



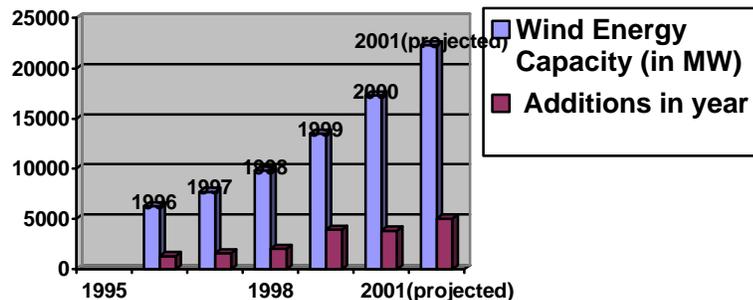
## Global Wind Energy Market Report

### Wind Energy Growth Was Steady in 2000 Outlook for 2001 Is Bright

Some 3,800 megawatts (MW) of new utility-scale wind energy generating capacity were brought online worldwide during the year 2000, making total installed capacity about 17,300 MW at the end of the year, enough to generate some 37 billion kWh of electricity each year, according to the American Wind Energy Association.<sup>1</sup>

As the year 2000 closed, several of the world's largest single wind farms were being prepared for completion in 2001 in the United States. Four wind farms of 200 MW or more will be installed in Texas, California, and the Pacific Northwest during 2001. AWEA anticipates that close to 2,000 new MW of wind energy will be added in the U.S. by the end of the year. Electricity from some of the new U.S. projects has been contracted at less than 3 cents per kWh—establishing wind energy as a power source that is now more affordable than natural gas. The cost of electricity from natural gas reached 15 cents to 20 cents per kilowatt-hour this winter in California<sup>2</sup>.

With steady growth in Europe, a bull market under way in the U.S. and a string of projects under development in several other countries, the global outlook for wind in 2001 is very bright. Additions to installed capacity in 2001 are likely to top 5,000 MW and push worldwide installed capacity well past the 20,000 MW mark in the course of the year.



<sup>1</sup> These are final figures for 2000. Initial estimates were released by AWEA in February 2001. AWEA and the European Wind Energy Association report capacity that has effectively come on-line during the year. BTM Consult figures for 2000 (4,492 MW in worldwide additions, and a total of 18,449 MW) released in March, are higher because they tally capacity consisting of turbines shipped during the year. BTM figures therefore reflect the “pull” from sales for the large number of projects to be completed in 2001.

<sup>2</sup> Wall Street Journal, January 26, 2001, “Windmill farms stage comeback.”

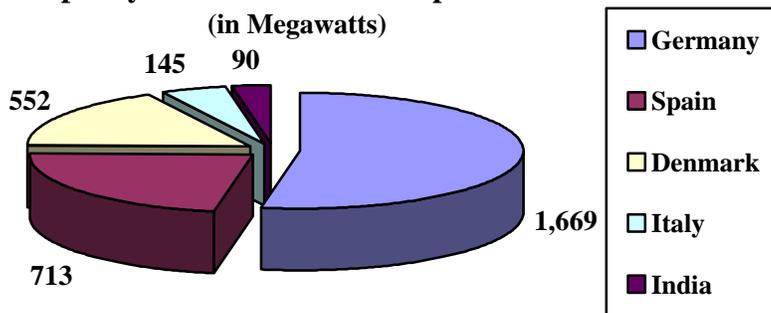
## World Growth

During the year 2000, some 3,800 MW of new wind energy generating capacity were installed worldwide, representing annual sales of about \$4 billion and boosting total installed capacity to about 17,300 MW. In 1999, a record-breaking total of 3,900 MW of new wind energy generating capacity were installed globally. About 2,500 MW came online in 1998.

