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Support for Solar Power: Reforms Call for Caution

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The proposed Adjustment of Germany's Renewable Energy Law – a critical assessment

by Jochen Diekmann, Claudia Kemfert, and Karsten Neuhoff

Support through the German Renewable Energy Sources Act (EEG) has led, in the past few years, to an unexpectedly wide expansion of systems for generating solar power (photovoltaics) because the system prices for photovoltaic (PV) systems have fallen at a faster rate than the solar power feed-in tariffs guaranteed by the law. This has also contributed to a substantial increase in the EEG surcharge to be paid by consumers. Also in order to slow down the rise in the surcharge, the federal German government has rapidly agreed on major changes to its support for solar power. The article critically reviews the elements of the initial legal proposal by the coalition government, concluding that proposed reductions of the expansion course for photovoltaic capacities are too extreme, the one-off reduction of the solar power feed-in tariffs is at least in parts too drastic, the envisaged rigid future degression of the tariffs is incompatible with market dynamics, and the model for integrating power from renewable energy sources into the market has not been properly thought through. An accompanying innovation strategy should also be considered.

On March 29th the Federal Parliament (lower house) voted in favor of a law that had already addressed some of the concerns voiced in the discussion and captured also in this article. However, the upper house, representing the Federal states, voted against this law. Hence the adjustments to solar support in Germany remain subject to political negotiations.

Due to its success over recent years, support for photovoltaics has become a subject of public debate. The price of photovoltaic (PV) systems, including assembly, have been falling faster than expected—by 60 percent over the last six years (see Figure 1). Despite decreasing feed-in tariffs in accordance with the German Renewable Energy Sources Act (EEG), unexpectedly high reductions of the system prices have made investments very attractive and led to an increase in capacity of around 7.5 GW per annum in the last two years—about double the medium-term target referred to in the German government's National Action Plan.[1]

The cost reductions of photovoltaics and the success of the EEG have encouraged many other countries to further develop support for solar power. While Germany's share in global demand for photovoltaic modules was still 53 percent in 2009, it dropped to 27 percent in 2011 (see Figure 2). This can be seen as a successful internationalization of the photovoltaic strategy. Its achievements in improving technology and internationalizing photovoltaics are a tribute to Germany's contribution to meeting global energy and climate challenges.

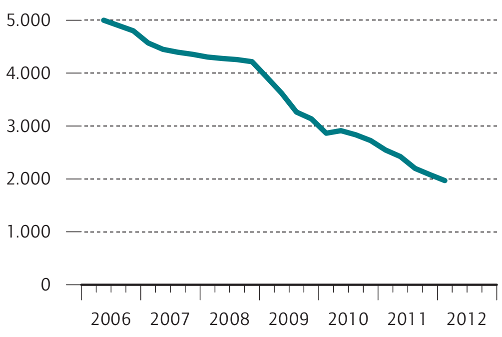
The costs of supporting electricity from renewable energy sources are passed on to the electricity prices and thus mainly assumed by private households and companies, unless these are exempt from the EEG surcharge. For non-privileged consumers, the overall EEG surchar-

1 The Federal Republic of Germany, National Renewable Energy Action Plan in accordance with Directive 2009/28/EC on the promotion of the use of energy from renewable sources (August 2010).

Figure 1

Average Retail Price (System Price) for Fully Installed Rooftop Systems up to 100 Kilowatts

In euros per kilowatt, excluding VAT



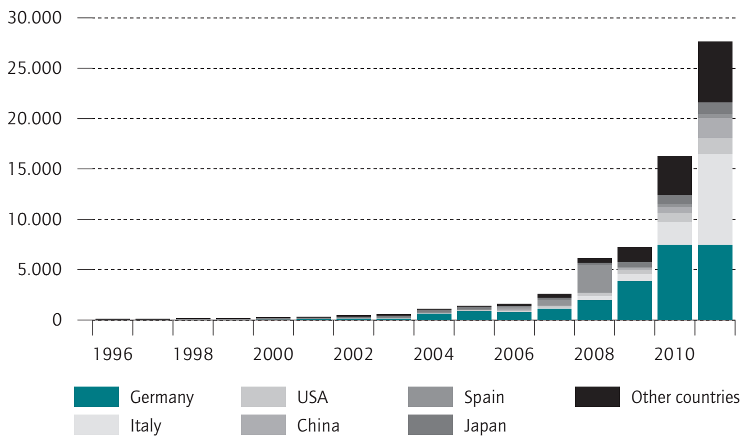
Source: German Solar Industry Association, Statistische Zahlen der deutschen Solarstrombranche (Photovoltaik). 2012. www.solarwirtschaft.de/preisindex.

