Germany: Wind Energy

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Summary

Wind power will remain the greatest contributor to the expansion of renewable energies in the electricity sector for the foreseeable future. In 2008, wind power generation contributed some 7.6 % to Germany's gross electricity consumption, and is therefore already one of the main producers of electricity in Germany. At the end of 2009, Germany had a total of 21,164 wind turbines with an installed capacity of 25,777 MW. In 2009, Germany lost its leading position as a leader in the installation of new turbines. China, the USA, and Spain installed more new capacity in 2009, and the USA now leads the total installed capacity with turn with 35,000 MW.

According to DEWI (Deutschen Windenergie-Institut/German Wind Energy Institute), were in 2010, 21.607 Wind Energy facilities with a total output of 27.214 MW newly installed. In 2010 showed a small dip for the number of newly installed turbines. 332 new mills equaling a capacity of 660 MW were installed (1st half of 2009: 380 mills/ 720 MW).

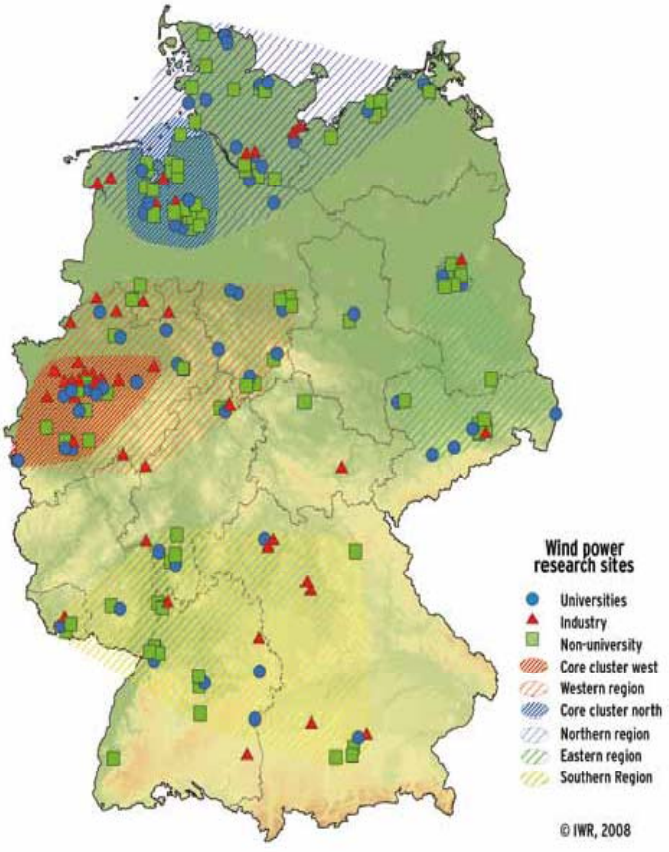
In 2011, the German wind energy industry expects 16 percent growth in new installations at home. Concerning the German Wind Energy Federation — BWE, an estimated 1,800 megawatts worth of new onshore and offshore wind turbines will be installed in 2011 in Germany, up from 1,550 MW last year.

In 2007, the German wind power industry generated revenues around EUR 7.6 billion from turbines and components alone. According to the German Machinery and Plant Manufacturing Association (VDMA), the export share is 80%.

A recent forecast by the German Wind Power Institute (DEWI GmbH) predicts that around 210,000 MW of wind power will be installed worldwide by 2014, which translates into an investment volume of around EUR 130 billion, with offshore technology and repowering playing a key role. As soon as offshore expansion picks up pace, the maritime industry anticipates a new boom. Locations such as Bremerhaven and Cuxhaven have already prepared for this by investing in infrastructure aiming at advancing wind power generation through research and development and reinforcing Germany's industry position in this expanding market.

The wind energy sector accounts for 90,000 jobs in Germany, of which 37,000 are employed by manufacturers and component suppliers.

End Summary



Germany's Wind Energy Market

	2008	2010
Total installed capacity	23,903 Megawatt	27,215 Megawatt
Newly installed capacity	1,665 Megawatt	1,551 Megawatt
Number of turbines	20,301	21, 697
New turbines in one year	866	754
Electricity generation from wind power Share in gross electricity consumption (basis 2007: 617.5 TWh)	40.43 bln. kWh 6.6%	37.3 TWh of electricity (in total 17% of electricity was generated from renewable sources in Germany in 2010)
Potential annual energy yield Share in gross electricity consumption (basis 2007: 617.5 TWh)	43.01 bln. kWh 7.0%	

source: DEWI/BWE

The above figures also include a total of 26 Wind Power Units (WPU) with 9.74 MW of capacity, which were removed in 2008, and 18 WPU with 23.94 MW of capacity being repowered in 2008. Only three WPU with a total capacity of 12 MW were in off-shore operation by the end of 2008.