The past year's growth remained concentrated in **Europe**. Some 3,500 MW of new installed capacity went online in Europe, of which half (1,669 MW) were in **Germany**. **Spain** installed 713 MW of new wind energy generating capacity in 2001, and **Denmark** 552 MW, according to those countries' respective trade associations. **Growth in the European wind energy market has been so strong and steady that the European Wind Energy Association (EWEA) has raised its goal for the region by 50%, from 40,000 MW to 60,000 MW of installed capacity by 2010, of which 5,000 MW are expected to be offshore capacity.**

The slightly slower rate of growth in projects coming online worldwide in 2000 (an increase of 28% in 2000 compared to 37 % in 1999) is largely due to a temporary dip in the U.S. market. Only a handful of projects was dedicated this year in the U.S. as the industry paused after the wind rush of 1999 and prepared for another in 2001: **new wind projects totaling some 2,000 MW are proposed for completion by the end of 2001 in Texas and other regions of the U.S.**

**New Capacity Installed in 2000: Top Five Markets**



The **Mediterranean region** is beginning to tap its winds. Just south of one of Europe's most dynamic wind energy markets, Spain, the kingdom of Morocco brought 50 MW of wind energy online as part of its program to diversify its energy portfolio. Southern Italy's province of Apulia now plays host to a new 170-MW project. Further to the east, Egypt saw 30 MW of new wind energy go online on the Red Sea coastline about 250 km south of Cairo. Turkey has approved contracts for projects totaling several hundred megawatts of new wind energy, some which are likely to be completed next year.

By contrast, **the Asian and Latin American markets**—with the exception of Argentina-- remain largely inactive or uncertain, . India and China, with historically the largest amount of installed wind energy generating capacity among developing nations, have only developed a minute fraction of their respective wind energy potentials so far.

In Central America, renewable energy still faces barriers even as electricity markets are restructured. Nicaragua's newly privatized power utility, ENEL, retracted its bid for a 22-MW wind in response to the Inter-American Development Bank's energy restructuring policy requirements (the bid had been won by a consortium involving Iberdrola/ENISA and Dallas-based International Wind Corp.). A 60-MW project in Honduras proposed by Enron Wind Corp. faced uncertainty as energy restructuring legislation was under preparation in the country. Even though wind energy is very price-competitive in the region, these examples show that wind energy projects will not be implemented in the region if restructuring and privatization proceed without including effective provisions to promote renewable energy.

<b>Top Wind Energy Markets</b> (by total installed capacity)	1999 Additions	1999 Year End Total	2000* Additions	2000* Total
Germany	1200	4444	1669	6,113
United States	732	2500	53	2554
Denmark	650	1748	552	2300
Spain	300	1,522	713	2235
India	62	1077	90	1167
Netherlands	53	410	39	449
Italy	50	282	145	427
United Kingdom	18	343	63	406
China	76	265	--	265
Sweden	40	195	36	231

Note: \* These figures are end-of-year estimates by national wind and renewable energy associations, and other sources. Additions only include projects that have been installed and are operating in the calendar year. Figures are rounded to closest integer.

### **Country highlights**

#### **Europe and Mediterranean rim**

**Germany:** Total capacity installed in Germany in 2000 was 1,669 MW, according to the German Wind Energy Association (BWE). Germany has 9,375 wind turbines in operation, producing 11.5 billion kWh of electricity and meeting 2.5% of domestic demand. The steady growth of wind energy in Germany is due to its “feed-in tariff” or price support mechanism, which first came into effect in 1991 and guarantees a set price for electricity generated from wind. Germany's Renewable Energy Law (EEG) in April 2000 sets a differentiated tariff that varies according to the actual production of a given wind energy

site. EEG also obliges grid operators to bear the cost of power lines needed for feeding wind power into the grid. Germany is seeking to obtain derogation for its existing price support mechanism for wind energy in the renewable energy directive under discussion among European member countries. Germany is on target to meet a 22,000-MW , or one-third, share of Europe's wind power production goal of 60,000 MW by 2010, as it develops offshore projects, according to European Wind Energy Association vice president Andreas Wagner. Further information is available on the Web at <http://www.wind-energie.de> .

**Spain:** Spain finished the year 2000 with some 2,235 MW of total online wind energy generating capacity, according to the Spanish Renewable Energy Trade Association. That figure includes an addition of 713 MW during the year, establishing Spain once again as Europe's most dynamic domestic wind energy market. The year 2000 opened in Spain with a record-breaking order for 1,800 wind turbines totaling approximately 1,400 MW from the Spanish utility Energia Hidroelectrica de Navarra SA. The order was placed with Spanish turbine builder Gamesa Eolica SA, which is 40% owned by Danish manufacturer Vestas. Delivery of the turbines is divided equally over the years 2000-2002, and the total value of the order is more than U.S. \$670 million. Enron Wind Corp. has opened a new plant south of Madrid, in the province of Toledo. It is producing wind turbines ranging in size from 750 kW to 2 MW for the Spanish and Mediterranean markets. Spain has established a network of national, local, price and manufacturing incentives for wind energy, which, coupled with the fact that Spain has few indigenous fossil fuel resources, makes wind energy an attractive option for electric utilities.