Prices for PV systems have fallen dramatically since 2009.

Figure 2

Annual Installed Capacity of PV Systems

In megawatts per annum



Source: calculations by DIW Berlin on the basis of various sources.

The installation of PV systems worldwide is increasing sharply. The share of systems installed in Germany decreased in 2010 and 2011.

ge is currently 3.59 cents per kWh (2011: 3.53 cents per kWh). Approximately half of this accounts for photovoltaics. The net burden of consumers is lower than the surcharge, however, since the wholesale price of electricity is falling as a result of this additional energy supply.[2] This price-lowering effect is particularly strong in the case of solar power.

The main concern in the current political debate is to avoid an increase in the EEG surcharge. The tariff rates and development of photovoltaic capacity are key determining factors here. The feed-in tariff is guaranteed by law for existing solar power systems.[3] In other words, existing systems are not affected by the legislative changes, so as to protect operators' and investors' existing stock. New legislation can, therefore, only apply to tariffs for new systems. Continued strong growth of photovoltaic capacities could contribute to an additional increase in the EEG surcharge, and acceptance of this is politically contentious. The future rate of the EEG surcharge also depends on other factors, however, particularly on the development of the wholesale prices of electricity. If CO_2 prices increase and the climate costs of fossil fuels are adequately reflected in the price of electricity, then the surcharge will also fall.

As well as stabilization of the EEG surcharge, the current debate is also focused on avoiding overfunding in favor of the plant operator. Additionally, the rate of expansion of photovoltaics is to be reduced and short-term market fluctuations, triggered by pull-forward effects in particular, are to be avoided. However, the market development should not be exposed to excessive shocks and a continuous development of photovoltaics in Germany facilitated.

Major Changes to Solar Energy Subsidies Planned

Following controversial political disputes, the Federal Environment and Federal Economics Ministers agreed on new legislation on solar energy subsidies on February 23, 2012, and submitted a draft law ("draft wording,")[4] which was passed by the Cabinet on February 29. This political compromise consists of a package of amendments to reduce both solar power feed-in tariffs and the

2 See T. Traber, C. Kemfert, and J. Diekmann, „German Electricity Prices: Only Modest Increase Due to Renewable Energy expected" DIW Berlin Weekly Report no. 6 (2011): 37–45.

3 Consequently, the nominal tariffs for these remain unaffected. Since the tariffs for existing systems are nominally fixed, however, they fall with inflation in real terms.

4 Germany Federal Economics Ministry (Bundeswirtschaftsministerium)/ German Federal Environment Ministry (Bundesumweltministerium), Ergebnispapier EU-Effizienzrichtlinie und Erneuerbare-Energien-Gesetz, February 23, 2012. BMU, Formulierungshilfe der Bundesregierung. Entwurf eines Gesetzes zur Änderung des Rechtsrahmens für Strom aus solarer Strahlungsenergie und zu weiteren Änderungen im Recht der erneuerbaren Energien (2012). BMU – KI III 4. Last updated February 24, 2012.

expansion of photovoltaic capacities.[5] This includes in particular a restriction of the planned expansion course, a one-off reduction of the tariffs, and subsequently a rigid monthly degression. There are also plans to limit the amounts of electricity eligible for the tariffs under the EEG (what is known as the market integration model). On the basis of this, the coalition parties introduced a (partly amended) draft law amending the EEG on March 6, which was debated in the Lower House of the German Parliament (Bundestag) on March 9 at its first reading and ultimately rejected by the Upper House of the German Parliament on May 11th.[6]

The EEG has been amended several times over the past few years.[7] In particular a comprehensive review of the EEG resulted in new legislation that came into effect on January 1 (EEG 2012). While the additional reduction of PV system prices do warrant an additional one-off adjustment of the PV support level, we are critical about the scale of this adjustment and the overall package that complements it. In particular, we are critical of the excessive reduction of the expansion course, the drastic one-off cut of the tariffs particularly for some size categories of solar power, the rigid monthly degression for future tariffs, and the proposed market integration model. An accompanying innovation strategy should also be considered.