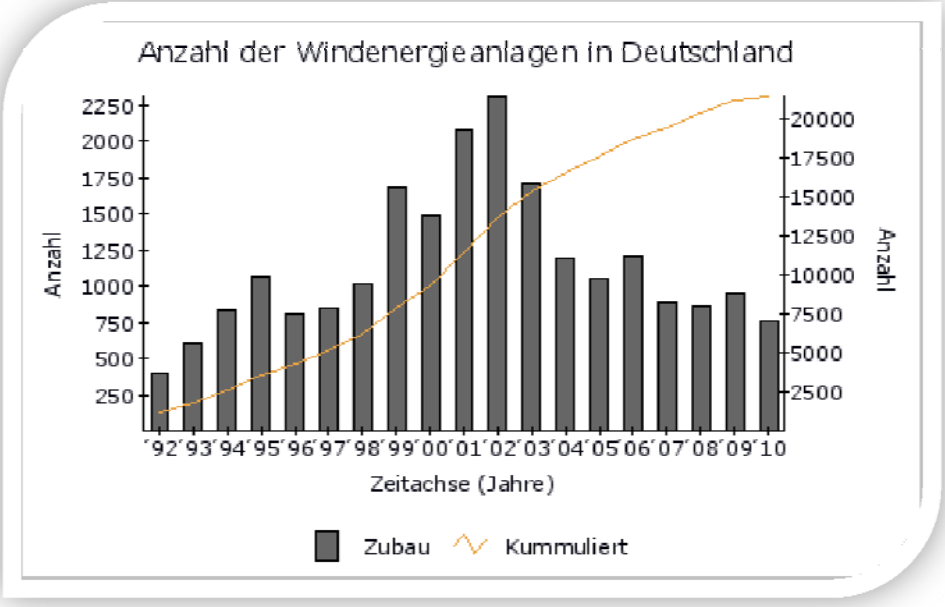


Figure: Number of Wind Energy Facilities in Germany
(Source: www.wind-energie.de)

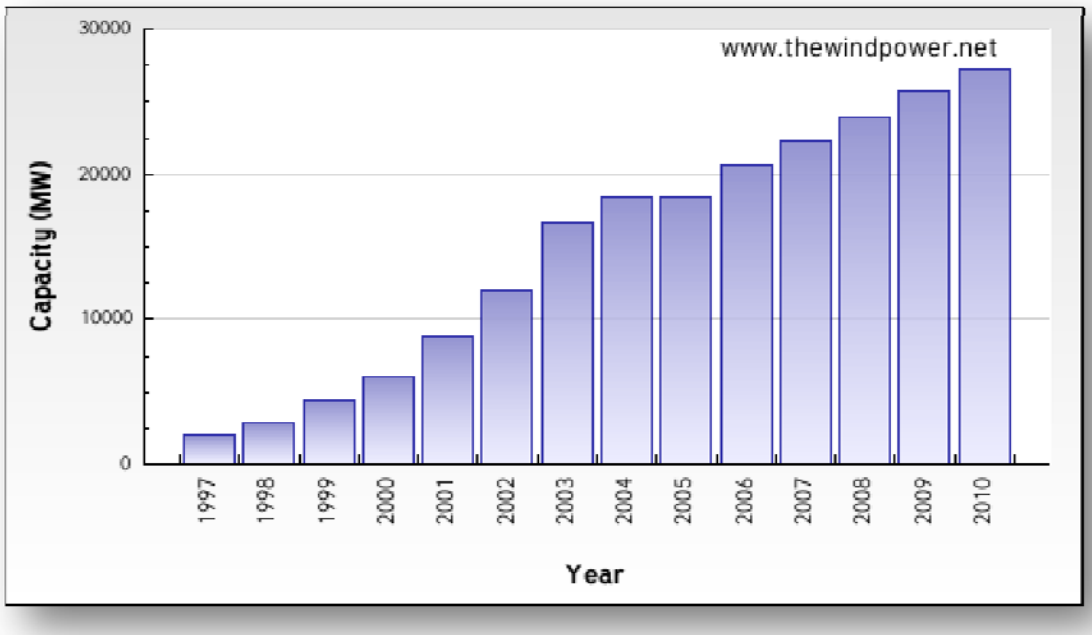
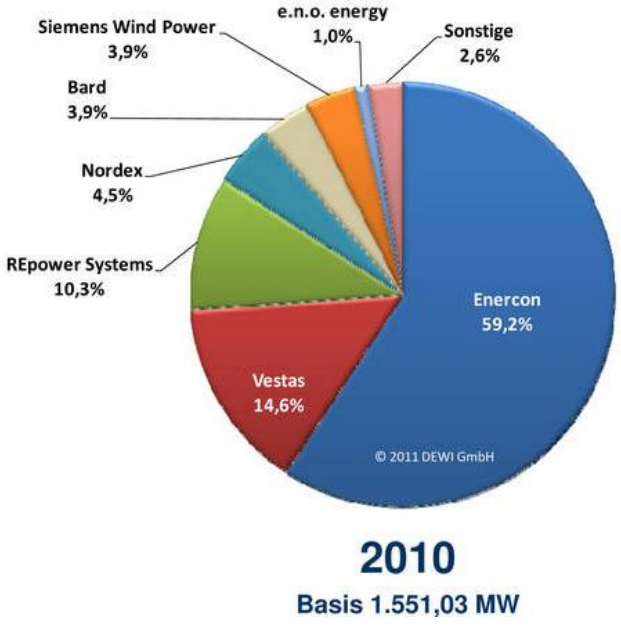


Figure: Wind Energy production capacity evolution for Germany until 2010 (source: www.thewindpower.net)

Provisional figures for 2010: New installed capacity: 1.551,03 MW (released by BWE, January 2011).

The two WPU market leaders, Vestas and Enercon were able to gain in market share, with Vestas taking the biggest leap forward (Enercon 2009: 60.4%, 2010: 59,2%; Vestas 2009: 19.5%, 2010: 14,6%), the largest drop in market share was recorded for Repower (2009: 8.8%, 2010: 10.3%).



