The Expansion of Electricity Generation from Renewable Energies in Germany

A review based on the Renewable Energy Sources Act Progress Report 2007 and the new German Feed-In Legislation

by[1]

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Abstract

The expansion of electricity generation from renewable sources in Germany is promoted by the EEG, which was last amended in June 2008. In a review of the EEG the political parameters, the progress achieved, and the impacts of the Act itself are set out. This Progress Report addresses cross-sectoral aspects, notably CO_2 emissions reduction, job creation, investment and turnover in the renewables industry, and that industry's prospects for the future. Trends in the individual renewables sectors are described and policy recommendations formulated, as appropriate, on this basis. The policy recommendations have been incorporated into the new EEG from 6 June 2008.

The overarching goal of the new EEG is to achieve a renewables share of at least 30% in Germany's electricity consumption in 2020. This underlines the need for radical modernisation of the energy system as a whole.

This article presents an overview of the content of the Progress Report and supplements it with current statistical data and research findings contained in other publications from the Federal Ministry for the Environment (BMU). It also highlights the points on which the new EEG diverges from the policy recommendations contained in the Progress Report.

Keywords: renewable energy, feed-in system, Germany

1 Legal mandate and background

Germany now has 17 years of experience with a legally regulated system of fixed minimum payments for renewable-generated electricity: the Electricity Feed Act (*Stromeinspeisungsgesetz* – StrEG), which was adopted unanimously by the German Bundestag in late 1990 and entered into force on 1 January 1991, was revised three times during the 1990s. It was finally replaced by the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz* – EEG) on 1 April 2000, which in turn was further improved in amended versions which came into force on 1 August 2004 and, most recently, on 6 June 2008.

In the Coalition Agreement adopted by the Christian Democratic Union (CDU), the Christian Social Union (CSU) and the Social Democratic Party of Germany (SPD) in November 2005, the governing parties agreed to maintain the basic structure of the EEG but to review the fees and degression steps in particular. At its closed meeting in Meseberg in August 2007, the Federal Cabinet agreed the cornerstones of an Integrated Energy and Climate Programme, including the key elements of the forthcoming revision of the EEG.

These policy decisions adopted by Germany are based on those established by the European Union. In March 2007, the European Council, under the German Presidency, set the course for an integrated European climate and energy policy, approving ambitious targets for climate protection and, explicitly, the expansion of renewable energies. For renewable energies, it set a binding target for the EU as a whole: a 20% share of renewable energies in overall EU energy consumption[2] by 2020. This 20% renewables share of total energy consumption does not have to be fulfilled by every individual Member State, however. Instead, the EU Member States will be required to meet different individual targets depending on their national

framework conditions, such as the current share of renewables in their energy supply or their economic capacities. On 23 January 2008, the European Commission therefore unveiled its draft of a new and comprehensive Directive on the promotion of the use of energy from renewable sources, which covers electricity, heat/cold and fuels and which, inter alia, is to replace the existing Directive on the promotion of electricity from renewable energy sources in the internal electricity market (European Commission, 2008b). While drafting the directive for the promotion of renewable energy in the electricity sector in 2000 and 2001 (77/2001/EC; European Commission, 2001), there was a strong discussion whether or not the directive should demand from EU Member States to install a support system based on quota systems and tradable green certificates. In the end, the directive made clear that Member States can choose the instrument they feel fits best to their policy. In the years after, many research projects were run to figure out which system is best. A number of studies found, that at least concerning wind energy onshore, feed-in tariff systems are both more effective and more efficient than quota systems (e.g. Butler and Neuhoff, 2004; Diekmann and Kemfert, 2005; EREF and WWI, 2005; Huber et al., 2004; ISI et al., 2007; Laube and Toke, 2005; Lehmann and Peter, 2005; Mitchell et al., 2004). In September 2008, the International Energy Agency also published an official paper saying that for wind energy feed-in tariff systems are more efficient and effective than quota systems (IEA, 2008). Other publications, mostly based on economical theory, claim, that quota systems are more efficient than feed-in systems (e.g. ECN, 2005; Holzer, 2004; Menanteau et al., 2003; Ondraczek, 2004). However, two Commission communications on the expansion of renewable energies in the electricity sector, the first published in 2005 (European Commission, 2005) and the second published together with the draft of a new directive on renewable energy on 23 January 2008, state that “well-adopted the feed-in tariff regimes”, as in operation in Germany and many other EU Member States, "are generally the most efficient and most effective support schemes for promoting renewable generated electricity" (European Commission, 2008a). Nevertheless, in its draft directive, the European Commission proposed a trading scheme for RE certificates (guarantees of origin) between private actors. While in theory there is the possibility for Member States to opt out from the trading scheme, it is seen that this opt-out option is an *empty box*. For legal reasons, the opt-out option could not actually be used. Hence there is major concern that if this system were to become law, the existing feed-in schemes – even the highly successful German Renewable Energy Sources Act – could no longer be maintained. However, both European Council and European Parliament request changes of the Commissions draft directive in particular concerning this issue.