Expansion Target for Solar Power is Wide of the Mark

In the draft law, the expansion target range for PV system capacity has been reduced from 2.5 to 3.5 gigawatts (GW) per annum currently to 0.9 to 1.9 GW per annum by 2017 (See Table 1). Consequently, expansion of photovoltaic capacity to 52 GW in 2020 as included in the Federal Republic of Germany's 2010 Action Plan will no longer be achieved (see Figure 3).[8] Such a change to the target scenario is surprising from an economic point of view because policy-makers are ultimately planning to make less use of this technology in the future as a reac-

Table 1

Expansion Range for PV Systems in Accordance with the Draft Law Amending the EEG
In megawatts (MW)

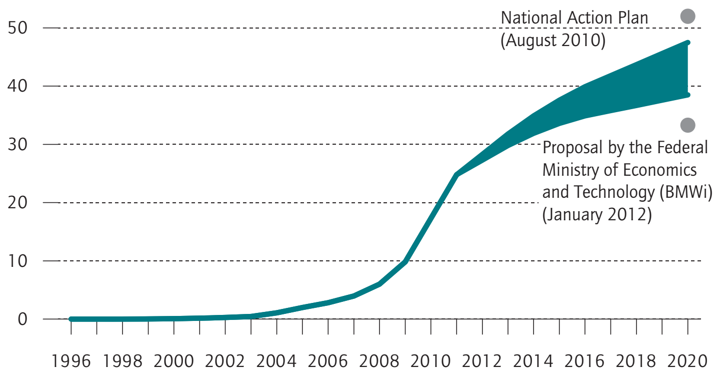
	From	To
2012	2,500	3,500
2013	2,500	3,500
2014	2,100	3,100
2015	1,700	2,700
2016	1,300	2,300
2017	900	1,900
2018	900	1,900
2019	900	1,900
2020	900	1,900

Sources: BMWi/BMU: Ergebnispapier EU-Effizienzrichtlinie und Erneuerbare-Energien-Gesetz. February 23, 2012; Gesetzentwurf der Fraktionen der CDU/CSU und FDP. Paper no. 17/8877 of the German Bundestag, dated March 6, 2012.

The expansion course of photovoltaics will be significantly reduced.

Figure 3

Development of the Total Capacity of PV Systems in Accordance with the Draft Law Amending the EEG
In GW



Sources: BMWi/BMU: Ergebnispapier EU-Effizienzrichtlinie und Erneuerbare-Energien-Gesetz. February 23, 2012; Gesetzentwurf der Fraktionen der CDU/CSU und FDP. Paper no. 17/8877 of the German Bundestag, dated March 6, 2012; Federal Republic of Germany: National Renewable Energy Action Plan in accordance with Directive 2009/28/EC on the promotion of the use of energy from renewable sources, August 2010; BMWi: Entwurf Gesetzestext. Änderung des Erneuerbare-Energien-Gesetzes. Last updated January 12, 2012; calculations by DIW Berlin.

With the new expansion range, the total output of photovoltaics provided for in the National Action Plan for 2020 will not be achieved.

5 At the same time, the government agreed upon a compromise on the European Energy Efficiency Directive. In this context, the EU climate policy emissions target is also of great significance. To date, the EU has committed to reducing greenhouse gas emissions by 20 percent compared with 1990. This EU target must urgently be increased to at least 25 to 30 percent (depending on the possibilities for credit transfer of project-based emission credits from third countries). The German government's position on this target still remains unclear, however.

6 Draft law by the parties of CDU/CSU and FDP. Entwurf eines Gesetzes zur Änderung des Rechtsrahmens für Strom aus solarer Strahlungsenergie und zu weiteren Änderungen im Recht der erneuerbaren Energien. Paper no. 17/8877 of the German Bundestag, dated March 6, 2012.

7 See T. Grau, „Targeted Support for New Photovoltaic Installations Requires Flexible and Regular Adjustments," Economic Bulletin, no. 6 (2012) (in this issue).

8 An EEG draft amendment by the Federal Economics Minister of January 2012 only provides for growth up to 33 GW by 2020, that is, just over a third less than in the 2010 National Action Plan.

