COUNTRY NOTES

The Country Notes on Wind Energy have been compiled by the Editors. In addition to national and international Wind Energy Associations' web sites and government publications/web sites, numerous national and international sources have been consulted, including the following publications:

- *IEA Wind Energy Annual Report 2005*, International Energy Agency;
- *Renewable Energy World,* PennWell International Publications Ltd.

Information provided by WEC Member Committees has been incorporated as available.

Albania

Historically wind energy has been used in isolated areas by traditional windmills and for water pumping; however, in recent years attention has turned to utilising the resource for power generation.

The areas of Albania best suited for wind installations have been found to be the mountainous regions of the northeast, the hilly areas of the south and southeast and the coastal strip.

It is considered that by 2020 4% of the country's electricity could be generated by wind power (some 400 GWh/yr). If priority is given to the construction of 20 coastal wind turbines adjacent to water pumping stations, the areas lying beside the Adriatic can be safeguarded from flooding. Pumping stations located in the coastal lowlands take around 30 GWh/yr (some 0.7% of domestic power generation). Studies conducted by the National Agency of Energy have shown that these areas have a sufficient wind resource for them to be considered as suitable sitings for turbines. Average annual wind speed is around 4-6 m/s at a height of 10 m (with an average annual energy density of 150 W/m^2).

Algeria

Algeria has a moderate wind potential, with speeds ranging from 2 to 6 m/s. The area between Adrar–Tindouf and Timimoun in the southwest of the country has been shown to have the best prospects.

The contribution of wind energy in the Algerian energy balance is not high. At the present time the resource is harnessed to good effect in isolated sites and the main applications are for water pumping, especially in the high plains. However, three projects are currently in progress: the completion of a wind atlas, the completion of a 10 MW hybrid power station (6 MW wind / 4 MW diesel) at Tindouf and the hybridisation of an existing diesel plant at Tindouf.

Argentina

Argentina is a country with a good wind resource. It is estimated that currently the Pampa Plain has the highest concentration of wind turbines in the world, with more than 400 000 existing installations. Certainly, the role of wind energy has been significant in the development of the country's agricultural and farming sectors.

With regard to electric power generation, Argentina currently has 12 wind farms located in 5 different provinces, with a total installed power of 27.7 MW. Many of the farms have been developed under the protection of the National System of Wind and Solar Energy passed by Act 25019/98. Among other tax concessions this saw the granting of a US$ 10 subsidy per MWh generated and transferred to the electricity grid. However, Argentina's current use of wind energy bears little relation to its immense potential. It has been calculated that the Patagonian wind potential south of parallel 42 is many times higher than the potential represented by the total annual Argentine oil production. Furthermore, it is not only the southern end of Argentina that presents favourable conditions for the installation of wind farms; there are many other suitable regions: in almost all the territory of the provinces of Río Negro and Neuquén; in many highland and coastal areas of the province of Buenos Aires as well as in many other sites in the rest of the country.

The National Wind Energy Plan, commissioned by the Ministry of Federal Planning and being implemented by the Chubut Regional Wind Energy Centre (CREE), lays the foundations for the first significant national development in this field. The Plan comprises both the compilation of a national wind map as well as the installation of numerous wind farms, with an aggregate power of about 300 MW to be achieved in about three years. The first stage of the Plan comprises the completion of the project Vientos de la Patagonia I (Patagonian Winds I), which comprises the construction of a wind farm of 50-60 MW near the city of Comodoro Rivadavia in Chubut province, although in subsequent stages it foresees the installation of similar farms in the provinces of Santa Cruz, Buenos Aires, Río Negro, Neuquén, La Rioja and San Juan.

Australia

The development of the wind energy sector got off to a slow start in Australia. The resource had been used historically for water pumping in isolated locations but there existed no comprehensive wind industry. The situation began to change at the end of the 1980s (when the first 20 kW grid-connected turbine was installed in Victoria) and gathered momentum during the 1990s. By end-1999, total installed capacity stood at just over 10 MW (wind-diesel hybrid and grid-connected schemes) and the Australian Wind Energy Association (AusWEA) had just been formed.

