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Production Tax Credit Incentives for Renewable Electricity: Financial Comparison of Selected Policy Options

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Summary

Under current law, the production tax credit (PTC) incentive for renewable electricity will expire at the end of 2013. Generally, congressional debate about the PTC falls within a spectrum of options. At one end of the spectrum, proposals have been made to eliminate the incentive. At the other end of the spectrum, proposals include making the PTC permanent. Other proposals, such as temporarily extending and phasing out the PTC over time, fall within these two extremes. This report examines selected alternatives for phasing out PTC incentives.

During the 2012 debate about the future of the PTC, the concept of phasing out PTCs over a period of time was considered as a potential option. In August 2012 the Senate Committee on Finance reported S. 3521, which expressed the sense of the Senate, regarding tax reform, that “whenever possible, federal energy tax expenditures should be responsibly phased-out in a manner that allows these technologies to function without a reliance on federal subsidies.” This language is not specific to any energy technology, and does not refer to either fossil energy or renewable energy. In December 2012, the American Wind Energy Association published a PTC phase out proposal that would result in the PTC being eliminated by 2019.

Debate about energy subsidies is multi-faceted. Different energy sources receive different types of subsidy support over varying time periods. Comparing tax incentives and subsidies across all energy types is beyond the scope of this report.

This report examines and considers possible options for renewable electricity PTCs, with a focus on phase-out alternatives. Generally, the goal of a tax credit phase-out approach is to reduce the incentive value over a period of time in order to encourage industry to reduce costs so that certain renewable power technologies might compete on an unsubsidized basis. In general, proponents of technology-promoting legislation aim to reduce the cost or price gap between preferred and conventional technologies. Opponents often view this approach as “picking winners.”

If the PTC were extended, Internal Revenue Code Section 45 includes provisions for phasing out the PTC based several parameters. However, a phase-out under current law is unlikely in the near to medium term due to the phase-out design—which is statutorily based on a threshold electricity value that escalates with inflation and a reference price that declines with technology and cost improvements—as well as forecasted electric power market conditions.

One phase-out approach under consideration is a linear reduction of PTC incentives each year. For example, the PTC could be reduced from its current level by 20 percentage points each year for five years. After the end of the five-year period, PTCs would no longer be available. This approach is simple conceptually, and may be easy to implement. However, this approach may or may not be effective, depending on market conditions (i.e., electricity prices, wind installation costs, natural gas prices). Alternatively, PTC incentives might also be reduced annually based on a non-linear formulation that incorporates the myriad of market variables that can affect the cost competitiveness of renewable electricity. While this approach is more complex when compared to the straight-line method, it could establish benchmark PTC levels using a comparative metric (e.g., natural gas power). A detailed examination and analysis of this “market-linked” phase-out approach is included in this report. Each phase-out approach differs in terms of complexity, implementation, and potential impacts to renewable electricity deployment.

Various proposals have been introduced in the 113th Congress that would eliminate the renewable electricity PTC (e.g., November 14, 2013, letter to Committee on Ways and Means from more than 50 House members), permanently extend the PTC (e.g., H.R. 2539, and the President's FY2014 budget) or phase out the PTC (e.g., H.R. 2081 and H.R. 2987). If Congress chooses to debate the future of the renewable electricity PTC, background and analysis of various policy alternatives may serve to inform discussions about this federal incentive.

Contents

| | |
|---|---|
| Introduction..... | 1 |
| Background..... | 3 |
| Overview of PTC Policy Approaches..... | 5 |
| Allow the PTC to Expire..... | 5 |
| Extend the PTC at Current Value..... | 6 |
| Phase Out the Renewable Electricity PTC: Selected Alternatives..... | 6 |
| Phase-out in Current Law..... | 6 |
| Straight Line Phase-out..... | 7 |
| AWEA Phase-out Concept..... | 8 |
| Market-linked Approach..... | 9 |

Figures

| | |
|---|----|
| Figure 1. Summary of CRS Analysis of PTC Policy Options..... | 2 |
| Figure A-1. NGCC and Wind Power LCOE Estimates: 2013 to 2019..... | 17 |
| Figure A-2. PTC Value Needed for Baseline Wind Project to be Economically Competitive with NGCC..... | 18 |

Tables

| | |
|---|----|
| Table 1. Comparison of PTC Phase-out Alternatives..... | 2 |
| Table 2. Hypothetical Example of a Straight Line Five-year PTC Phase-out Profile..... | 8 |
| Table 3. AWEA Conceptual PTC Phase-out Profile..... | 9 |
| Table A-1. Key Input Variables for NGCC LCOE Calculations..... | 14 |
| Table A-2. Key Input Assumptions for Baseline Wind Power LCOE Calculations..... | 15 |

Appendixes

| | |
|---|----|
| Appendix. Market-linked Phase-out Alternative: A Hypothetical Illustration..... | 11 |
|---|----|

Contacts

| | |
|---------------------------------|----|
| Author Contact Information..... | 20 |
|---------------------------------|----|

Introduction

Under current law, qualified renewable electricity projects that start construction before January 1, 2014, are eligible to receive PTCs during the first 10 years of project operations.¹ For projects started on or after January 1, 2014, the PTC would not be available. The debate about the future of PTC incentives generally falls within a spectrum of options. At one end of the spectrum, proposals have been made to eliminate the incentive. At the other end of the spectrum, proposals include making the PTC permanent. Various other proposals, such as extending and phasing out the PTC over time, fall within these two extremes. This report analyses several alternatives for phasing out PTC incentives.

As the deadline for PTC availability approaches, Congress may consider a variety of options regarding the future of PTC incentives. This report examines various alternatives for phasing out production tax credits (PTC) for qualified renewable electricity generation. The phase-out option would require congressional action to extend the availability of the incentive for the duration of the phase-out period.

While the concepts discussed in this report are universal to all PTC-eligible projects, examples and analysis included in the report are generally focused on wind power projects. A single technology was selected for the focus of the analysis in order to limit the scope of the report, since different technologies have different project and performance characteristics that would require in-depth financial analysis for each specific technology type. Wind power was selected for the analysis in this report because the wind sector has been the largest recipient of PTCs to date, and since much of the debate about the future of PTC incentives has centered on how the incentive impacts the wind power industry.

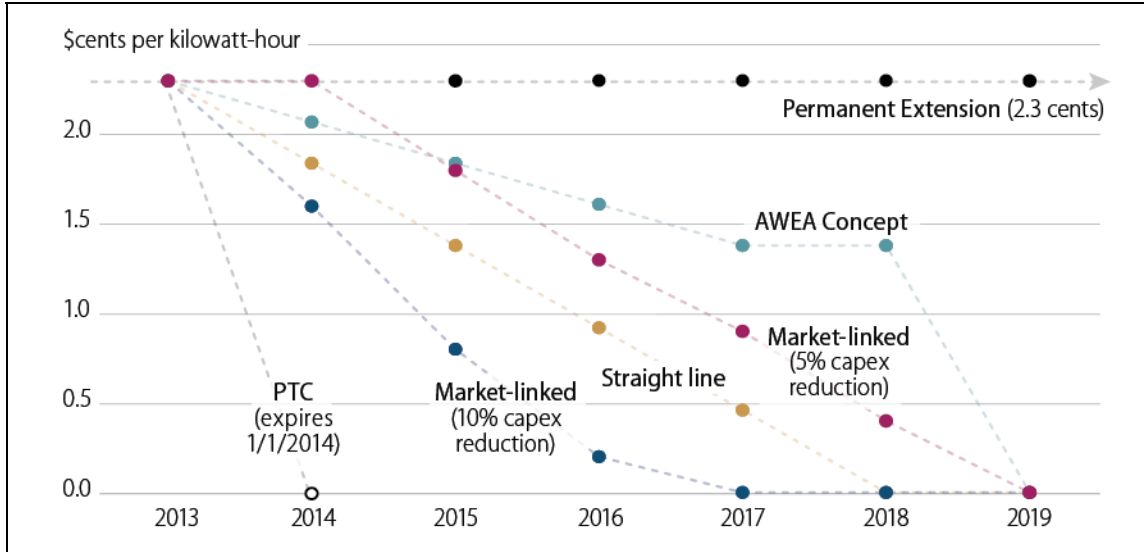
In response to congressional interest in PTC incentives for renewable electricity generation, this report provides an overview of different policy options, focusing on four different phase-out concepts that exist in current law, have been proposed, or have been discussed. Additionally, an alternative PTC phase-out approach that might be based on competitive, cost, and other market variables that can change over time is also examined.

