

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

## Renewable energy sources 2010

Data from the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the development of renewable energy sources in Germany in 2010 based on information supplied by the Working Group on Renewable Energy Sources –Statistics (AGEE-Stat)

Provisional data, as at 23 March 2011



#### IMPRINT

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As at:	23 March 2011; some figures provisional, data may still change

#### 1 Development of the expansion of renewable energy sources; shares of renewable energy sources in energy supply

In 2010 **renewable energy sources (RES)** further increased their contribution to Germany's energy supply. They provided 275 billion kilowatt hours (1 billion kWh = 1 terawatt hour, TWh), which is around 9 % more final energy in the electricity, heat and fuel sectors than in the previous year. Thus, in spite of the considerable rise in final energy consumption owing to the upswing in the economy, the renewables' share increased to 11.0 % (2009: 10.4 %). Renewable energy sources therefore kept pace with the economic recovery and the corresponding rise in energy demand and continued to gain a steadily rising share in Germany's energy consumption.

	2009	2010	Difference 2009 / 2010
Final energy from renewable energy sources	252bn kWh	275bn kWh	+ 9.1 %
Share of renewables in total final energy consumption <sup>1)</sup>	10.4 %	11.0 %	+ 5.8 %
Share of renewable electricity in total electricity consumption	16.3 %	16.8 %	+ 3.1 %
Share of renewable heat in total final energy consumption for $heat^{2)}$	9.1 %	9.8 %	+ 7.7 %
Share of renewables in total fuel consumption <sup>3)</sup>	5.5 %	5.8 %	+ 5.5 %
Share of renewables in total primary energy consumption <sup>4)</sup>	8.9 %	9.4 %	+ 5.6 %
Emissions avoided through use of renewables - Greenhouse gases - CO <sub>2</sub>	111m tonnes 110m tonnes	120m tonnes 117m tonnes	+ 8.1 % + 6.4 %
Investments in renewable energy sources installations	€ 19,9bn	€ 26.6bn	+ 33.7 %
Employees in renewables sector	339,500	367,400	+ 8.2 %

 Table 1:
 Renewable energy sources in Germany – key figures 2009/2010

1) Final energy consumption in 2010: 8,984 PJ, Energy Environment Forecast Analysis (EEFA) GmbH & Co KG

2) Final energy consumption for heat in 2010: 5,058 PJ; estimate ZSW

3) Fuel consumption and biofuel data for 2010 according to Federal Office of Economics and Export Control (BAFA)

4) Calculated according to the efficiency method; Working Group on Energy Balances (AGEB)

Data rounded and provisional, as at 23 March 2011; data may still change in the course of the year

Overall developments in 2010 show that Germany remains well on the way to achieving its ambitious targets for the expansion of renewable energy sources by 2020.



**Fig. 1:** Renewable energy sources as a share in final energy consumption in Germany - 2010

In 2010 **electricity generation** from hydro, wind, solar, biomass and geothermal energy climbed a good 7 % to just under 102 billion kWh, although poor wind conditions meant that wind energy fell even further short of its generation potential than in the previous year. While total electricity consumption rose by 4.3 % compared to 2009 as a result of the economic recovery, the renewable energy sources' share in electricity consumption rose to 16.8 % (2009: 16.3 %).

In 2010 around 80 billion kWh<sup>1</sup> - about 80 % - of renewable electricity was fed into the grid and paid for pursuant to the Renewable Energy Sources Act (EEG). The regulations of the EEG 2009 facilitated the further steady expansion of the share of renewable energy sources in the electricity sector.

Developments in new construction of electricity generation capacity in 2009 and 2010 show that in spite of the difficult economic climate this expansion continued successfully in most sectors. This is being analysed more closely in the framework of the EEG progress report which is currently being drawn up and which will be the main basis for EEG revision in 2012.

In the **heat market** use of renewable energy sources rose in 2010 by a good 11 % to just under 138 billion kWh. The main increases were recorded in the household use of wood, in heat pumps and heat generation in biogas-CHP facilities. Despite the rise in total heat consumption due to a combination of the economic upswing and cold weather, the share of renewable energy sources in heat consumption increased to 9.8 % (2009: 9.1 %).

<sup>1</sup> Provisional estimate, InfE, March 2011

Following a decline in the share of biofuels in 2008 and 2009, in 2010 the biofuels share in total fuel consumption rose to 5.8 % (2009: 5.5 %). Nearly 36 TWh of biofuels were consumed, around 6 % more than in the previous year.



Fig. 2: Renewable energy sources as a share in energy supply in Germany

#### **1.1** Renewable energy sources safeguard the climate protection target

The growing share of renewable energy sources reduces energy-related emissions and makes a significant contribution towards achieving the climate protection targets. Fossil energy sources are being replaced by renewables in all areas of consumption (electricity, heat, transport), with a corresponding drop in greenhouse gas emissions.

