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Energy policy and financing options to achieve solar energy grid penetration targets: Accounting for external costs

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ABSTRACT

This paper presents a review and assessment of public-policy options for supporting large-scale penetration of photovoltaics (PV) in the United States. The goal therein is to reduce the costs both of solar technology and of grid integration, so enabling solar deployment nationwide. In this context, we analyze the solar PV markets and the solar industry globally, and discuss the external benefits of PV that must be advertised, and perhaps marketed, to assure an increase in social support for PV. We discuss existing energy-policy mixes in those countries leading to the development of solar power, highlighting the lessons learnt, and outlining areas of improvement of the existing policy mix in the United States. We highlight that there is a need for a holistic approach including social in addition to economic considerations, and we discuss policy options for supporting the continuation of PV market growth when the current investment tax credits expire.

Contents

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1. Introduction

The solar photovoltaics (PV) market grew very rapidly in recent years, mostly driven by technological improvements that reduced costs and government policies supportive of renewable energy. However, solar energy in most places is still more expensive than conventional energy-resources despite rapidly declining costs, and thus, sustained policy support is needed, so that its growth will continue. The right mix of policy towards solar-energy development should arise from the hidden benefits of solar energy, and indeed go beyond the achievement of parity in grid costs. Policy makers′ agenda should include an expansion in the generation of renewable energy and so maintain the reliability of the power grid to address climate change, boost energy-security, develop a domestic industry for green jobs, secure access to electricity in remote areas, and address the external costs of fossil-fired power generation. The need to achieve multiple objectives and gain political- and social-support for the solar industry requires a coordinated effort to come up with the optimal policy mix. The U.S. Department of Energy (DOE) is providing this type of strong coordination through its SunShot Initiative, focusing on direct cost reduction. Launched in 2011, the initiative aims to lower the price of solar-energy systems by about 75% between 2010 and 2020 [1]. Meeting this target is expected to make the unsubsidized cost of solar energy competitive with that of other currently operating energy sources, so paving the way for the rapid, large-scale adoption of solar electricity across the United States. According to the Initiative′s vision study [1], attaining the level of price reductions envisioned in the SunShot Initiative could result in solar energy meeting 14% of U.S. electricity needs by 2030, and 27% by 2050. A more ambitious study shows the feasibility of renewable energy to satisfy 69% of the electricity needs of the U.S. by 2050 [2,3]. The later encompasses the dimension of environmental sustainability in addition to direct cost evaluations. The authors believe that the external benefits of photovoltaics which have driven the early steps of PV technologies development, should be highlighted and monetized, and that continuous attention to environmental, health and safety (EH & S) issues is required for successful commercialization and large scale deployment of PV technologies.

A review of previous studies on political and economic incentives towards renewable energy development revealed that often missing in the literature is the identification of barriers for solar energy development and of clear policy guides to ensure uninterrupted growth in solar deployment after existing policy instrument come to an end. Schmalensee [4] reveals the political appeal of renewable generation and risks involved with major incentive mechanisms. He examined a number of policy features associated with subsidizing the generation of electricity from renewable generation. Schmalensee concluded that in most countries FIT incentives are more popular than RPS policies mainly because this mechanism removes the risk on the investor side. However, he argues that this shifts the risk to other actors without necessarily reducing the risk to the society as a whole. Furthermore, he presented a simple model showing that the long term risk may in fact be lower under an RPS regime than under a FIT regime.

Timilsina et al. [5] covered different applications of FIT and RPS programs throughout the world and identified advantages and disadvantages in specific applications. The authors concluded that although FIT programs help to guarantee a fixed return on investments, they do not help in reducing high up-front costs. Secondly, FIT policies guaranteeing grid interconnection regardless of the location of the project put pressure on transmission infrastructure and electricity rates. Finally, adjustable FIT rates add to the uncertainty for the investors. Frondel et al. [6] harshly criticizes Renewable Energy Sources Act (EEG) in Germany arguing that the FIT scheme failed to achieve its promises on emissions reductions, employment, energy security, or technological innovation while resulting in massive expenditures. The authors argue that government intervention can serve to support renewable energy technologies through other mechanisms such as emission trading schemes and funding for research and development (R & D), which may compensate for under-investment from the private sector. According to their paper, policies investing in R & D in the early stages of development are cost-effective in achieving competitiveness. We are addressing these issues herein, by proposing a mix of different policy tools (‘push’ and ‘pull’ policies together) rather than coming up with a one-fit-all approach as in the German paradigm. Identifying locational potential of solar energy and balancing transmission infrastructures is a key aspect of our policy recommendations. Another critical takeaway from Timilsina et al. [5] is that it emphasizes the importance of loan financing programs at the retail scale level and collaboration between governments and the private sector exemplified by projects in India and China. Along the same lines, Srinivasan [7] studied the optimal subsidy and right incentives for solar energy development in India and concluded that to achieve a significant market share for solar energy comparable to other generation resources, retail solar financing must be flexible.

Certain papers greatly helped with detailing the early experience with RPS and RPS options for solar energy. Wiser et al. [8] summarized some of the early literature regarding efforts to come up with alternative policies to RPS [9]. Wiser also addressed concerns that overreliance on RPS may not support the diversity of renewable resources (e.g., [10,11]). Rowlands [12] expresses concerns that a whole-hearted commitment to RPS could be damaging for the development of renewable energy and devises a