In addition to elimination or permanent extension of the PTC, four different phase-out approaches are examined in this report: (1) phase-out under current law, (2) straight line phase-out over five years, (3) American Wind Energy Association (AWEA) phase-out concept, and (4) a market-linked phase-out policy option. The **Appendix** contains analysis of a market-linked phase-out policy option that considers multiple energy and financial market variables that can affect the economic competitiveness of wind power projects. Information in the **Appendix** includes the examination of an illustrative market-linked phase-out policy option and how such an approach could be used as a means to gradually reduce and eliminate PTC incentives over a period of time. Policy design options, preliminary analysis, and limitations of the illustrative market-linked phase-out policy approach are also discussed. Quantitative comparison and analysis results of the straight line, AWEA, and market-linked policy options are discussed in detail within the body of this report. **Figure 1** summarizes this analysis and illustrates how the PTC might phase out over

¹ Technologies eligible to receive PTCs include wind, closed-loop biomass, open-loop biomass, geothermal, landfill gas, trash/municipal waste, certain hydropower projects, and marine and hydrokinetic projects.

time under each policy approach. All policy options are further described in the body of this report.

Figure I. Summary of CRS Analysis of PTC Policy Options
(Expiration, Permanent Extension, and Phase-out Alternatives)



Source: CRS analysis of straight line, AWEA, and market-linked phase-out policy alternatives.

Notes: The term “capex” refers to the total capital costs required to install a new-build wind power project. Analysis of the market-linked phase-out scenarios is preliminary and illustrative only. Two market-linked scenarios are included in this figure: (1) one that assumes wind capital costs decline 5% annually, and (2) one that assumes wind capital costs decline 10% annually. These are discussed in detail in the **Appendix**.

Lines are added to this figure in order to allow the reader to follow the trajectory of different options. In practice, annual PTC values would be constant for an entire year.

Several PTC phase-out alternatives for renewable electricity are available. Each alternative is unique in terms of complexity, certainty, and other aspects. It is beyond the scope of this report to holistically examine all phase-out alternatives. However, **Table 1** compares each of the four phase-out alternatives discussed in this report.

Table I. Comparison of PTC Phase-out Alternatives

| | Design Features | Considerations |
|--------------------------|---|--|
| Extension of Current Law | Phase-out approach already exists IRS experience with this approach | Unlikely to reduce or phase out the incentive in the near to medium term |
| Straight Line | Simple, predictable and easy to implement Annual percentage point decrease | May, or may not, provide adequate incentive value to encourage new projects May also over-value the credit, depending on competitive, finance, and price conditions |

| | Design Features | Considerations |
|---------------|---|--|
| AWEA Concept | Option presented by an industry group Simple, predictable, and easy to implement | Steep incentive reduction at the end of the phase-out period May, or may not, provide adequate incentive value, or may provide a windfall if incentive is above the cost differential |
| Market-linked | Considers multiple market conditions that can impact wind power competitiveness Similar approaches used in Europe to reduce and phase out renewable electricity incentives | Complex implementation IRS and DOE may have little experience with such a detailed phase-out approach Imperfect comparison metrics |

Source: CRS.

Background

The U.S. tax code is frequently used as a vehicle to incentivize development, production, and use of multiple energy sources.² Different energy sources are incentivized in different ways (i.e., expense allowance, accelerated depreciation, and tax credits) and over different periods of time. As a result, comparing and contrasting treatment and equity across all energy sources is complicated. Doing such a comparison is beyond the scope of this report. Nevertheless, policy makers may be interested in understanding the history and background of U.S. energy tax incentives.³

This report is focused on production tax credits that are available for renewable electricity generation and potential options for eliminating, extending, or phasing out this financial incentive over a period of time. Further, the scope of the discussion is about wind power generation because wind electricity has been the primary recipient of PTCs since the incentive was made available in 1992.

At the end of 2012, approximately 60,007 Megawatts (MW) of wind power capacity had been installed in the United States and Puerto Rico.⁴ In terms of cumulative installed wind power capacity, the U.S. wind market is the second largest of any country in the world (China's is number one).⁵ Federal incentives for wind electricity generation projects that use large turbines—greater than 100 kilowatts (kW)—are generally in the form of production tax credits (PTC) and accelerated depreciation.⁶ PTC incentives provide a tax credit for each kilowatt-hour of electricity

² For more information about energy tax policy issues, see CRS Report R43206, *Energy Tax Policy: Issues in the 113th Congress*, by (name redacted).

³ For more information, see CRS Report R41953, *Energy Tax Incentives: Measuring Value Across Different Types of Energy Resources*, by (name redacted).

⁴ “AWEA U.S. Wind Industry Fourth Quarter 2012 Market Report,” American Wind Energy Association, January 30, 2012, available at http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf.

⁵ REN21. 2012. *Renewables 2012 Global Status Report* (Paris: REN21 Secretariat).

⁶ Large wind projects also have the option of electing an investment tax credit (ITC), equal to 30% of eligible installed costs, in lieu of the production tax credit.

generated by a wind project during its first 10 years of operation.⁷ The current value of the PTC incentive for wind projects, which is inflation-adjusted annually, is 2.3 cents (\$0.023) per kilowatt-hour. Originally established in the Energy Policy Act of 1992 (P.L. 102-486), the PTC, along with several other market and policy factors, has played a critical role in the evolution and growth of the U.S. wind industry.⁸

Historically, PTC incentives for wind power projects have expired, and have been subsequently extended, multiple times since the incentive became available in 1992.⁹ Generally, annual wind project installations increase as the incentive expiration date approaches and then experience a decline after the expiration date. Wind project development typically ramps back up following an extension of PTC incentive availability. In fact, 2012 was a record year for wind power installations, with over 13,000 MW of new capacity added during the calendar year.¹⁰ The large amount of wind power capacity coming online is generally attributed to project developers accelerating development plans in anticipation of PTC expiration on January 1, 2013.¹¹ The American Taxpayer Relief Act of 2012 (P.L. 112-240), which became law on January 2, 2013, extended the availability of PTCs by allowing wind projects that start construction before January 1, 2014, to be eligible for PTC incentives. However, due to a variety of factors (i.e., development timelines for new projects, over-subscribed state renewable policies, low electricity demand growth, and low natural gas prices), 2013 wind project installations are expected to be significantly less than installations in 2012.¹²

Policy makers may be interested in how deployment of wind power might be affected in the absence of PTC incentives. However, it is unclear what level of wind development would occur if the PTC were permanently eliminated. For example, the Energy Information Administration forecasts that annual wind capacity installations, on average, will be approximately 215 Megawatts (MW) between 2016 and 2030 under a scenario where the PTC expires on January 1, 2014.¹³ However, Bloomberg New Energy Finance (BNEF) forecasts annual capacity additions in the 4,000MW to 8000MW range without PTC incentives.¹⁴

During the 2012 debate about the future of wind PTC incentives, the concept of phasing out the PTC for wind over a period of time was discussed by both congressional and industry

⁷ Wind projects that are PTC-eligible have the option to elect a one-time investment tax credit (ITC) that is equal to 30% of eligible installation costs for a new wind project. Additionally, wind projects that started construction before January 1, 2012, and placed in service by January 1, 2013, had the additional option of electing to receive the one-time 30% ITC in the form of cash grant payable from the U.S. Treasury Department. For more information about the cash grant incentive, see CRS Report R41635, *ARRA Section 1603 Grants in Lieu of Tax Credits for Renewable Energy: Overview, Analysis, and Policy Options*, by (name redacted) and (name redacted).