**Denmark:** The Danish Manufacturers' Association estimates that an additional 552 MW came online in 2000. Denmark is switching from its price support system for wind energy to a domestic green credit, or certificate, trading system, which will also allow it to participate in a European-wide credit trading system when that is established. A unique set of policies has encouraged ownership and siting of single or small clusters of turbines and promoted private, cooperative ownership of equipment over the years. This model is likely to evolve with the introduction of the green certificate trading system. Denmark currently generates more than 10% of its electricity from wind, and aims to produce 50% of its electricity from renewable energy (primarily wind) by 2030. Information on windpower and the Danish wind energy market is available at [www.windpower.dk](http://www.windpower.dk);

**Ireland:** Ireland brought online 43 MW of wind energy generating capacity in 2000. By the end of the year there were wind energy projects in about 20 locations, totaling 118.2 MW of installed capacity, and producing 2% of the nation's electricity, according to the Irish Wind Energy Association. The country's Alternative Energy Requirement (AER) has resulted in over 200 MW of wind power contracts, and the country's renewable energy program is currently under government review. Ireland is introducing electricity competition, and two "green electricity" companies market green power to customers. Ireland should get another 100 MW over the course of 2001, according to IWEA. Several consortia are actively assessing offshore sites.

**Netherlands:** Wind and solar energy provided power for the international climate change negotiations that took place in The Hague this year. All 400,000 kWh of electricity used to light and heat the conference center, run the computers and fax machines, and otherwise enable the negotiations to run smoothly over two weeks were generated by wind and solar energy provided by Nuon, the Netherlands' largest utility, which offers a "green power" product to its customers. The electricity consumed at the conference equaled about one half the annual production of a 160-foot windmill, according to the utility.

The number of new turbines installed was considerably below the Ministry of Economic Affairs' official goal of 100 MW a year. In 2000, 48 new turbines went on line with a capacity of 39.4 MW, making total installed capacity 449 MW, according to Wind Service Holland. For more information on wind energy in the Netherlands see Wind Service Holland's Web site at <http://home.wxs.nl/~windsh/statsnl.html/>

**United Kingdom:** Ten new projects including the country's first offshore wind project came online in the UK, adding 63 MW to its utility-scale generating capacity in the country, according to the British Wind Energy Association. The UK is debating whether to establish a Renewable Obligation, or Renewables Portfolio Standard, of 10% by 2010.

(see government discussion document on <http://www.dti.gov.uk/renew/ropc.pdf>).

Key implementation issues such as the penalties for non-compliance have yet to be resolved. Some UK companies have begun to trade renewable energy certificates from wind projects, such as Blyth Offshore, within Europe.

**Italy:** Italian Vento Power Corp. (IVPC) and Japanese trading company Tomen Corp., in a joint project, completed a 170-MW wind plant, one of the world's largest, in southern Italy at a total cost of about \$260 million. The wind farm is located in Campania and Puglia near Naples and consists of 282 Vestas 600-kW turbines. Electricity from the facility will be sold to the Italian state utility ENEL.

Financial institutions Mediocredito Centrale (MCC) and Fortis Bank Joint Bookrunners successfully closed one of the largest wind farm financing deals in the world to date, the syndication process for an IVPC4 731.5 billion Italian Lire (U.S. \$325 million) wind farm project financing with a total of 23 participant banks. The transaction was oversubscribed, according to IVPC. The IVPC4 16-year project finance facility, sponsored with a shared equity participation of 50-50 by IVPC and Edison Mission Energy, will involve wind farms for a total capacity of 283 MW in southern Italy and on the island of Sardinia.

**Sweden:** A 10-MW offshore wind farm was completed in Sweden at Utgrunden. The project consists of seven 1.5-MW turbines manufactured by one of Enron Wind's European subsidiaries.

**Greece:** By the end of 2000 the total installed/operating wind energy capacity in Greece had reached 189 MW, according to the Hellenic Wind Energy Association.

**Turkey:** Turkey is proceeding with a first phase of utility-scale wind energy development totaling 350 MW, and Turkish officials have signed implementation agreements with Cannon, a U.S. wind energy developer, for wind projects totaling 185 MW. Additional wind power bids have been submitted under a renewable energy tender issued by the Turkish government.