The system of remunerating renewable-generated electricity with fixed minimum tariffs established in the Renewable Energy Sources Act transposes the current Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market into national law. Due not least to the success of Germany's EEG, a total of 19 EU countries and at least 30 other countries worldwide have introduced similar feed-in schemes for renewable-generated electricity (European Commission, 2008a; ISI, 2008) (see Figure 1).

In view of the dynamic expansion of renewable energies in Germany's electricity sector, regular monitoring of the existing support instruments is required. Pursuant to Article 20 (1) of the EEG of 21 July 2004, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) is therefore required to submit a progress report to the German Bundestag on the EEG by 31 December 2007 and

subsequently every four years thereafter. This report must be produced in agreement with the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and the Federal Ministry of Economics and Technology (BMWi). The present progress report was adopted by the Federal Government on 7 November 2007 and transmitted to the German Bundestag (BMU, 2007b).

The BMU requested a group of eight research institutes to support it in producing the progress report (ZSW et al., 2007) and made use of several other research projects dealing with relevant aspects, in particular IfnE (2007), Krewitt and Schlomann (2006), Nitsch (2007), Ragwitz and Klobasa (2005) and Sensfuss and Ragwitz (2007). The BMWi also run a research project on the EEG, which was used to complement the BMU projects and support BMWi in the governmental negotiations (IE and Prognos, 2006).

On the basis of the Progress Report on the EEG and its comprehensive policy recommendations, the Federal Government adopted on 5 December 2007 the draft of a new version of the EEG (Bundesregierung, 2007a), together with a further 13 laws and ordinances and seven policy measures forming part of the Integrated Energy and Climate Programme. This comprehensive package was adopted in time for the United Nations Climate Change Conference in Bali, with the Federal Government thus sending out a clear signal to the international community that it is taking firm action at home to protect the climate. Among the instruments in the Integrated Energy and Climate Programme, the EEG will make the largest single contribution to climate protection by cutting CO_2 emissions until 2020 by around 55 million tonnes compared with 2006 levels (Bundesregierung, 2007b). On 6 June 2008, the German Bundestag confirmed the activities of the Government by adopting the new EEG (Bundesregierung, 2008) – with some changes concerning tariffs in particular – and a number of other acts such as the Renewable Energy Heat Act as well as the Combined Heat and Power Act.

2 The EEG: The track record

As a basis for decision-making to improve the EEG, the Progress Report begins by reviewing its impacts in Germany to date. Summing up, the Federal Cabinet notes that the EEG is an important and successful instrument to promote renewable energies and that, as a result of the Act, the development of renewable energies in the electricity sector is particularly dynamic. Indeed, no other instrument has resulted in similar CO_2 reductions in Germany (BMU, 2007b). The success of the Act can be summed up in a few figures:

- Since the EEG entered into force in 2000, the share of renewable energies in total gross electricity generation in Germany has almost doubled, from 6.3% in 2000 to approximately 11.7% in 2006, with well in excess of 13% forecast for 2007 (BMU, 2007b). Indeed, current figures indicate that a share of 14.2% was achieved in 2007 (BMU, 2008a and 2008b). This means that the target set by the Federal Government and the German Bundestag for 2010 of at least 12.5%, which is also enshrined in the current Directive 2001/77/EC, was exceeded by a substantial margin as early as 2007.
- The EEG is a powerhouse for German climate protection: in 2006, carbon dioxide (CO_2) emissions were reduced by around 44 million tonnes solely through the EEG, i.e. by some 6 million tonnes more than in 2005, and the trend is increasing (see Figure 4) (BMU, 2007b). Around 13 million additional tonnes of CO_2 were saved in 2007, taking total CO_2 reductions

resulting from the Act to around 57 million tonnes. Together, all renewable energies cut Germany's CO_2 emissions by around 100 million tonnes in 2006[3] (see Figure 4). Reductions achieved in 2007 are as high as 115 million tonnes (BMU, 2007b, 2008a, 2008b).

