Demand Growth**  
(2011-2015)



**Source:** EIA Annual Energy Outlook 2011, U.S. Energy Information Administration.

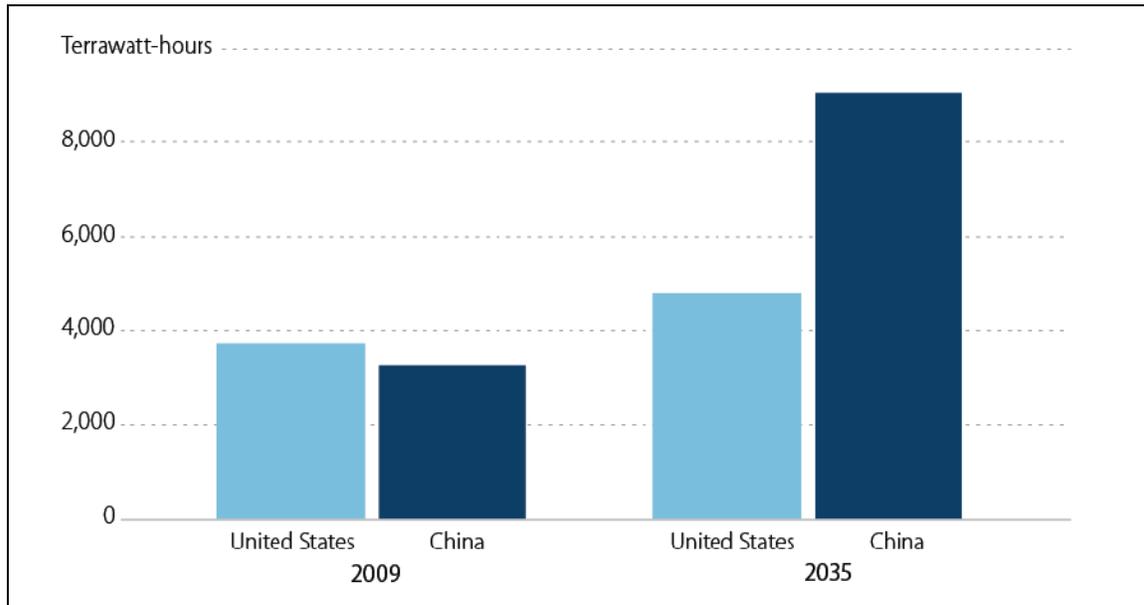
Long-term U.S. electricity demand is expected to continue along a modest annual growth path out to 2035. However, electric power demand in developing economies, such as China, is expected to experience significant annual growth out to 2035 (see **Figure 5**).

(...continued)

2011.

<sup>26</sup> Ibid.

**Figure 5. U.S. and Chinese Projected Electricity Demand Growth**  
(Annual Demand in 2009 and 2035)



**Source:** *World Energy Outlook 2011*, International Energy Agency, 2011.

As indicated in **Figure 5**, expected electric power demand growth profiles for the United States and China are very different, with China's growth level forecasted to be much larger than that of the United States. Therefore, opportunities for new electric generation capacity in China will be commensurately larger. As result, the Chinese electricity market may present more opportunities for renewable electricity projects, including wind power, due to the large amount of additional installations needed to meet projected electricity demand.

## Natural Gas Price

The price of natural gas also has an impact on the U.S. wind market. Generally, lower natural gas prices can reduce the economic competitiveness of wind power, while higher natural gas prices can create opportunities for wind to compete on economics alone, in some cases without subsidies. Since wind power economics vary depending on project location, there is no single natural gas price level at which all wind projects can compete either on an unsubsidized basis or with the availability of PTC incentives. Furthermore, natural gas prices can affect wind power in different ways depending on the state or region in which a wind project operates.

U.S. electricity markets are complex, and a comprehensive analysis of electricity markets is beyond the scope of this report.<sup>27</sup> Generally, however, there are two distinct types of markets in the United States: (1) competitive markets: power generators are subject to price competition when selling power into wholesale markets, and (2) cost-of-service markets: power generators earn a regulated rate of return established by a public utilities commission.<sup>28</sup> According to one

<sup>27</sup> For additional background on the U.S. power sector, see *Electricity Primer—The Basics of Power and Competitive Markets*, Electricity Power Supply Association, available at <http://www.epsa.org/industry/primer/>.

<sup>28</sup> Ibid.

estimate, approximately two-thirds of electricity consumed in the United States is within competitive markets.<sup>29</sup> Furthermore, there are several regional power markets in the United States, each with a unique market structure, fuel mix, and set of rules that govern market operations. Depending on the respective market characteristics, natural gas prices can impact wind projects in different ways. The following sections provide two simplified examples of how natural gas prices might impact the economics, and development, of U.S. wind power projects.