As a result, around 120 million tonnes of  $CO_2$  equivalents were avoided. The electricity sector accounted for 76 million tonnes of avoided greenhouse gases, around 58 million tonnes of which were attributable to electricity subject to the EEG tariffs. Around 38 million tonnes of  $CO_2$  equivalents were avoided in the heat sector and around 5 million tonnes of  $CO_2$  equivalents in the fuel sector. For carbon dioxide ( $CO_2$ ), avoidance in 2010 was around 117 million tonnes.

The accounting of avoided emissions always considers upstream process chains for extracting and supplying energy sources, as well as the manufacture of installations (upstream chains). In a net balancing, the fossil-based emissions which have been replaced by renewable energy sources are contrasted with the emissions arising from the upstream chains and the operation of renewable energy sources installations.

The greenhouse gas avoidance of bioenergy sources depends on both the emissions intensity of the replaced energy sources and on the type and origin of the raw materials used. Where these are not residual substances or waste, changes in land use due to the cultivation of energy crops have a significant influence on the level of greenhouse gas avoidance. Since current knowledge of the actual impacts is still inadequate and reliable methodologies have yet to be developed, at present changes in land use cannot be included in the calculation<sup>2</sup>.



**Fig. 3:** Greenhouse gas (GG) emissions avoided via the use of renewable energy sources in Germany 2010

## 2 Contributions by the different branches of renewable energy sources

#### 2.1 Electricity market

In 2010 the German wind energy market fell a little short of the previous year's rate of expansion. 1,551 MW of wind energy capacity were installed, around 19 % less than in 2009. Deducting the capacity which was dismantled in the course of repowering, in 2010 there was net new build of over 1,488 MW. By the end of 2010 a total of 21,585 wind turbines with an installed capacity of 27,204 MW were connected to the grid<sup>3</sup>. Offshore wind parks accounted for a good 108 MW of new build in 2010, and over the coming

<sup>2</sup> Federal Environment Agency (UBA): Emissionsbilanz erneuerbarer Energieträger. Durch Einsatz erneuerbarer Energien vermiedene Emissionen im Jahr 2007. Climate Change 12/2009, Dessau-Roßlau, 2009.

<sup>3</sup> German Wind Energy Institute (DEWI GmbH), February 2011

years, besides continued wind energy use on land, the number of wind turbines for offshore generation can also be expected to grow.

Despite the year's newly installed capacity, the wind power yield dropped again in 2010 due to poor wind conditions. At 36.5 billion kWh, it was even substantially below the 2007 level (39.7 billion kWh). An average wind year could be expected to yield around 6 billion more kWh. Nevertheless, in 2010 wind still retained its lead among renewables in the electricity sector, covering a good 6 % of total electricity consumption. This is equivalent to more than 10 million average households.<sup>4</sup>

At 19.7 billion kWh, electricity generation from **hydropower** stayed at around the same level as the previous year (19.1 billion kWh), thus proving once again to be a stable factor. As in previous years, increased capacity arising from new build or the modernisation of existing installations played a minor role.

**Table 2:** Share of renewable energy sources in total final energy consumption in 2009 and 2010 in Germany

	Electricity		Heat		Fuel		Total		Changes
	2009	2010	2009	2010	2009	2010	2009	2010	2009/2010
		[%]							
Hydro	19.1	19.7	-	-	-	-	19.1	19.7	3.1
Wind	38.6	36.5	-	-	-	-	38.6	36.5	- 5.4
Biomass <sup>1)</sup>	30.3	33.5	114.1	127.0	33.8	35.9	178.2	196.4	10.2
Photovoltaics	6.6	12.0	-	-	-	-	6.6	12.0	81.8
Solar thermal	-	-	4.7	5.2	-	-	4.7	5.2	10.6
Geothermal	< 0.1	< 0.1	4.9	5.6	-	-	4.9	5.6	14.3
Total	94.6	101.7	123.8	137.8	33.8	35.9	252.2	275.4	9.2

1) Solid and liquid biomass, biogas, landfill and sewage gas, biogenic share of waste

Figures are rounded and provisional, as at 23 March 2011; deviations in totals due to rounding

Electricity generation from **biomass** continued its upward trend in 2010. Around 12.8 billion kWh was produced from biogas – that is nearly 19 % more electricity than in the previous year (10.8 billion kWh). Together with other biogenic energy sources – solid and liquid biomass, biogas, landfill and sewage gas, as well as the biogenic share of waste – around 33.5 billion kWh were supplied from biomass in 2010, that is around 10 % more electricity than in 2009 (30.3 billion kWh). This gave biomass a 5.5 % share in electricity consumption (2009: 5.2 %).