- Domestic turnover from the installation and operation of renewable energy systems increased from €12.3 billion in 2004 to €25 billion in 2007, with around two thirds of this being directly attributable to the EEG. Export figures are also rising: around 75% of the wind energy systems produced in Germany is now exported (BMU, 2007b, 2008a, 2008b; ZSW et al., 2007).
- This has been accompanied by a substantial increase in employment in the renewables industry. The number of people employed in all the renewable energy sectors rose from 160,000 in 2004 to around 250,000 in 2007. About 60% of these jobs were created as a result of the EEG[4] (BMU, 2007b, 2008a, 2008b; ZSW et al., 2007).
- The differential costs arising from the EEG are passed on to the consumer in the form of the EEG surcharge.[5] This may be identified on electricity bills, which often occurs in practice. In 2006, these differential costs amounted to around €3.3 billion and rose – due to the strong increase of the renewable share – to €4.3 billion in 2007 (BMU, 2007b, 2008a, 2008b).
- In 2006 as in 2007, the differential costs (EEG surcharge) accounted for around 4% of residential electricity costs in Germany. A total of 13% of the electricity price increases between 2002 and 2006 was due to the EEG – far outweighed by production, transport and distribution costs, which accounted for approximately 75% of the price increases during this period (BMU, 2007b). The special equalisation scheme established under Article 16 of the EEG relieves much of the burden on particularly energy-intensive manufacturing companies and rail operators in the purchase of electricity paid for under the Act; their EEG differential costs are limited to 0.05 cent/kWh.

- The Progress Report lists other costs associated with the EEG. In particular, extra costs arise from the additional need for regulating and balancing energy, the lack of optimal full-capacity utilisation of existing conventional power plants, and additional costs of grid expansion and conversion. Transaction costs also arise for the transmission system operators and the distribution system operators, while the Federal Network Agency incurs costs in monitoring the transparency rules (BMU, 2007b).

  Nonetheless, these are all fairly modest costs. A background paper produced by the BMU, based on scientific research findings, on the costs and benefits of the EEG estimates the first two of these items to be in the order of €300-600 million in 2006. The costs of on- and offshore EEG-related grid expansion are estimated to total around €4 billion, which, allowing for a 25-year write-off period for electricity grids and an 8% interest rate, works out at less than €400 million p.a. The transaction costs are purely nominal, attesting to the negligible amount of red tape associated with the implementation of the EEG (BMU, 2007a; DIW et al., 2007; IfnE, 2007).

- The above-mentioned costs are offset by the economic benefits associated with the EEG. The EEG reduces hard coal and gas imports for electricity generation in Germany, resulting in savings of around €0.9 billion in 2006, according to the Progress Report. Attention is also drawn to the avoidance of

external costs of CO_2 damage through the substitution of renewables for fossil fuels in electricity generation and to the price-dampening effect of the Act on wholesale electricity prices in Germany (i.e. the merit order effect) (BMU, 2007b).

Experts estimate the external costs[6] saved by the EEG to be in the region of €3.4 billion for 2006 (BMU, 2007a; Krewitt and Schlomann, 2006). The figure for 2007 is around €4 billion. The cost-dampening effect of the EEG via the merit order effect is estimated to be as much as €3-5 billion for 2006 (BMU, 2007a; Bode and Groscurth, 2006; Neubarth et al., 2006; Ragwitz and Klobasa, 2005; Ragwitz and Sensfuss, 2007; Sensfuss and Ragwitz, 2007; Wissen and Nicolosi, 2007).[7]

- The expansion of the production of wind energy systems, biomass plants and PV installations in Germany has also enabled major cost-cutting potential to be exploited. Additionally, technological development – partly boosted by the research funding provided by the German Government – has led to the development of more efficient and now very reliable renewable energy technologies. These cost reductions and quality improvements are also benefiting other countries which are now pursuing their own renewables expansion in the electricity sector.

3 Prospects for renewable energies in light of climate change

Never change a winning team. In line with this motto, the basic structure of the EEG was maintained, but at the same time the Act was improved and adapted to current developments.

There are two reasons why the current expansion targets in Germany's EEG had to be adjusted upwards: firstly, the expansion of renewables in the electricity sector in Germany has progressed more rapidly in recent years than anticipated. With renewables accounting for more than 14% of electricity generated in 2007, the expansion target set in the EEG for 2010, i.e. 12.5%, has already been exceeded by a substantial margin (BMU, 2007b, 2008a, 2008b).

Secondly, in March 2007, the European Council, under the German Presidency, set a binding target for the EU as a whole: a 20% share of renewable energies in overall EU energy consumption[8] by 2020, i.e. an approximately 250% increase. Germany must make its contribution to this target.

Building on the decisions taken at its closed meeting in Meseberg in 2007, the Federal Government set an expansion target in the Progress Report of 25-30% of electricity consumption for renewable energies by 2020[9], with continued steady expansion after 2020 – although no firm longer-term target was set (BMU, 2007b). Compared to these targets, the German Bundestag was at that time even more ambitious. For example, the parliamentary group of the conservative parties CDU and CSU set the target of 30% in an official paper (CDU/CSU Bundestagsfraktion, 2007). Finally, the Bundestag adopted the target of a share of at least 30% renewables in electricity consumption in Germany by 2020, again with continued steady expansion.

