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The U.S. investment tax credit for solar energy: Alternatives to the anticipated 2017 step-down

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A B S T R A C T

Solar photovoltaic (PV) installations in the United States have been deployed at a rapid pace in recent years, a development that is attributed in significant part to the federal Investment Tax Credit (ITC). Yet, this credit is scheduled to step-down from 30% to 10% at the beginning of 2017 for corporate investors. For a sample of five U.S. states and different segments of the solar industry, we find that the anticipated ITC step-down in 2017 would increase the levelized cost of solar power by a significant margin, raising the specter of a 'cliff' for the solar industry. Our analysis identifies and evaluates an alternative phase-down scenario that would reduce the ITC gradually over time and eliminate it completely by 2024. For this alternative phase-down scenario, it is shown that solar PV would remain broadly competitive, provided the solar industry can maintain the pace of cost reductions demonstrated in past years.

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1. Introduction

Solar power has experienced remarkable growth in the United States in recent years. To illustrate, 105 MW of photovoltaic (PV) installations were added at an average system price of $7.90 per Watt in 2006. In 2013, 4776 MW of new PV capacity were installed an average system price of $2.93 per Watt. By 2014, new solar installations did account for more than one-third of all newly installed capacity for electricity generation in the U.S. [18]. Tax incentives have arguably had a significant role in initiating this growth, specifically the 30% federal Investment Tax Credit (ITC) in conjunction with the accelerated depreciation tax shield provided through the Modified Accelerated Cost-Reduction System. Current legislation, though, stipulates that the ITC for solar installations will be 'stepped down' from its current 30% rate to 10% on January 1, 2017.[1]

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[1] See 26 USC Section 25D and 26 USC Section 48. The ITC was initially created as part of the Energy Policy Act of 2005 and extended through the end of 2016 with the Emergency Economic Stabilization Act of 2008. Our analysis focuses exclusively on the tax credits available in connection with *corporate income taxes*. The 30% ITC is currently also available for individual taxpayers, yet this credit is scheduled to expire entirely by early 2017.

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This paper assesses the impact of the anticipated ITC step-down on the competitiveness of solar energy across different locations and different segments of the U.S. solar industry. As an alternative to the anticipated step-down, we evaluate a gradual 'phase-down' scenario. Our analysis focuses on five key states: California, Colorado, New Jersey, North Carolina and Texas. These sample states not only account for more than 65% of the cumulative solar installations in the U.S., they also exhibit considerable diversity in terms of solar energy market maturity, insolation rates, labor/material costs, and market structure. For each state, our analysis considers three market segments: residential rooftop (<10 kW capacity per installation), commercial-scale (10 kW–1000 kW) and utility scale (>1 MW). For utility-scale systems, we distinguish between two technology platforms: c-Si (crystalline silicon) and CdTe (thin film) solar cells. Taken together, our calculations thus cover $5\times4=20$ separate *settings*.

Our main metric for assessing the cost competitiveness of solar PV under different policy regimes is the Levelized Cost of Electricity (LCOE). The LCOE identifies the break-even value that a power producer would need to obtain on average per kilowatt-hour (kWh) as revenue in order to justify an investment in a particular power generation facility. We calculate LCOEs by segment and by state, taking a "bottom-up" cost estimation approach. Accordingly, we estimate the cost of each solar energy system subcomponent, with the aggregate then providing the initial (2014) estimate for both the system price and the applicable operations- and maintenance costs. To assess cost competitiveness, the LCOE is considered relative to a comparison price that is applicable for a particular segment in a specific state. For commercial-scale installations in Colorado, for instance, the comparison price is given by the average rate charged per kWh to commercial users by energy service providers in Colorado.

The following findings emerge at 2014 costs with a 30% ITC: (i) utility scale installations are not yet cost-competitive across the entire spectrum of states considered when the LCOE of these installations is compared to the wholesale price of electricity, (ii) commercial-scale installations are currently well positioned in California and marginally competitive in Colorado and Texas when their LCOE is compared to the average commercial retail electricity rates in those states, (iii) residential installations are comfortably competitive in California, breaking-even in Colorado and North Carolina, but not yet competitive in Texas and New Jersey when compared with retail rates, under the assumption that there are no restrictions on net energy metering. These findings ignore state-level incentives, in particular Renewable Energy Credits. These findings also maintain the assumption that there are no restrictions on net energy metering.[2]

To project cost reductions in the future, we forecast the LCOE for individual segments and states by applying a cost dynamic to the individual components of solar PV systems. For PV modules, we rely on a model of *economically sustainable prices* based on production cost fundamentals of the upstream manufactures. For inverters, balance of system (BOS) and operations and maintenance costs, we estimate exponential decay functions, the latter two adjusted for state-level differences in component costs. In all cases, these component costs are assumed to decrease with time due to efficiency gains and accumulated experience.[3] The rate of change at which BOS costs decrease is specific to the segment and geography reflecting local market conditions for labor and materials.