The Renewable Energy (Electricity) Act of 2000 established the Mandatory Renewable Energy Target (MRET) which came into effect in April 2001. This piece of legislation, the founding of the AusWEA and the establishment of an indigenous wind turbine manufacturing sector are considered to have been fundamental in transforming the country's wind industry. By end-2005 708 MW had been installed across all states, representing the third year in a row in which capacity had nearly doubled. By end-2006, the total had risen to 817 MW, comprising approximately 450 turbines. There are some 40 plants operating, of which 17 are wind-diesel hybrid projects, including Mawson Base in the Australian Antarctica Division.

The MRET scheme was designed to ensure that large energy users and wholesalers purchased 2% of their requirements from renewable sources by 2010. Its success has meant that this target was reached almost twice as quickly as planned. In place of any further mandatory legislation from the Federal Government, some of the State Governments have set their own targets in order to sustain the momentum of the renewable energy market.

The existing national electricity grid is capable of supporting up to 8 000 MW wind capacity - the planned projects are consistent with this level. At end-2006, there was 521 MW under construction and a further 2 109 MW with planning approval, 345 MW seeking approval, 165 MW under tender and 2 339 MW undergoing feasibility studies.

A synergy from combining wind and hydropower has been facilitated by the Basslink interconnector, an undersea cable across the Bass Strait. The cable, which became operational in April 2006, connects Tasmania to the national electricity market via Victoria, allowing Tasmania to supply peaking power at premium prices to Victoria at times of high demand in both summer and winter. It will also enable the export of new renewable energy from wind farm developments to the mainland market.

A considerable amount of wind-related legislation is in place: The National Greenhouse Strategy, the Renewable Energy Action Agenda, the 2004 White Paper on Energy and the Environment, the Green Power national accreditation program, and the Australian Greenhouse Office initiatives are all playing their role in the deployment of renewable energy in general. In order to sustain the growth of recent years it will be necessary for the wind energy industry to overcome various impediments and to implement the relevant policies. but at this stage the outlook for wind is promising.

Austria

Since the mid-1970s the production of renewable energy has grown steadily and has reached a stage where it currently generates 63% of Austria’s electricity. Hydropower supplies the majority share and to date the other renewable energies have played a minor role. With a view to changing this balance and taking into consideration the technologies available, wind power - largely available during the winter months - could complement hydro - at its lowest during the winter.

The first wind measurements were conducted in the late 1980s, discussions regarding feed-in tariffs began in 1991 and the first funding programmes commenced in 1994. These actions brought about the first modern wind turbines in 1996.

After growing slowly during the second half of the 1990s, Austria's total installed wind capacity has been rising steadily, from 606 MW at end-2004 to 819 MW by end-2005 and 965 MW by end-2006. Europe's highest wind park was officially opened in 2003. Situated at 1 900 m, the Tauernwindpark Oberzeiring consists of 11 turbines; its total 19.25 MW capacity is expected to produce 40 GWh/yr.

Although Austria does not manufacture wind turbines, it does make important components for the world's biggest producers of wind generators.

The Eco-electricity Act (Ökostromgesetz) of July 2002 came into effect on 1 January 2003. The law's objective is to raise the share of renewables to 78.1% of Austrian electricity consumption by 2010 and the non-hydro portion (the so-called 'new renewable resources') to 4% by 1 January 2008. The Act lays down an Austria-wide uniform purchasing and payment obligation for power suppliers concerning energy from renewable sources, defined as wind, sun, global heat, hydroelectric power, biomass, landfill gas, sewer gas and biogas. The subsidies for eco-electricity are funded via an extra charge on the electricity price. The Tariff Ordinance (Tarifverordnung) to the Eco-electricity Act provides for attractive and nationally uniform feed-in tariffs for electricity from new eco-electricity plants approved up to 2004.

On 23 May 2006 the National Council adopted an amendment to the Eco-electricity Act. The Amendment envisages a 10% share of so-called new renewable resources in power production in Austria by 2010. It refers exclusively to plants to be newly established and provides for a subsidy until 2011. The annual subsidy amounts to € 17 million, of which 30% is apportioned to biogas plants, 30% to biomass plants, 30% to wind energy plants and 10% to other new renewable resources (e.g. photovoltaics). The feed-in tariffs for these plants have to be refixed every year, with tariffs becoming lower in later years. The tariff applying at the time of the conclusion of the contract applies for 10 years. In the 11th year only, 75% and in the 12th year only, 50% of the respective tariff is to be paid, but at least the market price. The Eco-electricity Amendment also lays down criteria of energy efficiency and minimum full load hours for the individual types of energy.