⁸ For additional background on the PTC incentive and the U.S. wind industry, see CRS Report R42576, *U.S. Renewable Electricity: How Does the Production Tax Credit (PTC) Impact Wind Markets?*, by (name redacted).

⁹ For history and background of the federal PTC incentive, see Congressional Research Service, "Tax Expenditures: Compendium of Background Material on Individual Provisions," December 2012, <http://www.gpo.gov/fdsys/pkg/CPRT-112SPRT77698/pdf/CPRT-112SPRT77698.pdf>.

¹⁰ "AWEA U.S. Wind Industry Fourth Quarter 2012 Market Report," American Wind Energy Association, January 30, 2012, available at http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf.

¹¹ For additional analysis of the PTC expiration and the impact on U.S. wind markets, see CRS Report R42576, *U.S. Renewable Electricity: How Does the Production Tax Credit (PTC) Impact Wind Markets?*, by (name redacted).

¹² Ibid.

¹³ U.S. Energy Information Administration, *Annual Energy Outlook 2013*, April 2013.

¹⁴ Bloomberg New Energy Finance, "H2 2013 North America Wind Market Outlook," November 15, 2013.

stakeholders.¹⁵ In the 113th Congress, two bills—H.R. 2081 and H.R. 2987—have been proposed that would phase out the PTC over time. Rationale for phasing out the PTC over time is generally based on the argument that the wind industry would have the opportunity to adapt to a gradual reduction of this federal financial incentive as opposed to adapting to a sudden and drastic elimination of the PTC based on a defined expiration date. Under current law, the PTC incentive is available to wind projects that start construction by the end of 2013. As the 2013 expiration of the PTC incentive approaches, Congress may choose to debate the future of wind PTC incentives and may also consider PTC phase-out policy options. This report is designed to inform debate about various policy options for the PTC that have been proposed.

Overview of PTC Policy Approaches

Various policy options for the future of the PTC have been discussed, including elimination, permanent extension, and extension with a phase-out of the incentive. Several phase-out approaches have been discussed, each with the goal of gradually eliminating the wind PTC over a period of time. In fact, current law includes a provision to phase out the PTC incentive based on certain criteria (discussed in more detail below), although it is unclear if the current law phase-out would ever be triggered. The following sections briefly describe different policy options, including four different PTC phase-out concepts. Phasing out the PTC would require, to some degree, an extension of PTC availability for the duration of the phase-out period because a partial PTC would be available each year.

Allow the PTC to Expire

Absent congressional action, new large wind power projects that start construction on or after January 1, 2014, will not be eligible for PTC incentives. However, new wind capacity additions in 2014 and 2015 are forecasted to be in the 6,000 MW to 8,000 MW per year range as the pipeline of new projects that met construction start requirements in 2013 are placed in service.¹⁶ Without a PTC incentive, the development pipeline for new projects will likely decline, compared to 2013. In the future, the ability of wind power to compete economically in a post-PTC environment is unclear and will depend on market factors such as the price of natural gas, project location, finance costs, equipment and installation costs, and wind turbine technology performance.

Proponents of PTC expiration argue that the tax credit has been available since 1992 and has supported the wind industry to a point where the technology should compete without the support of federal financial incentives. Furthermore, proponents also argue that large amounts of wind power distort competitive power markets and therefore should not be supported by federal financial incentives. In November 2013, a letter signed by more than 50 Members of the House of Representatives, delivered to the Committee on Ways and Means, expressing support for ending

¹⁵ The Senate Committee on Finance held an executive session on August 2, 2012, to consider the Family and Business Tax Cut Certainty Act of 2012. Phasing out the wind PTC was discussed in the context of comprehensive tax reform and the committee adopted an amendment titled “To Express Support for Comprehensive Tax Reform” that states the following: “Whenever possible, federal energy tax expenditures should be responsibly phased-out in a manner that allows these technologies to function without a reliance on federal subsidies.” Additionally, the American Wind Energy Association (AWEA) released a proposal in December 2012 that phases out the PTC over a six-year period. AWEA’s phase out proposal is discussed in further detail in this report.

¹⁶ Bloomberg New Energy Finance, “H2 2013 North America Wind Market Outlook,” November 15, 2013.

the PTC incentive.¹⁷ On November 4, 2013, more than 100 organizations issued a joint letter to Congress calling for the end of the wind production tax credit.¹⁸

Extend the PTC at Current Value

At the other end of the policy options spectrum, some groups have argued that the PTC should be extended for multiple years or even made permanent. In November 2013, 17 organizations sent a letter to the Senate Finance Committee calling for a multi-year extension of the Section 45 PTC.¹⁹ Also in November 2013, the Governor's Wind Energy Coalition sent a letter to House and Senate leadership requesting a "responsible multi-year extension of the production tax credit." The President's FY2014 budget proposes to make the PTC permanent and refundable. Estimates in the FY2014 budget indicate that this proposal would cost \$17.4 billion over 10 years.²⁰

Proponents of extending the availability of PTC incentives argue that the temporary nature of PTC incentives creates an investment climate that is uncertain and that other sources of energy have tax incentives that are permanent in nature, thus resulting in unfair treatment across the spectrum of energy sources and technologies. Furthermore, proponents argue that renewable electricity generation contributes towards emission reductions, along with other environmental benefits, and should therefore be supported by federal financial incentives.

Phase Out the Renewable Electricity PTC: Selected Alternatives

A potential policy alternative to either eliminating or extending the PTC might be an approach that could phase out the incentive over a period of time. Generally, the concept of phasing out the PTC is to gradually reduce the value of the PTC in order to incentivize the industry to position itself to compete without the support of federal financial incentives. There are several ways the PTC could be phased out, and any phase-out approach would require an extension of the PTC in some form. Four possible phase-out concepts are examined in the following sections.

Phase-out in Current Law

If it were extended, current law (Section 45 of the Internal Revenue Code), requires that the wind PTC be reduced and phased out when a reference price²¹ for wind power (calculated and published annually by the IRS) exceeds an inflation-adjusted threshold value, as discussed in the footnote below.²² In 2012, the threshold value was 11.8 cents.²³ If the reference price exceeds the

¹⁷ Juiano, Nick, "52 Lawmakers Sign Letter Urging End to PTC," *E&E News*, November 14, 2013.

¹⁸ Natter, Ari, "102 Groups Call on Congress to Let Wind Production Tax Credit Expire," Bloomberg BNA, November 5, 2013.

¹⁹ A copy of the letter send to the Senate Finance Committee is available at http://www.eenews.net/assets/2013/11/11/document_gw_01.pdf.

²⁰ Natter, Ari, "Call for Permanent Renewable Tax Credit May Signal White House Fight for Extension," Bloomberg BNA, April 12, 2013.

²¹ A "reference price" is generally used to reflect the average price of electricity received by all wind power projects. Each individual project will likely receive power prices that vary from the reference price. However, the reference price is used to determine if the phase-out provision in current law should be triggered.

