

# Wind and Solar PV Deployment after Tax Credits Expire: A View from the Standard Scenarios and the Annual Energy Outlook

A. Will Frazier, Cara Marcy, and Wesley Cole

## Abstract

The Production Tax Credit (PTC) and the Investment Tax Credit (ITC) are currently set to phase down and it is unclear how wind and PV deployment will be impacted by the phase down. This work draws from 14 scenarios of the National Renewable Energy Laboratory's 2018 Standard Scenarios Report and 32 scenarios from the Energy Information Administration's Annual Energy Outlook 2018 to explore wind and PV deployment following the tax credit expiration.

## Introduction

Renewable energy capacity in the United States has seen significant growth in the last 20 years and is projected to continue to grow through the 2020s (Best 2017; Haegel et al. 2017; U.S. DOE 2015). Much of this growth can be attributed to policy support and declining capital costs that have enabled renewable energy technologies, particularly wind and solar photovoltaics (PV), to become cost competitive with incumbent electricity generating sources such as coal, natural gas, and nuclear power (Mundaca and Luth Richter 2015; Jensen and Dowlatabadi 2017). Policy support has come largely in the form of federal tax credits offered to qualifying electricity generating sources (Abdmouleh, Alammari, and Gastli 2015) and state renewable portfolio standards (Barbose 2017). The Production Tax Credit (PTC) and Investment Tax Credit (ITC) are federal tax incentives for renewable energy sources that have contributed to the growth of wind and PV, respectively (Stokes and Breetz 2018). Recently, these tax credits were extended but with a gradual step-down or phase-out with the expectation that declining production costs would compensate for the reduction of the tax credits. This study aims to provide a perspective of future wind and PV deployment and CO<sub>2</sub> emissions in the electric power sector of the contiguous United States after the step-down of the current tax credits.

The PTC offers a per-kilowatt-hour tax credit for qualifying electricity generating technologies. Wind power receives a 2.3 cents/kWh tax credit for the first 10 years of the wind system lifetime<sup>1</sup>. It was originally enacted as part of the *Energy Policy Act of 1992* and applied to projects that started producing electricity for the grid in the years of 1994 through 1999 (U.S. Congress 1992). It was extended 10 times between 1999 and 2015, during which it lapsed and was extended retroactively 5 times (Sherlock 2015). The policy uncertainty during this period created a volatile market which had a boom-and-bust cycle that followed the lapses and extensions of the tax credit seen in Figure 1 (U.S. DOE 2017). The *Consolidated Appropriations Act of 2016* included a 5-year extension and gradual step-down of the PTC, while keeping the "commenced construction" requirement that was introduced in its most recent short-term extension in 2015 (U.S. Congress 2015).

The ITC offers a payment of 30% of the qualified property expenditures for the construction of a PV, solar thermal, or fuel cell power system (U.S. Congress 2005). PV has seen by far the most commercial deployment of the qualifying technologies (Upreti et al. 2016; Aslani and Wong 2014). The ITC was originally enacted as part of the *Energy Policy Act of 2005* for the years of 2006 and

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<sup>1</sup> When the policy was first enacted in 1993, the PTC was set at 1.5 cents/kWh; since then it has been adjusted upwards for inflation.

2007. It was later extended through 2008 and then extended for 8 more years as part of the *Emergency Economic Stabilization Act* in 2008 (Stokes and Breetz 2018). PV received a 5-year extension and step-down of the ITC from the *Consolidations Appropriations Act of 2016* (Mormann 2016). The most recent extension maintained the 10% payment of qualified commercial property expenditures beyond that 5-year extension and also adopted the “commenced construction” requirement for tax credit eligibility (Stokes and Breetz 2018). Many studies have shown that the ITC has played a significant role in the growth of the PV industry in the United States (Aslani and Wong 2014; Stokes and Breetz 2018; Comello and Reichelstein 2016).

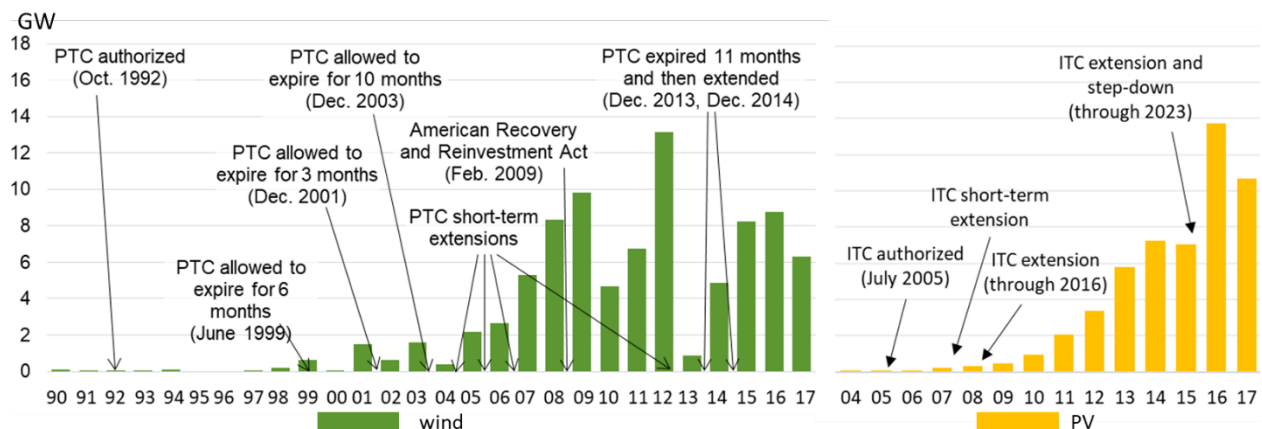


Figure 1. History of the PTC with historic annual wind capacity additions and history of the ITC with historic annual PV capacity additions in the United States. PTC figure adapted from Mai et al. (2016).