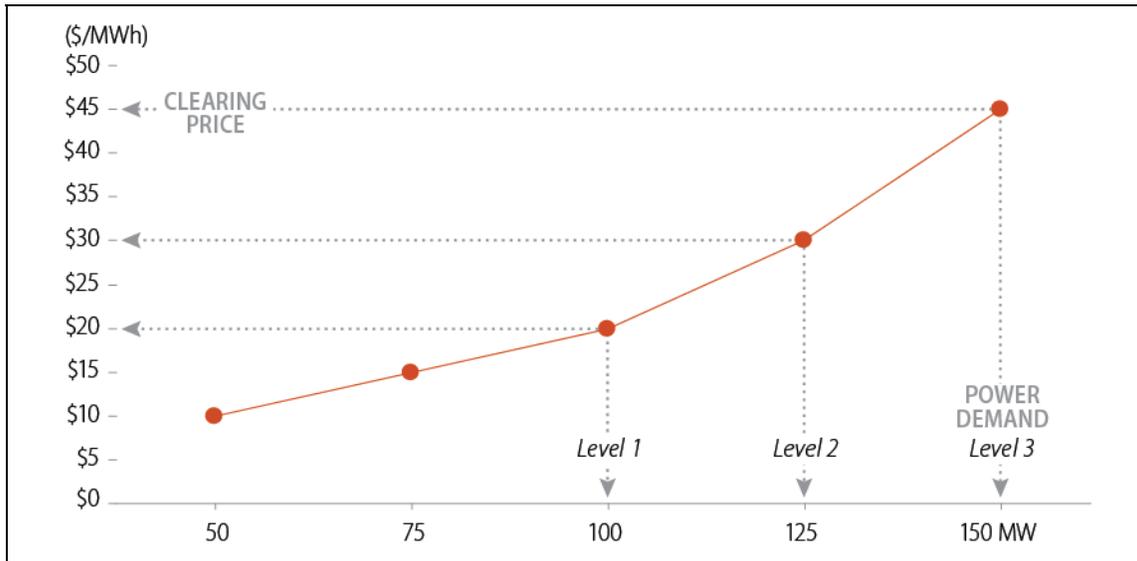
### **Example 1: Markets Coordinated by a Regional Transmission Organization**

Competitive electricity markets are typically managed by a Regional Transmission Organization (RTO) or an Independent System Operator (ISO), a third-party operator of the electricity transmission system for a defined geographical area. In essence, the RTO provides a market making function and is a critical interface between electricity purchasers and suppliers. RTO-coordinated markets can generally be described as markets where wholesale electricity rates are frequently established (typically on an hourly basis) through a bidding process. Power generators provide bids, usually based on the variable cost for each respective generator, to supply a certain amount of electricity. The RTO will organize the bids from the lowest to the highest. The bid offer price that matches the level of electricity supply necessary to meet power demand sets what is known as the “clearing price.” **Figure 6** provides a simplified example of how the clearing price might be established for wholesale electric power within an RTO-coordinated market. All generators that supply electricity at or below the clearing price are paid for their electricity supply at the clearing price level. However, many power generators may establish power purchase agreements (PPAs) directly with utility companies to provide long-term revenue certainty. In these instances financial transactions between generators and power purchasers will often occur exclusive of the RTO clearing price mechanism in order to satisfy PPA terms and conditions.

---

<sup>29</sup> ISO/RTO Council, <http://www.isorto.org/site/c.jhKQIZPBImE/b.2603917/k.B00F/About.htm>, June 20, 2012.

**Figure 6. Simplified Electricity Dispatch Curve for Wholesale Power**  
(Hypothetical RTO Market Example)



**Source:** CRS adaptation of *Locational Marginal Pricing (LMP) Overview*, page 22, PJM, October 18, 2011, available at <https://www.pjm.com/training/~media/training/core-curriculum/ip-lse-2011/lmp-overview.ashx>.

**Notes:** This figure illustrates how the wholesale electricity clearing price might change as a function of power demand. The red line represents the bid offer prices for electricity that are organized from low to high. Depending on the level of demand (three different hypothetical levels illustrated in this figure), the clearing price is adjusted in order to satisfy required demand for electricity delivery during a certain time period.  
MW = megawatts  
MWh = megawatt-hour

In certain electricity markets, during different times of year, and during certain times throughout a day, especially during daytime hours when electricity demand peaks, natural gas power generation sets the clearing price. Since natural gas fuel costs are the largest contributor to natural gas power generation costs, there will be some degree of correlation between the price of natural gas and the wholesale electricity clearing price within certain markets. Generally, as natural gas prices rise, so does the clearing price during certain times throughout the day. However, total electricity demand within a market can also impact wholesale electricity prices. For wind projects that participate in this type of market without a PPA, also known as “merchant wind,” the clearing price will usually determine the revenue received for electricity sold into the market. Although, in certain instances, wind projects can supplement their electric power revenue by selling renewable energy certificates (RECs) to entities required to comply with state RPS policies.<sup>30</sup> Nevertheless, higher natural gas prices and the resulting higher electricity clearing prices can increase revenues for wind projects thereby making them attractive investment and development opportunities. Conversely, lower natural gas prices and lower clearing prices can decrease wind project revenues to a point where projects are not economically viable.