Table 2

Tariffs for Electricity from PV Systems in Accordance with the Draft Law Amending the EEG

	Rooftop					Free-standing
Commissioned from	Up to 10 kW (new)	Up to 30 kW (not applicable)	Up to 100 kW (not applicable)	Up to 1,000 kW	Over 1,000 kW, up to 10 MW	Up to 10 MW
	Tariffs in cents per kWh					
1/1/2012	24.43	24.43	23.23	21.98	18.33	17.94
4/1/2012	19.50	16.50	16.50	16.50	13.50	13.50
5/1/2012	19.35	16.35	16.35	16.35	13.35	13.35
6/1/2012	19.20	16.20	16.20	16.20	13.20	13.20
7/1/2012	19.05	16.05	16.05	16.05	13.05	13.05
8/1/2012	18.90	15.90	15.90	15.90	12.90	12.90
9/1/2012	18.75	15.75	15.75	15.75	12.75	12.75
10/1/2012	18.60	15.60	15.60	15.60	12.60	12.60
11/1/2012	18.45	15.45	15.45	15.45	12.45	12.45
12/1/2012	18.30	15.30	15.30	15.30	12.30	12.30
1/1/2013	18.15	15.15	15.15	15.15	12.15	12.15
1/1/2014	16.35	13.35	13.35	13.35	10.35	10.35
1/1/2015	14.55	11.55	11.55	11.55	8.55	8.55
1/1/2016	12.75	9.75	9.75	9.75	6.75	6.75
	Change compared with 1/1/2012 in percent					
4/1/2012	-20.2	-32.5	-29.0	-24.9	-26.4	-24.7
5/1/2012	-20.8	-33.1	-29.6	-25.6	-27.2	-25.6
6/1/2012	-21.4	-33.7	-30.3	-26.3	-28.0	-26.4
7/1/2012	-22.0	-34.3	-30.9	-27.0	-28.8	-27.3
8/1/2012	-22.6	-34.9	-31.6	-27.7	-29.6	-28.1
9/1/2012	-23.3	-35.5	-32.2	-28.3	-30.4	-28.9
10/1/2012	-23.9	-36.1	-32.8	-29.0	-31.3	-29.8
11/1/2012	-24.5	-36.8	-33.5	-29.7	-32.1	-30.6
12/1/2012	-25.1	-37.4	-34.1	-30.4	-32.9	-31.4
1/1/2013	-25.7	-38.0	-34.8	-31.1	-33.7	-32.3
1/1/2014	-33.1	-45.4	-42.5	-39.3	-43.5	-42.3
1/1/2015	-40.4	-52.7	-50.3	-47.5	-53.4	-52.3
1/1/2016	-47.8	-60.1	-58.0	-55.6	-63.2	-62.4

Notes: The tariffs in effect from January 1, 2012 already include a 15 percent reduction. In the government's draft, the one-off reduction was in fact planned for March 9, 2012, see BMWi/BMU: Ergebnispapier EU-Effizienzrichtlinie und Erneuerbare-Energien-Gesetz. February 23, 2012. For free-standing systems, the draft by the coalition parties contains a transitional regulation applicable until July 1, 2012. This does not take into account the 15 or 10 percent reductions for electricity eligible for payment. Further amendments are to be expected during the parliamentary procedure. Sources: Gesetzentwurf der Fraktionen der CDU/CSU und FDP. Paper no. 17/8877 of the German Bundestag, dated March 6, 2012; EEG 2012; Federal Network Agency, 2011; calculations by DIW Berlin.

tion to an unexpectedly substantial cost reduction for photovoltaics. In order to achieve the overall objectives for expanding renewable energies, a reduction of solar energy would have to be compensated for by higher power production by wind turbines, for example.

One-Off Reduction in Tariffs Too Drastic

There was already a 15 percent reduction in tariffs (statutory degression) at the beginning of 2012. The one-off reduction in tariffs planned now, ranging from 20 to over 30 percent, is very dramatic and sudden (see Table 2). It is medium-sized systems of 10 to 100 kilowatts that are most affected by this, since the size categories for the support have been changed. After the compromise of February 23, 2012, the one-off cut was even set to come into effect as of March 9, 2012. Since this would have damaged investor confidence, following the draft by the coalition parties, entry into force was subsequently planned for April 1, 2012. The level of the tariff reduction has to be evaluated in the medium term together with the monthly degression (as of May 2012) and the integration model (effective as of 2013). Overall, the package results in significant cuts in tariffs, which is hardly likely to allow economically viable operation of new systems in many cases (also depending on financial resources).

Rigid Monthly Degression Goes Against Market Dynamics

The draft law provides for a monthly degression. This type of monthly adjustment means that the individual adjustment steps are smaller, thus reducing the pull-forward effects—which is something to be welcomed.[9] The degression rates would be essentially fixed in accordance with the draft law, however, and no longer take into account market trends. In view of the dynamics of the photovoltaic market, regulations like this are fraught with risk.