Belgium

With its heavy reliance on nuclear power, Belgium has been slow to deploy wind turbines. However, the planned closure of its seven nuclear stations (between 2015 and 2025) has prompted discussion of how renewable energies could take their place. At the present time, renewable energy accounts for less than 1% of Belgium's electricity generation.

A demonstration wind farm (21 turbines of 200 kW each, one turbine of 400 kW and one of 600 kW) was established on the eastern pier of Zeebrugge harbour in 1986. Another 600 kW turbine was added in 1999. Apart from the contribution the wind farm makes to the local electricity generation, its main purpose has been to publicise and popularise the concept of wind power.

By end-2005 Belgian installed wind capacity stood at 167 MW; by end-2006 it was reported that it had risen to 193 MW.

Brazil

According to the *Atlas do Potencial Eólico Brasileiro* (Brazilian Wind Atlas) the gross wind resource potential is estimated to be about 140 GW. However, only a portion of that amount could be effectively transformed into wind power projects.

In 2002 the Brazilian Government launched PROINFA - Alternative Sources for Energy Incentive Program, a national programme designed to promote the use of wind, biomass and micro-hydro. It was revised in November 2003. The first phase of 3 300 MW included 1 100 MW of wind power.

Although the main application of wind energy in Brazil is for installed capacity to be grid-connected, the end-2005 installed capacity totalled just 29 MW, of which the main installations were as follows:

City	State	Capacity (MW)
Aquiraz	Ceará	10
São Gonçalo do Amarante	Ceará	5
Gouveia	Minas Gerais	1
Palmas	Paraná	2.5
Fortaleza	Ceará	2.4

However, by October 2006 operational capacity had risen to 158 MW.

Bulgaria

Bulgaria's wind energy resources are quite modest. The territory can be divided into four zones according to their wind potential. However, only two of them are of interest with regard to electricity generation: 5–7 m/s and > 7 m/s. The area where the annual average wind speed is in the region of 6 m/s or above is about 1 430 km^2.

Canada

Canada's wind energy capacity has grown significantly during the current decade. By end-2005 Canada had 683 MW installed capacity; by end-2006 it had grown to 1 460 MW from just 138 MW in 2000. Wind generators produced an estimated 1.8 TWh of electricity in 2005.

The federal Government's Wind Power Production Incentive (CDN$ 0.01/kWh) has assisted in the development of wind power generation. It aims to increase wind power to 4 000 MW by 2010. By end-2005 approximately CDN$ 300 million had been allocated for 22 projects, with a total capacity of 920 MW.

Provincial incentives and Renewable Portfolio Standards have also assisted in the development of wind projects. Each Canadian province is planning to increase its wind power capacity. An example of the ambitious programmes for encouraging renewable energy is the Standards Offer Program in Ontario, which provides CDN$ 0.11/kWh for small renewable energy producers. Ontario also has a Renewable Portfolio Standard and aims to generate 5% of its power from renewable energy by 2007 and 10% by 2010. It is expected that up to 80% of this generation will be met through wind power. Saskatchewan has enacted a Green Power Portfolio strategy, stating that all new provincial electricity generation will come from non-GHG emitting sources by 2010. Prince Edward Island (PEI) passed a Renewable Energy Act in 2004 requiring utilities to acquire at least 15% of their electrical power from wind by 2010. Under this Act, there are plans for 59 MW of new wind capacity to be installed in PEI by end-2007. By 2015, Quebec is looking to increase its wind capacity by 4 000 MW, while Manitoba, New Brunswick and Nova Scotia are aiming to add 1 000 MW, 400 MW and 380 MW respectively over the same time period.