According to the Lead Scenario 2008 (Nitsch, 2008) , to reach the target for 2020 is possible, and the continued steady expansion will amount to a renewables share of more than 50% in Germany's total gross electricity generation in 2030 (see Figures 2

and 3). The amount of RE power produced will reduce Germany's CO_2 emissions by more than 100 million tonnes in 2020 – almost twice the 2007 emissions reduction figure of 57 million tonnes (BMU, 2007b; Nitsch, 2007).

At this point it is important to stress that – as today – not all renewables can and will use the fixed EEG tariff in future. The share of renewables using the fixed tariff will be determined by the electricity price in the market, the generation costs of RE power, the possibilities to market RE power and the general legal, economic and technical conditions for marketing power in Germany and Europe. It can be expected that in the coming years more and more renewable power producers will prefer to market RE power instead of asking for fixed tariffs, since the market price has been rising strongly and may rise even further – and thus become higher than the EEG tariffs. This is relevant in particular for wind power onshore, since tariffs are relatively low and wind power accounts for the largest share of all renewables. But also some biomass and hydro power plants do get tariffs that might soon be lower than market prices.

However, in the new EEG, on the one side, the possibility to leave the fixed price system for a short time in order to sell RE-power on the market has been limited in the new act. With this, the possibility of selling RE power to the spot market whenever prices are high enough has been restricted. On the other side, the new EEG gives the possibility for the Government to enact, with approval of the Bundestag, an ordinance to provide financial support for the market integration of RE power. Such an ordinance has jet to be finalised.

Renewable energies will therefore make a major contribution to Germany's fulfilment of its climate commitments. The Progress Report notes, however, that this will "only" enable a 35% decrease in CO_2 emissions to be achieved by 2020 (see also Bundesregierung, 2007b). Also the Lead Scenario 2008 results in a decrease of 36% CO_2 emissions. Challenging measures have been adopted in other renewable energy sectors[10], along with an ambitious target for an increase in energy productivity of 3% p.a. (BMU, 2007b; Bundesregierung, 2007b; Nitsch, 2008).[11] Furthermore, Nitsch (2008) assumes a shift in the fossil fuel mix for power production towards the greater use of gas,[12] as well as the implementation of the nuclear phase-out pathway, as agreed between the Federal Government and the electricity companies running nuclear power plants in Germany in 2000 and established in German law in 2002.

According to the Lead Study 2008, however, the 40% reduction in Germany's CO_2 emissions which the BMU is aiming for by 2020 (against the 1990 baseline) can be achieved by an even greater increase of the energy efficiency and a further increasing the share of renewable energies, especially in electricity consumption ("efficiency scenarios") (Nitsch, 2008). In view of the current dynamic expansion of renewable energies in Germany, a renewables share of more than 30% of electricity consumption by 2020 seems quite realistic, especially if parallel measures aimed at improving energy efficiency and curbing demand for electricity take effect.[13] The efficiency scenarios 2 and 3 in Nitsch 2008 see a share of 37% renewable energy in the electricity sector. However, a substantial increase in the share of renewable energy electricity to 30% or more also requires better grid management to balance supply and demand, as well as technical optimisation and expansion of grid systems and a restructuring of the power plant pool towards units that are more flexible and more easily regulated. Appropriate parameters and incentives must be created here as a matter of urgency (BMU, 2008c).

This issue is partly addressed in the Progress Report. It recommends, for example, the introduction of optimised feed-in management to replace the existing system of generation management. This optimised feed-in management system should ensure that in the event of grid bottlenecks occurring, only the power flow from those renewable energy plants which are causing the current grid problem is regulated by the network system operator. Due to the current legal position and technical equipment in operation in the renewable energy plants, this is currently not always the case. In order to ensure that this system of feed-in management substantially reduces the number of renewable energy plants whose power flow has to be regulated in this way, the grid system operator should be able to regulate by remote control all renewable energy plants with a capacity of more than 100 kW_{el}. The Progress Report recommends that a hardship scheme be considered to protect affected renewable energy plant operators from excessively high burdens (BMU, 2007b). The new EEG has established the provisions for this (Bundesregierung, 2008).

The Progress Report also makes recommendations for measures to promote the use of storage technologies and system integration, such as the use of virtual power plants[14], load management and energy storage systems (BMU, 2007b). In the new EEG, an authorisation is given to the Federal Government to adopt an ordinance for the better integration of renewable electricity in both the electricity market and the technical electricity system (Bundesregierung, 2008).

