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Federal Ministry for Environment,  
Nature Protection and Reactor Safety

## **Indicative target of the Federal Republic of Germany for the consumption of electricity from renewable energy sources in 2010 and measures to achieve that target**

Report from the Federal Republic of Germany in accordance with Article 3(2) of EU  
Directive 2001/77/EC

Berlin, March 2003

## **1. Introduction**

Achieving a sustainable energy supply is a central policy objective of the Federal Government. It is a question of guaranteeing the energy supply for future generations, taking account of both ecological aims and economic growth. A key element of this strategy is also to increase significantly the proportion of renewable energies in the energy supply in the interests of ensuring lasting energy resources and environmental and climate protection. The Federal Government aims to double the proportion of renewable energies in electricity production between 2000 and 2010 to 12.5%. After 2010 there should be a significant acceleration of this trend. By the middle of the century, renewable energies should account for around half of energy consumption. This gives rise to indicative targets<sup>1</sup> for 2010 to 2050. The Federal Government aims to make renewable energies competitive in the internal energy market in the medium to long term. Only when renewable energies can compete without financial support can they play a leading role in the energy market on a permanent basis. Taking account of the various external costs (in particular long-term environmental and climatic damage) of conventional and renewable energies, whilst at the same time being economically acceptable, is still an important goal.

Germany's objective is embedded in a European context. In the EU Directive of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, targets for the share of electricity produced from renewable energy sources are given until 2010. According to this, the national target for Germany is to increase the proportion of electricity from renewables to 12.5%.

Despite unmistakable successes (renewable energy sources accounted for 4.6% of total energy consumption in 1998, almost 6.3% in 2000 and 6.7% in 2001) for the foreseeable future, the further development of renewable energies will still require targeted state support. This extends from the promotion of research and development in the field of renewable energies through the granting of investment incentives to stimulate demand to statutory feed-in and payment schemes.

One of the key elements of the energy package of the Federal Government is the Law on priority for renewable energy sources (Renewable Energy Law [Erneuerbare-Energien-Gesetz] - EEG, Annex I). The German Bundestag (lower house) adopted this law on 29 March 2000; it entered into force on 1 April 2000. Under this law, the feed-in and payment system for renewable energy already introduced in 1991 under the Grid Feed-In Law [Stromeinspeisungsgesetz] was adapted to the conditions in the liberalised electricity market and considerably improved.

Apart from the obligation to purchase electricity from renewable sources under the EEG, in conjunction with the Biomass Order (BiomasseV, Annex II), there are a number of investment incentives (including renewable energy incentive package, "100 000 roofs" solar electricity programme) and regulations promoting the development of renewable energies.

## 2. National indicative target for Germany

The national targets in the EU Directive on the promotion of electricity from renewable sources in the internal electricity market are based on the indicative objective of doubling the share of renewable energy in the Community by 2010. For the EU internal electricity market, the target is a 22% share of electricity from renewable energy sources by that date.

**The target for Germany in this process is to achieve at least a 12.5% share of electricity from renewable sources in the national electricity market by 2010.** This means more or less a doubling of the share of renewable energy sources over 2000 levels. This target is set in §1, Article 1 of the law on priority for renewable energies of 29 March 2000: *"The objective of this law is to promote the sustainable development of energy supply in the interest of climate and environmental protection and significantly increase the share of renewable energy sources in electricity generation, in order to at least double the share of renewable energy sources in total energy consumption by 2010 in accordance with the targets of the European Union and the Federal Republic of Germany."*

The share of gross electricity consumption accounted for by renewable energy sources is shown in Table 1.

	1997	1998	1999	2000*	2001*	2002*		2010
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<sup>1</sup> Cf. 2002 environment report and sustainable strategy of the Federal Government 2002.