The rapid growth of the German **photovoltaics market** made headlines in 2010. In the course of the year total installed capacity rose by around 7,400 MW - nearly 75 % - to 17,320 MW (2009: 9,914 MW). Photovoltaics generated 12 billion kWh, around 82 % more than in the previous year. This gave photovoltaics a 2 % share in total electricity consumption.

<sup>4</sup> Based on a household with 3,500 kWh/a



Fig. 4: Contribution of renewable energy sources to electricity generation in Germany



**Fig. 5:** Structure of electricity generation from renewable energy sources in Germany 2010

#### 2.2 Heat market

With its share of renewably generated heat still at around 92 %, total **biomass**<sup>5</sup> remained the dominant renewable in this sector in 2010, supplying a total of around 127 billion kWh – over 11 % more heat than in the previous year (114 billion kWh). The highest rate of increase was recorded in heat generation from biogas at just under 17 %, and in heat pumps and wood in private households, both with a good 14 % share.

While traditional logwood accounts for most heat generation from biomass, in recent years there has been a steady rise in the use of wood pellets in modern heating systems, reaching 1.2 million tonnes in 2010 (2009: 1.1m tonnes). However, new construction of pellet heating systems in 2010 was down by one quarter against 2009, with a total of 15,000 units. There are currently around 140,000 pellet heating systems<sup>6</sup>.



Fig. 6: Contribution of renewable energy sources to heat supply in Germany

The expansion of solar thermal energy slowed in 2010. Around  $1,150m^2$  new solar collector area was installed - about 27 % less than in the previous year. At the end of 2010, total installed collector area was thus approximately 14 million m<sup>2</sup>. With around 5.2 billion kWh (2009: 4.7 billion kWh) – equivalent to around 0.4 % of total heat consumption in Germany – heat supply from solar thermal energy was about 10 % higher than in 2009. There are currently some 1.15 million solar thermal installations operating in Germany<sup>7</sup>.

<sup>5</sup> Solid and liquid biomass, biogas, landfill and sewage gas, biogenic share of waste

<sup>6</sup> Deutscher Energieholz- und Pellet-Verband e.V. (DEPV), Press release of 28 January 2011

<sup>7</sup> Bundesverband Solarwirtschaft e.V. (BSW), Press release of 30 December 2010

New build of heat pump systems also lost a little momentum in 2010, with 47,700 new systems<sup>8</sup>. This is around 13 % less than the previous year. By the end of 2010 there were just under 360,000 systems which supplied around 5.3 billion kWh (2009: 4.6 billion kWh) of renewable heat.



Fig. 7: Structure of heat supply from renewable energy sources in Germany - 2010

#### 2.3 Biofuels

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After a decline in the biofuels market over the two previous years, 2010 saw a slight rise. Total biofuels sales rose to 3.8 million tonnes (2009: 3.5 million tonnes). Both more biodiesel (+ 3 %) and more bioethanol (+ 28 %) were sold in 2010, while vegetable oil played a far less significant role with sales of 61,000 tonnes.

Bundesverband Wärmepumpe e.V. (BWP), information provided by BWP, 3 February 2011



Fig. 8: Contribution of renewable energy sources to fuel consumption in Germany

## 3 Economic aspects of the expansion of renewable energy sources in 2010

#### 3.1 Tariff payments, differential costs and EEG apportionment

In line with the continued increase in electricity volumes covered by the EEG, the corresponding **tariff payments** to installation operators also rose last year. According to the transmission system operators (TSOs), these payments amounted to around 12.7 billion euros in 2010. This is an increase of around 13 % against 2009 (10.8 billion euros)<sup>9</sup>, and can primarily be attributed to intensive new build in the photovoltaics sector.

However, for electricity consumers the resulting **differential costs** and the so-called **EEG apportionment** are relevant. Since 2010, on the basis of the Ordinance on the further development of the equalisation scheme (AusglMechV)<sup>10</sup>, these costs have been derived from the full sale of EEG electricity on the electricity exchange. Due to the change in the calculation method, it is only possible to make a limited comparison of these figures with those of the previous year.

Under the provisions of the AusglMechV at the end of 2009, the TSOs had initially forecast a total of 8.2 billion euros in EEG differential costs for 2010, and laid down an EEG

<sup>9</sup> Total figure, excluding avoided grid charges

<sup>10</sup> Ordinance on the further development of the equalisation scheme (AusglMechV) of 17 July 2009 including the relevant implementing ordinance (AusglMechAV).

apportionment of 2.05 cent/kWh<sup>11</sup>. This was to be charged as an advance payment throughout 2010 and applied to all electricity consumers not covered by the special regulations in the EEG (in particular, Section 37 EEG/ the so-called green electricity privilege, and Section 40 ff EEG/special equalisation scheme). Over the course of the year it became apparent that the TSO forecast was too low as they had underestimated new build in the photovoltaics sector and estimated the revenues from EEG power sold on the electricity market too high. The TSO forecast for 2011, drawn up on 15 October 2010, therefore included a back payment of around 1.1 billion euros<sup>12</sup>. This means that the EEG apportionment for 2011 (3.53 cent/kWh), also levied as an advance payment, is around 0.3 cent/kWh higher than it would be given a precise calculation for the year.