The first of Cannon's projects, west of Istanbul, will have a generating capacity of 30 MW. The other two, with a combined generating capacity of 90 MW, are in the Cesme area not far from the city of Ismir. Construction at all three sites is expected to be completed by the end of 2001. Cannon is using Vestas and NEG Micon turbines for its projects. Cannon is the only U.S. group among the growing number of wind energy companies active in Turkey.

**Morocco:** Morocco dedicated its first wind power plant in May, 2000. The 50-MW wind plant, at Koudia al-Baida, is expected to generate 200 million kWh annually, an amount equal to 2% of Morocco's total electricity generation. It was built by a consortium, Compagnie Eolienne du Detroit, in which the French state utility Electricite de France and Paribas, a major bank, are shareholders. Additional wind farms totaling 200 MW in capacity in Tangiers and Tarfaya are under proposal or development.

**Egypt:** Egypt installed 30 MW of wind energy on the Red Sea coastline about 250 km south of Cairo.

## **The Americas**

**United States:** The U.S. recorded little net growth in 2000, as the industry paused for breath after the 1999 wind rush and contracts were being signed for new projects to be built in 2001. A total of 53 MW of new utility-scale projects came online in New York, Pennsylvania, Minnesota, Tennessee, and Wyoming. Some 120 MW of wind power are being repowered in California's Altamont and San Geronio passes.

Some of the world's largest wind farms were proposed for construction in the course of the year 2000, including 208-MW 160-MW projects in Texas and the 300-MW Stateline project spanning Washington and Oregon states in the Pacific Northwest. In all, approximately 2,000 MW of wind energy are under development or proposed for completion before the end of 2001, when the federal wind energy Production Tax Credit is scheduled to expire. More than 700 MW are under development or proposed in Texas alone, largely as a result of the state's Renewables Portfolio Standard, which calls for 2,000 MW of new renewable energy capacity to be developed by 2009. The chairman of

the state's Public Utility Commission expects Texas to meet that requirement several years ahead of schedule.

**Canada:** Canada's wind energy generating capacity increased by 10 MW to about 137 MW, according to the Canadian Wind Energy Association (CanWEA). The province of Quebec has the most installed wind capacity, followed by Alberta. Natural Resources Canada made an announcement this year which outlines financial incentives and mandated purchases of green products by federal departments. By 2002, half of the power consumed by facilities owned and operated by the Government of Canada in Saskatchewan will be wind-powered, according to Natural Resources Canada. Wind is responsible for less than one-tenth of one percent of electricity generation in Canada.

**Chile:** A village wind-diesel hybrid power system was dedicated this year in Isla Tac, Chiloe, Chile, bringing electricity to local residents. The system includes two Bergey Windpower 7.5-kW wind turbines, batteries, a Trace inverter, and a backup 12-kW diesel generator. For further more information on the project, see [http://www.chiloeweb.com/barra\\_editorial/lagos\\_tac.html](http://www.chiloeweb.com/barra_editorial/lagos_tac.html)

**Central America:** The utility-scale wind farms in Guanacaste, Costa Rica, are operating with an average 40% capacity factor—turning in one of the best performance records in the hemisphere. At 5.5-7 cents/kWh in the region, wind energy is more than competitive with petroleum-fired plants, which get paid 13 cents/kWh in some cases in those countries. Small wind systems are economical in many locations, and help provide power autonomy and security in a region that lacks rural electrification and that is often hit by natural disasters. In spite of this evidence, investments in renewable energy are only a trickle compared to those in fossil fuels.

**Argentina:** Proposed projects are lining up in Argentina. Two large Spanish firms, ENDESA, a utility, and ELECNOR, an architectural and engineering firm, said December 27, 2000, that they have signed an agreement to incorporate Energias Argentinas, S.A. (Enarsa), to develop an anticipated 3,000 MW of new wind energy capacity and electric infrastructure in the regions of Patagonia, Rio Negro, Chubut, Neuquen, and Santa Cruz in Argentina. The alliance has been signed by their wholly owned energy subsidiaries Enerfin (owned by Grupo Elecnor) and ENDESA Cogeneracion y Renovables. It has also been approved by the Argentine government and the local governments in the regions where the wind turbines will be installed over the next 10 years, starting with 280 MW in Chubut and Neuquen," at a cost of 42 billion Pesetas (U.S. \$240 million).