Not surprisingly, Northern Germany hosts most WPU. Lower Saxony clearly ranks first with over 6 GW of installed capacity (Brandenburg: 4.4 GW). The State with the highest number / capacity of new installations in 2009, however, was the State of Brandenburg (MW 402) with Lower Saxony closely behind (MW 391).

The trend clearly goes towards larger turbines (5-6MW), larger rotor diameters (over 120 m) and higher hub heights (100 m-140 m)

The Renewable Energy Act (EEG) – Success story for the entire renewables industry

The renewed Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz / EEG), which guarantees fixed feed-in tariffs for the duration of 20 years allowing for an optimal planning base, remains the main market driver in Germany.

Under EEG regulations, electricity produced from renewable energy sources enjoys priority for grid connection, grid access in either distribution and transmission grid, and power dispatch. These renewable energies include hydropower, wind, solar, and biomass energy, geothermal energy as well as landfill, pit and sewage gas. Grid operators are obliged to feed in electricity produced from renewable energy and buy it at a minimum price within their supply area.

Feed-in Tariffs for Wind Energy in Germany at a glance:	
Onshore:	• 9.11 EUR Cent/kWh (initial tariff for a minimum of 5 years) • 5.02 EUR Cent/kWh (basic tariff) • annual digression rate: 1 percent as of 2010
Onshore Repowering:	• 9.2 EUR Cent/kWh plus 0.5 Cent/kWh (*repowering bonus – see details below*) (initial tariff for a minimum of 5 years) • 5.02 EUR Cent/kWh (basic tariff); • annual digression rate:1 percent as of 2010
Offshore:	• 13 EUR Cent/kWh (initial tariff for a minimum of 12 years), • "Early Bird" Bonus: 2.0 EUR Cent/kWh if installation will be in operation prior to December 31, 2015; • annual digression rate: 5 percent as of 2015
System Bonus	• 0.5 Cent/kWh (for new plants) • 0.7 Cent/kWh (for old plants)

Explanatory Notes:
The above tariffs are generally fixed for 20 years.
Based on where the offshore power plant is located, an extension of this period is possible, depending on factors such as water depth and the distance to the coast. The initial tariff is granted between 5 and 20 years, depending on a rather complex catalog of additional rating criteria for wind plants (see www.bmu.de (Federal Environment Ministry - BMU) or www.wind-energie.de (German Wind Association) for details).
In order to set incentives for technological progress and continuing cost reduction, the compensation rates (feed-in tariffs) are subject to nominal annual digression.
The *Repowering Bonus* in the amended EEG reflects the political will to favor repowering over new installations. Repowered installations will receive an increased bonus of 0.5 EurCt per KWh, under the condition that

- one or more installation get replaced in the same or neighboring count(y)ies
- the old installation has been in operation for ten years or more
- the performance output is doubled (as a minimum limit) up to quintupled (as the maximum limit)

A *System Bonus* (Systemdienstleistungsbonus) is granted when specific technical measures are applied which either facilitate and ease grid connection or allow for remote or integrated peak control.

Another important regulation is the German Federal Building Code, which treats wind energy plants as so-called privileged projects. Local authorities are supposed to designate specific priority - or preferential zones - for wind energy utilization. However, this also means that specific areas (exclusion zones) can be subject to partial or complete construction restrictions.

Since system operators do not receive government payments, German feed-in incentives do not constitute public subsidies. The guaranteed tariffs instead combine regular grid power charges with mandatory utility price supports. This practice is not unique to renewable energies. For example, price fixing is employed for the sale of books, sheet music, maps, cigarettes, taxi services, and prescription medicines to prevent commercial corporations from undercutting small retailers. Regulated prices allow sufficient returns on investment to be achieved. Presently, the EEG provisions add about 0, 64 Eurocent per KW to the bill (1 KW ranges between 18 and 23 Eurocent on average.)

Earlier federal and state monetary incentives for renewable energies in Germany were often truncated by budgetary limitations. As shown in the graph above below, the number of wind turbines has increased significantly since guaranteed feed-in payments were introduced in 2000. Financial constraints have been eliminated by this practice, since all costs are passed on to ratepayers. Grid operators are obligated to accept renewable power on a priority basis, thereby insuring operator income even if conventional generating plants are forced to reduce operation in consequence.