²² The "threshold value" is established in IRC Section 45 as way to limit situations whereby wind power projects are contracting for electricity sales at high rates, yet are still receiving the PTC incentive. The original threshold value (continued...)

threshold value by more than 3 cents, then the PTC incentive for that year would be zero.²⁴ However, if the reference price exceeds the threshold value by more than zero but less than 3 cents, then the PTC is reduced by an amount equal to the PTC value multiplied by the ratio of (1) the difference between the reference price and the threshold value, and (2) 3 cents.²⁵ If the difference between the reference price and the threshold value is zero or less, then the PTC value is not adjusted.

As an example, the 2012 PTC value was 2.2 cents per kilowatt-hour and the current inflation-adjusted threshold value was 11.8 cents.²⁶ If the reference price were, hypothetically, 13.8 cents then the PTC value would be reduced by 2/3 based on the following calculation:

- (1) (Reference Price – Threshold Value) ÷ 3
- (2) (13.8 cents – 11.8 cents) ÷ 3 = 2/3
- (3) 2/3 × 2.2 cents PTC Value = 1.47 cents [amount by which the PTC is reduced]
- (4) 2.2 cents – 1.47 cents = 0.73 cents [adjusted PTC value for this example]

In 2012, the actual wind electricity reference price was 5.31 cents and the inflation-adjusted threshold value was 11.8 cents.²⁷ As a result, the wind PTC value was not adjusted in 2012. Wind electricity contract prices have generally been trending down in recent years as equipment costs decline and turbine performance improves. Since the threshold value generally trends up based on inflation, it is uncertain if or when conditions might exist that would result in a downward PTC value adjustment under current law.

Straight Line Phase-out

One phase-out approach discussed during the 2012 debate about PTC incentives was a straight line incentive reduction over a five-year period.²⁸ Generally, this proposed approach would reduce the PTC level by 20% of its current (2013) level, each year, for five years. **Table 2**

(...continued)

established in Section 45 was 8 cents per kWh and this amount is inflation-adjusted annually.

²³ The IRS publishes inflation adjustment factors and reference prices for renewable electricity production tax credits each year in the Federal Register. The 2012 Federal Register publication is available at <http://www.gpo.gov/fdsys/pkg/FR-2012-04-11/pdf/2012-8804.pdf>.

²⁴ The IRS provides guidance for calculating the PTC phase-out. For more information see, “2012 Instructions for Form 8835: Renewable Electricity, Refined Coal, and Indian Coal Production Credit,” Department of the Treasury, Internal Revenue Service, available at <http://www.irs.gov/pub/irs-pdf/i8835.pdf>.

²⁵ Ibid.

²⁶ The example used for this section uses information (PTC value, reference price, and threshold price) available for 2012. Note that the PTC value was adjusted for inflation in 2013 and is now 2.3 cents per kWh. The 2013 inflation adjustment is not reflected in this example.

²⁷ “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 / Wednesday, April 11, 2011, p. 21835.

²⁸ Senator Grassley has discussed the concept of a straight-line PTC phase-out that could occur over a four- to five-year period: *The Energy Daily*, “Grassley Floats Gradual PTC Phaseout over Four Years,” November 14, 2012.

provides an example of how the PTC incentive might be reduced and eventually eliminated using the straight line phase-out approach.

Table 2. Hypothetical Example of a Straight Line Five-year PTC Phase-out Profile

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---------------------------|------|------|------|------|------|------|
| PTC Level (cents per kWh) | 2.3 | 1.84 | 1.38 | 0.92 | 0.46 | 0 |

Source: CRS.

Notes: kWh = kilowatt-hour.

The straight line phase-out approach is simple and provides predictability of the incentive value over the phase-out period. This predictability could be very important to the wind industry, as it allows project developers, manufacturers, and other stakeholders to plan their business and development activities accordingly. On the other hand, the straight line phase-out approach does not consider energy and financial market dynamics that can impact the economic competitiveness of wind power. As a result, an arbitrary 20% annual PTC reduction could result in a PTC level that could, depending on market conditions, either provide generous returns to equity investors or not be adequate enough to incentivize the installation of new wind power projects.

AWEA Phase-out Concept

On December 12, 2012, the American Wind Energy Association (AWEA) sent a letter to the Senate Committee on Finance and the House Committee on Ways and Means that outlined a PTC phase-out concept. The AWEA phase-out concept is in the context of broader tax reform, under a scenario where all energy incentives might be reduced and eliminated over time.²⁹ AWEA's concept has subsequently been proposed twice in the 113th Congress (H.R. 2081 and H.R. 2987). Following is the PTC phase-out concept, as described in AWEA's letter:

The industry has undertaken an extensive analytical effort to determine what level of the PTC over a specific number of years would be needed to keep the industry minimally viable. The analysis assumed that the industry would meet ambitious technology-improvement and capital-cost targets. Analytical results indicate that a PTC beginning with 2.2 cents per kilowatt-hour, or 100% of the current level for projects that begin construction in 2013, followed by 90%, 80%, 70%, 60%, and then 60% of the current level for projects that are placed in service in years 2014 through 2018, with no PTC in 2019 or afterwards, would sustain a minimally viable industry, able to continue achieving cost reductions.³⁰

Table 3 shows how the PTC would be phased out and eventually eliminated under the AWEA phase-out concept.

²⁹ AWEA's letter states the following: "The wind industry recognizes that our country is facing significant fiscal challenges and is supportive of all energy technology incentives being reviewed and even phased down when Congress considers tax reform." See AWEA PTC Letter to Senate Finance and House Ways and Means Committee Leadership, American Wind Energy Association, December 12, 2012, available at <http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA-PTC-Letter-to-Committee-Leadership.pdf>.

³⁰ Ibid.

Table 3. AWEA Conceptual PTC Phase-out Profile

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---------------------------|------|------|------|------|------|------|------|
| PTC Level (cents per kWh) | 2.3 | 2.07 | 1.84 | 1.61 | 1.38 | 1.38 | 0 |

Source: AWEA, CRS.

Notes: This table uses 2.3 cents per kWh as the current value for 2013 instead of 2.2 cents mentioned in AWEA's letter. The 2.3 cent value reflects the 2013 IRS announcement of inflation adjusted PTC values.

AWEA had not publicly released an analysis supporting their phase-out concept as of the writing of this report. However, one characteristic of AWEA's concept worth noting is the dramatic and immediate PTC reduction between 2018 and 2019. This immediate reduction could potentially result in a "hard landing" for the industry in 2019 should market conditions at that time make it difficult for wind power to compete economically with other generation alternatives.³¹ However, the certainty provided by this concept could potentially allow for enough time to adjust to eventual PTC elimination.

Market-linked Approach

Elements of Congress have expressed interest in other PTC phase-out alternatives that might be linked to competitive and market variables. A market-linked phase-out approach could be designed a number of different ways and the approach examined in this report represents only one alternative option for potentially phasing out PTC incentives. Linking PTC values to market variables could potentially be a complex endeavor. For the purpose of illustration, a detailed **Appendix** is included in this report that describes a hypothetical market-linked approach that incorporates several energy and financial market parameters that can impact the financial competitiveness of wind electricity.³² The **Appendix** also includes a discussion of the limitations and challenges associated with such a phase-out approach. The market-linked analysis, as discussed for the purposes of this report, assumes that a PTC value is set annually so that it would result in a baseline wind power project being economically competitive with new-build natural gas combined cycle power generation.