Instead, the degression could be made conditional upon the actual development of the system prices for PV systems or upon the actual expansion of photovoltaic capacities. Alignment with the system price would most likely correspond to the EEG logic of cost orientation and would thus avoid overfunding. Since there is no clear reference price for system costs, it could be difficult to implement an automatic adjustment. In the current situation, the objective of slower photovoltaic expansion is also being pursued at the same time, particularly in order to counteract a further increase in the EEG surcharge. Therefore, it might make sense for the degression to be aligned with expansion, as has been the case to date (a "breathing cap").

The constant degression rate of 0.15 cents per month—or 1.8 cents per year—contained in the draft law would be appropriate if this reflected the anticipated future cost trend. There are, however, no existing relevant studies

9 For an evaluation of various degression models, see Grau, „Targeted Support for New Photovoltaic Installations Requires Flexible and Regular Adjustments" l.c.

that draw this conclusion. Moreover, forecasts of system prices are extremely unreliable. An extrapolation of the linear reduction of the tariffs leads to extremely low or even negative values after a few years. This is very unlikely to match the future development of system costs.

Arbitrary Short-Term Adjustments Risky

To regulate short-term adjustments, subsidiary legislation by the Federal Environment Minister in agreement with the Federal Economics Minister is planned. This provides authorization to issue statutory instruments and does not require the approval of the German Bundestag (Section 64h of the draft EEG): If the target range of the expansion in three consecutive months is exceeded or undershot, it will be possible to change the tariffs limited to six months[10] (the planned tariff adjustments for exceeding or undershooting the range are not symmetrically formulated). An adjustment mechanism of this type is not without problems since the option of discretionary adjustments without the amounts being known in advance creates additional uncertainty for investors.

Market Integration Model Unsuitable

Support for renewable energies must be geared toward more long-term prospects in the energy industry as a whole. This also entails increased system integration of power from renewable energy sources. With this in mind, the draft law provides for a market integration model which will mean 85 percent (for small systems) or 90 percent (for larger systems) of solar power generated will be eligible for payment under the EEG. The remainder would have to be used or sold by system operators themselves. Otherwise, only the wholesale market price would be paid.

The intention behind this, particularly in the household sector, is to create incentives for people to align their own consumption of solar power with their own production. A responsible attitude toward using energy is certainly desirable. From the perspective of energy management, however, it would be more important to coordinate supply and demand better throughout the entire energy system so as to minimize the overall costs of production, networks, storage, and load management. Opportunities for direct marketing would apply more to larger systems.[11] But forced sale of residual electricity is not the best approach for efficient market integration. Unless these direct sales are successful, the only option is to sell at wholesale prices.

In this respect, particularly for larger systems, the market integration model serves to further reduce the overall return on investment. At the same time, this results in additional complexity and uncertainty, but is hardly conducive to further market integration.

Transfer to Other Renewable Energies Problematic

The draft also contains subsidiary legislation on transferring the market integration model to other technologies such as wind and bioenergies (Section 64g of the draft EEG). Such legislation would lead to further changes in tariffs which we cannot yet predict. In accordance with the draft by coalition parties, the Bundestag's approval is required, and this was not stipulated in the government's draft.

Irrespective of this, the first course of action would be to investigate in depth to what extent reducing the amount of generated electricity eligible for the tariffs, in turn creating strong pressure to carry out some direct sale of residual electricity, would most efficiently promote market integration in the various segments.

Further Development of Innovation Policy

Support for photovoltaics is also linked with industrial and technological policy. There is great innovation potential to be seen both in cell design and production processes, and in electrical components (converters and control systems). Such improvements are essential to ensure that photovoltaic costs continue to fall and, in the longer term, solar power can replace fossil fuels to a large extent worldwide.

Research and development in Germany in this field receives annual support of around 30 to 40 million euros through project funding provided by the Federal Environment Ministry[12]—in addition to institutional research funding. However, new approaches and ideas can only have an impact if they are put into practice in production. Only then does it become apparent how well ove-

10 According to the government's draft legislation, it was twelve months.

11 Here, the new market premium model for electricity eligible for payment under the EEG is ruled out.

12 In 2010, a project volume of 39.8 million euros was granted by the BMU for photovoltaics, see German Federal Environment Ministry (Bundesumweltministerium), Innovation durch Forschung. Jahresbericht 2010 zur Forschungsförderung im Bereich der erneuerbaren Energien, May 2011.

rall efficiency can be improved and costs lowered. Frequently, new questions concerning how to implement further improvements arise during this process. Thus, investments in new and innovative production plants are a key component of future innovation.[13]

One major factor for investments in new production capacities is the prospect of further market development. The more confidence investors have in long-term market growth, the more worthwhile it is to invest in innovative approaches. The German EEG is also a role model for promoting photovoltaics in many other countries. Consequently, predictable and clearly communicated further development is of the essence so that other countries, too, can continue to foster support for solar power and thus contribute to consistent market growth.