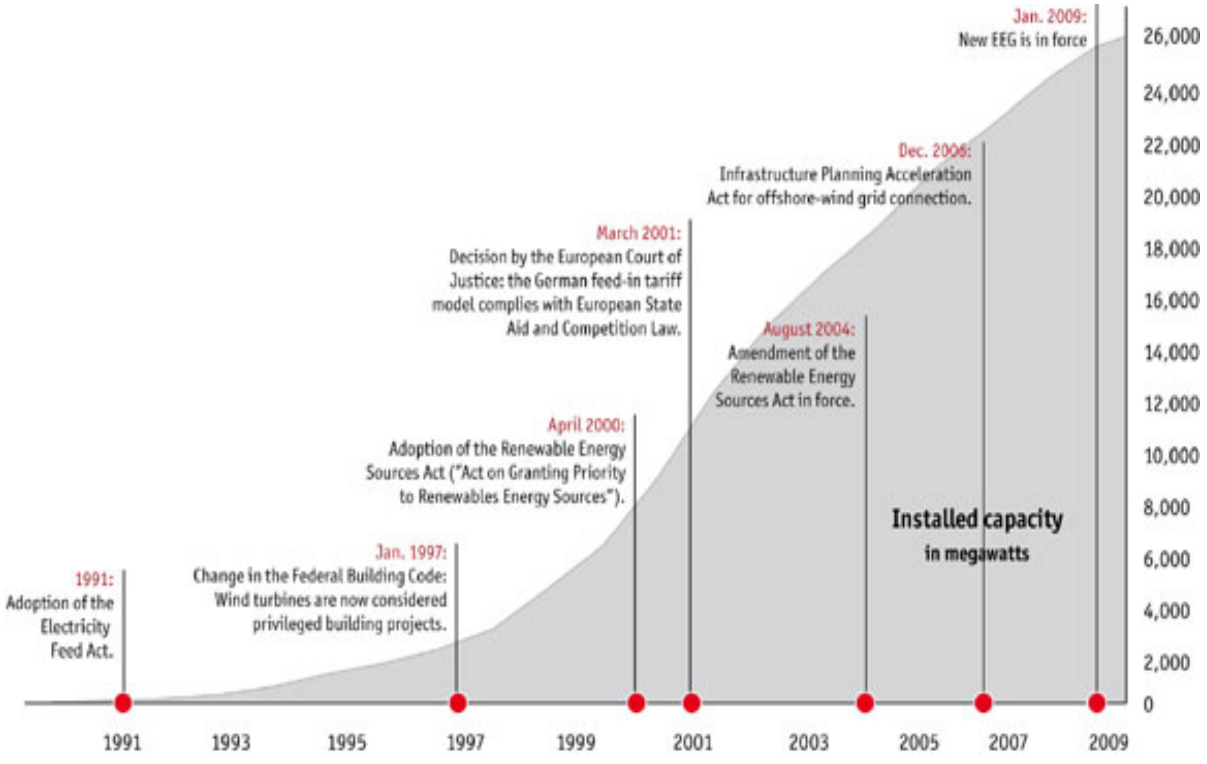


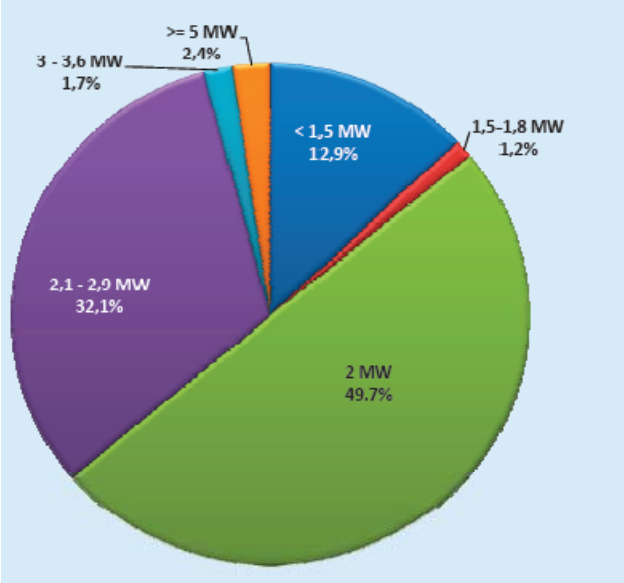
Figure: The EGG and installed Wind Capacity in Germany

Repowering

Repowering offers important market opportunities. Since the erection of new wind parks is subject to sometimes lengthy bureaucratic procedures, and public opinion is not always favorable towards WPU-cluttered landscapes, repowering of turbines (mostly by reducing the number of towers while increasing turbine capacity and sometimes by elevating hub heights) represents an economic way to increase wind park performance. “Only 183 MW were installed in repowering projects in 2010, but this rate should increase significantly and by 2015, 6,000 MW will be older than 15 years and ready for repowering.

Offshore wind energy in Germany grew to 108 MW in 2010, and this is expected to reach 3,000 MW by 2015. To date, 24 projects have been licensed by the national maritime authority and the Federal States, bringing the overall capacity close to 7,000 MW. The costs for connecting offshore wind farms to the mainland grid are taken over by transmission systems operators, and they have started to plan for connection lines for clusters of offshore projects. Three 400 MW HVDC light lines have already been completed”.
(source: DEWI).

Figure: Share of individual WTGS size classe in the newlz installed WTGS in year 2010



Small WPU

Differing from photovoltaic incentives, particularly with respect to feed-in rates, small WPU, typically in the 30-100 KW range, do not enjoy higher feed-in tariffs, making this kind of investment relatively unattractive for private or commercial investors. The investment cost per KW/p is much higher than for photovoltaics, yet the remuneration is much lower, and grid parity for small WPU is not on the near horizon. Lobbying groups have addressed this issue, but so far have had no success in getting heard. Therefore, small WPU remain to be used for off-grid or for self-use applications only.

New Fraunhofer Institute for Wind Energy founded

2009 marked the launch of the new Fraunhofer Institute for Wind Energy and Energy System Technology (FhG-IWES) in Bremerhaven. It builds on the former Fraunhofer Centre for Wind Energy and Maritime Technologies and the associated rotor blade competence centre. This research cluster will be complemented by close collaboration with the universities of Hanover, Oldenburg, Bremen and Kassel, and will encompass the entire value-added chain for wind power, right through to grid integration, at a high level.

Research begins at “alpha ventus” offshore test site

45 kilometers north of the North Sea island of Borkum, the first German offshore wind farm, “alpha ventus,” is under construction. A wide range of individual projects on offshore wind power under the RAVE (Research at alpha ventus) umbrella have begun, ranging from wind analyses, to defining technical requirements for wind turbines and their foundations, to grid integration and ecological research. The first structure for the offshore wind farm “alpha ventus” was a transformer station, completed in 2008.