The market-linked phase-out approach example is a policy option that annually sets a PTC level, based on changes to multiple energy and financial market variables, for wind projects that would start construction in the following calendar year. Overall, the goal of the market-linked policy option examined in this report would be to set the PTC at a level that results in a baseline wind power project being financially competitive with new natural gas combined cycle (NGCC) power generation. Levelized cost of electricity (LCOE) is the metric used to compare wind and natural gas generation and then determine the PTC level needed to achieve price parity. When calculating wind power LCOEs, the example policy option assumes that wind project capital costs would be reduced annually by either 5% or 10%. The logic behind this assumption is to create a policy-based incentive for wind power to continue reducing costs and improving performance in order to

³¹ This "hard landing" is similar to what project developers, investors, and manufacturers might encounter under the current law expiration.

³² Existing tax credits include phase-out provisions that are linked to market indicators or reference prices that can trigger a reduction or elimination of the credit. As an example, the enhanced oil recovery credit (Section 43) was phased out completely in 2013 as a result of a market-linked "reference price" that exceeded an inflation adjusted value by a certain amount. For more information about this phase-out example, see IRS Notice 2013-50 on Phaseout of Enhanced Oil Recovery Credit for 2013 Costs.

become economically competitive with NGCC power on an unsubsidized basis. The 5% and 10% annual cost reductions were selected as a starting point to illustrate the mechanics of this phase-out approach. Whether or not wind capital costs might be able to realize this assumed annual reduction is unclear and is one of the potential challenges (discussed in more detail below) with the market-linked approach. Finally, the illustrative policy includes a design option whereby once LCOE price parity is achieved, the PTC incentive would no longer be available.

Preliminary analysis of the market-linked phase-out approach indicates that, under current market conditions and using certain key assumptions, the PTC might phase out completely sometime between 2017 and 2019. However, the market-linked approach is naturally dynamic and incorporates the many variables used to calculate the needed PTC level. As a result, actual phase-out time frames would depend on actual market conditions. Additionally, the market-linked policy option has a number of limitations and challenges such as: (1) complex implementation, (2) issues with using LCOE as a way to compare the economics of wind and NGCC power generation, (3) regional resource and market variations, and (4) industry ability to realize cost reductions. Nevertheless, a market-linked PTC phase-out approach is a potential policy option that might be of interest, and this report explores such an approach by analyzing and critiquing an example market-linked PTC phase-out policy design.

Other countries use various approaches to re-set and reduce the value of financial incentives that are available to renewable power producers. While other countries use different incentive types (e.g., feed-in tariffs³³ versus production tax credits) to encourage renewable power development, a brief examination of feed-in tariff (FIT) adjustment strategies may offer some perspective when considering a market-linked PTC phase-out approach. One example is Germany, which uses an active degression approach to periodically adjust feed-in tariff financial incentives for renewable power projects.³⁴ Degression, by its definition, implies a decrease in the incentive value available for new renewable projects and the active approach refers to the periodic review of market activity stimulated by the FIT incentives. The FIT degression has recently been tied to the amount of new renewable power installations within Germany during a specific period.³⁵ Essentially, Germany uses the degression approach to manage the amount of renewable power capacity installed, and thus the FIT commitments that will be needed to compensate qualified projects. Another example is Japan, where FIT rates for renewable power are periodically reviewed and adjusted based on certain market conditions.³⁶ Japan has a pricing committee that periodically reviews capital cost and operation and maintenance cost data for renewable energy projects.³⁷ Cost data is used as input into a financial model that calculates, and adjusts, a FIT rate that results in an expected internal rate of return.³⁸

³³ Feed-in tariffs are incentives for renewable power projects that generally provide access to the electrical grid and a guaranteed long-term price for electricity produced from a qualified renewable power project. For more information on feed-in tariffs, see “A Policymaker’s Guide to Feed-in Tariff Policy Design,” National Renewable Energy Laboratory, July 2010, available at <http://www.nrel.gov/docs/fy10osti/44849.pdf>.

³⁴ For more information about German FIT incentives, see CRS Report R43176, *European Union Wind and Solar Electricity Policies: Overview and Considerations*, by (name redacted).

³⁵ Ibid.

³⁶ “Japan’s First Tariff Review—Expecting a Partial Eclipse of the Sun,” Bloomberg New Energy Finance, January 24, 2013.

³⁷ Ibid.

³⁸ Ibid.

Appendix. Market-linked Phase-out Alternative: A Hypothetical Illustration

If Congress determines that extending the PTC for some time is warranted, Congress may choose to consider a PTC phase-out that takes into account the multiple, and changing, market dynamics (energy and financial) that can impact the economic competitiveness of renewable electricity. In the case of wind power—used as an example only for the purpose of this illustration—implementing such a policy alternative on a national level may be difficult for a number of reasons, which include (1) wind resource quality differences throughout the country, (2) market structures, wholesale power prices, and electric power resource mix variations in different regions, and (3) the complex calculations required to annually estimate the value of the PTC incentive. Additionally, it is important to recognize that comparative energy metrics (e.g., natural gas prices and natural gas power generation costs) are only one consideration for calculating the value of PTC incentives needed for wind power to be financially competitive. Financial market conditions are also a critical variable that can have an impact on the relative competitiveness of wind power generation. Factoring financial market considerations into PTC value calculations adds additional complexity to the process of phasing out PTC incentives. CRS has analyzed a hypothetical market-linked phase-out policy option that illustrates the mechanics of one possible alternative for phasing out the PTC incentive. It is important to note that such an approach is imperfect and has several limitations and challenges. An overview, a preliminary analysis, and discussion of limitations of the market-linked phase-out approach are presented in the following sections.

Overview of Approach

An overall characteristic of this hypothetical market-linked approach is to reduce, and eventually eliminate, PTC incentives for wind power projects over a period of time. In order to achieve this aim, policymakers could consider some sort of policy pressure element that might encourage the continuous cost reduction of electricity generated from wind projects. According to this approach, once the PTC is completely eliminated, wind projects would be intended to be financially competitive based on a comparative metric, in this case the levelized cost of electricity for a new-build natural gas combined cycle power plant.

Policy Design Elements and Options

Fundamental design elements and options of such a hypothetical market-linked PTC phase-out policy might include the following:

- ***Benchmark comparison for annually calculating the PTC value could be the levelized cost of electricity (LCOE) for a new-build natural gas combined cycle (NGCC) power plant³⁹ and the LCOE for a baseline wind power project:*** Power

³⁹ New-build NGCC power plant is used for comparison purposes only. One assumption used for this hypothetical analysis is that electric power market conditions require new capacity and all energy sources compete to provide the needed generation. Generally, wind competes with natural gas power generation in terms of cost. However, a separate analysis could be performed to compare wind power generation costs with those for existing natural gas power plants. Analysis results under such a scenario could be quite different than those presented in this hypothetical example.

generation from an NGCC power plant is commonly used as a reference case for determining the economic competitiveness of new-build wind power projects. Calculating the LCOE for a wind project and for a NGCC project is very common and the relative LCOEs can be used as a basis for calculating the PTC value that would result in an equivalent LCOE for both a NGCC and a wind project. As discussed in the section below titled “Limitations and Challenges,” there are several issues that should be considered when using LCOE as a comparative metric.