Gross electricity consumption [TWh]	549.9	556.7	557.3	576.4	580.5	581.7		-
Share of renewable energy sources in gross electricity consumption	4.0 %	4.6 %	5.3 %	6.3 %	6.7 %	8.0 %		12.5 %

*Table 1: Share of renewable energy sources in gross electricity consumption (Source for the figures for years 1997 to 2002: DIW, VDW, BMU; \* provisional figures)*

## **2. Measures to achieve the national indicative target which have been adopted or are planned.**

### **Law on priority for renewable energies (EEG)**

The EEG regulates the grid feed-in and payment of electricity from hydropower, wind power, solar, geothermal, landfill gas, sewage gas, methane and biomass. Substances considered to be biomass within the meaning of §2 EEG are defined in a Biomass Order. These substances are thereby included in the statutory feed-in and payment scheme. It also contains provisions on the processes to be used for the production of electricity from biomass and lays down special environmental requirements for the biomass plants subsidised under the EEG in respect of certain categories of scrap wood.

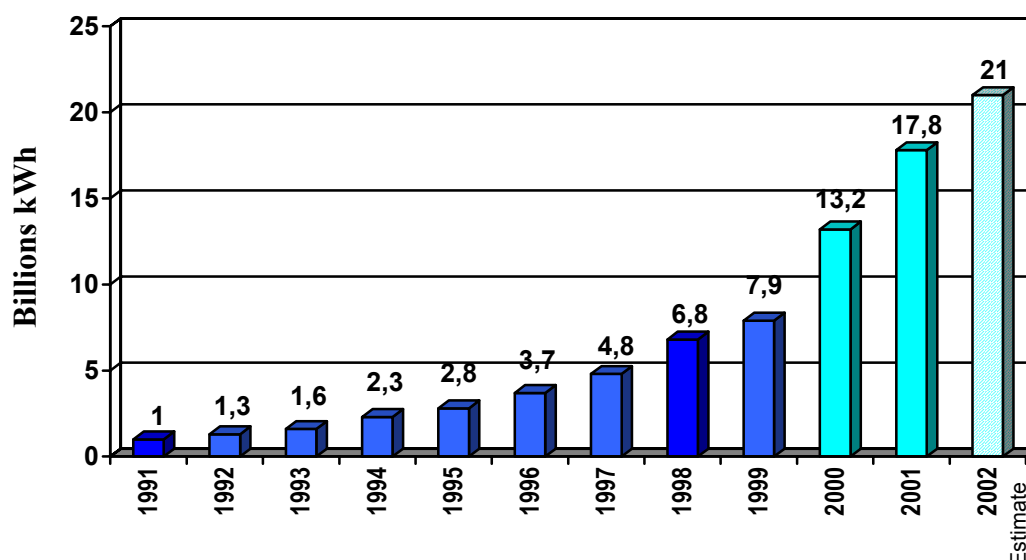
The EEG requires the grid operators to purchase electricity produced from renewable sources and to pay minimum rates to the generators. The price is based on the costs of producing the electricity from renewable sources, in order to make it economic to operate the plants producing electricity from such sources. The minimum rates depend on the type of energy source and to some extent the generating capacity of the plants and in the case of wind energy the location. With the exception of hydropower, they are fixed for a period of 20 years, commencing with the year of entry into service. Investors and credit institutes thus have planning certainty for their investment and lending decisions. Plant operators and planners also have to take account of anticipated inflation trends in the sector.

The rates for new plants producing electricity from biomass, wind energy and solar energy (particularly photovoltaic) also depend on the calendar year in which such plants are put into service: for the first time for electricity from plants which have entered into service since 1 January 2002, the rates are reduced by a statutory percentage depending on the type of energy source; this degression will be extended in the coming years. The digressive charging structure for electricity from new plants is intended to encourage producers to constantly improve efficiency in the production process and plant operation and exploit to the full their capacity to innovate. The following table (Table 2) shows the trend in the statutory rates for the period from 2000 to 2003 (disregarding inflation):