Source: BMU

With a height of 60 meters and weighing more than 1,300 tons, it forms the heart of the wind farm by conditioning the electricity generated offshore to be transported onto the mainland. The RAVE 7 projects are being coordinated by the "Institut für Solare Energieversorgungstechnik" (ISET) in Kassel. By the end of 2008, some 20 projects with a total volume of EUR 33.7 million had been approved under the RAVE umbrella. The company DOTI GmbH, owned by the power utilities EWE, E.ON, and Vattenfall, will construct and operate 12 wind turbines from Multibrid and Repower, with a total installed output of 60 MW. "Since the gradual commissioning of the turbines, the offshore test field has fed some 170 gigawatt hours of climate friendly power into the national power grid and has already achieved a balanced EROEI (Energy Return on Energy Invested). According to plans by the German Federal Government, 10,000 megawatts of offshore wind power are to be installed by 2020, contributing to the supply of climate friendly energy in Germany. More obvious efforts and incentives are still needed to bring about this further expansion" (*http://www.alpha-ventus.de/index.php?id=80)*
(For more information: http://rave.iset.uni-kassel.de/rave/pages/welcome)

Rotor blade research

The Fraunhofer Centre for Wind Power and Offshore Technology has started to work on construction of the rotor blade competence centre in Bremerhaven. Rotor blades are subjected to in-depth analysis regarding their ability to withstand vibrations and deflection for offshore and onshore use. Measurements are carried out on whole rotor blades, and supplemented by test rigs to allow much cheaper and extreme loads component testing, as well as a climate chamber which allows the simulation of offshore conditions. In future, the rotor blades will be simultaneously deflected, both vertically and horizontally, during the load tests (total BMU funding: EUR 11.1 million).

Foundation research

Around 50% of the cost of an offshore wind farm is attributable to the supporting structure. Various manufacturers have devised concepts for foundation structures. These include the monopile (one supporting pillar), the tripod or tripile (a three-legged foundation) and the jacket (a lattice structure), together with the floating foundation. One solution which has yet to be subjected to extensive international testing is the so-called "suction bucket," where a steel cylinder with a sealed top is pressed into the ocean floor by an internal vacuum and the exterior water pressure.
Over the next few years, demand for foundations for offshore wind farms looks set to rocket. With this in mind, several offshore construction companies and the Fraunhofer Institute have launched a joint project to pave the way for high-quality, cost-effective mass production of offshore foundations. There are currently no production plants anywhere in the world suitable for mass production of this type of steel structure weighing several hundred tons (BMU funding total: EUR 2.8 million.) Another project with a R&D budget of over EUR 350,000 focuses on fatigue behavior of high strength concrete in filigree structures. Other research is being carried out regarding pile driving vs. boreholes for foundations.

Other research areas:

- Logistics and assembly (platforms, transport solutions for personnel and equipment, lifting devices for nacelles, etc.)
- Aerodynamics of wind turbines (optimization of rotor blades, sound minimization, optimization of load profiles)
- Minimization of radar reflections
- Automated surface coating for rotor blades
- Underwater noise reduction techniques during construction as an ecological / environmental protection measure