4 New regulations and policy recommendations for individual sectors

4.1 Onshore wind:

In 2006, wind energy accounted for the largest share of electricity production from renewable sources, i.e. around 5.6% of Germany's gross electricity consumption. This alone achieved a reduction of around 20 million tonnes of CO_2. In 2007, the wind share increased to 6.4%. Nonetheless, expansion in the onshore wind energy sector peaked in 2002 and has slowed since then. This is partly due to the obstacles posed by new spacing and height restrictions set by the states (Bundesländer), as well the rising costs of raw materials, which are making new wind energy projects increasingly uneconomical at rates of remuneration under the old EEG. As a result, repowering[15] has also failed by a considerable margin to match expectations; this is exacerbated by problems arising under planning law. Nonetheless, wind energy accounts for the largest share of electricity production from renewable sources in Germany (2007: around 39.5 TWh), and still offers good expansion potential both on- and offshore (BMU, 2007b, 2008a, 2008b).

Against this background, the Progress Report recommends providing greater incentives for repowering; it also recommends that the annual rate of degression be set at a value between 1 and 2% p.a. (BMU, 2007b). The Federal Government's draft EEG provides for a rate of degression of 1% (Bundesregierung, 2007a), which would reduce the rate of degression from the present level of 2% under the old EEG. Due to the high proportion of wind-generated electricity in some areas, notably in northern and eastern Germany, onshore wind energy systems should also be able to contribute to grid stability. The Progress Report therefore proposes that efforts be made to determine whether technical specifications aimed at ensuring that these plants contribute to network stability should be made mandatory for new plants, with the initial fees payable under the EEG being increased by 0.7 ct/kWh for this purpose.

For existing plants, retrofitting to bring them up to this standard would attract a bonus of 0.7 ct/kWh (BMU, 2007b).

The new EEG provides an initial tariff increased by around 1.3 ct/kWh to 9.2 ct/kWh, with an additional bonus of 0.7 ct/kWh for existing and 0.5 ct/kWh for new plants if additional criteria to safeguard grid stability are fulfilled. The final tariff is set slightly higher compared to the EEG 2004, to 5.02 ct/kWh. The degression is set to 1% per year (Bundesregierung, 2008).

4.2 Offshore wind:

Even though the potentials for offshore wind power production in Germany is high, until today, no real offshore wind power plants are installed in the German sea. One important reason is that almost the entire German coast is protected for environmental reasons. Therefore, wind power plants can only be located in a distance of at least 10 km from the coast, in water that is 20 to 40 meter deep. Such wind parks have not been installed worldwide by now, and are a huge challenge.

The development of offshore wind energy in Germany has stagnated, even though many authorisation procedures have already been completed. By mid-2007, permits had been issued for 1,100 plants with a capacity of around 5,000 MW in the North Sea, and for 240 plants with a capacity of 1,200 MW in the Baltic Sea. Unlike the offshore wind projects implemented elsewhere in the world, Germany's offshore wind projects in the North and Baltic Seas must meet very high technical standards. This is due to the deep waters (20-40 m) and the substantial distances from main land, sometimes well in excess of 20 km. This distance is necessary as Germany's coastal areas are ecologically valuable and sensitive sites with nature conservation status, and are therefore not available for use as locations for wind energy generation. The level of remuneration payable under the old EEG is also judged to be inadequate, and is a further factor in the current stagnation in offshore wind development. The Progress Report therefore recommends increasing the remuneration rate from the current figure of 8.74 to 11-15 ct/kWh (starting rate), with a reduction of the final rate from 5.95 to 3.5 ct/kWh (BMU, 2007b).

This is elaborated in more detail in the Federal Government's draft of the new Act, adopted on 5 December 2007. An early-starter rate of 14 ct/kWh was proposed to be paid as an incentive until 31 December 2013, with 12 ct/kWh payable thereafter. The rate of degression was proposed to be set at 5% p.a. for new plants with effect from 1 January 2015 (the current rate is 2% p.a. from 2008) (Bundesregierung, 2007). The new EEG now offers an initial tariff of 15 ct/kWh for wind turbines installed until end of 2015 with a final tariff of 3.5 ct/kWh. From 2016, the initial tariff will decrease to 13 ct/kWh, and a degression of 5% will come into effect (Bundesregierung, 2008a).

4.3 Biomass:

Electricity generation from bioenergy amounted to around 2.7% of Germany's total gross electricity consumption in 2006 and reduced its CO_2 emissions by approximately 11 million tonnes. In 2007, its share was at about 3.2%. Electricity generation from gaseous and liquid biomass in particular has shown a strong upward trend in Germany since 2004. However, only a relatively small percentage of biomass plants are set up for combined heat and power production (CHP). Increasing the energy productivity of biomass use for electricity generation is becoming more

important, too, due to the sharp rises in the price of cultivated biomass in 2007. Furthermore, the substantial increase in the use of imported palm oil must be viewed critically: in South-East Asia in particular, natural areas, especially tropical forests, are being destroyed – in some cases through illegal logging – to create palm oil plantations. The use of palm oil from non-sustainable sources for electricity generation conflicts with the objectives of the EEG as defined in Article 1 – notably conservation of the environment and nature. It is proving increasingly difficult to demonstrate conclusively that the palm oil used in biomass plants within the scope of the Act comes from renewable sources. At present, then, it is debatable whether the use of this type of palm oil, at least, in electricity generation should be eligible for the cultivated biomass (NawaRo) bonus scheme (BMU, 2007b, 2008a, 2008b).

