

Research project
commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Short- and long-term impacts of the expansion of renewable energy on the German labour market: annual report on gross employment

(Project ref.: 0325042)

**Gross employment from renewable energy in Germany in
2010**

- a first estimate -

As at: 18 March 2011

**Marlene O'Sullivan (DLR), Dietmar Edler (DIW), Kerstin van Mark (ZSW),
Thomas Nieder (ZSW), Ulrike Lehr (GWS)**

INTRODUCTION

The expansion of renewable energy (EE) in Germany has generated a domestic industry that continues to grow in economic importance and has already achieved significant successes in international markets. In 2010, the economic development of the individual sectors of this industry differed greatly. Despite cuts in feed-in tariffs for photovoltaic systems, 2010 still saw a record number of installations in Germany, with the domestic industry managing to keep pace with this development. On the other hand, the suspension of the market incentive programme for renewable energies (MAP) weakened the heat market significantly. The wind energy market in Germany suffered its worst year since 1999 and internationally no uniformly stable development could be identified.

This study focuses on the employment attributable to the renewable energy sector in Germany. For 2009, gross employment in the renewables industry was estimated at around 339,500 [BMU11]. Gross employment refers to the total number of people employed directly in the manufacturing, operation or maintenance of renewable energy facilities or the supply of fuel for them, as well as to people indirectly employed as a result of the demand from these activities for supplies of goods and services. This brochure describes the latest trends in the industry and gross employment for 2010. This is done in the context of an ongoing study commissioned by the Federal Environment Ministry (BMU) on the short- and long-term impacts of the expansion of renewable energy on the labour market.

Central to the calculations is the turnover of companies manufacturing renewable energy (RE) facilities in Germany. This turnover represents domestic and international demand covered by domestic production. It is based on 2010 investments in Germany and estimates of developments in international trade. Based on this turnover, gross employment is determined by input output analysis, using the 2006 Input Output Table from the Department of Statistics [StaBu10]. The RE sector is represented by technology-specific vectors derived from a survey using the base years 2004 and 2007. Relevant benchmark data, such as the productivity of individual sectors, are adjusted in the same way as in the estimates from previous years [BMU06/BMU07a/BMU08/BMU09/BMU10/BMU11].

A similar procedure is used to estimate the employment provided by operating and maintaining plant and equipment installed in Germany. Employment arising from the supply of biogenic fuels is also determined using input output analysis.

In addition to this, the expansion of renewable energy jobs has also generated administrative and research jobs financed by public funding. They have once more been included in the following estimate.

Jobs with German manufacturers of equipment to produce renewable energy installations have to date not been included in this short-term estimate. To underline the relevance of this sector, the 2009 results will be depicted, along with an explanation of how they differ from the sectors previously described.

EMPLOYMENT PROVIDED BY MANUFACTURE OF RENEWABLE ENERGY INSTALLATIONS

In 2010, investments in renewable energy installations in Germany reached a new record high. At roughly € 26.57 billion, they were 28 % above the 2009 level. This first estimate is based on expansion figures published by the interministerial Working Group on Renewable Energies - Statistics (AGEE-Stat). On closer examination, it becomes clear that, at 73.4 % (€ 19.5 billion), the photovoltaics sector accounted for the greatest share of investments in 2010 (cf. Figure 1). By comparison, in 2009, that share was just less than 60 % (€ 12.4 billion).