- Annual PTC value calculations incorporating changes to both energy and financial markets:*** The dynamic nature of this market-linked phase-out approach requires annually incorporating changes to multiple energy and financial variables that could determine the PTC level for a certain year. Variables such as the cost of debt, the cost of equity, leverage ratios, loan terms, and natural gas prices can change over the course of a year and the market-linked approach allows for consideration of these energy and financial market changes, if so desired.
- PTC values could be calculated annually and could be available to projects that start construction in the following calendar year:*** The market-linked phase-out policy approach would require an annual calculation of the PTC value needed for a baseline wind project to be economically competitive with an NGCC power plant. The PTC value could, for example, be calculated in the fall (October/November) time frame and then be made available to projects that start construction in the following calendar year (January through December). Allowing projects that “start construction” to qualify for the PTC incentive may be necessary due to the typical 18 to 24 month development time required for a new project. The annual PTC value calculation could incorporate changes in financial and energy markets that are relevant to comparing wind and NGCC LCOEs.
- Policy pressure to motivate wind electricity cost reduction could be accomplished by a declining capital cost assumption used to annually calculate PTC values:*** Capital costs are the largest contributor to the cost of wind-generated electricity. Annual calculations for the PTC value could include an assumption that wind project capital costs decline by a certain percentage each year. The preliminary analysis provided in the following section includes two cases: (1) 10% annual capital cost reduction, and (2) 5% annual capital cost reduction. Including one of these assumptions when calculating annual PTC values may provide the industry with an incentive to realize continuous cost and performance improvements that may result in economic competitiveness on an unsubsidized basis. In practice, the wind industry could respond to this policy pressure by either reducing capital costs or by increasing technology performance. For simplicity, this analysis assumes that capital costs decline and technology performance does not change throughout the analysis period.
- PTC value could be capped to not exceed its current level (2.3 cents per kilowatt-hour) and when price parity with NGCC generation is achieved, the PTC incentive is no longer available:*** The underlying goal of the market-linked phase-out policy option would be to reduce and eventually eliminate federal PTC incentives for wind power projects. To that end, one policy design element of a phase-out policy could be to not allow, under any circumstances, the PTC

incentive to exceed its current level of 2.3 cents per kilowatt-hour. This would, in effect, place a ceiling on the PTC value. As annual capital cost reductions are factored into the PTC incentive calculation, at some point LCOEs for the baseline wind power project, without a PTC incentive, and the NGCC power plant might become equal. At that point, the policy could be structured such that the PTC would no longer be available to new wind power projects. Essentially, once wind and NGCC LCOEs reach parity the PTC incentive might cease to exist.

Methodology and Assumptions

The methodology and assumptions used to calculate annual PTC values are important factors when considering any phase-out policy approach. There are different calculation methodologies, models, and metrics that could potentially be used to implement a market-linked phase-out policy design. Using different assumptions, methods, and models could result in analytical outcomes that vary, in some cases potentially significantly, from the outcomes discussed in this hypothetical example. For the purposes of this analysis, a project finance model that solves for PTC incentive values that would result in a threshold equity rate of return was used. For the example analysis performed for this report, a 10% equity rate of return (for both wind and natural gas generation) was assumed.⁴⁰

Performing analysis of a market-linked PTC phase-out approach requires three primary calculations: (1) NGCC LCOE estimates, (2) wind power LCOE estimates, and (3) how much the PTC, over the entire 10-year period in which it is available, is actually worth to the project. The following sections describe how each of these estimates was calculated for the preliminary and illustrative analysis contained in this report.

NGCC LCOE Estimates

Levelized cost of electricity estimates for a new-build NGCC power plant were provided by Bloomberg New Energy Finance (BNEF). LCOE estimation methodology used by BNEF calculates the electricity price needed in order to provide project equity investors a 10% rate of return over the life of the project. BNEF used its proprietary project finance model to estimate LCOEs for new-build NGCC power generation, and LCOE estimates for NGCC plants that are expected to come on line in the years 2013 to 2019 were provided. The BNEF model uses a number of key input variables in order to calculate NGCC LCOEs. **Table A-1** provides a list of some of the key assumptions used by BNEF.

⁴⁰ For additional information and detail about the model and methodology used to derive the illustrative calculations contained in this report, please contact the author directly.

Table A-1. Key Input Variables for NGCC LCOE Calculations

| Variable | Value |
|----------------------------|------------------|
| Plant Capacity (MW) | 600 |
| Capacity Factor (%) | 75 |
| Operating Life (yrs) | 25 |
| Total Plant Costs (USD/MW) | 916,278 (2012) |
| Fixed O&M (USD/MW/Yr) | 14,390 |
| Variable O&M (USD/MWh) | 3.43 |
| Heat Rate (MMBtu/MWh) | 6.43 |
| Term Loan Spread (bps) | 250 ^a |
| Loan Term (yrs) | 15 |
| Debt Finance (%) | 80 |
| Equity Finance (%) | 20 |
| Depreciation | Straight Line |

Source: Bloomberg New Energy Finance.

Notes: bps = basis points.

- a. The 250 basis point spread is measured relative to LIBOR (London Interbank Offered Rate). While this spread over LIBOR might be used to initially establish the debt interest rate for the project, each project would likely purchase an interest rate swap that would provide for a stable and predictable interest rate over the duration (i.e., tenor) of the loan.

Finally, a critical input for determining the LCOE for an NGCC power plant is the price of natural gas that is be used to generate electricity. BNEF used natural gas price forecasts provided by the Energy Information Administration (EIA) in its Annual Energy Outlook (AEO) 2012 publication. EIA publishes natural gas price forecasts each year and these annual predictions could be used to update and revise NGCC LCOE estimates for determining the PTC value needed for a baseline wind project to achieve electricity price parity.

Wind LCOE Estimates

Levelized cost of electricity estimates for wind power generation were calculated by CRS using a project finance model to solve for the price at which a baseline wind project must sell its electricity in order to provide equity holders a 10% rate of return. This LCOE calculation does not include any production tax credit, renewable energy credit (REC) sales, or other state/federal incentives that might be available to wind projects.⁴¹ As a result, the wind LCOE estimates are on an unsubsidized basis and can be compared directly with NGCC LCOEs in order to determine the economic competitiveness of wind power in relation to NGCC electricity generation.

⁴¹ The project model used to derive wind LCOE calculations does assume that the baseline wind project depreciates capital costs based on a five-year Modified Accelerated Cost Recovery System (MACRS) schedule. While some projects may be able to monetize the value of MACRS depreciation through a tax equity investor, the calculations made for this analysis assume that MACRS depreciation is not monetized and is simply included in the project-level income statement.

In order to calculate LCOEs for the baseline wind project, assumptions for several key input variables were used. **Table A-2** provides a list of assumptions used by CRS for some of the key input variables.

Table A-2. Key Input Assumptions for Baseline Wind Power LCOE Calculations

| Assumption | Value |
|----------------------------|-------------------------------|
| Plant Capacity (MW) | 100 |
| Capacity Factor (%) | 35 |
| Operating Life (yrs) | 20 |
| Total Plant Costs (USD/MW) | 1,800,000 (2012) ^a |
| O&M (USD/MW/year) | 30,000 |
| Debt Finance (%) | 70 |
| Debt Rate (%) | 6 |
| Equity Finance (%) | 30 |
| Equity Rate (%) | 10 |
| Loan Term (yrs) | 15 |
| Depreciation | MACRS 5 yr ^b |

Source: CRS.

Notes: Assumptions for input variables are notional and can change based on market conditions and/or the specific characteristics of a particular wind project. The input variables in this table were selected to calculate LCOEs from 2013 to 2019 for a baseline wind electricity project.

- a. The annual (2013 to 2019) LCOE analysis performed assumes that total plant costs are reduced by either 5% or 10% annually. The \$1,800,000/MW figure in this table is for projects installed in calendar year 2012. The \$1,800,000/MW figure is used for illustrative purposes only and the analysis results would be different if a different assumption were used. The total plant cost figure was selected based on conversations with industry analysts regarding total plant costs for a 100 MW project. CRS recognizes that the number used for this illustrative analysis is lower than the capacity weighted average total project cost reported by the Department of Energy (\$1,940,000/MW) in DOE's 2012 Wind Technologies Market Report.
- b. MACRS = Modified Accelerated Cost Recovery System. Some wind projects may opt to monetize MACRS depreciation through a tax equity investor. However, calculations derived for the analysis contained in this report assume that MACRS depreciation is not monetized. Rather, it is included in the baseline project income statement. In effect, this MACRS depreciation assumption reduces the near-term tax liability for the project, therefore increasing free cash flow available to equity holders. Wind projects that are able to monetize the value of MACRS depreciation, all else being equal, could potentially improve their economic competitiveness and/or equity rates of return.