	<i>Annual degression from 1.2.2002</i>	<b>2000</b> (€-Ct/kWh)	<b>2001</b> (€-Ct/kWh)	<b>2002</b> (€-Ct/kWh)	<b>2003</b> (€-Ct/kWh)
Hydropower (< 500 kW)	0 %	7.67	7.67	7.67	7.67
Hydropower (> 500 kW)	0 %	6.65	6.65	6.65	6.65
Biomass (< 500 kW)	1 %	10.23	10.23	10.1	10.0
Biomass (< 5 MW)	1 %	9.21	9.21	9.1	9.0
Biomass (> 5 MW)	1 %	8.70	8.70	8.6	8.5
Geothermal (< 20 MW)	0 %	8.95	8.95	8.95	8.95
Geothermal(> 20 MW)	0 %	7.16	7.16	7.16	7.16
Wind energy(< 5 years)*	1.5 %	9.10	9.10	9.0	8.9
Wind energy (> 5 years)*	1.5 %	6.19	6.19	6.1	6.0
Photovoltaic	5 %	50.62	50.62	48.1	45.7

*Table 2: Rates for electricity from renewable energies for the years 2000 to 2003 (the figures apply for plants which have come onstream in the calendar year in question). Figures from VDN (Annex to EEG list of criteria for transmission grid operators, position at 1.1.2002) \*The duration of the payment for electricity from wind energy is stipulated in §7 EEG.*

The following diagram (Diagram 1) shows the trend in amounts of electricity fed in under the Grid Feed-in Law (1991 to 31.03.2000) and Renewable Energies Law (from 1.4.2000).



*Diagram 1: Amount of electricity fed in under Grid Feed-in Law and EEG since 1991<sup>2</sup>.*

Measures relating to selected technologies (photovoltaic, wind energy, biomass, hydropower, landfill gas and sewage gas) from the use of renewable energies are described in detail below.

### **Cost of EEG support**

Unlike its predecessor, the Grid Feed-in Law of 1991, the EEG provides for national equalisation of the costs arising from its feed-in and payment system between the grid operators and thus a uniform distribution of costs for the electricity generated among all energy consumers. The system of support for electricity generation from renewable energy sources under the EEG is based solely on relations under private law between the parties. For the eligible plant operators, the EEG establishes claims under private law to the feed-in and payment of the electricity from renewables falling within the scope of the law.

The national equalisation mechanism is also based on claims under private law between the grid operators: in addition the amounts of electricity from renewables taken by the respective grid operators and the statutory payments to be made

therefore are passed on to the level of the transmission system initially on an annual basis. The transmission system operators adjust amounts of electricity and payments between themselves so that each company assumes an equal share in electricity from renewables within the meaning of the EEG and the payments. The shared quantities and payments are then passed on by the transmission system operators - in the same proportions - to the electricity supply undertakings (EVU), which supply the end consumers, and electricity brokers in accordance with their share of electricity sales. The result is that all final supplier electricity undertakings and electricity brokers receive a uniform quota of EEG electricity (see so-called EEG-quota<sup>3</sup>) at a national uniform average price.

According to the figures of the Deutschen Vebundgesellschaft (DVG<sup>4</sup>), in the abbreviated year 2000 (01.04.2000 to 31.12.2000), with electricity generation from renewables of 9.9 billion kWh and total payment under the EEG of around €845.06 million, the EEG quota amounted to 2.9% and average payment<sup>5</sup> to 8.54 €-Ct/kWh. For 2001 the VDN gives a total volume of around 17.820 billion kWh in EEG feed-ins with around €1.54 billion in payments. This gives for 2001 an EEG quota of 3.90% and an average payment of 8.64 €-Ct/kWh.

For 2002 the VDN gives a total amount of around 24.600 billion kWh in EEG feed-ins with around €2.187 billion in payments (provisional figures).

The apportionment of EEG payments to total electricity production leads for 2001, in purely mathematic terms, to average costs per kWh of the order of €0.03. However this amount exaggerates the effect of the EEG, since the power procurement (17.82 billion kWh in 2001) by the electricity suppliers and electricity brokers displaced by the obligation to purchase EEG electricity must also be brought into the cost equation.

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<sup>2</sup> Source: 1991-1999: Staiss, Annual Report 2001, II-24; 2001,2000: VDN, 2002 (Estimate): VDN.

<sup>3</sup> EEG-quota: ratio of EEC feed-ins in all regulated areas to total amount of electricity supplied to the end consumers, minus the amounts falling within the scope of §11 para. 4 of EEG.