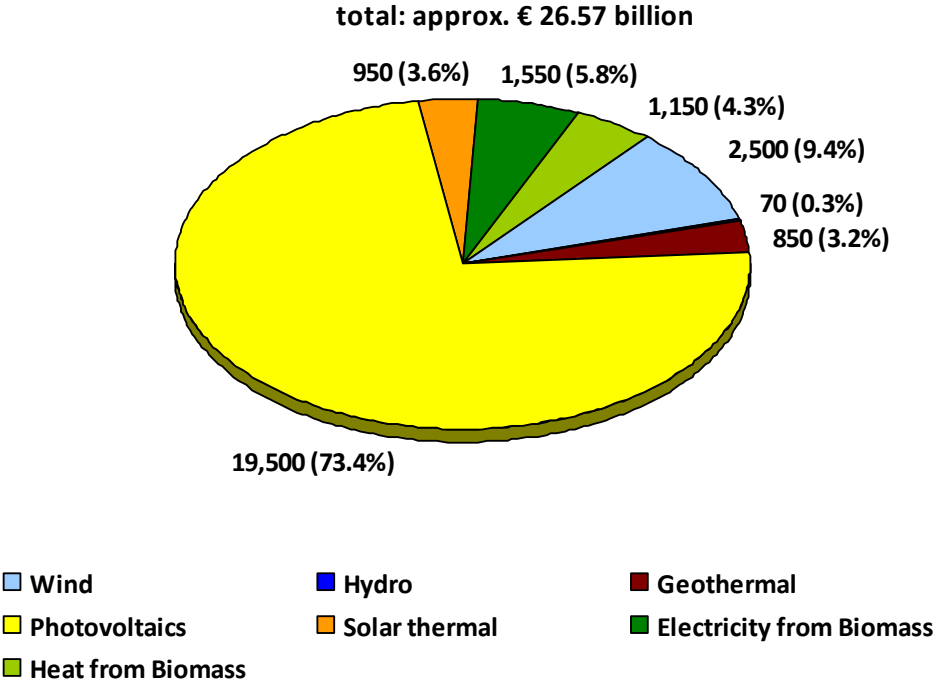


Figure 1: Investments in renewable energy installations in Germany in 2010, in million € [ZSW11].

The turnover of German-based manufacturers of RE facilities and components also rose markedly last year. At € 25.32 billion, an initial estimate indicates that turnover rose by almost 20 % over the previous year (cf. Figure 2). This trend is primarily due to companies in the photovoltaics industry, who were able to increase their sales significantly. A positive trend was also observed in biogas installations. Companies in the offshore wind energy, hydropower, deep geothermal and solar thermal power station sector were able to more or less maintain the previous year’s level. However, the on-shore wind energy industry had to cope with a marked decline in turnover, since trends on the world market for the first time were not able to offset the decline in German investments. Companies in the heat market also experienced significant losses. For the second consecutive year, investments in this segment in Germany were in significant decline, which was reflected in the industry’s sales figures. In the solid biomass sector, 2010 saw a decline in sales not only for heat generation facilities but also for biomass-fired power plants.

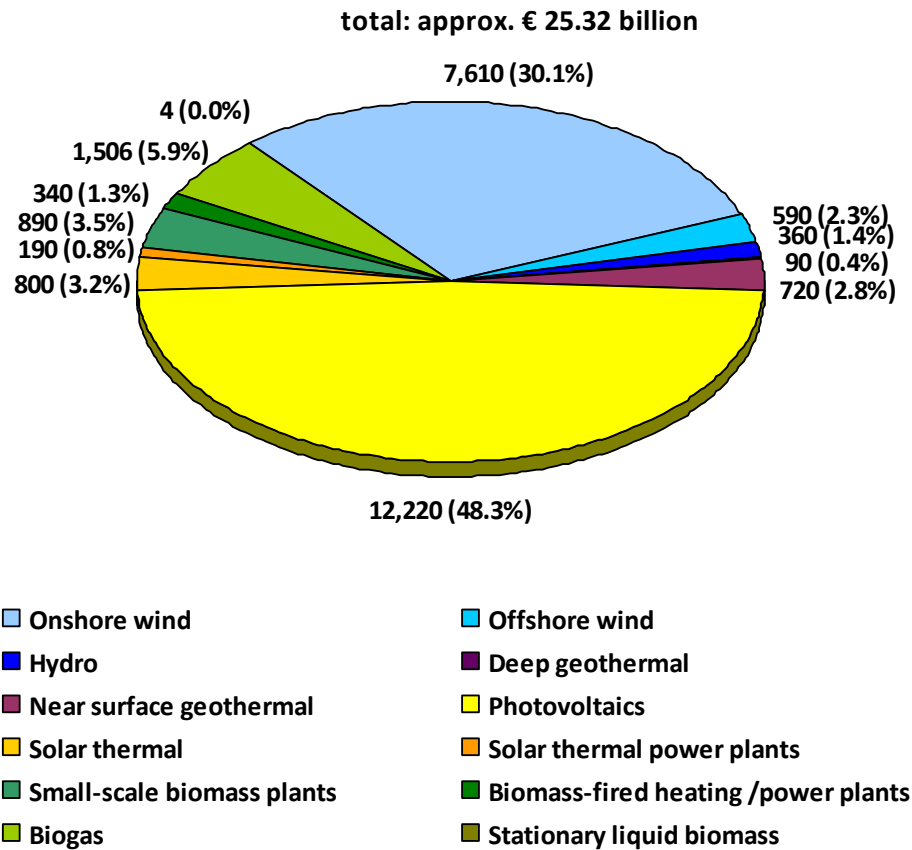


Figure 2: 2010 turnover of German-based manufacturers of renewable energy installations, including their exports, in million €.