One key element of the wind LCOE estimates used for this example analysis is an assumption that total installed costs decline by either 5% or 10% annually. These capital cost decline assumptions are for illustrative purposes only and were selected as a starting point for the analysis and to show some degree of sensitivity associated with incorporating this assumption into the phase-out approach. However, according to the U.S. Department of Energy (DOE) wind turbine costs have declined between 20% and 35% since 2008. This represents an average annual cost

decline of approximately 4% to 8%.⁴² Additionally, DOE analysis indicates that total installed costs for a wind project declined by approximately 10% from 2011 to 2012.⁴³

As indicated in **Table A-2**, the initial total plant cost assumption is \$1.8 million per MW in 2012.⁴⁴ For 2013 to 2019 LCOE calculations, the model assumes that wind projects realize 5% or 10% annual capital cost reductions. In essence, this cost reduction assumption is the policy pressure mechanism that might incentivize the wind industry to continuously reduce costs in order to be economically competitive with NGCC power generation. Whether or not the industry can realistically achieve these capital cost reductions is uncertain and is further discussed in the section below titled “Limitations and Challenges.”

Estimating the Value of the PTC for a Wind Project

The third essential calculation needed to determine a PTC level that could result in wind power being economically competitive with NGCC generation is to estimate the value of the PTC incentive for the entire 10 years it is available. Such an estimate is performed by calculating the present value of PTCs during the first ten years of project operations. A key assumption made for this analysis is that wind projects monetize the value of the PTC through a partnership with a tax equity investor.⁴⁵ As a result, the discount rate used to calculate the value of PTC incentives for this analysis was 8.5% based on indications from tax equity investors.⁴⁶ However, the financial structure used for a wind project can impact tax equity yields (the rate of return required by tax equity investors) and some investors have indicated yield requirements between 13% and 16%.⁴⁷ Indeed, as discussed in this example, the value of the PTC incentive is dependent on the tax equity yield assumed.

Preliminary Analysis

CRS performed preliminary quantitative analysis of this policy option for illustrative purposes only.⁴⁸ As discussed above, analysis results are highly dependent on the methodology and assumptions used to calculate LCOEs and PTC values. Assumptions used for this illustrative analysis are hypothetical and were used as a means to show the mechanics of how such a phase-out policy option could be implemented. All assumptions are subject to change and the analysis provided in this section is intended to be viewed and interpreted as illustrative only.

⁴² U.S. Department of Energy, “2012 Wind Technologies Market Report,” August 2013.

⁴³ Ibid.

⁴⁴ See note “a” to **Table A-2** above for information about the total project cost figure used for this hypothetical analysis.

⁴⁵ For an overview and description of tax equity markets and investors, see CRS Report R41635, *ARRA Section 1603 Grants in Lieu of Tax Credits for Renewable Energy: Overview, Analysis, and Policy Options*, by (name redacted) and (name redacted).

⁴⁶ “Cost of Capital: 2013 Outlook,” *Project Finance NewsWire*, Chadbourne & Parke LLP, February 2013.

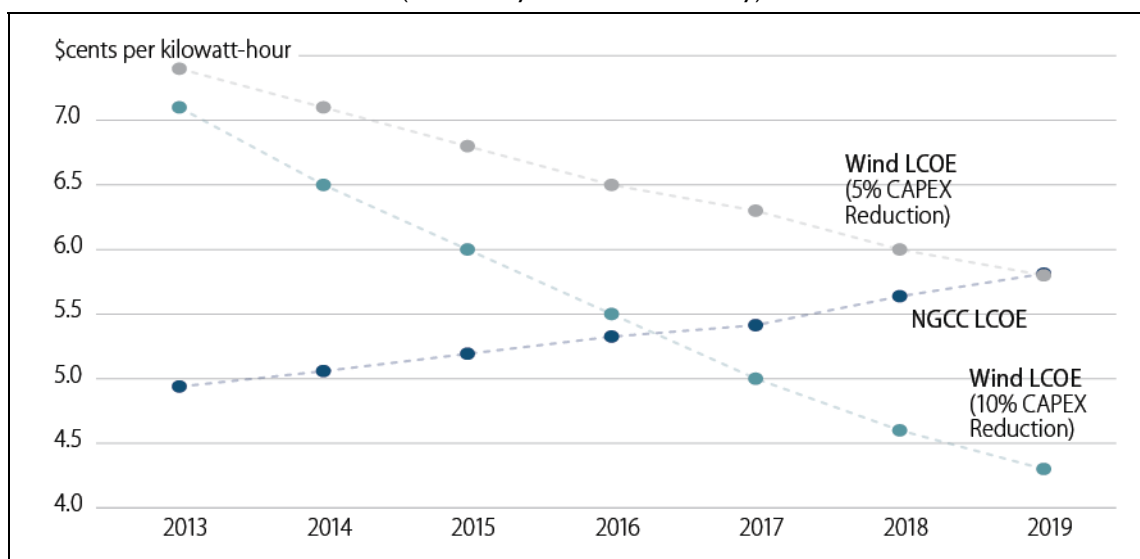
⁴⁷ Ibid. Tax equity investors have indicated that a yield premium is typically required for a project that raises debt finance at the project level, as doing so can potentially increase cash flow risk to the tax equity investor.

⁴⁸ While CRS has selected this example policy option for further analysis, for illustrative purposes only, it takes no position on any of the various options discussed in this report.

Using the framework, methodology, approach, and assumptions described above, the PTC value necessary for the baseline wind power project to be economically competitive with a NGCC power plant was estimated. The PTC value was calculated by first comparing the NGCC LCOE with the unsubsidized wind project LCOE. If the wind project LCOE was higher, then the model solves for a PTC value that, once monetized and included in the wind power LCOE calculation, results in equivalent LCOEs for NGCC and wind generation. **Figure A-1** illustrates how NGCC and wind power LCOEs might change over time based on the data and assumptions used to perform the calculations.

Figure A-1. NGCC and Wind Power LCOE Estimates: 2013 to 2019

(Preliminary and Illustrative Only)



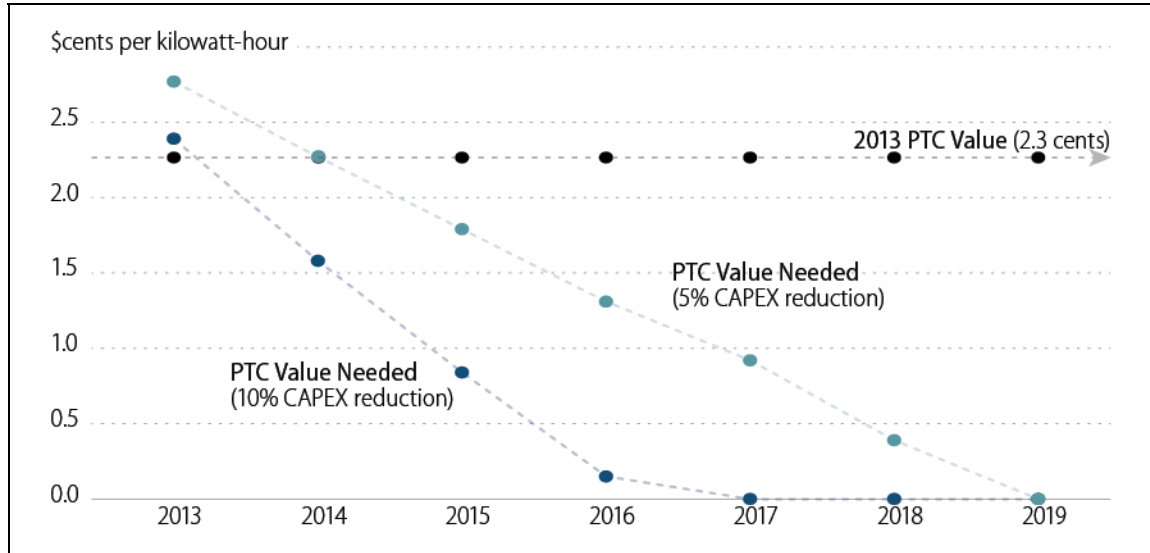
Source: NGCC LCOEs from Bloomberg New Energy Finance. Wind LCOE scenarios (5% and 10% CAPEX reduction) calculated by CRS.