According to the Canadian Wind Energy Association, there are 33 projects under development, some of which have signed power purchase agreements and are under construction. Should all of these wind farms be developed, Canada’s wind power capacity will increase by a further 2 800 MW. Of this, the majority of the development will take place in Quebec (1 245 MW) and Ontario (955 MW), with other significant contributions in British Columbia (325 MW) and Alberta (134 MW).

Wind-diesel hybrid projects in remote Canadian communities, operating on an isolated grid, demonstrate that wind energy can offset some of the costs associated with transporting diesel fuel to remote sites. The Government of Canada, through the Technology Early Action Measures and Natural Resources Canada, supported Frontier Power Systems in the installation of hybrid wind-diesel systems on the island of Ramea, in Newfoundland. Further to this, there are some systems online in northern communities, including Rankin Inlet and Cambridge Bay in Nunavut and others in the Northwest Territories. There is also a significant rural Canadian, and potentially large international, market for small non-electric wind turbines for pumping water and aerating ponds.

China

Although the use of the Chinese wind resource for water pumping is many hundreds of years old, it is only in recent years and with the country's rapid economic growth that attention has turned to utilising wind power by means of modern turbines.

The country not only has an enormous energy/electricity generation requirement, an historical reliance on coal and limited indigenous oil resources, but also severe environmental problems. To address these issues, the Government has targeted renewables to supply an increasing share of power output from green energy.

The provinces of Inner Mongolia and Hebei and the eastern coastal areas are well blessed with wind energy. The theoretical potential of the country as a whole has been estimated to be over 3 000 GW, but the Chinese Meteorology Research Institute states that the practical potential is in the region of 250 GW onshore (at 10 m) and 750 GW offshore (at 50-100 m).

The China Renewable Energy Law, issued at the end of February 2005, became effective on 1 January 2006. The legislation is intended to provide the basis for favourable long-term financial arrangements in order to encourage private investors and hence to expedite the development of the wind industry.

The strategic targets set by the Energy Bureau of the National Development and Reform Commission (NDRC) were for 4 GW of installed wind capacity by 2010 and 20 GW by 2020. The targets were subsequently raised to 5 GW by 2010 and 30 GW by 2020. At the beginning of 2007 it was reported that the 2010 target had been raised again, to 8 GW. It has been suggested that these goals could be surpassed, with capacity in 2010 totalling nearly 10 GW and in 2020, 54 GW.

From a very small beginning in 1986, when a pilot wind farm was established in Shandong province, the sector had grown to approximately 1 300 MW by end-2005, a 30% annual increase since 2000. Installed capacity was spread across more than 60 wind farms in 15 provinces. By end-2006, capacity more than doubled to about 2 630 MW. In April 2007 it was reported that installed capacity would reach 4 GW by the end of the year and that the 5 GW target would probably be attained some two years earlier than expected.

The size of installed turbines ranges from 600 kW to 1.5 MW. The national manufacturers are now fully capable of producing turbines up to 750 kW and several large-scale turbines – 1.2 and 1.5 MW – are being tested. However, it is generally felt that it will be necessary for the industry to become expert in producing the larger machines in order to supply the ambitious development plan.

It is estimated that by end-2005 some 65 MW, representing approximately 320 000 small stand-alone turbines, had been installed in remote areas.

Costa Rica

Costa Rica is reputed to have a better wind regime than California and some of the highest average wind speeds in the world. In addition to using the country's geothermal and biomass resources, the Government is demonstrating its commitment to the utilisation of its wind resource in an effort to develop sustainably and reduce GHG emissions.

In 1993 the Costa Rican Government issued a tender for a 20 MW (30 x 660 kW) grid-connected wind plant near the town of La Tejona. The project was designed for the installation of between 40 and 100 turbines on two parallel ridges to the northwest of Lake Arenal. However, many problems were encountered, which delayed the project until the late 1990s. It was not until September 2001 that the turbines were shipped and installation could begin.

A further project, also near Lake Arenal, financed by private and public loans, various banks and the Danish International Development Agency, has been developed. The 24 MW Tierras Morenas wind farm sells approximately 70 000 MWh/yr electricity to the Instituto Costarricense de Electricidad (ICE), the state-owned national electric utility, under a 15-year power purchase agreement.

At the present time Costa Rica is the only country in the Central American isthmus to have wind parks connected to the electrical grid. By end-2002, installed wind energy capacity totalled 62 MW and by end-2005 it had increased to 71 MW.