Gross employment resulting from the manufacture of RE facilities in 2010 was roughly 234,100 amounting to an increase of 12 % since 2009 (cf. Table 1).

EMPLOYMENT GENERATED BY THE OPERATION AND MAINTENANCE OF INSTALLATIONS AND BY THE SUPPLY OF FUELS

The relevant drivers of employment from operations and maintenance (O & M) of existing installations are the costs of operation (without fuel costs), which are calculated as a percentage of the investment costs. With growing installation numbers, employment in O & M is becoming increasingly relevant. In 2010, it increased to 70,100 (cf. Table 1).

In the biomass sector, employment from the supply of fuels for both transport and power has to be considered in addition to operations and maintenance. Last year employment rose to approximately 57,000.

BREAKDOWN OF GROSS EMPLOYMENT

Gross employment arising from industry's activities in the field of renewable energy in 2009 amounted to about 359,900 jobs. Almost 73.4 % (264,100) of jobs can be attributed to the installation and use of **electricity generation** facilities. About 20.2 % (72,700) of jobs can be attributed to the production and installation of heat generation facilities, while the remaining 6.4 % of jobs were in production of biofuels for transport.

262,100 jobs can be ascribed to the impact of the **Renewable Energy Sources Act** in 2010. Of that total, 107,800 people work in photovoltaics, followed by 96,100 in wind energy and 55,300 in the biomass sector. The number of people working in hydropower amounted to about 1,700, while another 1,200 were employed in the geothermal sector. As described in Figure 3, the number of jobs generated by the Renewable Energy Sources Act in 2004 was 98,000 of a total of 160,500. This means that the Renewable Energy Sources Act's relevance for trends in levels of gross employment rose from about 61 % in 2004 to 71 % in 2010.

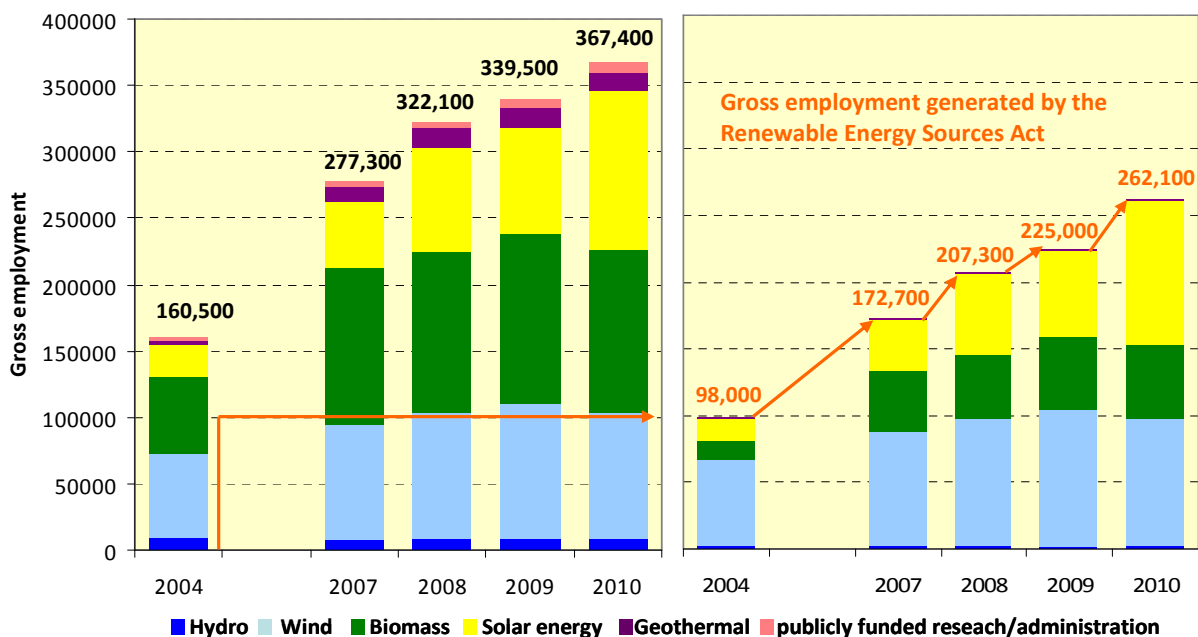


Figure 3: Development of Employment in the Renewable Energy Industry in Germany and of Employment Generated by the EEG between 2004 and 2010