While the expected magnitude of further reductions in system prices for solar PV is significant, we nonetheless find that if the step-down to a 10% ITC were indeed to occur at the beginning of 2017, solar PV would become uncompetitive essentially across the entire spectrum of scenarios considered in our study. Furthermore, the magnitude of the anticipated step-down in the ITC is likely to result in a 'cliff' for the U.S. solar industry in early 2017. At the same time, the sustained reduction in PV system costs demonstrated over the past decades suggests that, in order to be cost competitive, solar energy will not require an indefinite continuation of the 10% ITC. An alternative to the current tax law therefore could specify a more gradual glide path that would entail larger tax incentives than the currently specified 10% ITC for a limited number of years in exchange for a complete elimination of the federal tax incentives at some definitive future date. The ultimate elimination of the ITC effectively introduces a *quid-pro-quo* element that should make the proposal more acceptable politically.

For simplicity, we evaluate a policy scenario that involves only three distinct phases, starting at the beginning of 2017, 2021 and 2025, respectively. For the first two phases, the revised tax rules are calibrated so as to result in LCOEs that are in between those corresponding to the 10% and the 30% ITC benchmarks. The impact of gradually reduced tax incentives would be partially offset by the anticipated cost reductions during the previous phase. Because smaller residential systems tend to be the most expensive on a per Watt basis, the current solar ITC provides the largest support to residential PV systems in terms of dollars per Watt installed. More flexible and targeted tax incentives can be achieved by providing investors with a choice between alternative methods for calculating the ITC.

For the years 2017–2020, the phase-down scenario evaluated in this paper entails a choice between a 20% ITC or a lump-sum ITC in the amount of 35 cents per Watt installed. The 35 cents figure is obtained by putting a price on the stream of future carbon emissions that would be avoided by generating electricity from solar cells rather than a state-of-the art natural gas facility.[4] Consistent with the overall concept of diminishing ITC support, the second phase would cut the previous parameters in half for the years 2021–2024. Investors would then have the choice between a 10% ITC or a lump-sum ITC in the amount of 17.5 cents per Watt.

Our simulation results show that the proposed alternative phase-down scenario would go a long way towards avoiding the cliff that is likely to result from the currently anticipated step-down in federal tax support. Residential installations would continue to opt for an ITC calculated as a percentage of the system price. The 20% ITC for the years 2017–2020 would be sufficient to keep the residential segment cost competitive in most of the five states we examine. Furthermore, the anticipated additional reductions in cost are projected to leave residential installations with an LCOE that is within 10–20% of the retail rates expected for the years 2021–2024, in all states other than New Jersey.

Commercial and utility-scale systems would prefer the lump-sum ITC under our policy proposal. With this option, commercial-

[2] Renewable Energy Credits (RECs) and their Renewable Portfolio Standard carve-out equivalents known as Solar Renewable Energy Credits (SRECs) have not been included in our analysis due to the difficulty of forecasting their value over the operational lifetime of a solar generation facility. To be sure, our findings suggest that RECs and SRECs have enabled solar PV development within some of the states with Renewable Portfolio Standards.

[3] Our cost reduction assumptions for PV modules are based on a standard learning-by-doing model in which cumulative production volume is the explanatory variable. Since PV modules are a global commodity, the pace of future production volumes is arguably not affected materially by our analysis of alternative scenarios in the U.S., as the overall share of modules installed in the U.S. is less than 10% of the worldwide production volume.

[4] For direct comparison, our LCOE figures indicate that in the current environment solar PV is not yet cost competitive with natural gas combined cycle facilities, even under ideal conditions for solar: a 30% ITC and high insolation levels. This conclusion, however, hinges on the availability of natural gas at its current low price in the U.S. [7].