Targeted Support for New Photovoltaic Installations Requires Flexible and Regular Adjustments

by Thilo Grau

corrected version

Feed-in tariffs have proven to be an effective instrument in supporting renewable energies. As a result of the dynamic price trend of photovoltaics, the actual number of systems installed has repeatedly exceeded initial government targets. Therefore, the support for new solar power installations by the German Renewable Energy Sources Act (EEG) has been adjusted several times. Based on the experiences with these adjustments, DIW Berlin analyzed how feed-in tariffs can also be used to meet specific installation targets. For photovoltaic (PV) systems of up to 30 kW, a model analysis indicates that a bi-monthly adjustment of the tariffs for new systems, on the basis of installation volume, is a more effective instrument for achieving targets than the biannual mechanism employed to date.

Feed-in tariffs have now been introduced in over 60 countries as they have proven to be an effective instrument in supporting renewable energies.[1] The German Renewable Energy Sources Act (EEG) guarantees technology-specific payment for grid feed-in of electricity generated by renewable energy sources. The aim is for renewable energy sources to contribute at least 35 percent of total electricity supply by 2020. Simultaneously, the German government's National Renewable Energy Action Plan provides for the installation of PV systems with a total capacity of 52 gigawatts (GW) by 2020.[2] This equates to an annual expansion of approximately 3.5 GW from 2011 onwards.

The EEG was implemented in Germany in 2000 as the successor to the 1990 Electricity Feed-In Act. It regulates tariffs for electricity feed-in generated by renewable energy sources. These tariffs are differentiated by energy source (solar, wind, etc.) and provide a purchase guarantee, normally for a period of 20 years. The respective feed-in tariff levels are reduced by annual degression rates and reviewed every three or four years to ensure that renewable energies will become competitive with conventional power generation technologies in the long term.

Due to the historic high cost of photovoltaics, its support has always played a special role within the framework of the EEG, firstly with particularly high tariffs but, at the same time, also with a high annual tariff degression.[3]

1 REN21, Renewables 2011 Global Status Report, (Paris: 2011).

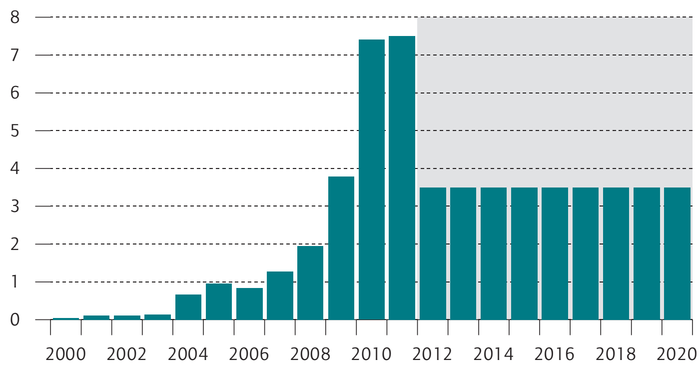
2 The Federal Republic of Germany, Nationaler Aktionsplan für erneuerbare Energie gemäß der Richtlinie 2009/28/EG zur Förderung der Nutzung von Energie aus erneuerbaren Quellen (August 2010).

3 The first feed-in tariff for solar power in 2000 was 0.99 DM/kWh (approximately 51 cents/kWh) and the annual tariff degression was originally fixed at five percent. Since 2004, tariffs have been fixed according to system capacity and type (rooftop, façade or free-standing systems) at between 46 cents and 62 cents/kWh. From 2006 onwards, the annual degression rate for free-standing systems was increased to 6.5 percent.

Figure 1

Annual PV Installations in Germany from 2000 to 2011 and Targets up to 2020

In GW



Source: T. Grau, "Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development," DIW Berlin Discussion Paper, no. 1189 (2012).

In 2011, the planned annual expansion of PV systems was, once again, exceeded by a wide margin.

Unexpectedly Strong Price Reductions Pose New Challenge to Policy-Makers

In recent years, Germany has consistently exceeded its planned annual expansion of photovoltaics to such an extent that the country has become the largest photovoltaics market in the world, accounting for 44 percent of global installed capacity up to 2010. This presents a challenge as the greater solar power generation leads via the EEG allocation to increased electricity costs to consumers. Therefore, in order to align the tariffs for solar power with the rate of development, an automatic adjustment mechanism was incorporated into the 2009 EEG based on installation ranges. Tariff regulations were additionally adjusted in 2010 and 2011. However, in 2011, Germany once again significantly exceeded its planned expansion with 7.5 GW of new installations (see Figure 1).