A first cautious estimate of employment generated in Eastern Germany shows a clear rise over the previous year. Here it was the increase in jobs in the photovoltaics sector that had the greatest effect, since a large proportion of photovoltaic systems are produced in Eastern Germany. The reservations normally expressed at this point with regard to indirect employment along the value chain, which lagged slightly behind this increase, hold true, since, on the one hand, upstream goods and services are still sourced in the traditional industrial regions and, on the other hand, the states of Southern Germany still have the highest installation figures for photovoltaics. Nevertheless, the rise

in jobs in the PV sector, along with the dynamic development in the biogas field, brought about a significant rise in employment to roughly 85,000.

RESEARCH AND ADMINISTRATIVE JOBS FINANCED BY PUBLIC-SECTOR FUNDING

In addition to the turnover of German manufacturers of facilities and components and the operation and maintenance of facilities installed in Germany and the supply of biomass and biofuels for transport, public-sector and non-commercial funding is also spent on the development of renewable energy, which also has an impact on employment. This funding comes mainly from German federal and state ministries and the EU, but also from foundations. It is mostly used to finance demonstration facilities and research projects, but some of it is spent on PR.

According to a first estimate, the funds provided by public-sector and non-commercial institutions in 2010 amounted to € 464 million. The majority - over 80 % - was provided by federal ministries. The employment generated in 2010 by public-sector and non-commercial funding amounted to about 7,500, which represents a 15 % rise over the previous year.

Overall, the number of jobs directly or indirectly attributed to renewable energy can be estimated at 367,400 in 2010; this is an increase of almost 8 % over the previous year (cf. Table 1).

Table 1: Employment from Renewable Energy in Germany in 2010

	Jobs provided by investment (incl. export)	Jobs provided by maintenance & operation	Jobs provided by fuel supply activities	Total no. of jobs in 2010	Total no. of jobs in 2009
Onshore wind	71,300	17,900		89,200	<i>95,600</i>
Offshore wind	6,400	500		6,900	<i>6,500</i>
Photovoltaics	102,100	5,700		107,800	<i>64,700</i>
Solar thermal	8,800	2,300		11,100	<i>13,900</i>
Solar thermal power plants	2,000			2,000	<i>2,000</i>
Hydropower	3,300	4,300		7,600	<i>7,800</i>
Deep geothermal	1,100	200		1,300	<i>1,300</i>
Near surface geothermal	9,100	2,900		12,000	<i>13,200</i>
Biogas	15,900	7,100	12,100	35,100	<i>30,900</i>
Stationary liquid biomass	100	1,600	1,200	2,900	<i>3,000</i>
Small-scale biomass plants	9,700	13,600	13,100	36,400	<i>41,400</i>
Biomass-fired heating / power stations	4,300	14,000	6,200	24,500	<i>26,600</i>
Biofuels for transport			23,100	23,100	<i>26,100</i>
Total	234,100	70,100	55,700	359,900	<i>333,000</i>
Publicly funded re-research/administration				7,500	<i>6,500</i>
Total				367,400	<i>339,500</i>

EMPLOYMENT ARISING FROM THE EXPANSION OF PRODUCTION CAPACITIES

Recent years have witnessed a global expansion of production capacity in the renewable energy facilities sector. German manufacturers have also attained worldwide recognition for the expertise they have been able to develop in this area, especially in photovoltaics, which has led to a marked rise in employment in this field. The gross employment situation depicted thus far takes these effects into account in the indirect employment figures, in that the costs incurred from expanding production capacity have been incorporated into manufacturers' pricing. However, the number of jobs has not been fully taken into account in the year in which the work occurred. Instead, they have been spread over the amortisation period of a production machine. The project estimated employment generated by the expansion of production capacities for the years 2007 to 2009. The estimate put turnover for 2009 at € 3.6 billion, generating gross employment of 41,600 [BMU11]. It is not possible

to simply add these jobs to the gross employment described above, firstly because double counting would result and not least because the 2010 figures are not yet available.