## Models and Scenarios

To evaluate the interaction of the PTC and ITC we use published scenarios from the Energy Information Administration’s (EIA) National Energy Modeling System (NEMS) and the National Renewable Energy Laboratory’s (NREL) Regional Energy Deployment System (ReEDS) capacity expansion models. Both models project the evolution of the contiguous U.S. electricity sector through 2050, though for this work we only consider scenario results through 2030. In this section we give a brief overview of each model to aid in understanding model results and provide an overview of the scenarios considered.

NEMS is an integrated modularly-designed energy-economy model primarily written in FORTRAN, with each module representing the operational and planning activities of the appropriate economic agent in that area. The Electricity Market Module (EMM) (U.S. EIA 2017b) of NEMS provides U.S. capacity planning and dispatch decision projections to 2050 using a least-cost linear optimization model. The energy-economy linkage in NEMS allows the model to capture the economic feedback in energy sector evolution. The iterative nature of NEMS results

in near-perfect foresight<sup>2</sup> of future system conditions. For distributed generation, NEMS uses both a 30-year cash flow analysis and a ZIP code-level hurdle model depending on technology type and building sector (U.S. EIA 2017a). The NEMS scenarios considered in this work were published as part of the Annual Energy Outlook 2018.<sup>3</sup>

ReEDS is a sequential linear optimization model that determines the electric system capacity expansion from the present to 2050 (Eurek et al. 2016). It is written in the GAMS software environment. ReEDS is designed to represent the unique attributes of variable renewable energy with detailed resource and transmission representations. It also includes separate non-linear methods, performed outside of the optimization, to calculate some of the impacts of variability and uncertainty. ReEDS has limited foresight because of its sequential structure. The distributed rooftop PV projections used in ReEDS are from the NREL Distributed Generation (dGen) model (Sigrin et al. 2016), which uses Bass diffusion and annual bill savings to assess the rate of adoption of rooftop PV for the residential, commercial, and industrial sectors. The ReEDS scenarios presented here were published as part of the 2018 Standard Scenarios (Cole, et al. 2018).

In total, 32 scenarios from NEMS and 14 scenarios from ReEDS are considered in this work. However, many of the scenarios have outcomes that are very similar to the reference scenario (which uses default settings) or otherwise provide little additional insight. We therefore focus on those scenarios listed in Table 1, which identifies the scenarios in which wind and PV deployment varies from the reference case results. Additional information on the scenarios, including other scenario results, can be found in the 2018 Annual Energy Outlook (U.S. EIA 2018a) and 2018 Standard Scenarios (Cole, et al. 2018). These models and resulting publications and analyses are *not* intended to forecast what *will* happen in the power sector, but they are used as tools to understand how various drivers, assumptions, and system conditions might change the evolution of the electricity sector. Additional details about how these models represent specific system elements, including features specific to wind and PV, are provided in Section 2 of Cole et al. (2017).

Table 1. Summary of scenarios considered in this work.

Scenario Name	NEMS	ReEDS	Description
Reference	✓	✓	Current laws and policies
Tax credit expiration	✓		PTC & ITC fully expire in 2020
Tax credit extension	✓	✓	PTC & ITC extended to 2050 in NEMS and to 2030 in ReEDS
Clean Power Plan (CPP)	✓		Electricity sector must comply with CPP
Carbon dioxide (CO <sub>2</sub> ) fee	✓		\$25 per ton CO <sub>2</sub> (2017\$) starting in 2020 and escalating in real terms at 5% per year
Low wind cost		✓	Low capital cost assumptions for wind
Low PV cost		✓	Low capital cost assumptions for PV
Low RE cost		✓	Low capital cost assumptions for all renewable energy sources

<sup>2</sup> NEMS uses the results of the prior iteration to inform model decisions of the current iteration until the solution from iteration to iteration converges to a near-identical solution, thus giving the model near-perfect foresight into planning decisions.

<sup>3</sup> The Annual Energy Outlook 2019 results were not available at the time of this writing. Readers can consult the latest Annual Energy Outlook for the most recent projections from EIA.

High RE cost		✓	High capital cost assumptions for all renewable energy sources
Low natural gas prices	✓	✓	High oil and gas resource case, results in lower natural gas prices
High natural gas prices	✓	✓	Low oil and gas resource case, results in higher natural gas prices
High economic growth	✓	✓	High economic growth, results in higher electricity demand growth
Low economic growth	✓	✓	Low economic growth, results in lower electricity demand growth

## Results

### i. Wind/Solar PV Capacity

Figure 2 shows the range of total installed capacity for the scenarios assessed in each of the models, NEMS and ReEDS, with the reference case for each shown as the dashed line. Of the range of cases tested by NEMS (32 cases) and ReEDS (14 cases), by 2030 the total projected U.S. operating installed wind capacity ranges between 111 GW and 194 GW (NEMS) and 115 GW and 338 GW (ReEDS) or a total range of 227 GW. Total installed PV capacity shows a wider range in capacity by 2030, between 112 GW and 288 GW (NEMS) and 121 GW and 383 GW (ReEDS) or a total range of 271 GW. In general, we see that the projected capacity for wind and PV technologies is highly sensitive to the assumed future conditions.