The expansion figures now known for 2010 indicate that differential costs were probably around 9 billion euros last year, giving an EEG apportionment of around 2.2 cent/kWh.

The special equalisation scheme under the EEG means that particularly electricityintensive companies and rail operators have very low EEG apportionment costs, mostly restricted to 0.05 cent/kWh. Without this concession, the general EEG apportionment costs for non-privileged electricity customers would be nearly 20 % lower.

However, a sound economic evaluation of renewable energy sources or the EEG cannot be conducted solely on the basis of the above-mentioned cost variables, which are generally the main focus of public debate. A wide range of other effects and various complex interactive mechanisms must also be taken into account, including the effects of renewables on revenues and employment, as outlined below. In particular, the environmental damage avoided through the substitution of fossil energy sources, which up to now has generally not been properly accounted for in accordance with the polluter pays principle (external costs), has a significant influence on the **macro-economic cost benefit analysis** of renewable energy sources. In 2009 gross external costs in the electricity and heat sectors were just under 8 billion euros, or 7 billion euros if the CO2 costs internalised through emissions trading are netted out. In terms of distribution, the price-curbing effect of electricity generated from renewables on the electricity market (merit order effect) must also be taken into account. In recent years, this has been around 0.6 cent/kWh per annum, thus lowering the purchase price of electricity<sup>13</sup>.

#### 3.2 Support for market introduction and research

The expansion of heat generation from renewable energy sources (RE) has continued to develop. This is partly due to the utilisation obligation under the Renewable Energy sources Heat Act (EEWärmeG) and partly to the financial support under the EEWärmeG, i.e. the **market incentive programme for renewable energy sources (MAP)** 

<sup>11</sup> Detailed information on the forecasts and calculations of the TSOs, including for 2011 and beyond, can be found at www.eegkwk.net. Precise calculations can only be made in the following year on the basis of the EEG annual accounts which the TSOs must submit by 31 July.

<sup>12</sup> This was the (negative) balance of the EEG account on 30 September 2010. By the end of the year the shortfall had risen slightly to 1.3 billion euros.

<sup>13</sup> More details on the cost-benefit effects of renewable energy sources: Fraunhofer ISI (project management)/DIW/GWS/IZES: Einzelund gesamtwirtschaftliche Analyse von Kosten- und Nutzenwirkungen des Ausbaus erneuerbarer Energien im deutschen Stromund Wärmemarkt/Zahlenupdate für 2009: Study on behalf of the BMU, May 2010; published at www.erneuerbare-energien.de. An update of key cost-benefit effects for 2010 is due to be published shortly.

The MAP was established over a decade ago and has been legally anchored in the EEWärmeG since the Act entered into force on 1 January 2009. Details of support under the MAP are laid down in guidelines.

The Federal Office for Economics and Export Control (BAFA) processes MAP grants, and in 2010 around 146,000 investment grants were approved for solar thermal installations, biomass boilers and efficient heat pumps<sup>14</sup>. Under the KfW section of MAP (KfW premium scheme for renewable energy sources) over 2,260 long-term loans with redemption grants were approved for larger investment projects such as heat grids fed with renewable energy sources, solid biomass installations and biogas pipelines.

In all, MAP triggered investments of 2.15 billion euros, with a support volume of 346 million euros.



**Fig. 9:** Investment and funding volumes of the German market incentive programme for renewable energy sources (MAP), 2005 to 2010

**Research funding** for renewable energy sources also grew again in 2010. Funding of over 120 million euros flowed into project support from the BMU, which is responsible for supporting research and development in the field of renewables.

<sup>14</sup> As support under the BAFA section of the MAP is sometimes paid considerably after the time of investment, it is difficult to apportion the support amount to the investment year. In the KfW section of the programme, on the other hand, payment is made prior to the investment.



Fig. 10: Federal Government expenditure on research into renewable energy sources

This was a rise of around 10 % compared to 2009 (about 109.5 million euros) and continues the upward trend in funding noted in previous years. Taking the research funding of other federal ministries into account, the German government's research support last year was in the region of 220 million euros<sup>15</sup>.

In addition to supporting projects, the German government also promotes research and development in the field of renewables through core funding of research centres and institutes which are affiliated to the **Helmholtz Association (Helmholtz-Gemeinschaft - HGF)** and the **Fraunhofer-Gesellschaft**. The HGF institutes are also supported by the respective federal state (90 % federation and 10 % federal state). In 2010, research institutions active in the field of renewables received federal funding of 56 million euros in total.