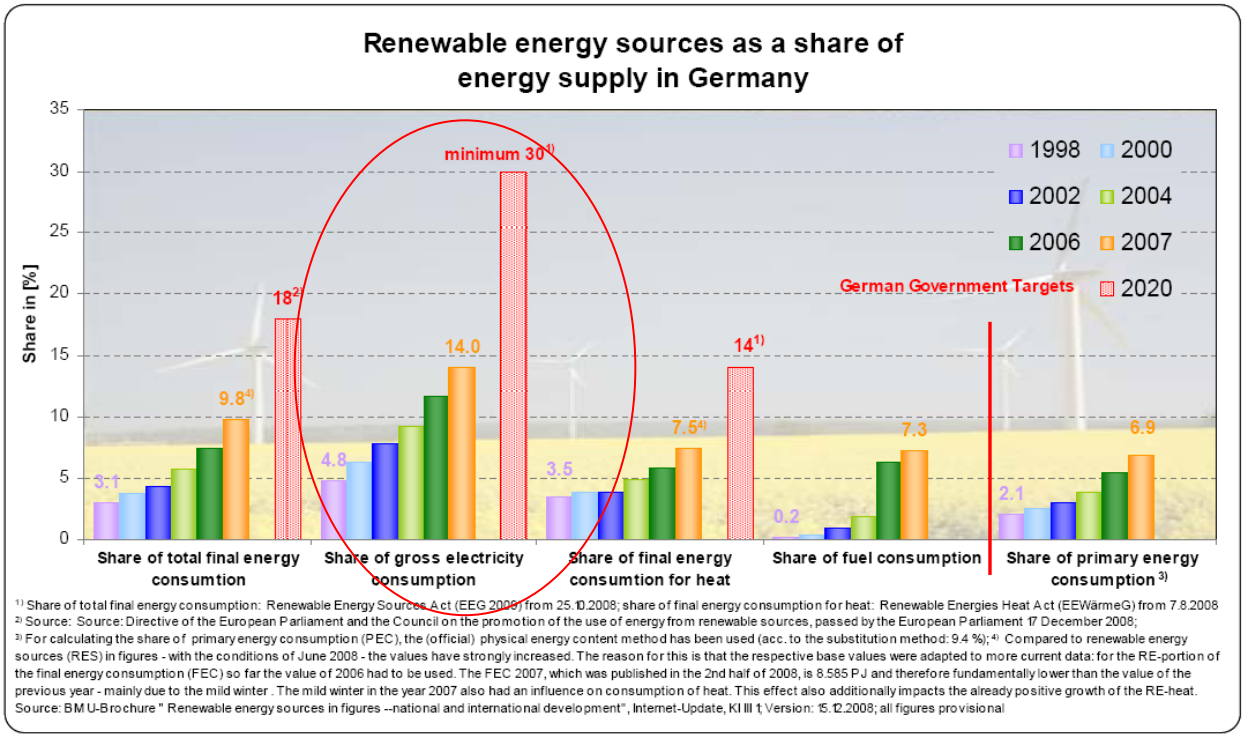
Future Development

According to calculations by the national German Association for Wind Energy (BWE) there is potential for new turbine capacity of up to 10,000 MW that could be realized on already commissioned sites onshore. Additional capacity will come from repowering.

First projects and studies clearly show that repowering has the potential of doubling the amount of onshore wind energy capacity in Germany, with significantly fewer turbines able to triple the energy yield. By 2020, the overall German onshore capacity could reach 45,000 MW of installed capacity, with an additional 10,000 MW for offshore wind energy. With a generation of approximately 150 TWh/year, wind energy could then satisfy 25 % of German electricity demand.

The preference by the German government clearly lies in offshore wind plant operation, which is reflected by the offshore feed-in tariffs, which were fixed at 13 EUR cents/kW for the first 12 years of operation. The discussion about onshore wind, however, is much more difficult. Prices for wind turbines have risen – not only in Germany – by 20-30 %, which is mainly due to higher raw material prices. The price of steel, for example, (which makes up 80% of material of a wind turbine) has increased dramatically. Higher prices, together with a restrictive planning framework stipulating height limits for turbines, make it much more difficult for operators to implement attractive new projects.

The BWE is therefore proposing a dynamic system to compensate for fluctuations in prices of important input factors, such as raw material prices. The BWE believes that this will be crucial for the continuation of a successful deployment of wind energy in Germany. Germany has signed off on the EU climate protection goals, which set a minimum 20 percent target for renewable energies within total gross energy consumption, but hope to reach 30-35 percent.



[1] Share of total final energy consumption: Renewable Energy Sources Act (EEG 2009) from 25.10.2008; share of final energy consumption for heat: Renewable Energies Heat Act (EEWärmeG) from 7.8.2008
[2] Source: Source: Directive of the European Parliament and the Council on the promotion of the use of energy from renewable sources, passed by the European Parliament 17 December 2008;
[3] For calculating the share of primary energy consumption (PEC), the (official) physical energy content method has been used (acc. to the substitution method: 9.4 %); [4] Compared to renewable energy sources (RES) in figures - with the conditions of June 2008 - the values have strongly increased. The reason for this is that the respective base values were adapted to more current data: for the RE-portion of the final energy consumption (FEC) so far the value of 2006 had to be used. The FEC 2007, which was published in the 2nd half of 2008, is 8.585 PJ and therefore fundamentally lower than the value of the previous year - mainly due to the mild winter . The mild winter in the year 2007 also had an influence on consumption of heat. This effect also additionally impacts the already positive growth of the RE-heat.
Source: BMU-Brochure " Renewable energy sources in figures --national and international development", Internet-Update, KI III 1; Version: 15.12.2008; all figures provisional

Wind energy in Germany already helps significantly to reduce CO^2 emission. Once wind energy is used not only for direct use in electric grids but also for other energy production or storage applications in the near future (e.g. in combination with fuel cell technology, to generate hydrogen, to help produce BTL or other fuels), the effect will be even more significant.

On an economic level, renewable energies already play an important role. The impressive sales and revenue figures lead economists to stress that the decentralized character of the renewables industry and the in-country value addition (e.g. the installation, maintenance, servicing and operations teams) is a major key to the industry's success and sustainability, which offsets the slight increase in energy prices for end-users.