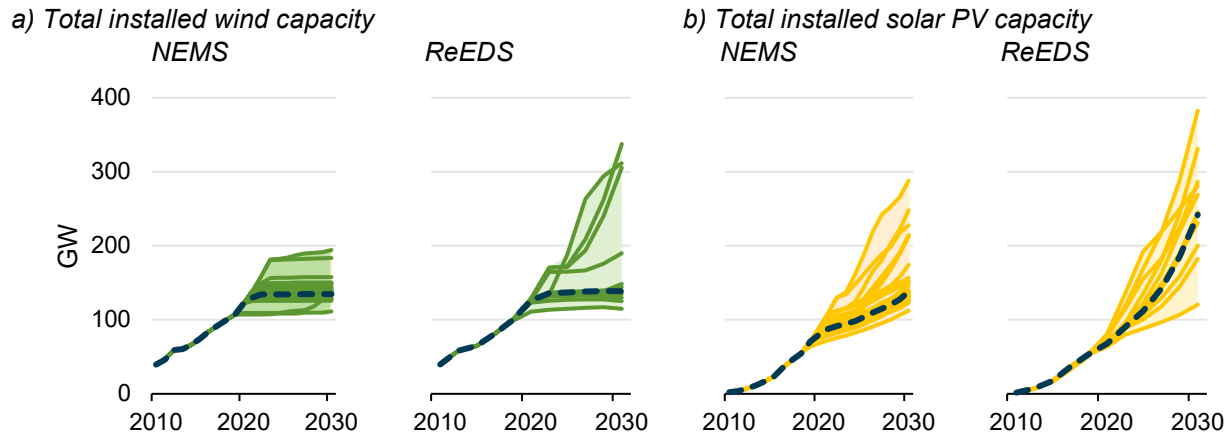


Figure 2. Range in projected U.S. total installed capacity, 2016-2030, (a) for wind (b) and solar. The reference case in each plot is represented with a dashed line.

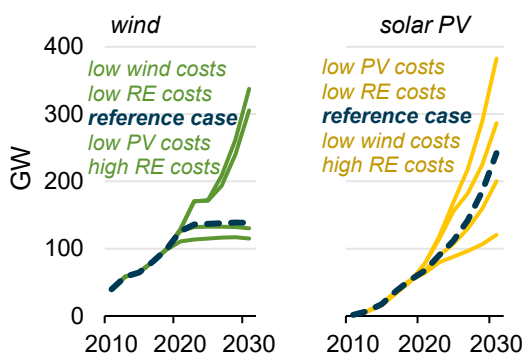
The rest of this section discusses different mechanisms that influence the deployment of these technologies. The discussion will be broken into three sections: policies, costs, and external factors. We analyze across a wide range of scenarios from the two capacity expansion models with the goal of providing a broad and robust perspective of future wind and PV deployment after the step-down of the current tax credits. Each subsequent section aims to contribute to this perspective. Because the results of many scenarios fall very near to the reference case, we focus

our discussion on those scenarios with results that deviate from reference case outcomes, which are listed in Table 1 above.

### Technology Cost-Related Cases

The cost of wind and PV systems affects how quickly the annual capacity additions of either technology recovers after the expiration of the tax credits. NREL has modeled several cases in ReEDS that explore the impacts of assumed capital cost declines throughout the projection period. These cases showed a wide range in future deployment of wind and PV. The four cases shown in Figure 3 include a low renewable cost case, a low wind cost case, a low PV cost case, and lastly a high renewable cost case. The cost assumptions for these scenarios are taken from NREL's 2018 Annual Technology Baseline which contains both current and projected cost and performance data for both renewable and conventional electricity generating technologies.

ReEDS: a) total installed capacity



b) annual capacity additions

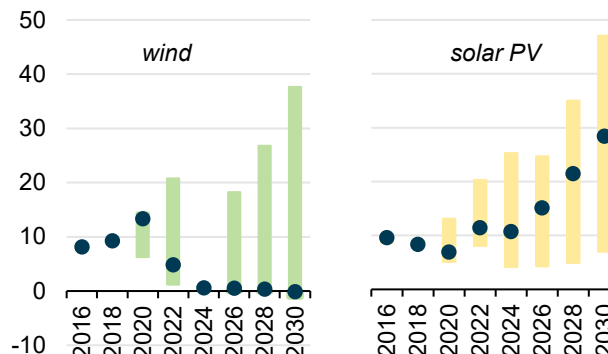


Figure 3. (a) Projected U.S. total installed capacity with the reference case shown as a dashed line and (b) projected U.S. annual capacity additions with the reference case shown as a blue dot along with the range of all scenarios

Installed wind capacity across the four cost cases ranges between 115 GW and 338 GW by 2030. For wind, changes in cost do not necessarily lead to commensurate changes in capacity additions. Capacity in 2030 ends up near reference case results across two of the four cases. Higher wind costs and/or lower PV costs do not significantly affect the deployment of wind capacity. This is because new capacity additions in these scenarios happen only before the expiration of the PTC and the cost ranges have not yet diverged significantly over these early years. On the other hand, lower wind costs, either alone or in conjunction with lower PV costs, lead to greater buildout of wind capacity, most notably beyond the expiration of the PTC. These scenarios reach annual additions as high as 38 GW by 2030.