## 3.3 Investments and employment in the renewable energy sources sector

In 2010, renewables again underlined their growing importance as an economic factor. Initial estimates for the BMU show that investments in renewable energy sources installations had again risen by one quarter against the previous year and stood at around 26.6 billion euros (2009: 19,9 billion euros).

<sup>15</sup> Some figures based on estimates. Details will be published in April 2011 in the BMU annual report on reserach support in the renewables sector.



Fig. 11: Investments in renewable energy sources installations in Germany - 2010

Photovoltaics accounted for by far the largest share, at around 19.5 billion euros. Other branches experienced a slight decline in investments. In the electricity sector this was due in part to the after effects of the financial and economic crisis, while in the heat sector there was uncertainty on the market due to the temporary suspension of the MAP.

Employment in the renewables sector reflects the increase in investment, and was up again compared to the previous year. In an estimate for 2010, an ongoing research project for the BMU gives 367,400 jobs in the manufacture of renewable energy sources installations, including exports, their operation and in the supply of biomass and biofuels, including the respective upstream value-added stages<sup>16</sup>.

Compared to the previous year (around 339,500 employees) this is an increase of just under 8 %. Thus the number of jobs attributable to renewable energy sources is more than double the 2004 figure of around 160,500 employees (a plus of 206,900 jobs or about 129 %).

<sup>16</sup> O'Sullivan/Edler/van Mark/Nieder/Lehr: Bruttobeschäftigung durch erneuerbare Energien im Jahr 2010 – eine erste Abschätzung (Stand: März 2011). Interim report on the research project "Kurz- und langfristige Auswirkungen des Ausbaus erneuerbarer Energien auf den deutschen Arbeitsmarkt" (short and long-term effects on the German employment market of the expansion or renewable energy sources) commissioned by the BMU and conducted by GWS/project management, DIW, DLR, Fraunhofer ISI, ZSW; as at 18 March 2011, Publication in preparation. The study also looks at employment in Germany manufacturers of facilities for the production of renewable energy installations. For methodological reasons, this is not taken into full account in the figures; it was, however, a significant factor due to high export quotas, especially in the solar power sector.



Fig. 12: Jobs in the renewable energy sources sector in Germany

The positive developments in employment this year were primarily due to growth in the photovoltaics industry. A slight upward trend was also recorded in the biogas sector. The above study noted a decline – in some cases marked - in all areas of the heat market, with less significant falls in the wind sector.

Biomass (totalling around 122,000 jobs) and solar power (120,900 jobs) each contributed about one third to gross employment in renewables in 2010. These are followed by wind energy with just under 26 % (96,100) geothermal energy with around 4 % (13,300) and hydropower with 2 % (7,600).

Employment in the field of publicly funded research and administration is estimated at around 7,500 jobs for 2010.

#### Sources:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)

Working Group on Renewable Energy Sources -Statistics (AGEE-Stat)

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Wuerttemberg, ZSW)

Federal Environment Agency (UBA)

Federal Statistical Office (StBA)

Federal Office of Economics and Export Control (BAFA)

Bundesnetzagentur (Federal Network Agency, BNetzA)

Fachagentur Nachwachsende Rohstoffe e. V. (FNR)

Arbeitsgemeinschaft Energiebilanzen e.V. (Working Group on Energy Balances, AGEB)

Bundesverband der Energie- und Wasserwirtschaft e.V. (Federal Association of the Energy and Water Industries, BDEW)

Bundesverband Solarwirtschaft e.V. (BSW-Solar)

Bundesverband WindEnergie e.V. (BWE)

Bundesverband Wärmepumpe e.V. (BWP)

Bundesverband Geothermie e.V. (GtV)

The German Biomass Research Centre (DBFZ)

Deutscher Energie und Pellet-Verband e.V. (DEPV)

Deutsches Institut für Wirtschaftsforschung e.V. Berlin (German Institute for Economic Research, DIW Berlin)

Deutsches Windenergie-Institut (German Wind Energy Institute, DEWI GmbH)

Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Aerospace Centre, DLR)

Gesellschaft für Wirtschaftliche Strukturforschung mbH (Institute of Economic Structures Research, GWS)

Ingenieurbüro für neue Energien (IfnE)

#### Note:

The data published here are provisional and may still change in the course of the year. Differences between the figures in the tables and the corresponding column or line totals are due to rounding.

Further information on renewable energy sources can be found on the BMU website www.erneuerbare-energien.de.