<sup>4</sup> On 01.01.2002 the DVG became the Association of grid operators (VDN). The figures on electricity generation and feed-in are always given for the previous calendar year. The figures for 2000 therefore come from the DVG, and those for 2001 from VDN.

<sup>5</sup> Average payment: average of feed-in payments for the various renewable energy sources, weighted according to their share of electricity generation from renewables.

According to the achievable market price for electricity from conventional energy sources, then on the basis of total payments for 2001, the costs per kWh under the EEG come to around 0.18 – 0.26 €-Ct/kWh<sup>6</sup>.

According to the Federal Lander responsible for electricity price supervision and monitoring of abuse of a monopoly position in the electricity field (insofar as only national procurement is concerned), acknowledge costs of around 0.25 €-Ct/kWh were to be assumed for 2001.

Not taken into account are the network costs avoided, according to the plant operators, through the mainly decentralised feed-in of electricity generated from renewables as well as the costs saved by lower network losses. Also left out of the equation are those costs which according to the grid operators arise through additional balancing power requirements as a result of the feed-in of electricity from renewables, and grid development costs as a result of the priority scheme under the EEG.

The passing on of costs under the EEG to the end consumers is not regulated in the law. In the liberalised electricity market, electricity suppliers and brokers are in principle free to determine how they pass on their costs and similar charges to their various customers and customer groups. Provided that there is objective justification, suppliers may under the law as it stands make a distinction between various customers and customer groups.

## **Photovoltaic**

Electricity from photovoltaic plants put into service before the end of 2001 is paid at a rate of 50.62 €-Ct/kWh, while in the case of plants coming on stream in 2002, the rate is 48.1 €-Ct/kWh. Photovoltaic (PV) energy, which currently makes the smallest contribution to energy supply in Germany, has the highest growth rates in comparison with other renewables. With the start of the "100 000 roofs" solar energy programme in January 1999 and the introduction of the EEG in April 2000 total installed PV capacity rose from 67 MW<sub>p</sub> in 1999 within a year to 111 MW<sub>p</sub> in 2000;

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<sup>6</sup> Medium and long term energy price trends are not taken into account in these calculations.



for 2001 loan commitments were approved for a further 67 MW<sub>p</sub> under the "100 000 roofs" solar energy programme. Further loan commitments of 80 MW<sub>p</sub> and 95 MW<sub>p</sub> respectively are forecast for 2002 and 2003 (according to the expansion target of the "100 000 roofs" solar energy programme); between 2001 and 2003 the installed capacity of around 180 MW<sub>p</sub> will therefore almost double to around 350 MW<sub>p</sub>.

According to DVG figures, in abbreviated year 2000 (01.04.2000 - 31.12.2000) around 26 million kWh were fed into the grid from PV plants and paid for under the EEG. In 2001, 60 million kWh of electricity were produced by PV plants, according to the VDN, and fed into the grid, and the EEG total payment for PV electricity amounted to around €30.4 million. The share of electricity supply accounted for by photovoltaic was therefore less than 0.05% in 2001.

## **Wind energy**

In recent years there has been such a boom in wind energy that today at around 60% it accounts for the largest share of electricity generation supported under the EEG. At the beginning of the 90s, there were according to the DVG only 18 MW of installed wind capacity in Germany; as a result above all of the 1991 Grid Feed-In Law installed wind capacity had already risen to 4 500 MW when the EEG was introduced on 1 April 2000. From over 8 700 MW of installed capacity at the end of 2001, total installed wind capacity increased to around 11 900 MW at the of 2002. The EEG total payment for wind energy was around €952 million in 2001. According to industry figures, turnover of around €3 to 3.5 billion was achieved in 2001.

According to the VDEW, around 16 800 million kWh of electricity from wind power plants were fed into the grid and paid under the EEG in 2002; this represents some 3.5% of net electricity consumption. The EEG total payment for wind generated electricity for 2001 is estimated at around €1 530 million.