In September 2006 Econergy International announced that ICE had awarded the company and its partners a 20-year contract to build, own, operate and transfer a 49.5 MW project. Work on the 55 turbine Proyecto Eólico Guanacaste wind park was expected to start in early 2007.

Denmark

With the utilisation of wind energy featuring in each Danish energy strategy, the country has made use of its wind resource since the early 1980s. The installed wind turbine capacity grew slowly but steadily until the mid-1990s when growth became very rapid. This situation continued to end-2002, when capacity totalled some 2 900 MW. At that point further onshore expansion ceased, owing to a substantial rise in the investment risks incurred by the turbine owners selling production on the electricity market. This was caused by a set of complicated regulations and a reduced environmental premium paid to wind power.

The wind energy market was influenced during 2004 by a political agreement that encouraged the establishment of offshore wind turbines, together with the introduction of a market-orientated pricing system for wind, leading to increased R&D. In the same year a second re-powering scheme was launched for replacing wind turbines sited in unfavourable positions with new installations in more suitable locations. Following on, in June 2005, the Government published its *Energy Strategy 2025* in which economically viable on- and offshore wind power will both play a rôle. Environmental considerations are central to the Strategy and within six months the Danish Energy Agency (DEA) had begun to formulate a plan for the siting of offshore wind turbines in the period 2010-2025, taking these into consideration.

At end-2005 total installed wind power stood at 3 129 MW, comprising 5 293 turbines and supplying 6 614 TWh (18.5% of Denmark’s total electricity consumption). Capacity at end-2006 was very similar to the end-2005 position but owing to poor wind conditions during the period generation was over 7% down.

The country has the world's largest offshore wind farms: the 160 MW (80 x 2 MW) Horns Rev installation in the North Sea was commissioned during 2002. It is located 14-20 km offshore from the western Danish coast, off Blaavands Huk. During 2003, a sister farm (Nysted) was installed in the Baltic Sea, south of the island of Lolland. Nysted consists of 72 x 2.3 MW turbines.

The Government's 2004 agreement called for two more offshore wind farms, each of 200 MW and tenders were duly called for. Horns Rev II will be located about 10 km to the west of the existing farm. An EIA was submitted to the DEA in October 2006 which stated that the farm would be commissioned by end-September 2009. During 2005 the DEA received tender bids for a second farm at Nysted in preparation for evaluation.

In addition to supplying the home market, Denmark is a major supplier of wind turbines to the world: during 2004, the two largest manufacturers, Vestas and Siemens had a global market share of more than 40%. There are also many Danish companies specialising in wind turbine component manufacture.

With the highly significant role that Denmark plays in the world wind industry, R&D is of the utmost importance. A multidiscipline consortium comprising the Risø National Laboratory, the Technical University of Denmark, Aalborg University and the Danish Hydraulic Institute plays a significant part in the R&D programme and the first three named are numbered amongst the 40 European partners of the UpWind project. The aim of UpWind, formed in March 2006 and funded by the EU's Sixth Framework Programme, is to undertake research into all design aspects of the 8-10 MW turbines that are considered to be necessary for the wind farms of the future.

Egypt (Arab Republic)

Egypt is endowed with an excellent wind energy potential, especially in the Red Sea coast area where a capacity of 20 000 MW could be achieved, as the annual average wind speed is around 10 m/s.

The *Wind Atlas for the Gulf of Suez*, published in March 2003, identified the areas of greatest suitability for wind farm projects. It included data for 13 sites covering the period from 1991 to 2001 and was undertaken with the assistance of the Danish Government.

Since 1992, 5 MW wind capacity has been in service at Hurghada.

At end-2006 there was 225 MW of installed capacity at Zafarana on the Red Sea coast, developed in cooperation with Denmark, Germany and Spain. The wind farm has 5 separate operating stations:

- Zafarana 1 (50 x 600 kW) became operational in April 2001,
- Zafarana 2 (55 x 600 kW) in May 2001,
- Zafarana 3 (46 x 660 kW) in November 2003,
- Zafarana 4 (71 x 660 kW) in June 2004 and

- Zafarana 5 (100 x 850 kW) in September 2006.