The reason for this unexpectedly high rate of expansion is that prices of PV systems fell more quickly than anticipated. Therefore, designing the EEG so that the PV feed-in tariffs are adjusted in such a way as to maintain the planned annual rate of installations poses a significant challenge. Furthermore, overfunding and short-term market fluctuations due to pull-forward effects shall also be avoided.

The average end user prices for fully installed PV rooftop systems (with a capacity of up to 100 kW) has fallen by 57 percent over the past five years, with a particularly dramatic drop in the last three years.[4]

These dynamics must be taken into account when fixing appropriate tariffs.

Solar Power Tariffs had to be adjusted many times

Since 2008, in response to the unexpectedly sharp price reductions, various legislative initiatives have led to short-term adjustments to solar feed-in tariffs.

Revision 1: EEG 2009

In October 2008, the EEG was revised as planned. The EEG 2009 introduced a »breathing cap« for new solar power installations (annual 2009 target corridor: 1 to 1.5 GW) in order to align the tariffs with annual installations. The annual base degression rate was increased to eight percent for PV rooftop systems of up to 100 kW and to ten percent for other systems. Additionally, the degression should be either reduced or increased by one percent if installations fall either below or above the target range.

In 2009, the substantial 26 percent reduction in PV system prices led to total installations of 3.8 GW. It became apparent that the flexible degression adjustment was too weak. Moreover, it became clear that an annual adjustment mechanism can lead to a large final surge at year end.

Revision 2: EEG Amendment From August 2010

Due to the strong deployment at the end of 2009, in 2010 additional tariff reductions were implemented: between eight and 13 percent on July 1, and three percent on October 1. These short-term responses were delayed by political negotiations for several months.

A new degression system was established with an annual growth corridor of 2.5 to 3.5 GW. The nine percent degression rate was to be increased by up to four percent

4 German Solar Industry Association (Bundesverband Solarwirtschaft e.V., BSW-Solar), Statistische Zahlen der deutschen Solarstrombranche (Photovoltaik) 2012. See also Figure 1 in J. Diekmann, C. Kemfert, and K. Neuhoff, „The proposed Adjustment of Germany's Renewable Energy Law —a critical assessment," Economic Bulletin, no. 6 (2012) (in this issue).

dependent on installations volumes. After the strong deployment of 7.4 GW in 2010, tariffs were reduced accordingly by 13 percent on January 1, 2011.

Revision 3: EEG Amendment From April 2011

The April 2011 EEG amendment saw the introduction of a new mechanism which provided for the following biannual adjustments dependent on the pace of deployment:[5]

- On July 1, 2011 by up to 15 percent.[6]
- On January 1, 2012 by a base degression of nine percent, with an additional adjustment of between -7.5 and 15 percent.[7]

However, the new mechanism introduced in 2011 did not result in any degression in July or September 2011 (as less than 875 MW was installed between March and May 2011) and a 15 percent degression in January 2012 (as 5.2 GW was installed between October 2010 and September 2011).

Revision 4: EEG 2012

The EEG 2012, passed by the Lower House of German Parliament (Bundestag) in June 2011, stipulated that the valid degression system for solar power was to continue. Following the 15 percent reduction which came into effect on January 1, 2012, a further reduction of up to 15 percent would be planned for July 2012.

Revision 5: Draft From February 2012

According to the German Federal Network Agency (Bundesnetzagentur), Germany set a new monthly installations record of three GW in December 2011, which resulted in annual deployment of 7.5 GW for 2011. This significant expansion strengthened calls for further adjustments to tariffs. On February 23, 2012, the German Federal Economics and Environment Ministers agreed on cornerstones[8] for the support of solar power which, inter alia, included a short-term one-off reduction in tariffs, a monthly degression, and a market integration model. Draft legislation proposed by coalition parties has been debated in the Bundestag.[9]

Market Responds to Changes of Tariffs and System Prices

To improve market trend monitoring, all new PV systems have to be registered with the German Federal Network Agency since January 2009. Although the individual adjustments to EEG tariffs for new installations varied significantly, the market has responded similarly in each case. In the weeks preceding a reduction in tariffs, new installations always increased as system operators wanted to profit from the higher rates (see Figure 2).

Photovoltaic market dynamics can be simulated with a simple model (see box). Using the example of the small system category (up to 30 kW), there is a close alignment between observed and simulated weekly installations (see Figure 3).