The Progress Report therefore recommends an increase of 1 ct/kWh in the basic rate of remuneration for small biomass facilities, an increase in the CHP bonus from 2 to 3 ct/kWh, and an increase of 1 ct/kWh in the NawaRo bonus for small facilities. It also recommends an increase of 1 ct/kWh in the NawaRo bonus for electricity from biogas (new and existing facilities) if at least 30% farm manure is used. The degressive rate of remuneration for new facilities should be reduced from 1.5% to 1% p.a., and annual degression of 1% introduced for all (previously non-degressive) biomass bonuses in future (BMU, 2007b).

In the new EEG, the increase in the NawaRo bonus for the use of slurry is payable only for electricity generated from biogas. For biogas plants up to 500 kW_{el}, the NawaRo bonus is increased by 1 to 7 ct/kWh. Additionally, a bonus for using at least 30% slurry is given: for plants up to 150 kW_{el} 4 ct/kWh and for plants up to 500 kW_{el} 1 ct/kWh. When using a minimum of 30% manure plant material predominantly from landscape conservation, plants up to 500 kW_{el} can get a bonus of 2 ct/kWh. If biomass plants up to 5 MW_{el} use wood from short rotation coppice and landscape management material, they can get a bonus increased by 1.5 ct/kWh to now 4 ct/kWh. New installations using liquid biomass are able to get the NawaRo bonus only if they remain under 150 kW_{el}. The bonus for combined heat and power production is increased by 1 to 3 ct/kWh for installations up to 20 MW_{el}. The degression in the new EEG is decreased to 1%, but also applies to all boni (Bundesregierung, 2008a).

In addition to the amendments to the fees payable, the Progress Report recommends the exclusion of palm and soya oil from the NawaRo bonus scheme until an effective certification scheme is in place. For electricity generation from biomass in particular, it is essential that its sustainable cultivation is safeguarded in future, primarily by means of an ordinance which defines sustainability criteria for the cultivation of renewable feedstocks (Bundesregierung, 2007). Building on this, the new EEG provides the authorisation for the Federal Government to adopt a corresponding ordinance (Bundesregierung, 2008a).[16]

4.4 Geothermal:

In order to harness geothermal energy for electricity generation in Germany, deep drilling must take place, in some cases to depths well below 3,000 m. It is only at these depths that the requisite temperatures – above 100 degrees Celsius – are found in Germany. To date, the appropriate technology has only been deployed at two projects in Germany and is not in general use worldwide, with the result that there is no empirical experience to draw on. Electricity generation from geothermal energy is therefore still in its infancy in Germany. At the time the Progress Report was

adopted, there was still only one plant generating electricity from deep geothermal energy in operation in Germany, namely in Neustadt-Glewe near Schwerin (Mecklenburg-Western Pomerania). However, a second geothermal power plant came into operation in Landau, Rhineland-Palatinate, at the end of 2007, and a third – in Unterhaching, Bavaria – is due to follow soon. Around a dozen other projects, mainly in the Upper Rhine valley and the Molasse Basin in southern Germany, have reached various stages in the development process.

However, the technical difficulties associated with geothermal energy have proved to be more complex than anticipated. Furthermore, due *inter alia* to high oil and gas prices, the costs of drilling equipment have increased substantially. This is a result of the boom in exploration activities in the oil and gas industries, which is driven by these high energy prices and has pushed up demand for drilling equipment. Due to the resultant increase in the production costs of geothermal electricity, the Progress Report recommends increasing the basic fees by a good 1-3 ct/kWh as well as introducing a heat extraction bonus of 2 ct/kWh and an additional technology bonus of 2 ct/kWh for non-hydrothermal technologies.

Furthermore, outside the scope of the EEG, the creation of a fund to cover the exploration risk is also recommended, with special drilling risks to be covered by investment subsidies in cases where unfavourable geological conditions result in additional costs being incurred due to increased technological inputs (BMU, 2007b).

In the new EEG, the proposed tariffs for the basic fees and the degression are adopted. However, the boni were increased to 3 ct/kWh for heat extraction and to 4 ct/kWh when petrothermal (instead of non-hydrothermal) technology is being used. On the other hand, the boni apply to installations up to 10 MW_{el} only. Overall, the Federal Government is hoping that this will result in a breakthrough for electricity generation from geothermal sources, which offers considerable potential in the medium term. Geothermal systems are capable of supplying base load and can be regulated as required, and are also ideally suited for combined heat and power production (Bundesregierung, 2008).