<sup>30</sup> Renewable Energy Credits (RECs) are issued to renewable electricity generators as a means of documenting, and accounting for, the renewable energy attributes of power generation. In some markets, RECs are “bundled” with electric power, in which case the purchaser of the power also receives the RECs. In other markets RECs are “unbundled,” in which case the electric power and the RECs may be sold to different buyers. For additional background on RECs, see Holt, E., Sumner, J., and Bird, L., *Role of Renewable Energy Certificates in Developing New Renewable Energy Projects*, National Renewable Energy Laboratory, 2011, available at <http://www.nrel.gov/docs/fy11osti/51904.pdf>.

Wind projects in RTO-coordinated markets can mitigate wholesale market price risk by entering into long term PPAs with utility companies. In this case, utility companies absorb the risks associated with low wholesale clearing prices. Utilities may be motivated to enter into PPAs with wind projects as a means of complying with state RPS policies or as a way to hedge against rising natural gas and wholesale electricity prices. However, many state RPS policies include an alternative compliance payment (ACP) design element whereby utilities can opt to make payments to an ACP fund instead of generating or purchasing a required amount of renewable electricity. Low natural gas prices can lower electricity prices and result in making ACPs more economical than either building or paying for renewable generation. Thus, the short- and long-term price of natural gas, along with any ACP policy, can impact a utility company's decision to enter into PPAs with renewable electricity generators.

### **Example 2: California RPS Cost Containment Approach**

The state of California currently has one of the most aggressive RPS policies.<sup>31</sup> However, as part of the policy design, the California RPS includes a cost containment design element, which is directly linked to the price of natural gas. California has used a Market Price Referent (MPR) as a benchmark for determining the price premium required to support certain sources of renewable electricity. If contract prices for renewable electricity exceed MPR levels, then formal approval by the California Public Utilities Commission (CPUC) of the contract must be obtained and above market funds (AMFs) must be available to compensate for the additional cost associated with purchasing the renewable power.<sup>32</sup> AMFs establish cost limits for California electric utility companies required to comply with the state's RPS policy.<sup>33</sup> Benchmark MPR prices are set based on the levelized price of electricity from a 500 MW natural gas-fired combined cycle gas turbine (CCGT).<sup>34</sup> Consequently, natural gas prices can significantly influence MPR benchmark price levels. This approach is designed to contain costs associated with RPS implementation since "the MPR sets a limit on the procurement obligations of retail sellers under the RPS program."<sup>35</sup>

## **Policy Discussion**

The 112<sup>th</sup> Congress may decide if the PTC incentive for wind electricity will be extended, modified, or terminated. During the congressional debate about the future of the wind PTC incentive, Congress may consider various policy options, including those discussed below.

---

<sup>31</sup> For additional information about California's RPS policy, see [http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=CA25R&re=1&ee=1](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA25R&re=1&ee=1).

<sup>32</sup> Additional information about California's Market Price Referent is available at <http://www.cpuc.ca.gov/PUC/energy/Renewables/mpr>.

<sup>33</sup> For more information about California's approach to RPS Cost Containment, see <http://www.cpuc.ca.gov/PUC/energy/Renewables/SB1036implementation.htm>, June 11, 2012.

<sup>34</sup> The term "levelized price" basically reflects the average price at which the baseline CCGT power generation plant would need to sell electricity in order to pay for capital, operation, maintenance, fuel, and finance costs over a defined period of time. A critical assumption used for calculating levelized price is the power plant capacity factor, the amount of operating time during each calendar year.

<sup>35</sup> *Resolution E-4442*, Public Utilities Commission of the State of California, December 1, 2011, available at [http://docs.cpuc.ca.gov/WORD\\_PDF/FINAL\\_RESOLUTION/154753.PDF](http://docs.cpuc.ca.gov/WORD_PDF/FINAL_RESOLUTION/154753.PDF).