The development of **offshore wind power plants** is of great importance for the Federal Government. In the areas of the EEZ probably available from a current perspective, under present conditions at least 500 MW of offshore wind power capacity could be achieved in the start-up phase up to 2006 and 2 000 to 3 000 MW

in the medium term - up to 2010. In the long term, i.e. by 2025 or 2030, some 20 000 to 25 000 MW of installed capacity is possible (coastal waters and EEZ) if efficient wind power generation can be achieved. For this it is necessary for investors in offshore wind farms and the electricity industry to create the conditions for the transmission of electricity generated offshore on this scale. Such use of offshore wind energy would represent 15% of electricity consumption, taking 1998 as reference year.

Under the EEG, electricity from wind power plants at coastal locations with restricted availability and above average yields, which went onstream before the end of 2001, qualify for a rate of 9.10 €-Ct/kWh in the first five years of their operational life, decreasing thereafter to 6.19 €-Ct/kWh.

For plants at inland locations with average yields, the initial phase of increased rates is extended. For offshore wind power plants the higher initial rates apply for a period of nine years, insofar as they come onstream by 31 December 2006.

On the basis of the degression provided for in the EEG, the rates were lowered for the first time on 1 January 2002 by 1.5%.

## **Biomass**

In 2001, some 1 400 million kWh of electricity were generated from biomass, representing 0.3% of domestic consumption. Because of the universal availability of biomass and the many electricity generating processes with a wide range of capacities, a **growing market** for electricity generation from biomass is anticipated. Electricity generation from biomass is however in competition with heat generation (according to the IOW biomass has a 3% share of heat consumption) and fuel production.

The Biomass Order (Annex II) determines which substances are regarded as biomass within the meaning of the EEG, which technical processes for the generation of electricity from biomass fall within the scope of the EEG and which environmental conditions have to be met.

According to the DVG, in the abbreviated year 2000 (01.04.2000 to 31.12.2000) some 540 million kWh biomass electricity was fed into the grid and paid for under the EEG. For the 1 400 million kWh of electricity fed into the grid in 2001, the total EEG payment for biomass amounted to some €132 million. Installed biomass capacity is currently around 300 to 350 MW.

Biogas plants have profited greatly from the introduction of the EEG and the market incentive programme. According to the IOW, there are now some 1 600 plants in Germany with total installed capacity of 140 MW; of this the year 2000 alone accounted for 600 new plants and 85 MW of newly installed capacity.

Electricity from biomass is paid according to capacity.

- up to 500 kW<sub>el</sub>: 10.23 €-Ct/kWh (2001); from January 2002: 10.1 €-Ct/kWh;
- up to 5 MW<sub>el</sub>: 9.21 €-Ct/kWh (2001); from January 2002: 9.1 €-Ct/kWh;
- up to 20 MW<sub>el</sub>: 8.70 €-Ct/kWh (2001); from January 2002: 8.6 €-Ct/kWh.

Plants with a capacity exceeding 500 kW receive the payment for the capacity range up to 500 kW for the proportion of electricity fed into the grid corresponding to the ratio of 500 kW to the nominal capacity of the plant in kW. The same applies for plants exceeding 5 MW. The minimum payments will be reduced annually by 1% from 1 January 2002 for new plants coming on stream.

## **Hydroelectric power**

In 2001, hydroelectric power, with 19 800 million kWh (figures from VDEW/Electricity industry association) accounted for some 4.4% of domestic electricity consumption. This is well over half of all electricity produced from renewables in Germany. Hydropower is therefore the most important renewable energy source at present. Electricity from hydroelectric power plants with an installed capacity of up to 5 MW is eligible for payment under the EEG.

It is not possible to give a precise indication of the amount of electricity fed into the grid or the payments to the around 6 000 hydroelectric power plants covered by the

EEG, since the data collected covers electricity from hydroelectric power, landfill gas, methane and sewage gas. The VDN gives the global figure for electricity fed into the grid of 5 909 million kWh, for which EEG payments amounting to €426 million were made. Of this, it is estimated that hydroelectric power accounts for around 4 200 million kWh and some €322 million.