4.5 Solar radiation:

Due to the improved remuneration regulations under the EEG, Germany's photovoltaic sector has experienced a boom period of rapid expansion since 2004: with around 3,800 MW_p in 2007, total installed capacity has increased more than ninefold compared with 2003. Due to this strong growth, Germany has become the world's most important market for photovoltaic systems. As a result of this development, the production costs of photovoltaic systems have fallen sharply in recent years (learning curve effects). The Progress Report therefore recommends a one-off 1 ct/kWh reduction in the basic rate of remuneration for all photovoltaic systems, while progressively increasing degression from the current rate of 5% to 7% p.a. from 2009 and 8% p.a. from 2011 (BMU, 2007b).

The new EEG applies the new degression rates from 2010 only. For 2010 they are set to 8% for installations up to 100 kW, and to 10% for larger ones and for freestanding facilities. From 2011 on, the degression is set to 9% for all installations. However, in view of the strong expansion of photovoltaic systems in Germany and the corresponding costs for the consumer, a new system aiming to control the expansion is adopted in the new EEG. In the event that additional photovoltaic installations exceed 1,500 MW in 2009, 1,700 in 2010 or 1,900 in 2011, degression will increase

by 1%. On the other side, degression will decrease by 1% if less then 1,000 MW in 2009, 1,100 MW in 2010 or 1,200 MW in 2011 are installed additionally in Germany (Bundesregierung, 2008).

5 Economic aspects of the new draft of the EEG

The continued expansion of renewable energies in the electricity sector has been, and remains, the primary goal of the EEG and a key government objective. The changed fees and degression steps in the new EEG of 6 June 2008 are essential if Germany is to achieve its new and more ambitious targets for renewable energies and climate protection.

As electricity production from modern renewable energies is currently still more expensive than electricity generation from Germany's existing stock of conventional power plants, this growth will initially lead to a further increase in the differential costs of the EEG[17] and the ensuing EEG surcharge payable by consumers.

In order to approximate the costs and the economic benefits of the EEG and of support provided for renewable energy in the electricity sector, beside other research projects, the BMU requested IfnE to work on a project on this issue (IfnE, 2007). Based on the quantity structure for renewables expansion in the electricity sector assumed in the lead scenario 2008 (Nitsch, 2007)[18], the differential costs of the EEG can be expected to almost double from €3.3 billion in 2006 to a maximum of around €6.2 billion in 2015. The increase in the differential costs is proportionately less than the increase in the amount of electricity produced within the scope of the EEG, however, which by then will have more than doubled from 51.5 to 130 TWh. After 2015, the differential costs will fall, despite continued increase in the amount of electricity being generated within the scope of the Act, as a growing share of this electricity will become more and more price-competitive, allowing the remuneration scheme to be phased out on a progressive basis (BMU, 2007a). The additional costs identified – which do not take account of positive macroeconomic factors – are moderate. Furthermore, latest developments at the European stock exchange for electricity in Leipzig, Germany, indicate that electricity prices might be considerable higher than had been expected when calculations for the differential costs were made in the context of writing the progress report. Hence the differential costs in future might be lower than expected and described above.

If macroeconomic factors are included in the economic analysis (reduction of external costs and energy import costs, downward pressure on prices due to the merit order effect, creation of jobs, investment and domestic turnover, exports, etc.), a very positive picture emerges, not only now but especially in the future.

For the individual customer who is not a beneficiary under Article 16 of the old EEG, these trends mean that the EEG surcharge of around 0.75 ct/kWh in 2006 is likely to increase to a maximum of approximately 1.5 ct/kWh within around 10 years, and will then steadily fall. These values must be viewed in context: residential electricity prices in Germany increased by around 5 ct/kWh in the 2000-2006 period alone, but for reasons unrelated to the EEG (BMU, 2007a).

If the expansion of renewables in the electricity sector is viewed in terms of the quantity structure posited in the lead scenario 2008 (Nitsch, 2007), the Federal Government's recommendations of 5 November and 7 December 2007 will result in additional differential costs of around €740 million p.a. in 2020 compared with the situation if the EEG had been retained as it stood. These additional differential costs

result primarily from more generous remuneration of offshore wind generation, which will create additional differential costs of around €800 million under the Act by 2020. The changes in the remuneration and degressive rates in the onshore wind energy, biomass, geothermal and hydropower sectors will increase the differential costs to around €250 million in total by 2020, whereas the reduction in the remuneration and increase in the degressive rates for photovoltaics will achieve savings of around €310 million.[19] However, the additional costs of the new EEG as adopted by the Bundestag will be slightly higher. (IfnE, 2007)

6 Conclusions

With its basic structure, which provides minimum rates of remuneration for the feed-in of renewable-generated electricity, the EEG has proved to be an exceptionally successful instrument for the promotion of renewable energies, both at national level and when compared with schemes elsewhere in the EU and worldwide. This is reaffirmed in the recent Commission communication of 23 January 2008. The Act's legal basis has created reliable investment conditions for system manufacturers, operators and financial institutions alike. No other instrument in Germany has resulted in greater reductions in CO_2 emissions. The Act will continue to be an essential element of climate protection in future. Its basic structure which has been so successful is retained, while improvements have been made on points of detail.