## Allow the PTC to Expire

Absent congressional action, the PTC incentive for wind electricity projects will no longer be available for new installations placed in service after January 1, 2013. Some market projections suggest that annual wind capacity additions will decline precipitously if the PTC expires (see **Figure 2**). As a result, wind-related manufacturing and project development employment would decline as well. Allowing the PTC to expire may motivate wind equipment manufacturers and developers to take certain actions (e.g., maximize turbine performance, minimize manufacturing costs) necessary to make wind electricity more broadly competitive on an unsubsidized basis. These actions could potentially result in a stronger and more robust, although possibly smaller, wind industry that can compete directly with all sources of power generation. However if state RPS policies remain as-is and low natural gas prices persist, a prolonged industry contraction could limit the ability of the wind industry to respond once, and if, market conditions change.

## Extend the PTC Incentive

Congress might also consider extending the PTC incentive. Some market estimates indicate that a PTC extension would result in increasing U.S. wind capacity installations, when compared with allowing the PTC to expire—but at levels less than those observed since 2009 and less than current U.S. wind turbine manufacturing capacity (see **Figure 2**). Determining the duration of a possible PTC extension is also an important policy consideration. Generally, the shorter the extension the more near-term wind market activity that may be stimulated since project developers are motivated to install new capacity in order to qualify for PTC incentives. However, depending on the timing of an extension, a one-year extension may have limited impact due to 12-18 month wind project development lead times. Also, as discussed above, the near-term market stimulation that might result from a PTC extension may accelerate wind development at the expense of future-year RPS-driven demand. A permanent PTC may not stimulate near-term wind development activity since there would likely be less motivation to accelerate projects in order to qualify for federal tax incentives (see **Figure 3**). However, in a market where natural gas prices are rising, a permanent PTC could potentially stimulate wind electricity demand that might not otherwise occur.

Some bills have been introduced in the 112<sup>th</sup> Congress that would extend the availability of the PTC incentive for wind electricity projects. **Table 1** includes four bills that have been introduced and compares the duration of the PTC extension under each proposal.

**Table 1. Selected Bills Introduced to Extend Wind PTC Incentives**  
(112<sup>th</sup> Congress)

<b>Bill Number</b>	<b>Bill Title</b>	<b>PTC Extension</b>	<b>Status</b>
H.R. 3307	American Renewable Energy Production Tax Credit Extension Act of 2011	4 years	November 2, 2011; referred to House Committee on Ways and Means
H.R. 5187	IMPACT Act of 2012	8 years	April 27, 2012; referred to House Energy and Commerce Subcommittee on Energy and Power

Bill Number	Bill Title	PTC Extension	Status
S.Amdt. 1812	Amendment to S. 1813 (MAP-21)	1 year	March 13, 2012; not agreed to by a vote of 49-49
S. 2201	American Energy and Job Promotion Act	2 years	March 15, 2012; referred to Senate Finance Committee
S. 2204	Repeal Big Oil Tax Subsidies Act	1 year	March 29, 2012; Senate voted 51-47 to not invoke cloture

Source: Legislative Information System.

## Phase-Out of the PTC

Another policy option that has been discussed during the 112<sup>th</sup> Congress is the possibility of an extension that phases out the PTC incentive over time.<sup>36</sup> The basic concept of a PTC phase-out is to gradually reduce the value of the incentive over time in order to provide the industry a degree of certainty and a motivation to improve cost and performance efficiencies in order to become price competitive without the PTC.<sup>37</sup> The design of a PTC phase-out policy could potentially be difficult because, in order to stimulate U.S. wind development, the rate at which the PTC is reduced may need to be offset by, or aligned to changes in, other market factors (e.g., higher natural gas prices, more stringent state RPS policies, increased U.S. electricity demand). These other market factors will likely be beyond the scope of control of the PTC phase-out policy. An alternative approach may be a dynamic PTC phase-out design that requires a minimum PTC incentive reduction annually but could also be adjusted based on other market conditions (e.g., natural gas prices, system costs, technology improvements). Implementation of a dynamic PTC phase-out could potentially be complicated as well and the policy would need to be designed in such a way to motivate the industry to continue cost reduction and technology improvement initiatives.

## Author Contact Information

Phillip Brown  
Specialist in Energy Policy  
pbrown@crs.loc.gov, 7-7386

<sup>36</sup> Nick Juliano, "Interest grows in Senate for phaseout of production tax credit," *E&E Daily*, March 28, 2012.

<sup>37</sup> Under current law (IRC Section 45), the PTC includes a phase-out provision that is based on a reference electricity price. Details of the phase-out existing phase-out provision are included in IRC Section 45, available at [http://www.novoco.com/energy/resource\\_files/irs\\_guidance/irc/section\\_45.pdf](http://www.novoco.com/energy/resource_files/irs_guidance/irc/section_45.pdf).