Appendix

# Graphs and tables on the development of renewable energy sources in Germany 2010

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 Table 3:
 Contribution of renewable energy sources to energy supply in Germany 2010

Contribution of renewable energy sources to energy supply in Germany 2010								
Share of renewable energy sources								
in total final energy consumption		11.0						
in total gross electricity consumption		16.8						
in total heat supply	[%]	9.8						
In total fuel consumption*		5.8						
in total primary energy consumption		9.4						
Greenhouse gas emissions reduction through the use of renewable energy sources								
all renewable energy sources		approx.120						
electricity quantity generated by renewables paid for under the EEG	[mill. t]	approx.58						

Final energy supply from renewable energy sources									
Electricity									
Hydropower		19.7							
Wind energy		36.8							
Biomass (total)		33.5							
therefrom:									
solid biomass, including biogenic waste	ITWh	16.9							
liquid biomass	= (1 bn	2.0							
biogas	kWh)	12.8							
landfill and sewage gas	1	1.8							
Photovoltaics	1	12.0							
Geothermal energy		0.027							
Total electricity		101.7							
Heat									
Biomass (total)		127.0							
therefrom:									
solid biomass, including biogenic waste	1	113.4							
liquid biomass		4.6							
biogas	[TWh]	7.6							
landfill and sewage gas	kWh	1.5							
Solar thermal energy	Í	5.2							
Deep geothermal energy		0.3							
Near surface geothermal energy	1	5.3							
Total heat		137.8							
Biogenic fuels									
Biodiesel (approx. 2.6 mill. t)		26.6							
Vegetable oil (approx. 0.1 mill. t)	[TWh]	0.6							
Bioethanol (approx. 1.2 mill. t)	= (1  bh)	8.7							
Biogenic fuels total	,	35.9							
Total final energy from renewable energy sources	[TWh] = (1 bn kWh)	275.4							

1) Total consumption of engine fuels, excluding fuel in air traffic

2) Calculated according to efficiency method; Source: Working Group on Energy Balances e.V. (AGEB)

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009	2010
Final energy consumption (FEC)	[%]											
Electricity generation (in relation to total gross electricity consumption)	3.1	3.7	4.2	4.1	4.7	6.4	7.8	9.2	11.6	15.1	16.3	16.8
Heat supply (in relation to total heat supply)	2.1	2.1	2.2	2.0	3.6	3.9	4.3	5.5	6.2	7.4	9.1	9.8
Fuel consumption <sup>1)</sup> (in relation to total fuel consump- tion)	0.0	0.01	0.05	0.09	0.2	0.4	0.9	1.8	6.3	5.9	5.5	5.8
Renewable energy sources as a share of total FEC	1.9	2.1	2.2	2.1	3.2	3.8	4.5	5.9	8.0	9.3	10.4	11.0
Primary energy consumption (PEC)	Iry energy consumption (PEC) [%]											
Renewable energy sources as a share of total PEC <sup>2)</sup>	1.3	1.4	1.8	1.8	2.6	2.9	3.2	4.5	6.4	8.1	8.9	9.4

#### **Table 4:** Renewable energy sources as a share of energy supply in Germany

1) Until 2002 the reference variable was fuel consumption in road traffic, from 2003, the reference variable is the total consumption of engine fuels, excluding fuel in air traffic

2) Calculated according to efficiency method; Source: Working Group on Energy Balances e.V. (AGEB)

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data



Fig. 13: Share of renewable energy sources in total final energy consumption 2009/2010

	Hydro- power <sup>1)</sup>	Wind- energy	Biomass <sup>2)</sup>	Biogenic share of waste <sup>3)</sup>	Photo- voltaics	Geothermal energy	Total electricity generation	Share of gross elec- tricity con- sumption
	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[%]
1990	15,580	71	222	1,213	1	0	17,086	3.1
1992	18,091	275	296	1,262	3	0	19,927	3.7
1994	19,501	909	569	1,306	8	0	22,293	4.2
1996	18,340	2,032	759	1,343	16	0	22,490	4.1
1998	18,452	4,489	1,642	1,618	32	0	26,233	4.7
2000	24,867	7,550	2,893	1,844	64	0	37,218	6.4
2001	23,241	10,509	3,348	1,859	76	0	39,033	6.7
2002	23,662	15,786	4,089	1,949	162	0	45,648	7.8
2003	17,722	18,713	6,086	2,161	313	0	44,995	7.5
2004	19,910	25,509	7,960	2,117	556	0.2	56,052	9.2
2005	19,576	27,229	10,978	3,047	1,282	0.2	62,112	10.1
2006	20,042	30,710	14,841	3,675	2,220	0.4	71,488	11.6
2007	21,249	39,713	19,760	4,130	3,075	0.4	87,927	14.2
2008	20,446	40,574	22,872	4,659	4,420	17.6	92,989	15.1
2009	19,059	38,639	25,989	4,352	6,578	18.8	94,636	16.3
2010	19,694	36,500	28,710	4,750	12,000	27.2	101,681	16.8

#### **Table 3:** Contribution of renewable energy sources to electricity generation in Germany

1) In the case of pump storage power plants, electricity generated from natural inflow only

2) Solid and liquid biomass, biogas, landfill and sewage gas; until 1998 only feed-in the general supply grid