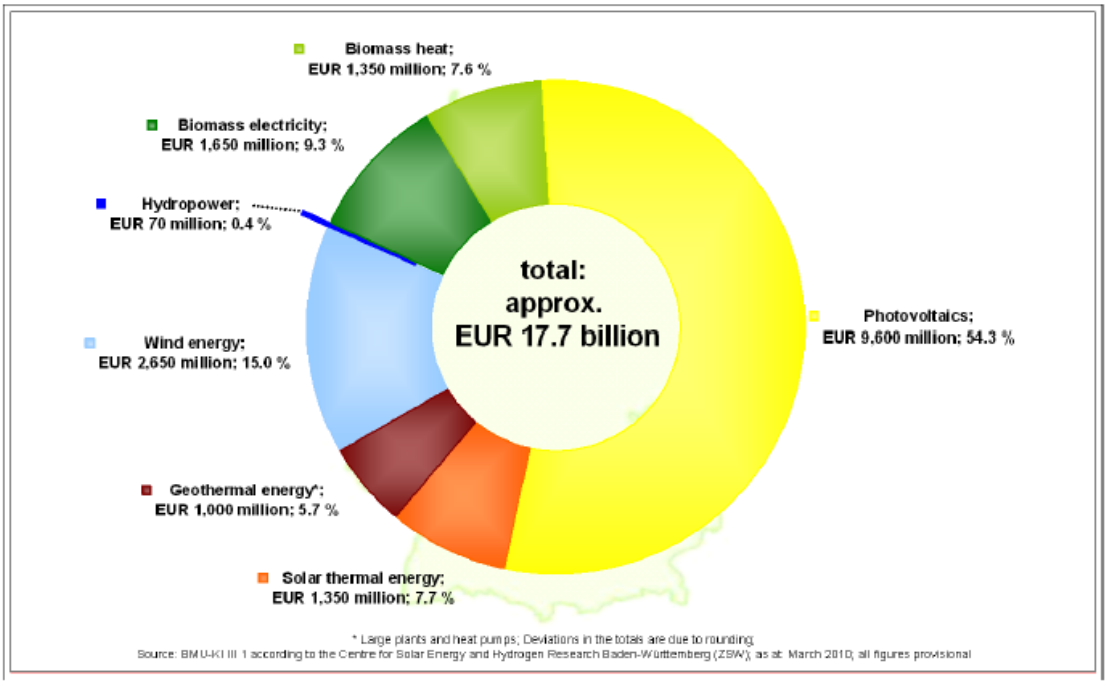


Figure: Turnover from renewable energy installations in Germany, 2009

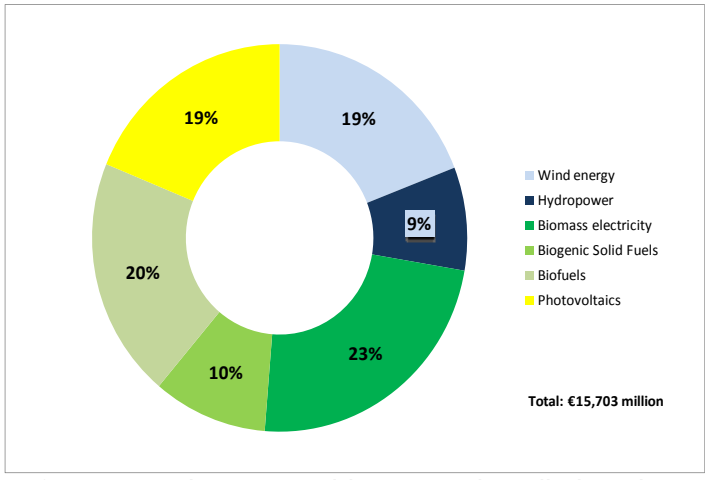
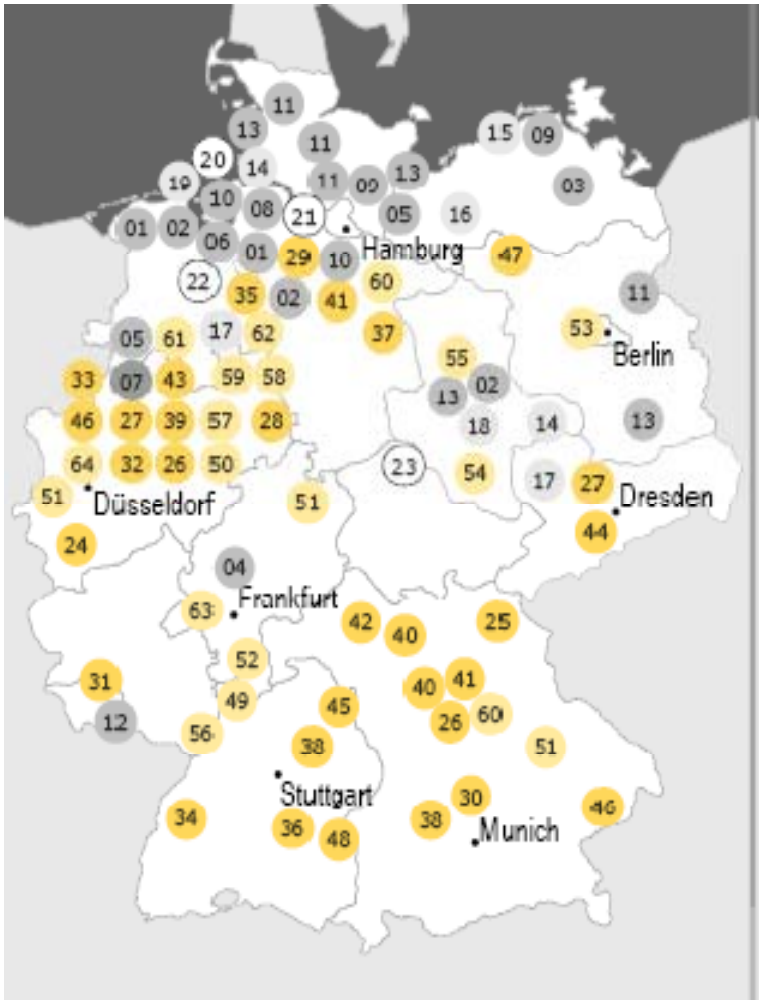