BACKGROUND INFORMATION

Wind energy in Germany expanded at a considerably lower rate than expected in 2010. At 1,443 MW, 22 % less capacity was installed onshore than in 2009. Although the picture for offshore wind energy was different, with 108 MW or 80 % more new capacity being installed than in 2009, the trend nevertheless fell clearly short of expectations [DEWI10]. Internationally, there was also a slight decline in expansion. Overall, 35.8 GW of new capacity was installed worldwide, which represents a 4 % drop in new installations. A glance at the world's two largest markets clearly illustrates the very different development that occurred in 2010. New capacity installed in the USA totalled only 5.1 GW, which reflects a 48 % decline in the market since the previous year. By contrast, China once more recorded strong growth. For 2010, estimated growth in wind capacity was about 16.5 GW (+27 %) [GWEC11]. Overall, 2010 was not particularly successful for the German wind industry. It must be assumed that for the first time since our analyses began in 2004, the industry has experienced a decrease in turnover since the previous year. This indicates that for the first time foreign business was not able to fully offset the decline in the domestic market. Since German manufacturers hold a strong position in individual markets that did experience growth, it is assumed that in terms of volume, the German wind energy industry's exports remained at the same level as the previous year. Thus, overall turnover in installations and components fell by only about 6 % to € 8.2 billion. The employment resulting from this turnover amounted to roughly 96,100, including employment in operation and maintenance. 89,200 of those jobs were in onshore wind energy and 6,900 were generated by offshore developments (cf. Table 1). The comparatively high number of offshore jobs in the field of operations can be accounted for by the replacement of 6 nacelles at the Alpha Ventus wind farm.

Last year proved to be a turbulent, but very successful, year for the **photovoltaics** industry. The debate in Germany over feed-in tariffs under the Renewable Energy Sources Act and the lowering of those tariffs that same year produced a degree of uncertainty. However, ultimately Germany was able to end 2010 with record figures for new PV installations predicted to total 7.4 gigawatts, which is an increase of roughly 88 %. German manufacturers saw an increase in production on almost the same scale. Module production rose by about 65 % over the previous year, whereas cell production increased by 51 % and inverter production by an astounding 123 % [Photon11]. Overall, it is assumed that the turnover of German manufacturers and suppliers amounted to about € 12 billion in 2010, which corresponds to a rise of 73 % over the previous year. The employment associated with this turnover, along with jobs in operations and maintenance, totalled about 107,800.

The German **solar thermal** market witnessed a slight downturn for the second consecutive year. Overall, the additional area of solar collectors installed was 27 % down on the previous year. An initial estimate indicates that the European market also saw a drop of 7 % in 2010 [Sarasin10]. This resulted in German companies suffering a slowdown in sales not only in the domestic market but also in their export markets. For that reason, the sector's turnover in 2010 has been estimated at about € 800 million, representing a drop of almost 22 %. Taking operation and maintenance into account, this meant a total of 11,100 jobs in the sector in 2010.

In the **solar thermal power plant** sector, a total of 14 projects worldwide, in which German companies were actively involved, were identified as being in the construction phase in 2010. The turnover of these companies is estimated to be around € 190 million. The employment resulting from it was 2,000, which is the same as the previous year.

As in previous years, no major changes were observed in the **hydropower** sector. Gross employment here totalled about 7,600 jobs in 2010, which, due to an increase in labour productivity compared to the previous year, represented a slight decrease.

In the field of **geothermal energy**, investment dropped by € 850 million in 2010 which is almost 11 % lower than the previous year. The sole reason for this was an almost 13 % decrease in installations of heat pumps. Due to the trend in the European market, which according to a study conducted by the European Heat Pump Association was 7 % lower in 2010 than the year before [EPHA10], it is assumed that companies' exports will not have been able to offset the poor trends in the German market. It is therefore assumed that turnover in the near surface geothermal sector dropped by a total of 13 % to € 720 million. By contrast, investments and turnover in the deep geothermal sector remained stable. Jobs resulting from these turnovers and from operation and maintenance totalled 13,300, of which 12,000 are in near surface geothermal and 1,300 in deep geothermal.