3) Share of biogenic waste in incineration plants estimated at 50 %

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data

Table 4:	Installed capacity for electricity generation from renewable energy sources in Ger-
	many

	Hydropower	Wind energy <sup>1)</sup>	Biomass <sup>2)</sup>	Biogenic share of waste <sup>3)</sup>	Photovoltaics	Geothermal energy	Total capacity
	[MW]	[MW]	[MW]	[MW]	[MW <sub>p</sub> ]	[MW]	[MW]
1990	4,403	55	85	499	1	0	5,043
1992	4,489	174	105	499	3	0	5,270
1994	4,529	618	178	499	6	0	5,830
1996	4,563	1,549	253	551	11	0	6,927
1998	4,600	2,877	432	540	23	0	8,472
2000	4,600	6,097	579	585	76	0	11,937
2001	4,600	8,750	696	585	186	0	14,817
2002	4,620	11,989	843	585	296	0	18,333
2003	4,640	14,604	1,091	847	435	0	21,617
2004	4,660	16,623	1,444	1,016	1,105	0.2	24,848
2005	4,680	18,390	1,964	1,210	2,056	0.2	28,300
2006	4,700	20,579	2,620	1,250	2,899	0.2	32,048
2007	4,720	22,194	3,434	1,330	4,170	3.2	35,851
2008	4,740	23,836	3,969	1,440	6,120	3.2	40,108
2009	4,760	25,716	4,519	1,460	9,914	7.5	46,377
2010	4,780	27,204	4,910	1,480	17,320	7.5	55,702

1) Source: DEWI GmbH

2) Solid and liquid biomass, biogas, landfill and sewage gas

3) Share of biogenic waste in incineration plants estimated at 50 %

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data

	Biomass <sup>1)</sup>	Biogenic share of waste <sup>2)</sup>	Solar thermal energy	Geothermal energy	Total heat generation	Share of heat consumption
	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[%]
1990	28,265	2,308	107	1,515	32,195	2.1
1992	28,362	2,308	221	1,522	32,413	2.1
1994	28,375	2,308	355	1,537	32,575	2.2
1996	28,277	2,538	549	1,551	32,915	2.0
1998	49,740	3,405	848	1,604	55,597	3.6
2000	51,419	3,548	1,261	1,694	57,922	3.9
2001	58,220	3,421	1,587	1,765	64,993	4.2
2002	57,242	3,295	1,884	1,855	64,276	4.3
2003	69,182	3,169	2,144	1,956	76,451	5.0
2004	75,376	3,690	2,443	2,086	83,595	5.5
2005	79,746	4,692	2,778	2,294	89,510	6.0
2006	83,023	4,911	3,218	2,762	93,914	6.2
2007	86,670	4,783	3,638	3,415	98,506	7.4
2008	93,133	5,020	4,134	4,168	106,455	7.4
2009	103,247	10,863	4,733	4,931	123,774	9.1
2010	115,150	11,850	5,200	5,585	137,785	9.8

#### **Table 5:** Contribution of renewable energy sources to heat supply in Germany

1) Solid and liquid biomass, biogas, landfill and sewage gas

2) Share of biogenic waste in incineration plants estimated at 50 %, Increase in 2009 compared to previous year due to newly available data being taken into account for the first time. This is a statistical modification and does not allow a statement on the actual expansion to be made

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data

Table 6:	Contribution of	renewable energy	sources to fuel	supply in German	y
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	Biodiesel	Vegetable oil	Bioethanol	Total biofuels generation	Share of biofuel consumption
	[GWh]	[GWh]	[GWh]	[GWh]	[%]
1990	0	n.a.	0	0	0.0
1992	52	21	0	73	0.01
1994	258	42	0	300	0.05
1996	516	84	0	600	0.09
1998	1,032	115	0	1,147	0.2
2000	2,579	167	0	2,746	0.4
2001	3,611	209	0	3,820	0.6
2002	5,674	251	0	5,925	0.9
2003	8,253	292	0	8,545	1.4
2004	10,833	345	481	11,659	1.8
2005	18,570	2,047	1,674	22,291	3.7
2006	29,310	7,426	3,540	40,276	6.3
2007	33,677	8,066	3,412	45,155	7.2
2008	27,812	4,188	4,673	36,673	5.9
2009	25,972	1,043	6,748	33,763	5.5
2010	26.641	636	8,662	35.939	5.8

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat), BMF, BAFA, StBA and FNR; as at: 23 March 2011, provisional data



Fig. 14: CO<sub>2</sub> avoidance via the use of renewable energy sources in Germany