PV capacity, however, is quite sensitive to assumptions of both higher and lower costs. Higher cost assumptions lead to a total installed capacity of 121 GW by 2030, compared to 242 GW in the reference case, while lower capital cost assumptions lead to PV reaching a total of 383 GW by 2030. The total range in installed capacity by 2030 in these cases is 262 GW for PV and 223 GW for wind. A large range both above and below the reference case is seen for PV capacity in part because PV tends to be on the margins in terms of what additional capacity is built.

### Policies-Related Cases

Alternative policy cases in NEMS resulted in a wide range of cumulative capacities for wind and PV by 2030. The impact of the PTC and ITC was examined using the following two cases: first, the tax credit extension case, which extends the existing tax credit policies at their full value out to the end of the projection period, and second, the tax credit expiration case, which reviews the impact of the immediate expiration of these credits (Boedecker, 2018). In addition, scenarios from NEMS also enable assessment of the impact of other policy mechanisms, such as the Clean Power Plan (CPP) (Martin, 2016) and a carbon fee (Scott, 2018), on capacity additions. The carbon fee case shown in Figure 4 examines a \$25 per ton CO<sub>2</sub> (2017\$) starting in 2020 and escalating in real terms at 5% per year.

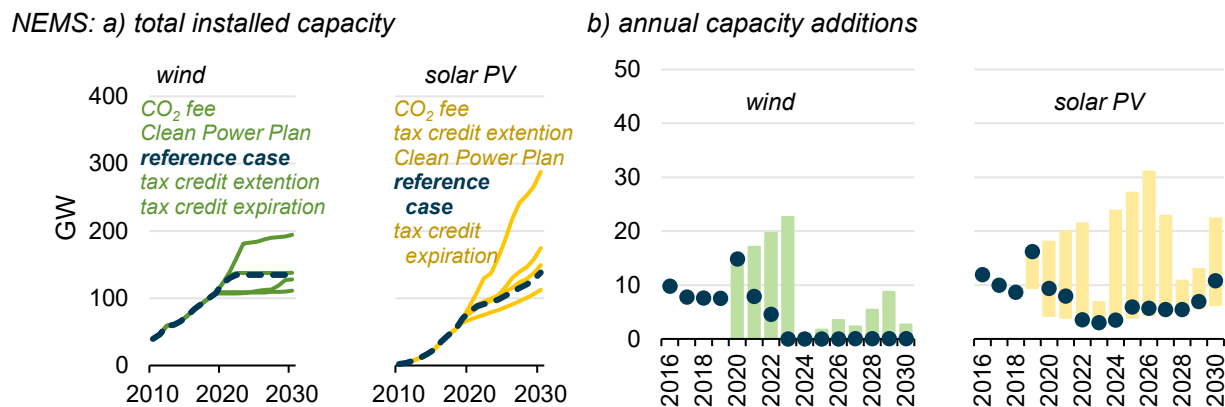


Figure 4. (a) Projected U.S. total installed capacity with the reference case shown as a dashed line and (b) projected U.S. annual capacity additions with the reference case shown as a blue dot along with the range of all scenarios

As Figure 4 shows, wind capacity across the four policy cases ranges between 111 GW and 194 GW by 2030. In the tax credit extension case, wind capacity is actually lower than in the reference case in the early 2020s, suggesting that capacity in the near term is overbuilding in the reference case in order to take advantage of the tax credits before they expire. By 2030, capacity in the extension case returns to reference case levels around 135 GW, and, though not shown here, that growth continues after 2030 to exceed deployment in the reference case. In the tax credit expiration case (where the tax credit fully expires in 2020), capacity additions immediately fall to zero in 2020 and total installed capacity remains at 111 GW through 2030. Capacity additions for wind in the CPP case do not change significantly in the near term, suggesting that the regions with higher quality wind resources in the reference scenario are already meeting or exceeding the compliance levels set by the CPP. In the carbon fee case, capacity climbs to 181 GW by 2023, the last year the tax credit is available, with annual capacity additions averaging 19 GW from 2020 to 2023. However, capacity additions slow—but do not stop—after expiration of the tax credit, averaging 2 GW annually between 2024 and 2030. This suggests that the PTC is still a significant driver of near-term wind capacity in this alternative policy case.