Hydroelectric power plants are located mainly in Southern Germany. The shortage of so far unexploited locations, given the present conditions of economic viability, stringent environmental requirements and difficult approval procedures, mean that only modest growth in the number of plants can be expected in the future. According to the industry, the current growth rate of 20 to 25 MW per year should continue for another 10 to 15 years (giving a total of a further 200 to 300 MW).

The modernisation or replacement of old plants is also extremely important. In both cases both increased output and at the same time environmental improvements (e.g. areas reopened to walkers) can be achieved.

The average capacity of hydroelectric power plants has increased in recent years as a result of modernisation and replacement with more efficient plants. However, 3 200 (i.e. more than half) hydroelectric power plants still belong to the <50 kW category under the EEG; together they supply some 200 million kWh electricity each year.

The rate for electricity from hydroelectric power plants is 7.67 €-Ct/kWh (< 500 kW) or 6.65 €-Ct/kWh (500 kW - 5 MW). The law does not provide for any degression of the payments.

### **Sewage and landfill gas**

Landfill and sewage gas plants with a capacity of up to 5 MW also come under the EEG. The rate for electricity from plants up to a capacity of 500 kW is 7.67 €-Ct/kWh. In the case of larger plants this applies only to that proportion of the electricity fed into the grid corresponding to the ratio of 500 kW to the capacity of the plant; the rate for electricity generated above that figure is 6.65 cent/kWh.

According to the VDEW there were in 2000 268 landfill gas plants feeding electricity into the grid with a total installed capacity of 227 MW<sub>el</sub> and around 873 million kWh of electricity were fed into the grid from sewage and landfill gas plants. In 2001, around 1 700 million kWh of electricity was produced in landfill gas plants with an installed capacity of around 400 MW<sub>el</sub> and fed into the grid.

## **Investment support programmes for the promotion of renewable energies**

### **Market incentive programme in favour of renewable energies**

Funds from the market incentive programme are used to support the setting up of plants to produce electricity and/or heat from renewable energy sources; in practice the overwhelming majority of applications for aid under the market incentive programme concern plants for the generation of heat (e.g. solar collectors, biomass plants etc.). Since its start in September 1999 up to mid-2002, funds totalling some €550 million have been allocated to the market incentive programme from the Federal budget.

Up to 06.05.2002, the Federal Office for Industry and Export Controls (BAFA) received more than 252 000 applications for subsidies representing investments of around €2.58 billion for solar collectors, small plants for the firing of solid biomass, heat pumps and energy saving measures in buildings carried out in conjunction with the installation of solar collectors. Some 238 000 applications were approved during that period and grants totalling some €360 million committed. Grants totalling more than €220 million have already been paid out for around 156 000 projects.

Over the same period, the Kreditanstalt für Wiederaufbau (KfW) approved 880 loans totalling more than €195 million for biogas plants, large plants for the firing of solid biomass, plants for the exploitation of deep geothermal energy and small hydroelectric plants. These loans have also been approved by the Federal Government with partial debt remission amounting to €39.4 million.

### **"100 000 Roofs" Solar Energy Programme**

The "100 000 Roofs" Solar Energy Programme, which began on 1 January 1999, promotes the installation of photovoltaic equipment for the production of electricity. The aim is to achieve a further 300 MW of installed PV capacity by the end of 2003. By 31.05.2002, loans totalling €784 million had been committed for more than 35 000 projects with a PV capacity of 142 MW.

According to the development targets for the "100 000 Roofs" Solar Energy Programme, an additional 65 MW are to be achieved for 2001, 80 MW<sub>p</sub> for 2002 and 95 MW<sub>p</sub> for 2003.

### **Other support programmes**

Other limited possibilities of support for photovoltaic installations exist under the KfW-CO<sub>2</sub> Building Renovation Programme, in the case of houses built before 1979, and the KfW CO<sub>2</sub>-Reduction Programme.

The Federal Länder provide other means of support for the use of renewable energies under their own programmes.

### **ANNEX I: (Text of EEG)**

### **ANNEX II: (Text of Biomass Order)**