		<b>2000</b> <sup>1)</sup>	2002	2004	2006	2008	2009	2010
Total end consumption	[GWh]	344,663.4	465,346.4	487,626.9	495,203.0	493,505.8	466,054.7	485,000
Privileged end consump- tion <sup>2)</sup>	[GWh]	-	-	36,865.3	70,160.9	77,990.5	65,022.7	75,000
EEG electricity volume total <sup>3)</sup>	[GWh]	10,391.0	24,969.9	38,511.2	51,545.2	71,147.9	75,053.4	80,527
Hydropower, gases <sup>4)</sup>	[GWh]	4,114.0	6,579.3	4,616.1	4,923.9	4,981.5	4,877.2	5,000
Gases <sup>4)</sup>	[GWh]			2,588.6	2,789.2	2,208.2	2,019.5	2,000
Biomass	[GWh]	586.0	2,442.0	5,241.0	10,901.6	18,947.0	22,979.9	25,000
Geothermal energy	[GWh]	-	-	0.2	0.4	17.6	18.8	27
Wind energy	[GWh]	5,662.0	15,786.2	25,508.8	30,709.9	40,573.7	38,579.7	36,500
Solar irradiation energy	[GWh]	29.0	162.4	556.5	2,220.3	4,419.8	6,578.3	12,000
Averade fee	[ct/kWh]	8.50	8.91	9.29	10.88	12.25	13.95	15.3
Total fee <sup>5)</sup>	[Mrd. EUR]	0.88	2.23	3.61	5.81	9.02	10.78	12.70
EEG differential costs <sup>6)</sup>	[Mrd. EUR1	0.9	1.7	2.4	3.3	4.7	5.3	8.8

Table 9: 3	Structure o	f electricity	volumes	remunerated	under the	EEG since 2000
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1) Short year: 01/04. - 31/12/2000

2) Privileged end consumer under the special regulations (Sections 11 and 16 EEG) (since July 2003)

 Does not include post-corrections by the VDN (2002 to 2009) because according to auditors' certificates the additional feed-ins for the previous years cannot be allocated to energy sources

4) Landfill, sewage and mine gas listed separately for the first time in 2004

5) Total tariff payments to operators of installations covered by EEG (before deduction of avoided grid use charges)

6) EEG differential costs, taking avoided grid charges into account

Sources: EEG annual accounts, information platform of the German transmission grid operators, http://www.eeg-kwk.net; as at: March 2011; data for 2010: estimate based on data of AGEE-Stat; source: Ingenieurbüro für neue Energien (IfnE), as at: March 2011, data provisional pending publication of the EEG annual account of the TSOs.

### Table 7: Investments in the construction of renewable energy sources installations in Germany 2010

Investments 2010						
Hydropower	70 mill. EUR	0,3 %				
Geothermal energy	850 mill. EUR	3,2 %				
Solar thermal energy	950 mill. EUR	3,6 %				
Biomass, heat	1.150 mill. EUR	4,3 %				
Biomass, electricity	1.550 mill. EUR	5,8 %				
Wind energy	2.500 mill. EUR	9,4 %				
Photovoltaics	19.500 mill. EUR	73,4 %				
Total	26.570 mill. EUR	100 %				

Source: BMU-KI III 1 according to the Working Group on Renewable Energy Sources -Statistics (AGEE-Stat); as at: 23 March 2011, provisional data

Table 8:	Jobs in the renewable energy sources sector in Germany	- 2010
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	Employment through invest- ment (incl. export)	Employment through service and operation	Employment through fuel supply	Employment total 2010	Employment total 2009
Wind onshore	71,300	17,900		89,200	95,600
Wind offshore	6,400	500		6,900	6,500
Photovoltaics	102,100	5,700		107,800	64,700
Solar thermal energy	8,800	2,300		11,100	13,900
Concentrated solar thermal power installations	2,000			2,000	2,000
Hydropower	3,300	4,300		7,600	7,800
Deep geothermal energy	1,100	200		1,300	1,300
Near-surface geothermal energy	9,100	2,900		12,000	13,200
Biogas	15,900	7,100	12,100	35,100	30,900
Liquid Biomass	100	1,600	1,200	2,900	3,000
Biomass (small installations)	9,700	13,600	13,100	36,400	41,400
Biomass (co-generation power and heating installations)	4,300	14,000	6,200	24,500	26,600
Biogenic fuels			23,100	23,100	26,100
Total	234,100	70,100	55,700	359,900	333,000
Employment through publicly funded research/administration				7,500	6,500
Total				367,400	339,500

2009 and 2010 provisional estimates; deviations in the totals due to rounding;

Source: O'Sullivan/Edler/van Mark/Nieder/Lehr: "Bruttobeschäftigung durch erneuerbare Energien im Jahr 2010 – eine erste Abschätzung" (as at 18 March 2011); interim report on research project "Kurz- und langfristige Auswirkungen des Ausbaus erneuerbarer Energien auf den deutschen Arbeitsmarkt"

#### INFORMATION ON RENEWABLE ENERGY SOURCES

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