Figure: Income from operating renewable energy installations in Germany, 2009

Main Products			Companies	Selected Locations
WEC	Wind energy Converters	1	Bard Engineering GmbH	Emden, Bremen
		2	ENERCON GmbH	Aurich, Bremen, Magdeburg
		3	e.n.o. energy GmbH	Rostock
		4	Fuhrländer AG	Liebenscheid
		5	GE Energy	Salzbergen, Hamburg
		6	Innovative Windpower AG	Bremerhaven
		7	Kenersys GmbH	Wismar
		8	Multibrid GmbH	Bremerhaven
		9	Nordex SE	Norderstedt, Rostock (and others)
		10	PowerWind GmbH	Hamburg
		11	REpower Systems AG	Hamburg, Husum, Trampe, Büdelsdorf
		12	Vensys Energy AG	Neunkirchen (Wellesweiler)
		13	Vestas Deutschland GmbH	Husum,Lübeck,Magdeburg,Lauchhammer
TOWERS	Towers, tubes and foundations	14	AMBAU GmbH	Gräfenhainichen, Cuxhaven (and others)
		15	EEW Special Pipe Constructions GmbH	Rostock
		16	KGW Schweriner Maschinen- und Anlagenbau GmbH	Schwerin
		17	SIAG Tube & Tower GmbH	Leipzig
		18	smb Schönebecker Maschinenbau GmbH	Schönebeck
		19	WeserWind GmbH Offshore Construction Georgsmarienh.	Bremerhaven
BLADES	Rotor blades	20	PowerBlades GmbH	Bremerhaven
		21	PN Rotor GmbH	Stade
		22	SGL ROTEC GmbH & Co KG	Lemwerder
		23	23 SINOI GmbH	Nordhausen
MECHANICAL COMPONENTS	Hydraulic equipment, genrators, gearboxes, bearings, brakes, etc.	24	3M Deutschland GmbH	Neuss
		25	BAIER + KÖPPEL GmbH + CO	Pegnitz
		26	26 Bosch Rexroth AG	Nürnberg, Witten
		27	Gebr. Eickhoff Maschinenfabrik u. Eisengießerei GmbH	Bochum, Klipphausen
		28	HANNING & KAHL GmbH & Co KG	Oerlinghausen
		29	HANSA-FLEX Hydraulik GmbH	Bremen
		30	HAWE Hydraulik SE	München (and others)
		31	HYDAC INTERNATIONAL GmbH	Sulzbach (Saar) (and others)
		32	Jahnel-Kestermann Getriebewerke GmbH	Bochum
		33	KTR Kupplungstechnik GmbH	Rheine
		34	Liebherr-Werk Biberach GmbH	Biberach
		35	Lloyd Dynamowerke GmbH & Co. KG	Bremen
		36	MAG Europe GmbH	Göppingen
		37	PEINER Umformtechnik GmbH	Peine
		38	RENK Aktiengesellschaft	Augsburg (and others)
		39	Rohte Erde GmbH	Dortmund
		40	Schaeffler KG	Herzogenaurach,Schweinfurt (and others)
		41	Siemens AG Hamburg,	Nürnberg
		42	SKF GmbH	Schweinfurt
		43	VAT Getriebetechnik GmbH	Ibbenbüren
		44	VEM Sachsenwerk GmbH	Dresden
		45	Voith Turbo GmbH & Co. KG	Crailsheim (and others)
		46	WINERGY AG Voerde,	Ruhstorf
		47	Zahnradwerk Pritzwalk GmbH	Pritzwalk
		48	ZOLLERN GmbH & Co. KG	Herbertingen
ELECTRONIC COMPONENTS	Automation, controls, power converters, transmissions systems, etc.	49	ABB AG	Mannheim
		50	50 AEG SVS Power Supply Systems GmbH	Warstein
		51	AREVA Energietechnik GmbH	Regensburg, Kassel, Mönchengladbach
		52	Brüel & Kjær Vibro GmbH	Darmstadt
		53	Converteam GmbH	Berlin
		54	Driescher GmbH	Lutherstadt Eisleben
		55	GA Energieanlagenbau Nord GmbH	Hohenwarsleben
		56	Intellifast GmbH	Speyer
		57	Lti REEnergy GmbH	Unna
		58	OAT – Osterholz Antriebstechnik GmbH	Kirchlengern
		59	Powertronic Industrielle Leistungselektronik GmbH&Co.KG	Kirchlengern
		60	Siemens AG Hamburg,	Nürnberg
		61	SSB Wind Systems GmbH & Co. KG	Salzbergen
		62	Vensys Elektrotechnik GmbH	Diepholz
		63	Wachendorff GmbH	Geisenheim
		64	Woodward SEG GmbH & Co. KG	Kempen

Major Wind Energy Players in Germany



Trade Events

There are several major trade shows in Germany that are relevant for wind energy technologies and related services. The U.S Commercial Service strongly suggests that American exporters consider participating in some of these fairs because they are regarded as important vehicles to enter the German and other major European markets. The U.S. Commercial Service often partners with fair organizers to be able to offer attractive packages for U.S. exhibitors at featured events.

- www.husumwind.de (biannual international trade fair in the northern German town of Husum focusing on wind energy technologies and related services; next fair dates: September 21-25, 2010)
- http://www.hannovermesse.de/wind_e (Hanover Fairs features a special wind energy focus every second year in connection with the integrated energy fair (the event takes place in those years when there is no Husum trade fair; next show dates: April 2011)
- Other high-class conferences, seminars and workshops are organized on an ongoing basis and on various topics by the German Wind Association (BWE), and the main wind clusters (Economic development entities of Bremen, Bremerhaven, Hamburg, the state of Mecklenburg-Vorpommern,etc.) and industry incubators (Windenergie-Agentur Bremen/Bremerhaven - WAB).

Please visit www.buyusa.gov/germany/en for a detailed list of trade shows and an overview of what the U.S. Commercial Service has to offer to American exporters at featured events.

Sources:
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For More Information

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