Over the past few years, investments in new production plants in Germany have received funding of up to 30 percent of the investment costs.[14] Due to rapid technological progress, installations have to be replaced within a few years in order to remain competitive. With the gradual reduction of regional funding, less and less new photovoltaic production capacity has been developed in Germany. One major determining factor seems to be favorable financing options for investors.

Nevertheless, there is still a boom in export by German mechanical engineering companies as suppliers for a substantial proportion of the new photovoltaic production facilities in Asian countries, too. These are working in close cooperation with many medium-sized suppliers. Interviews have shown that it is in this network comprising various manufacturers of production facilities that many of the innovative approaches are implemented. However, the question arises whether the geographical separation of the equipment providers, on the one hand, and the production lines for cell production, on the other hand, will result in the innovation network being weakened and innovation capability being reduced.

Therefore, it seems appropriate to also give careful consideration to targeted funding of innovative production processes on the supply side. This would allow further innovation networks to be built on the basis of effective cooperation of existing networks, thus making an immediate contribution to further international development of the technology.

13 See K. Neuhoff, J. Lossen, G. Nemet, M. Sato, and K. Schumacher, „The role of the supply chain for innovation: the example of Photovoltaic Solar Cells," EPRG Working Paper 07/32 (Cambridge: 2007).

14 T. Grau, M. Huo, and K. Neuhoff, „Survey of Photovoltaic Industry and Policy in Germany and China," DIW Berlin Discussion Paper, no. 1132 (2011).

Conclusion

The EEG is of utmost importance for energy and environmental policy in Germany. Without this support, national and EU targets to reduce emissions and use renewable energies would be unattainable. Moreover, the German EEG also serves as an international role model for legislation in other countries. If amendments are made to the EEG, they should be designed so as not to lead to national and international uncertainty about the direction of promotion policy.

Support for photovoltaics is also linked with industrial and technological policy. At the current stage of development, it certainly cannot be the mandate of the EEG to guarantee sufficient demand for domestic sales of photovoltaics, particularly since both imports and exports now play a major role. With a view to developing the solar industry, the promotion policy should, however, also ensure continuity and predictability of the political framework conditions and avoid extreme shocks.

The drastic price reductions on the photovoltaic market and the boom in the construction of systems triggered by this repeatedly required a reduction of tariffs for new installations. The latest reduction entered into force in January 2012 and reduced tariffs for solar power by 15 percent. However, as photovoltaic system prices have fallen by a larger amount, the German government has proposed to an additional one-off reduction of the PV tariffs. It has combined this adjustment with a package of measures which provides for lowering the planned expansion course, a fixed monthly degression, and a restriction of the amount of electricity eligible for payment under the EEG. Although some individual elements of the proposed EEG amendments seem to make sense—such as shortening of degression steps—the package as a whole goes too far with its cuts, and brings new risks to the funding system. The implicit revision of the expansion targets for the year 2020 is also difficult to comprehend, particularly in view of reductions in system costs already achieved—but also in view of the declared review of energy policy already made public. A revision of the support framework for solar power will have to demonstrate its viability in the short and medium term and send out the right signals for long-term restructuring of the energy supply. As the proposal agreed by the Federal Parliament (lower house) was subsequently rejected by German states in the upper house, the discussion on the final outcome of the resulting adjustment is ongoing.

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Dr. Jochen Diekmann, Deputy Head of the Department of Energy, Transportation, Environment at DIW Berlin

SIX QUESTIONS TO JOCHEN DIEKMANN

»We should not overshoot the target«

1. Mr. Diekmann, in the past few years, the German Renewable Energy Sources Act (EEG) has led to an unexpectedly widespread expansion of photovoltaic systems. In order to stabilize the EEG surcharge to be paid by consumers, the solar power feed-in tariffs were reduced by 15 percent at the beginning of the year. Now the legislation to promote solar energy is about to be changed again. What exactly is planned here? The government has proposed an entire package of changes. It is about a one-off reduction of the feed-in tariffs, an additional rigid linear degression, and a reduction in the amount of electricity eligible for payment under the EEG. Taken as a whole, this package means very drastic cuts to the feed-in tariffs.