## Asia and the Pacific

**India:** India's wind farms are reported to now have a cumulative generating capacity of 1,167 MW. Renewable policy initiatives are being discussed at the state and federal levels.

**China:** The Global Environment Fund (GEF) approved a \$12 million grant to China to aid in the development of wind power generation and reduce emissions of greenhouse gases (GHGs) into the atmosphere. The grant is only one component of a \$98-million, GEF-supported project that is designed to help China diversify its energy resources and reduce its dependence on coal, which accounts for about 72% of the total commercial energy production in the country. The project should add 78 MW of electricity generation from three new wind farms in Dabancheng, Fujin and Xiwaizi. The present installed capacity of wind power generation in China is 265 MW, a fraction of 1% of the country's known potential, according to the Xinhua news agency. This amount should increase if steps are taken to implement a government blueprint, the "Key Points of the Program for Development of New Energy and Renewable Energy Industry in the 2000-2015 Period," which sets a target amount of new renewable energy sources developed by the end of 2015 at the equivalent of 43 million tons of standard coal, or 2% of the country's aggregate energy demand.

**Pakistan:** The United Nations Development Programme (UNDP) and the Economic Affairs Division of the government of Pakistan have agreed on a feasibility study for a large-scale wind power project. The project, with a total funding of \$471,000, will select sites and measure the wind energy potential on the shoreline in the southwestern province of Balochistan and make preparations for a large-scale wind power plant. Technical, economic, and regulatory issues are to be addressed in the assessment of feasibility.

**Japan:** Tokyo Electric Power Company has entered into a joint venture with other Japanese firms to promote the use of wind energy in Japan. Tomen Corp., a wind energy developer, is investing about 7 billion yen (\$64 billion) in a 32-MW wind plant. Japan has also placed in 2000 an order for 24 1.65-MW Vestas V66 wind turbines, according to a statement by Vestas. The total value of the order, placed via Vestas' Japanese distributor, Vestech Japan Corporation, is approximately DKK 225 million, or \$26 million. The 24 turbines are to be delivered in the beginning of 2001 for two sites in the northern part of Japan with approximate generating capacities of 25 MW and 15 MW, respectively.

**Australia:** Australia has more than 500 MW of wind energy at various stages of planning and under construction, including Hydro Tasmania's 130-MW Woolnorth wind farm, Pacific Hydro's 140-MW Portland wind farms in Victoria, and Babcock and Brown's 120-MW Lake Bonney wind farm in South Australia, according to Hydro Tasmania. These renewable energy projects are being developed in anticipation of new legislation in Australia similar to a Renewables Portfolio Standard requiring that 12.5% of the country's

electricity come from renewable energy sources by the year 2010. The Australian RPS will use a system of tradable renewable energy certificates (RECs) to achieve its objectives. Further information on the Renewable Energy (Electricity) Act 2000 is available on the Web at [http://www.greenhouse.gov.au/markets/2percent\\_ren](http://www.greenhouse.gov.au/markets/2percent_ren).

## **Conclusion**

The international negotiations in The Hague on implementation of the Kyoto Protocol to the convention on climate change ended in a stalemate, and differences are not likely to be resolved soon between the new Bush Administration in the U.S. and European nations. The failure of the world community to agree on mechanisms and incentives to reduce emissions of gases that contribute to global warming—even at a time when public opinion is increasingly aware of the impacts of climate change from the North Pole to small Pacific Islands—is not likely to slow wind energy's growth in the short term, although it sets back the likelihood of agreement on and implementation of international mechanisms to reduce greenhouse gas emissions, which could benefit wind energy.

The outlook for wind energy remains favorable because of the technology's economic competitiveness, growing demand for electricity, and effective renewable energy policies adopted in several markets. Market growth in 2001 is likely to exceed 50% in the United States, setting a new record and pushing worldwide installed capacity past the 20,000 MW mark in the course of the year. If state policies similar to that of Texas are adopted by other states or at the federal level in the United States and the U.S. federal wind energy production tax credit is extended, if European policies continue to support renewable energy as the region moves towards an increasingly competitive market, and if nations in the rest of the world adopt provisions to support renewable energy even as they restructure and privatize their energy markets, wind energy is likely to thrive, and provide growing economies worldwide with a clean source of electricity, high-tech jobs, and insurance against price spikes and shortages in natural gas and other fuel supplies.

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