Notes: The term “capex” refers to the total capital costs required to install a new-build wind power project. LCOEs reflected in this figure are on an unsubsidized basis and do not reflect any PTC or other incentives that might be available.

As indicated in **Figure A-1**, the preliminary example analysis indicates that NGCC LCOEs trend up and wind power LCOEs trend down over the 2013 to 2019 analysis period. It is important to note that the LCOE estimates are influenced by the assumptions and methodology used for the calculations. Two wind LCOE estimates are included in **Figure A-1**: (1) wind LCOE that assumes a 5% annual capital cost reduction, and (2) wind LCOE that assumes a 10% annual capital cost reduction. Based on this preliminary and illustrative example, the baseline wind power project may no longer need PTC incentives to be economically competitive in 2017 and 2019 based on the 10% cost reduction and the 5% cost reduction scenarios, respectively.

Additionally, the analysis included a calculation of the PTC level needed for wind power to be economically competitive with NGCC power generation. **Figure A-2** illustrates how, using the methodology and assumptions described above, the PTC might be reduced and eventually eliminated under the 5% and 10% capital cost reduction scenarios.

Figure A-2. PTC Value Needed for Baseline Wind Project to be Economically Competitive with NGCC
(Preliminary and Illustrative Only)



Source: CRS.

Notes: The term “capex” refers to the total capital costs required to install a new-build wind power project. PTC values in 2013, based on the preliminary calculations performed for this analysis, are actually higher than the current PTC level of 2.3 cents per kilowatt-hour; however, the example policy design includes an assumption that PTC incentives do not exceed the current 2.3 cent per kWh level. This analysis result does not necessarily mean that all wind projects are not competitive with NGCC generation even with the current 2.3 cents per kilowatt-hour incentive. Rather, the analysis suggests that the baseline wind project used for this illustrative analysis would require a higher PTC level in order to be economically competitive. However, wind projects with different project parameters such as higher capacity factors or lower capital costs could, in fact, be economically competitive with NGCC generation in 2013.

As expected, the PTC phase-out occurs faster under the 10% capital cost reduction scenario, and the incentive, based on this example analysis, might completely phase out in 2017. Under the 5% capital cost reduction scenario, the PTC might phase out more gradually and, based on the illustrative analysis performed for this report, might completely phase out in 2019, two years later than the 10% cost reduction scenario. Should such a policy approach be implemented, the actual PTC phase-out profile would likely be different than the example analysis shown in **Figure A-2**. This difference would be due to actual values for changing market dynamics, key input variables, and assumptions that would be used to annually calculate the PTC level available for new wind projects.

Limitations and Challenges

While the above phase-out approach may potentially provide an option that considers a variety of energy and financial market variables to annually establish a PTC level, there are numerous limitations and challenges associated with this approach. Following is a brief discussion of some of the limitations and challenges that may need to be evaluated when considering a market-linked PTC phase-out policy.

- **Complex implementation:** The market-linked phase-out approach requires some elaborate financial and market analysis in order to be properly applied and implemented.

The complex nature of establishing an agreed-upon framework, methodology, and set of assumptions for annually calculating PTC values may be one of the biggest challenges associated with implementing a market-linked approach. Additionally, the federal government would need to annually calculate and publish PTC values for the following year in order for industry participants to plan and execute their business and project development strategies. The Department of Treasury and the Department of Energy are examples of two agencies that might assume this role, with Treasury having strong capabilities in the areas of tax and finance and DOE having energy market and technology expertise. Other options may also be possible. Ensuring that this process is objective, fair, and unbiased would be a critical element for successful implementation of this approach. Furthermore, the illustrative policy design analyzed for this report does not take into account other state or federal incentives (e.g., REC sales, monetized MACRS depreciation) that might be available to wind power projects. Including these other incentives may further complicate the implementation of this market-linked PTC phase-out approach.

- ***LCOE is an imperfect comparison metric:*** Comparing the LCOE of a baseline wind power project to the LCOE for NGCC power generation provides for an assessment of the electricity price needed for wind and NGCC to pay for all capital, operations (including fuel), maintenance, and finance costs. However, LCOE estimates typically do not capture the relative value of electricity produced during certain seasons and times of day. For example, electricity produced during peak daytime hours is generally more valuable than electricity produced during off-peak nighttime hours. Wind generation is typically, although not always, highest at night, when the value of electricity is relatively low. However, NGCC power plants can generate electricity during all hours and therefore have the ability to capture high-priced peak power values. These time-of-day value differences could potentially influence investment decisions; however, they are generally not captured or reflected in LCOE calculations. Furthermore, decisions to purchase or contract for wind power may also include comparing a new wind project with simply generating more electricity from existing electric power assets (coal, natural gas, and others). As a result, comparing LCOEs for new-build wind and new-build natural gas may not reflect all inputs considered when deciding to add wind power to a generation portfolio.
- ***Regional renewable resource and electricity market variations:*** Wind resource quality varies significantly across the country. Generally, the best on-shore wind resources are located in the middle portion of the country. As a result, a certain PTC level may be more than adequate for a project in a Midwestern state but may not be adequate for a project located in the Southeast. Additionally, multiple competitive and cost-of-service electricity markets exist in the United States and each market generally has a different structure, set of rules, and energy mix. Given the regional resource and market variability that exists in the U.S. power sector, establishing one fixed PTC level might not stimulate wind development in all regions. However, the current PTC incentive also does not take into account regional variations.
- ***Wind industry ability to realize cost reductions:*** One of the key input assumptions used to perform analysis for the example market-linked phase-out approach discussed above is annual wind project capital cost reductions. This assumption was made as a way to include a policy lever to incentivize the wind industry to continuously reduce costs and improve technology performance in order to become economically viable on an

unsubsidized basis. Whether or not the wind industry can actually realize these assumed cost reductions is questionable and may warrant further analysis should Congress decide to further explore such a phase-out approach.

- ***Considers only one wind project business model:*** The illustrative phase-out policy design explored in this report only considers one basic business model for financing a wind power project. In reality, there are multiple financial structures and business models that could be used for an actual project. Generally, project developers and investors seek to find a business model that maximizes financial returns and is workable for all parties. Including PTC estimates for different business model types could likely further complicate implementation of a market-linked phase-out policy.

Other Design Approaches

The above hypothetical example illustrates one possible way to reduce and eventually eliminate PTC incentives for renewable electricity. Several other phase-out design options are available that may be better suited for phasing out the PTC. For example, the credit value could be indexed to fuel prices, wholesale electricity prices, or other comparative metrics.

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