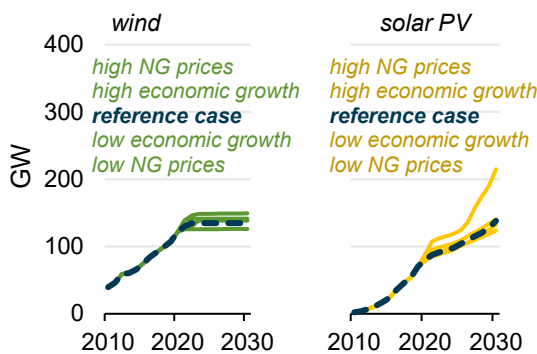
PV capacity ranges between 112 GW and 288 GW by 2030 across the four cases. The tax credit expiration case represents the lower bound here where annual capacity additions between 2020 and 2030 average just over 4 GW per year for all PV capacity. However, this is driven almost entirely by distributed solar PV capacity. Utility-scale PV capacity additions in this case average 0.6 GW per year between 2020 and 2030. In the reference case, utility-scale PV capacity additions are three times higher than in the tax-expiration case, averaging 1.8 GW per year

between 2020 and 2030. This partially results from the expiration of residential PV tax incentives early in the projection period, while utility-scale PV continues to receive the 10% tax credit up through 2030 and beyond. PV capacity increases in the tax credit extension case and the carbon fee case, reaching 174 GW and 288 GW by 2030, respectively, as compared to 138 GW in the reference case. The CPP, resulting in an additional 11 GW above the reference case by 2030, is shown to have less of an impact on the deployment of PV as compared to the other policy cases examined.

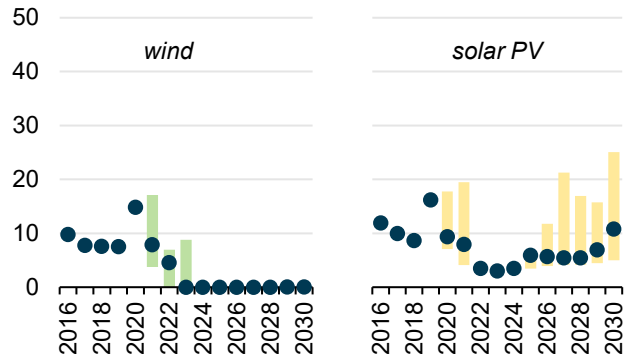
### Other External Factors

While installed capital costs and policy mechanisms directly impact the economic competitiveness of renewable technologies, there are other external factors that can also influence the relative competitiveness of these technologies. Four cases that examine this in more detail are the high and low macroeconomic cases and the high and low natural gas price cases. These four cases have similar assumptions across both NEMS and ReEDS. The macroeconomic cases assess changes in economic growth across the entire U.S. economy which lead to higher or lower increases in electricity demand growth. The natural gas price cases explore trends in natural gas production, including natural gas resource quality and well productivity (Van Wagner, 2018). Productivity impacts the price of natural gas seen by the electric power sector, which in turn influences the deployment of natural gas generating technologies.

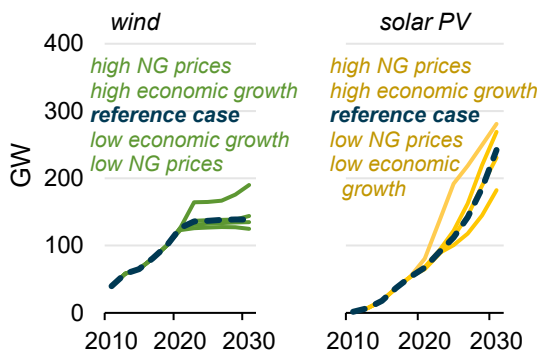
a) total installed capacity in NEMS



b) annual capacity additions in NEMS



c) total installed capacity in ReEDS



d) annual capacity additions in ReEDS

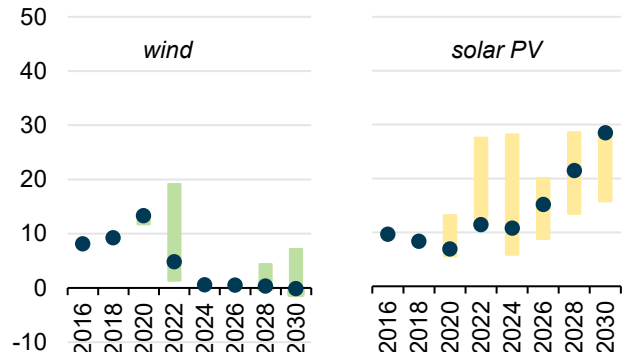


Figure 5. (a,c) Projected U.S. total installed capacity with the reference case shown as a dashed line in NEMS and ReEDS, respectively, and (b,d) projected U.S. annual capacity additions with

the reference case shown as a blue dot along with the range of all scenarios in NEMS and ReEDS, respectively

Of the four cases, wind capacity in both NEMS and ReEDS is most responsive to high natural gas prices, although the difference in wind deployment is small relative to the other cases examined in this paper. Wind capacity in 2030 in the high natural gas price scenario is 149 GW and 190 GW in NEMS and ReEDS respectively, 15 GW and 52 GW higher respectively than respective reference case projections. In all cases shown in Figure 5, the annual capacity additions after the expiration of the PTC for wind remain low. Between 2024 and 2030 annual capacity additions do not exceed 8 GW in either the NEMS or ReEDS scenarios, including in the high natural gas price scenario. This implies that wind capacity is often not on the margin for additional capacity and is mostly in competition with natural gas generation for the duration of the PTC.