Expansion of installed **biogas** capacity in Germany in 2010 did not reach the 2009 level. However, since in previous studies we have assumed that some of the capacity that was completed in 2009 was actually installed in 2008 [BMU11], a rise in turnover was also recorded for 2010. On the basis of current knowledge, turnover is estimated at about € 1.5 billion, which represents a 21 % increase over the previous year. Employment resulting from this turnover and from operation of facilities totalled about 23,000 in 2010. Supply of biomass in the biogas sector accounts for another 12,100 jobs. This marked increase of 19 % over the previous year is due to an almost 23 % increase in area used to 650,000 hectares [FNR11]. Overall, this means that employment in the biogas facility sector totalled 35,100 in 2010.

In 2010, a slight increase in installed capacity in the field of **stationary liquid biomass installations** was once more observed. With a turnover of € 4 million generating 100 jobs, the new build area of this sector currently plays a subordinate role. By contrast, some 1,600 people are employed in operating and maintaining existing installations and another 1,200 in the supply of plant oil. With a total of 2,900 jobs, employment levels were roughly the same as the previous year.

In the **small-scale biomass plant** sector, as in other areas of the renewable heat market, a decline in investments was observed. In parallel to this, the turnover of this segment fell to € 890 million, which is an 18 % decline. Employment in building and operating facilities totalled 23,300, which is markedly lower than the previous year. The number of people employed in the supply of biomass in 2010 was 13,100, which is almost 16 % lower than in 2009. The underlying reasons for this are first and foremost new insights into ways in which users of small-scale biomass plants harvest their own firewood,¹ which has led to a marked reduction in the volume of timber traded. Overall employment in the small-scale biomass plant sector in 2010 was 36,400.

Investments in **biomass-fired heat / power plants** in Germany were also a great deal lower in 2010 than in 2009. The estimated turnover of € 340 million is therefore also significantly lower than the

¹ This refers to the quantities of wood that users fell themselves in the forest.

previous year. Employment generated by building and operating facilities in 2010 can be put at 18,300. Biomass supply accounted for a further 6,200 jobs, which is 29 % more than the previous year. At 24,500, total employment was 8 % below the previous year.

Gross employment connected with **biomass supply** in 2010 thus totalled 32,600, which is 3.5 % higher than the previous year.

Sales of **biofuels for transport** in 2010 rose by roughly 8 % over 2009. The steepest rise was in bioethanol (28 %), but the rise in sales of biodiesel (just under 3 %) was also slightly higher than the previous year. Only plant oil sales were lower in 2010 than in 2009, experiencing a drop of 39 %. At 2.8 million tonnes, biodiesel production was 12 % higher in 2010 than the previous year [VDB/UFOP11] and 8 % higher than domestic consumption. By contrast, the area of land under crops for biodiesel and plant oil has decreased slightly [FNR11], which has contributed to the fact that the proportion of imported primary products has risen. Employment generated by biodiesel production in Germany in 2010 totalled 17,700, which is unchanged since the previous year. In the case of plant oil production, it is assumed that production matches consumption. Due to the decline in consumption, employment in this sector dropped to just under 800. At 584,000 tonnes, bioethanol production experienced a slight decrease in 2010 (1 %). At 4,600, the number of jobs resulting from sales of this production volume was, however, significantly lower than the estimate of the previous year. The underlying reason for that is an overestimate of the 2009 figures resulting from price assumptions being too high. Overall, the supply of biofuels for transport in Germany in 2010 accounted for 23,100 jobs.