The model confirms that PV deployment responds very rapidly to falling system prices and feed-in tariff changes. This applies in particular to small systems with an average planning and construction time of six weeks. The unexpectedly strong deployment can be explained by the increase in profitability.

The frequently discussed demand peaks arise because, preceding a tariff adjustment, projects which otherwise would have been concluded a few weeks after the adjustment are, instead, completed ahead of average schedule. The majority of new systems are already installed in the weeks before a demand peak—installations considerably increase more than a month beforehand.

Frequency and Flexibility of Tariff Adjustments Determine Development of Photovoltaics

During the discussions that took place in 2011, political parties proposed different designs for the adjustment mechanisms. The model outlined above was used

5 In 2011, different proposals were made by various political parties for new solar power subsidy adjustment mechanisms, but no studies were carried out to support any specific option.

6 For ground-mounted systems on September 1, 2011.

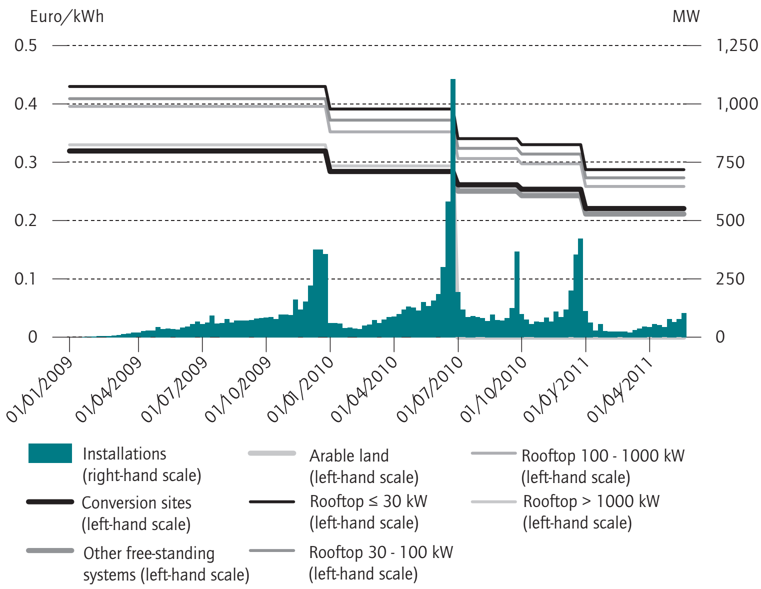
7 The possible annual degression rate could therefore be between 1.5 percent and 24 percent. When setting the new annual degression rate on January 1, 2012, the early „interim" degression of July 1, 2011, would be considered.

8 Germany Federal Economics Ministry (Bundeswirtschaftsministerium)/ German Federal Environment Ministry (Bundesumweltministerium), Ergebnispapier EU-Effizienzrichtlinie und Erneuerbare-Energien-Gesetz, February 23, 2012.

9 For a discussion of the planned EEG amendments, see Diekmann, Kemfert, and Neuhoff, „The proposed Adjustment of Germany's Renewable Energy Law —a critical assessment," Economic Bulletin, no. 6 (2012) (in this issue).

Figure 2

PV Feed-In Tariffs and Weekly Installed Capacity of New PV Systems in Germany, January 2009 to May 2011



Source: T. Grau, "Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development," DIW Berlin Discussion Paper, no. 1189 (2012).

A dramatic increase in the installation of PV systems can always be observed prior to feed-in tariff adjustments.

to analyze two proposals and the legislation that was in force in 2011:

Green Design: In February 2011, the German Green Party (die Grünen) proposed the following concept for solar power tariffs: distribution of the advanced market-dependent tariff reduction in 2011 over four dates (four reductions of up to 3.75 percent on May 1, July 1, September 1, and November 1 instead of a one-off 15 percent cut) based on the deployment in two preceding months (for example, February and March for the May 1 reduction) and transfer of any reductions that are not implemented to subsequent dates.

Red Design: In December 2010, the SPD made the following proposal for the design of the PV feed-in tariff: a reduction of four or 4.5 percent every three months from April 2011 onwards. The following analysis is based on four percent reductions.

Black Design: For purposes of comparison with the green and red designs, the adjustment mechanism that has been in force since 2011 will be referred to as the »black design«.

Whilst the red design includes fixed reductions of four percent each, reductions in the black and green designs depend on deployment in preceding months. Comparable with the black design's lack of degression in July 2011, the green design also sees no degression in May and July 2011 because, in the respective accounting periods, the annualized PV installations were less than 3.5 GW. For the green design, the simulation produces degression rates in September 2011, November 2011, and January 2012 of 6.75 percent, 8.25 percent, and 0.65 percent, respectively.