PV deployment is highest in the high natural gas price scenario in both models, with 215 GW and 281 GW in 2030 in NEMS and ReEDS, respectively. In NEMS, both macroeconomic growth cases and the low natural gas price case fall within 10 GW of the reference case. In ReEDS, PV deployment in the low natural gas price case also comes within 10 GW of its reference case, however the macroeconomic growth scenarios lead to cumulative installed capacities in 2030 of 269 GW for the high growth rate case and 182 GW for the low growth rate case. This is an increase of 27 GW and decrease of 60 GW relative to the reference case, respectively. These results indicate PV is generally on the margin for new capacity additions and is often in competition with natural gas for new capacity. The fact that PV is more responsive to demand growth in ReEDS than NEMS is in part due to the different capital cost assumptions of each model, but could also be affected by assumptions regarding weather, locational siting, and performance.

## **ii. CO<sub>2</sub> Emissions**

Results from both models in this study show similar themes regarding CO<sub>2</sub> emissions in the contiguous United States. Under each model's reference case, CO<sub>2</sub> emissions are lower in the near term as some coal-powered generation is replaced with natural gas, wind, and PV. However, emissions nearly return to current levels within a decade and remain relatively flat through 2030 as electricity demand grows but is met with additional natural gas-fired generation along with wind and PV. In both models, emissions in the reference case begin to decline again post-2030 due to increased renewable energy deployment and reduced coal generation.

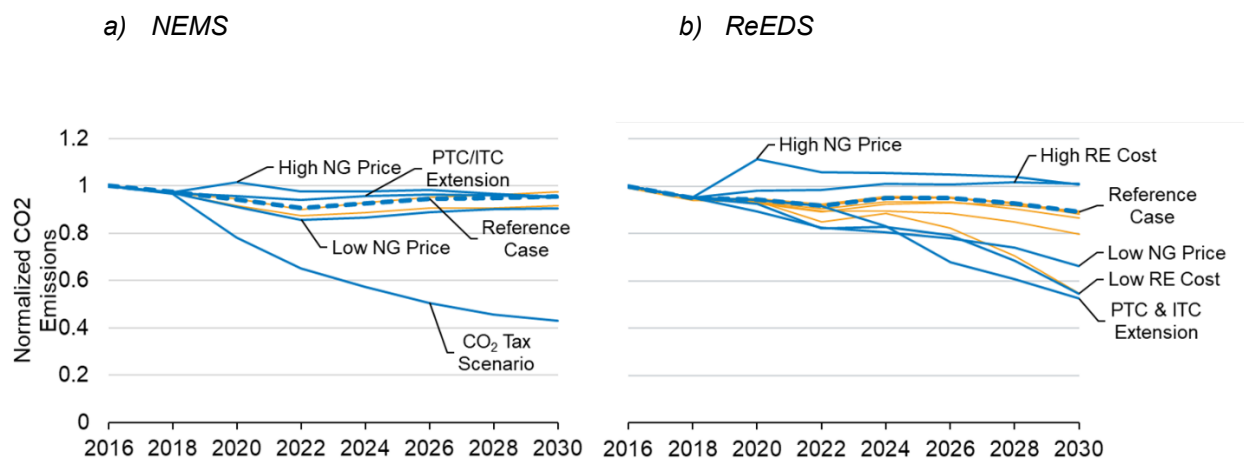


Figure 6. CO<sub>2</sub> Normalized emissions results from a variety of scenarios in (a) NEMS and (b) ReEDS, normalized to 2016 emissions. Important scenarios regarding NG prices, RE costs, and tax credit extensions highlighted.

Near-term emissions (through 2025) in both models are most strongly impacted by natural gas prices, with higher prices leading to higher emissions and lower prices to lower emissions (Figure 6). These short-term fluctuations in emissions relative to each models' respective reference case largely come from the displacement of coal generation by natural gas. Scenarios with higher penetrations of wind and PV show larger long-term emissions reductions and low cumulative emissions. Both models assume a steady increase in projected electricity demand and almost all new capacity comes in the form of natural gas, wind, and PV, so the timeline and extent of the displacement of coal generation, the growth in natural gas generation, and the penetration of wind and PV generation together largely determine CO<sub>2</sub> emissions for each scenario.

CO<sub>2</sub> emissions in NEMS are generally flat through 2030, indicating that the effects described above tend to offset one another regarding future power sector emissions. Other than the carbon fee scenario, which includes a carbon fee at \$25 per ton CO<sub>2</sub> (\$2017) starting in 2020 and escalating at 5% per year thereafter, the scenario in NEMS that has the lowest cumulative emissions through 2030 is the low natural gas price scenario. The tax credit extension scenario actually has slightly higher emissions than the reference case, which is in part due to the fact that NEMS builds more capacity in the near-term in its reference case compared with the tax extension case due to its foresight regarding the impending expiration of the policy. Results from ReEDS show slightly more variability in 2030 but in general show that lower natural gas prices or lower capital costs for wind and PV lead to lower future power sector emissions.

### iii. Tax Credit Extension/Sunset Financial Implications

From the results of the tax credit extension scenarios and others analyzed in this study, we find that wind is generally economically competitive before the tax credits expire but tends to become less competitive after, while PV is generally competitive both before and after the expiration of the tax credits. There are many complex factors at play here – some captured by the models and

others not – but one reason for this is the difference in the payment structure between the PTC and ITC. This difference leads to some interesting financial patterns which are amplified when an extension of the tax credits is considered. The PTC is a generation-based credit, and as wind turbine capacity factors improve and capital costs decline, the relative value of the PTC grows. Figure 7 shows that in 2016 the Levelized Cost of Energy (LCOE) of wind in regions with average<sup>4</sup> wind resource was reduced by 29% (\$23/MWh) by the PTC, compared to a projected reduction of 36% (\$23/MWh) in 2030 if the PTC were to be extended at full value through the next decade. This effect was seen in the ReEDS scenario results, where wind capacity more than doubled in the tax credit extension scenario relative to the reference case.