With the Federal Government's adoption of the Progress Report and the new EEG of 6 June 2008, this success story and Germany's pioneering role in the expansion of renewables in the electricity sector are set to continue. New and ambitious expansion targets for Germany are entirely appropriate given the dynamism of this well-performing industry and are essential if Germany is to achieve its climate targets. More rapid expansion of renewables and changes to the fees and degressive steps applicable under the Act will almost double the differential costs associated with the Act in around ten years. However, they will fall continuously thereafter and are therefore entirely justified from an economic perspective, especially bearing in mind the positive macroeconomic effects of the EEG. In order to facilitate this more rapid expansion, the EEG has been amended. One of the next and most important items on the German renewable energy agenda is to adopt an ordinance for better integration of renewable electricity. However, it is equally important also to adopt flanking measures on renewable energy expansion and create framework conditions and incentives which – especially in view of the growing share of renewable-generated electricity – facilitate the modernisation of the energy system towards sustainability. This includes e.g. a more comprehensive network management, the upgrade of the power grid system and more flexible conventional power plants (BMU, 2008c).

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Tables:

Table 1: Contribution of renewable energy sources to electricity generation in Germany, 1990-2007 (BMU, 2007b, 2008a, 2008b)

Figures:

Figure 1: Support schemes for renewables expansion in the European electricity market, 2008 (BMU, 2007b; ISI, 2008)

Figure 2: Trends in new capacity installed annually for electricity generation from renewable energies for the period 2000-2020 and 2030 Nitsch, 2008)

Figure 3: Trends in electricity generation from renewable energies 2000-2030 (Nitsch, 2008)

Figure 4: Development of energy-related CO_2 emissions in Germany, 1990-2020, based on the assumptions made by Nitsch (2007) (BMU, 2007b)

1 Both authors were responsible for producing and negotiating the Renewable Energy Sources Act Progress Report 2007 (BMU, 2007b) and were closely involved in the government and parliamentarian process of renewing the Act itself in 2007 (Bundesregierung, 2007) and 2008 (Bundesregierung 2008a). Furthermore, they are responsible for research projects used by the BMU to guide future strategy on the development of renewable energy in Germany (Nitsch, 2007 and 2008) and for the statistics on renewables in Germany (BMU 2008a, 2008b).

2 Electricity, heat and cold, and fuels/mobility

3 Electricity generated within the scope of the EEG, electricity generated outside the scope of the EEG, renewables-generated heat, biofuels.

4 Most jobs resulting from the Renewable Energy Sources Act are created in the wind energy sector with around 84,000 jobs.

5 The differential costs are the additional costs resulting from the total fee payments for renewable-generated electricity as compared with the energy supply companies' average avoided costs of purchasing the conventional electricity that would have been required without the feed-in of electricity from renewable sources under the Act, and which would have been charged to electricity consumers via their fuel bills.

6 Avoided climate and other damage.

7 It should be noted here that the above-mentioned positive macroeconomic effects – reduced energy import costs and external costs, as well as the merit order effect – cannot be offset against each other or against EEG-related costs as they must be attributed to different levels.

8 Electricity, heat/cold and fuels.

9 Under Article 1 of the EEG currently in force, the target is "at least 20%".

10 Heating, transport.

11 Between 1990 and 2005, the increase in energy productivity averaged around 1.6% p.a..

12 Since the consumption of gas for heating can be reduced through more efficiency and more renewable energy use for heat production, total demand for gas can remain constant over the short and medium term and can be reduced in the long run.

13 The numerator and denominator of the quotient have equal effect.

14 Networking of RE and other decentralised systems.

15 Replacement of old systems with new, more modern and efficient plants.

16 The Federal Government has already adopted a draft Biofuels Sustainability Ordinance on 5 December 2007.

17 See footnote 5

18 With the exception of photovoltaics, which due to the strong growth in recent years is now expected to achieve an installed capacity of 14 GW instead of the 10 GW stated in the Lead Scenario 2006.

19 In fact, the savings made by photovoltaics are much higher if the predicted stronger expansion of photovoltaics is taken into account; see footnote 18.