2. So far, the threat of overfunding of solar power has often been discussed. Is there now a threat of underfunding? It is true that it has partially come to overfunding. And so it was also a good thing to have a particularly high degression rate in the field of photovoltaics which was then subsequently readjusted. But you have to be careful not to overshoot the target now and, when making adjustments, also to consider the individual categories in the EEG because reductions in the individual size categories vary considerably.

3. Is it possible that the planned new legislation might lead to overshooting the target? On the one hand, there has been a sharp decline in system costs. This means there is some leeway for further adjustments. On the other hand, we don't know how the system costs or market prices will continue to develop. Consequently, there is the risk that drastic adjustments will mean photovoltaics are no longer profitable, at least in some fields. This may affect medium-sized systems in particular because the categories in this group have now been redefined.

4. Why is this new legislation being implemented so quickly? Wouldn't it have been better to wait until we can see the effects of the January 2012 reduction of the feed-in tariffs? There is some truth in this. On the one hand, however, this short-term approach is a result of trying to avoid pull-forward effects because these have already been observed here in the past. On the other hand, there is political pressure to reduce the tariffs at the moment because there have been differences of opinion in the government, too, and a compromise has now been reached.

5. Is the German government planning to limit the overall expansion of photovoltaic capacities with this new legislation? Yes, we see this as a major problem, and we don't understand this approach, either. The German government's National Action Plan for 2020 provides for a total volume of 52 gigawatts. To now use the drop in system prices as a reason for reducing this medium-term expansion target is something we just don't understand.

6. Should the entire package of new legislation on solar energy be reconsidered? We believe the entire package still has major short-comings. The cuts were very sudden, the short-term reduction is drastic, and we must distinguish more clearly between the individual size categories. Even the degression legislation is too rigid in our view and, in the medium term, it is a move in the wrong direction because it is linear and formulated in cents per kilowatt hour. Moreover, the planned adjustments are not stipulated by the law at present. There is subsidiary legislation which might authorize these, but we don't know what will actually happen, and, in our opinion, the market integration model which is also part of the new legislation is half-baked, too.

Interview by Erich Wittenberg.

Targeted Support for New Photovoltaic Installations Requires Flexible and Regular Adjustments

by Thilo Grau

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 bimonthly 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).

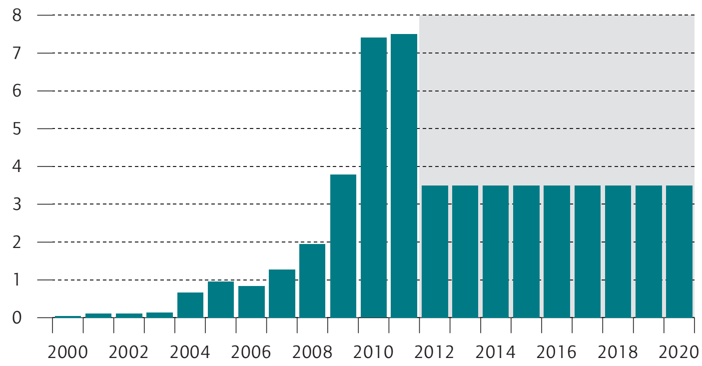
2 The Federal Republic of Germany, Nationaler Aktionsplan für erneuerbare Energie gemäß der Richtlinie 2009/28/EG zur Förderung der Nutzung von Energie aus erneuerbaren Quellen (August 2010).

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.