The ITC, on the other hand, is an investment-based credit, such that the value of the ITC (in absolute terms) is directly tied to the capital cost of the project. Here capital cost reductions work against the benefit of the tax credit because as the price of PV drops, the total value of the ITC drops with it. Figure 7 also shows that in 2016 the LCOE of PV in regions with average<sup>5</sup> solar resource was reduced by \$26/MWh (30%) by the ITC, compared to a projected reduction of \$12/MWh (30%) in 2030 if the ITC were to be extended at its full value. This increased impact of the PTC over time relative to the ITC means that wind tends to lose more value from the PTC expiration than PV loses from the expiration of the ITC. Additionally, the ITC (except for residential systems) steps down to 10% under the current legislation schedule, while the PTC phases out entirely.

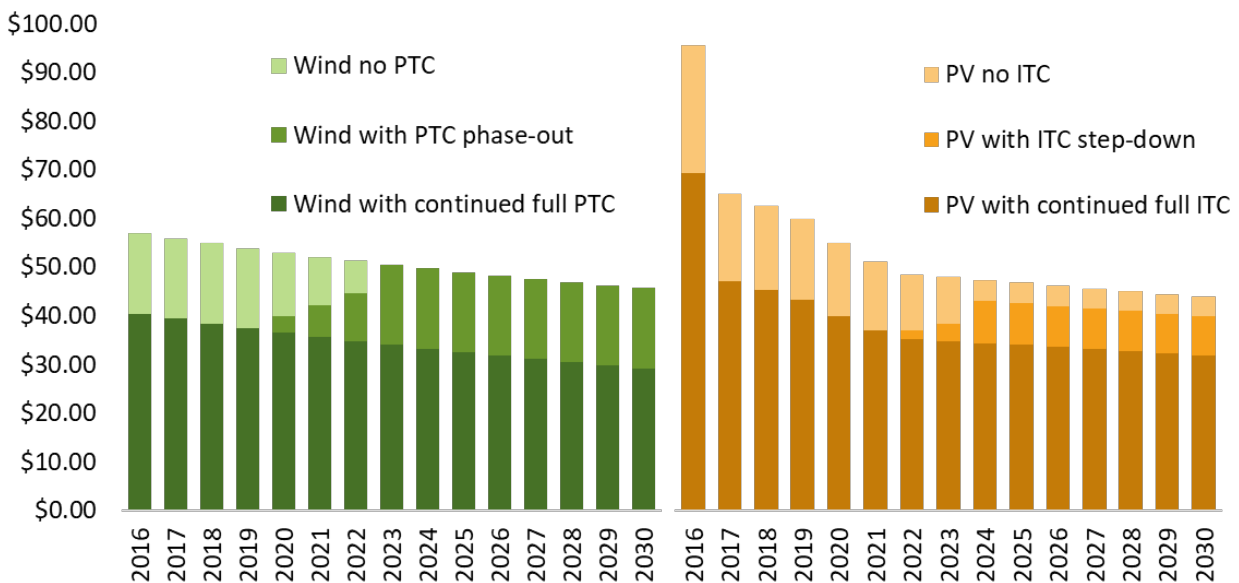


Figure 7. 2018 ATB LCOE projections in \$/MWh for wind and PV (assuming average resource availability), with real LCOE (no tax credits) shown as the total height of the bars, and the

<sup>4</sup> 2018 ATB wind resource assumptions (Class 4 out of 10) for the United States

<sup>5</sup> 2018 ATB solar resource for Kansas City, MO

LCOEs with the current sunset schedule and with a tax credit extension shown as the intermediate heights.

Another reason why wind generation increases more than PV generation in the tax credit extension scenarios can be explained using an analysis of LCOE and the Levelized Avoided Cost of Energy (LACE). LACE reports the difference between the cost of producing electricity with the current assets available on the power system and what the cost would be if new generators were added to the system. NEMS uses a learning algorithm to create model-predictive LCOE and LACE estimates for generation technologies. In general, when the LCOE is less than the LACE for a given technology in a given area, the addition of the technology is considered to have incremental economic value to the electricity system. Although neither of these metrics is considered directly in the model's economic decision-making for capacity additions, looking at both together generally provides improved insight to the model's build-decisions than considering LCOE on its own (U.S. EIA 2018b).

Within a given region or market, new wind plants will have correlative seasonal and time-of-day profiles to existing wind plants. Similarly, generation from new PV facilities will have very similar time-of-day output characteristics to existing PV facilities. Therefore, as more capacity of each technology is built within a region, the capacity more quickly satisfies demand for electricity within the times that the energy is being delivered and consequentially lowers the LACE for that technology in that region.