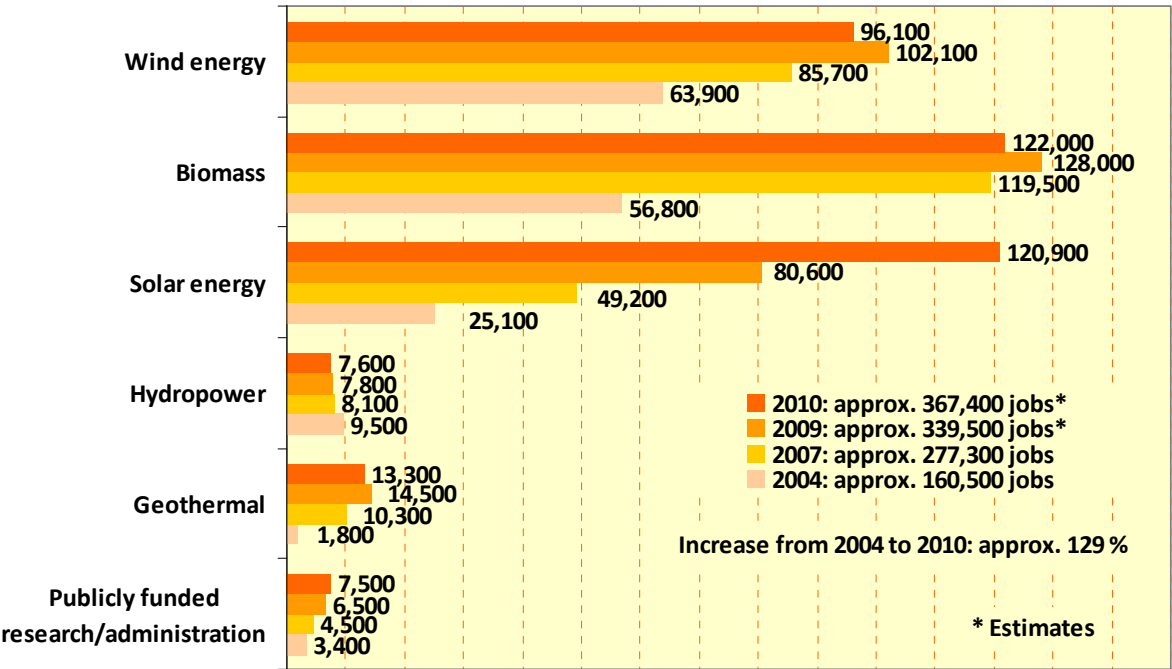


Figure 4: Development of Gross Employment Arising from Renewable Energy in Germany

According to this first estimate, gross employment in 2010 therefore totalled about 367,400, which represents a 129 % increase over 2004 (cf. Figure 4). Biomass (total of about 122,000 jobs) and solar energy (120,900 jobs) each contributed about a third to gross employment. They are followed by wind energy at just under 26 % (96,100), geothermal at about 4 % (13,300) and hydropower at 2 % (7,600). Publicly funded research and administrative jobs account for roughly a 2 % share in gross employment.

FUTURE PROSPECTS

2010 has illustrated two main things about the renewable energy market – both nationally and internationally: firstly, it is full of surprises and, secondly, it responds sensitively to policy fluctuations. Employment developments in Germany's renewable energy sector are dependent both on trends in the domestic market and the export success of companies in the sector and therefore on international developments. In recent years, a number of attractive markets have been created, due – amongst other things – to governments introducing funding instruments.² But the expansion of renewable energies was so successful that it also produced fears of markets overheating and a call to step up controls on growth, such as those imposed on the expansion of photovoltaics in Germany. The Spanish photovoltaics market experienced a drastic change in funding at short-notice in 2009, which, in conjunction with the financial crisis, unleashed a fierce price war in the remaining markets. All the signs indicate that in 2010 Italy witnessed an unexpectedly rapid development in its photovoltaics market with 4.7 to 6.4 GW³ of new installed capacity [NeueEnergie11]. The first calls for a fixed limit to expansion of 8 GW overall – as envisaged for the period up to 2020 in Italy's National Action Plan - [SWW11] should be taken seriously. The possibility of a further price collapse cannot therefore be ruled out. The German photovoltaics industry has, however, mostly kept pace with domestic market growth, and fears voiced during the course of the year that we were creating markets solely for foreign manufacturers have not come true and most certainly not to the extent expressed in some quarters. Furthermore, both nationally and internationally, we are observing a change in the objective underlying the expansion of renewable energy: the focus is shifting from it being an instrument for reducing climate gases to a way of improving energy security by mitigating import risks and of achieving technology goals. How this will impact on associated policymaking in individual countries remains to be seen.