However, when decisions on the adjustment mechanism are taken, future price developments are not yet known. System price trends are difficult to forecast as the global photovoltaics market is very dynamic. The proposals must, therefore, be tested in various system price scenarios. For a model-based analysis of the three feed-in tariff design options under different scenarios, see: T. Grau, »Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development,« DIW Berlin Discussion Paper, no. 1189 (2012).

Conclusion

In view of falling PV system prices, several adjustments have been made to solar feed-in tariffs over recent years—both within the planned mechanism and also through EEG amendments. However, deployment has continued to increase, particularly preceding the respective adjustment dates.

This characteristic market behavior can be simulated based on some simple factors. The model developed here is able to simulate the development of photovoltaic installations and feed-in tariffs using observed system prices. It allows to analyze various adjustment options for solar power tariffs in different price scenarios.

The simulation results demonstrate that system prices and feed-in tariffs are decisive for the profitability of PV systems. Due to the relatively short planning and construction periods required for small systems, increased profitability is rapidly reflected in higher installation figures. Furthermore, if tariffs are only adjusted at longer intervals, this results in strong pull-forward effects in periods preceding the adjustment dates. Projects are then implemented more rapidly so that operators can still profit from the higher tariffs.

If a trajectory for the deployment of photovoltaics is predetermined, feed-in tariffs can be aligned with the pace of installations. Since forecasts for system prices are very uncertain, a rigid tariff adjustment mechanism is fraught with risk. The »breathing cap« system for the degression of PV tariffs introduced as part of the EEG a number of years ago is in principle suited to helping counteract overfunding, and stabilize deployment, provided that the planned tariff adjustments are properly aligned with actual deployment.

Due to the dynamic development of the photovoltaics market, the frequency of adjustments is also of utmost importance. According to the 2011 simulation calculations, a deployment-dependent degression model with a bimonthly adjustment would have been a more effective instrument for achieving targets than the biannual adjustment mechanism that is currently in force.

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Box

Simulation Model for Deployment of Photovoltaics

The effects of a feed-in tariff scheme on the deployment of photovoltaics can be simulated using a simple analytical model.[1] The model only takes three factors into consideration that impact installation volumes:

- The installation volume increases linearly with project profitability which primarily depends on feed-in tariffs and system prices.
- With a given profitability, the weekly installation volume increased in previous years.
- Preceding a tariff reduction, projects are implemented more rapidly so as to still qualify for the higher tariffs.

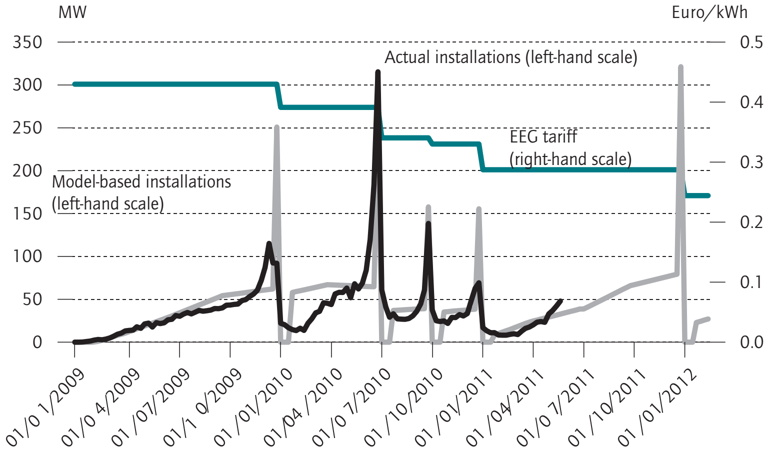
The model was specifically used to analyze the effects on small systems of up to 30 kW, which, in 2009 and 2010, contributed 44 percent and 35 percent of German installations, respectively.[2]

1 For detailed model structure and the selection of parameters, see T. Grau, "Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development," DIW Berlin Discussion Paper, no. 1189 (2012).

2 For the model calculations from 2011 onwards, these systems are treated as a representative category and their 2010 market share assumed to be constant for the future.

Figure 3

Development of Actual and Model-Based Weekly New Installations of Small PV Systems (up to 30 kW)



Source: T. Grau, "Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development," DIW Berlin Discussion Paper, no. 1189 (2012).

A simple model enables to simulate the development of new installations.

JEL: O30, O31, Q42, Q48

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