Projections for wind in the United States start off in 2016 at a higher level of capacity compared to utility-scale PV. As a result, wind has less room to build before it starts to become saturated in the times when the energy is available. In addition, wind is more resource-constrained relative to PV in NEMS. Accessible high-quality wind resources in a given region may already be built out, leaving the model to choose between sites with lower-quality wind resource or less accessible sites that result in increased costs of construction. Figure 8 shows that across the regions modeled, even though the LCOEs of wind and PV in NEMS in 2030 are comparable, PV is more often an economically favorable technology in the reference case when comparing LCOE to LACE. PV in 2030 in the both the reference case and tax credit extension case tends to be economically favorable (LCOE less than LACE), whereas wind tends to be unfavorable (LCOE greater than LACE) in the reference case and favorable in the tax credit extension case.

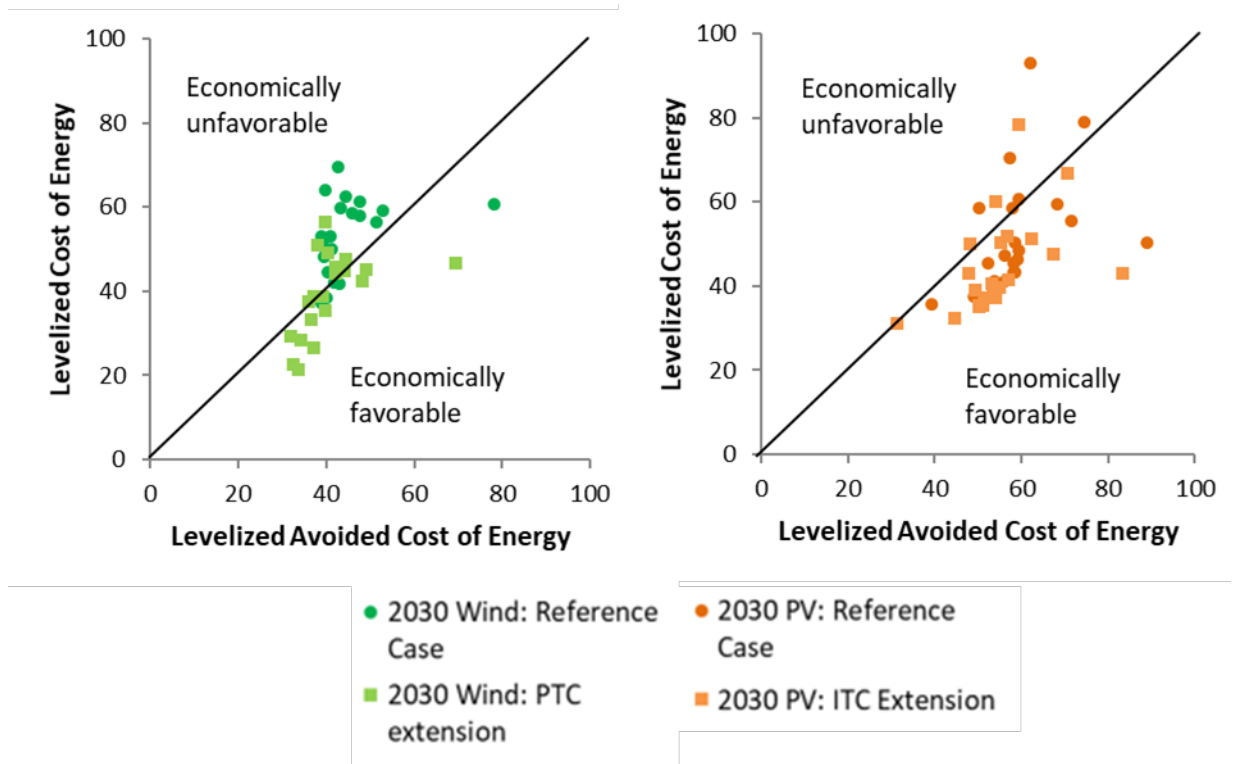


Figure 8. LCOE and LACE in \$/MWh of wind and utility-scale PV for each of the 22 NEMS regions in 2030 for the reference case and the tax credit extension case

## Conclusions

Federal policies have played a significant role in the growth of renewable energy capacity in the United States, particularly wind and PV. The PTC and ITC have contributed to the growth of wind and PV and the scenarios from recent modeling included in this work project continued growth of both technologies while the tax credits remain in effect. In both these NEMS and ReEDS sets of scenarios, annual wind capacity additions fall following the expiration of the PTC. That reduction is mitigated to some extent by factors that increase the competitiveness of wind, such as with lower wind cost or higher prices for natural gas. PV capacity, on the other hand, experiences relatively steady annual growth across the full suite of scenarios in both models, though the annual rate of growth varies considerably across scenarios and between models.

The projected CO<sub>2</sub> emissions from the two models show similar behavior. In the reference case, annual emissions tend to decline until the time period when the tax credits step down or phase out. Near-term CO<sub>2</sub> emissions are also impacted by the price of natural gas. In the long term, the range in CO<sub>2</sub> emissions widens depending on differences in factors, including the cost of renewable technologies and changes in federal policy.

In examining the relative economic competitiveness of wind and PV in the scenarios with and without the tax credit extensions, we find that the relative value of the PTC tends to grow over time as capacity factors of wind plants improve and as capital costs come down, while the

absolute value of the ITC tends to decline over time due to declining capital costs for PV. Also, in comparing LACE to LCOE, we find that PV is generally economically favorable in the scenarios regardless of whether or not the ITC is present at its current value (30%). Wind tends to be less economically favorable without the PTC.

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