The impact of these developments on the German renewables industry and its export success will become clear over the next few years. However, based on the current situation, it is possible that gross employment in Germany's renewable energy sector could reach between 500,000 and 600,000 by 2030. But, for this to happen, it is vital that German companies continue to operate successfully on world markets [BMU11]. As well as exports of complete facilities, exports of production machinery are becoming increasingly important for employment in the renewable energy sector. It is particularly in these markets that German industry is able to draw on its traditional expertise in tool-making and engineering. However, a precise assessment of the employment that might be associated with the export of production machinery in the future is outside the scope of this brief analysis and would require more detailed consideration. The third pillar of the domestic labour market that has increasingly important future prospects is the operation and maintenance sector, which has already been included in the 500,000 to 600,000 estimate of future gross employment.

² They include Canada, Italy, Britain, the USA, Brazil, China and India, to name just a few.

³ All figures known to date are subject to great uncertainty.

Bibliography

- [BMU06] Staiß, F.; Kratzat, M. (ZSW); Nitsch, J.; Lehr, U. (DLR); Edler, D. (DIW); Lutz, C. (GWS): Erneuerbare Energien: Arbeitsplatzeffekte – Wirkungen des Ausbaus erneuerbarer Energien auf den deutschen Arbeitsmarkt, research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), June 2006.
- [BMU07a] Kratzat, M. (ZSW); Lehr, U.; Nitsch, J. (DLR); Edler, D. (DIW); Lutz, C. (GWS): Erneuerbare Energien: Arbeitsplatzeffekte 2006 – Wirkungen des Ausbaus erneuerbarer Energien auf den deutschen Arbeitsmarkt – Follow up, research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), September 2007.
- [BMU08] Kratzat, M. (DLR), Edler, D. (DIW), Ottmüller, M. (ZSW), Lehr, U. (DLR): Bruttobeschäftigung 2007 – eine erste Abschätzung, research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), March 2008.
- [BMU09] O’Sullivan, M. (DLR), Edler, D. (DIW), Ottmüller, M. (ZSW), Lehr, U. (DLR): Bruttobeschäftigung 2008 – eine erste Abschätzung, research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), March 2009.
- [BMU10] O’Sullivan, M. (DLR), Edler, D. (DIW), Ottmüller, M. (ZSW), Lehr, U. (DLR): Bruttobeschäftigung 2009 – research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), March 2010.
- [BMU11] Lehr, U.; Lutz, C. (GWS); Edler, D. (DIW); O’Sullivan, M.; Nienhaus, K.; Nitsch, J.; Simon, S. (DLR); Breitschopf, B. (FhG-ISI); Bickel, P.; Ottmüller, M. (ZSW): Kurz- und langfristige Auswirkungen des Ausbaus der erneuerbaren Energien auf den deutschen Arbeitsmarkt – research project commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), February 2011.
- [DEWI11] Status der Windenergienutzung in Deutschland – Stand 31.12.2010.
- [EPHA10] Forsén, M.; Nowak, T.: Outlook 2010 – European Heat Pump Statistics. European Heat Pump Association (EHPA), 2010.
- [FNR11] Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe - FNR): Anbau nachwachsender Rohstoff in Deutschland, <http://www.fnr.de/>, Download:1.2.2011.
- [GWEC11] Global Wind Statistics 2010, Global Wind Energy Council (GWEC), 02.02.2011.
- [NeueEnergie11] Braun, M.: Rekord oder Bubenstück? Neue Energie, 03/2011, p. 104f.
- [PHOTON11] Krause, M.; Podewils, C.: Nicht schlecht geschlagen, PHOTON, January 2011, pp. 34-42.
- [Sarasin10] Faver, M.; Magyar, B.: Solarwirtschaft – unterwegs in neue Dimensionen, Bank Sarasin & Cie AG, November 2010.
- [StaBu10] Statistisches Bundesamt: Input-Output-Rechnung 2007, Volkswirtschaftliche Gesamtrechnungen, Fachserie 18, Reihe 2, Artikelnummer: 2180200079004, Wiesbaden 2010 (publication date: 30 August 2010).
- [SWW11] Italien will PV-Förderung deckeln. Sonne, Wind & Wärme, newsletter of 02.03.2011.
- [VDB/UFOP11] Biodieselproduktion 2011, information provided by Johannes Daum, Verband der deutschen Biokraftstoffindustrie e. V..
- [ZSW11] Zentrum für Sonnenenergie und Wasserstoff-Forschung Baden-Württemberg - Centre for Solar Energy and Hydrogen Research (ZSW), Stuttgart, As at: March 2011.