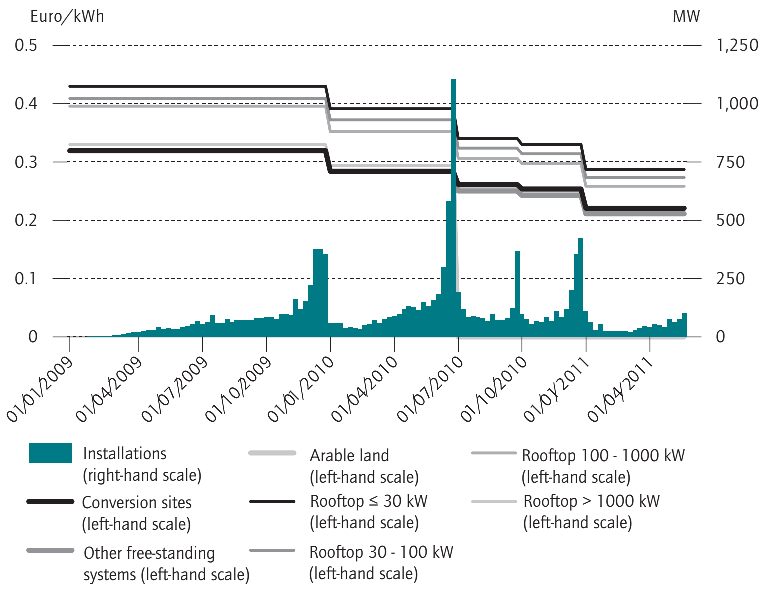
7 The possible annual degression rate could therefore be between 1.5 percent and 24 percent. When setting the new annual degression rate on January 1, 2012, the early „interim" degression of July 1, 2011, would be considered.

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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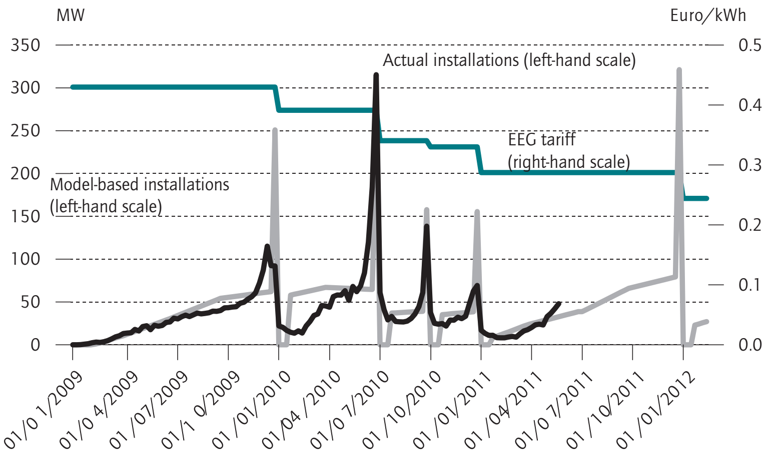
Figure 3

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.

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.

JEL: O30, O31, Q42, Q48

Keywords: Feed-in tariff, photovoltaic, renewable energy

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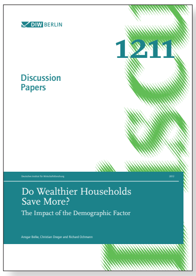
Discussion Papers Nr. 1211/2012
Ansgar Belke, Christian Dreger, Richard Ochmann



Do Wealthier Households Save More? The Impact of the Demographic Factor

This paper investigates the relationship between wealth, ageing and saving behaviour of private households by using pooled cross sections of German consumption survey data. Different components of wealth are distinguished, as their impact on the savings rate is not homogeneous. On average, the effect attributed to real estate dominates the other components of wealth. In addition, the savings rate strongly responds to demographic trends. Besides the direct impact of the age structure, an indirect effect arises through the accumulation of wealth. The savings rate does not decrease with age in a monotonic way, as the permanent income hypothesis suggests. Most prominently, older households tend to increase their savings in the second half of their retirement period, probably due to bequest motives and increasing immobility. Given the ongoing demographic trend, an increase of 1.4 percentage points in the aggregated savings rate should be expected over the next two decades.

JEL-Classification: G10, G11
Keywords: Savings, wealth, demographic change
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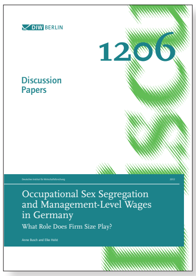
Discussion Papers Nr. 1206/2012
Anne Busch, Elke Holst



Occupational Sex Segregation and Management-Level Wages in Germany: What Role Does Firm Size Play?

The paper analyzes the gender pay gap in private-sector management positions based on German panel data and using fixed-effects models. It deals with the effect of occupational sex segregation on wages, and the extent to which wage penalties for managers in predominantly female occupations are moderated by firm size. Drawing on economic and organizational approaches and the devaluation of women's work, we find wage penalties for female occupations in management only in large firms. This indicates a pronounced devaluation of female occupations, which might be due to the longer existence, stronger formalization, or more established "old-boy networks" of large firms.

JEL-Classification: B54, J16, J24, J31, J71, L2, M51
Keywords: Gender pay gap, managerial positions, occupational sex segregation, gendered organization, firm size
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