A further 80 MW of capacity planned for Zafarana 6 is due to begin operating in 2008 with German cooperation. Zafarana 7 and 8, each of 120 MW capacity are planned with commissioning dates in 2009. These two latter plants are located in an extension to the west of the originally designated area in Zafarana and are being developed with help from Denmark and Japan.

A new area at the El-Zayt Gulf, some 150 km south of Zafarana, has been identified as being suitable for the installation of wind farms. At the present time feasibility studies are being undertaken for two plants – one of 80 MW with German assistance and another of 220 MW with Japanese assistance.

The *Wind Atlas for the Gulf of Suez* has been expanded to cover the entire country and the data extended to cover the period to 2005. The resulting *Wind Atlas for Egypt* was published in December 2005. It included a study of the migratory bird routes in the Suez Gulf region. This area was found to be a pathway for some 2.5 to 3.5 million birds each year – an essential element to consider when EIAs are undertaken as part of feasibility studies.

Egypt's national energy planning incorporates a target of 3% of electricity demand to be met by renewables by 2010. It is expected that this will be mainly satisfied by wind power.

Ethiopia

It has been found that Ethiopian wind speeds suitable for electricity generation vary across the territory. According to a recent survey, there are several stations with higher than 6 m/s annual average wind speed – the speed generally considered as the minimum necessary for power production. The highest wind speeds measured were in the Mekelle Region at Ashegoda with 8 m/s and Harena 6.84 m/s. Other high wind speed sites were found at Nazareth and Gondar with 6.64 m/s and 6.07 m/s respectively. Wind speeds at around 4 m/s were recorded in Harar, Debre Birhan and Sululta. This work was undertaken in 2005 with the assistance of GTZ of Germany, as part of the TERNA programme (Technical Expertise for Renewable Energy Application). The annual distribution shows a minimum in July and August and two peaks in March and October.

Medium wind speeds of between 3.5 and 5.5 m/s (energy values between 500 and 1 500 Mcal/m^2) exist over most of the eastern part of the country and the central rift valley zone. Such winds provide a promising potential for water lifting in the rift valley settlements, where water is scarce both for irrigation and domestic uses. At the present time there are a dozen wind turbines installed by a Catholic Mission in the Meki-Zeway area to pump water for schools and villages.

By the end of 2006, the management of the Ethiopian Electric Power Corporation (EEPCO) had decided to construct two parks of approximately 60 MW each for immediate implementation. The first turbine is planned to be online by June 2007 (end of the dry season).

Finland

The country possesses a considerable wind energy potential, estimated at more than 300 MW onshore and 10 000 MW offshore and this will play a rôle in meeting Finland's target of 31% of electricity generation from renewable sources by 2010 (although it is foreseen that most of the increase in renewables will be met by biomass). In 2001 the National Climate Strategy included a target for installed wind capacity of 500 MW by 2010 and a vision of 2 000 MW by 2025. By 2004 it was clear that the funds available were inadequate for the 2010 goal to be met. With the present circumstances (funding and regulatory conditions), a more realistic target has been set at 300 MW by 2010.

By end-2005 total installed grid-connected wind energy capacity stood at 82 MW (unchanged from 2004) and by end-2006 had only grown to 86 MW. However, there are projects representing more than 150 MW in various stages of development. Seven plants (totalling 44 MW) are currently either under construction or planned for operation during 2007 and a further 124 MW is planned for 2008.

Wind-powered generation provided 0.2% of national electricity consumption during 2005. In 2006 it was expected that wind would supply 10% of demand in the Åland islands, an autonomous region between Finland and Sweden having its own legislation and energy policy.

There is no specific wind energy research programme but two related programmes (DENSY – Distributed Energy Systems, launched in 2003) and CLIMBUS (Business Opportunities in Mitigating Climate Change, launched in 2004) aim to develop the technological aspects for an enhanced future wind sector.

France

Despite having a considerable wind resource, France has historically not been dedicated to developing either the wind industry in particular or renewable energy in general. The Eole 2005 programme, introduced in February 1996, was designed to promote wind power but the programme did not live up to expectations.

The Electricity Law of February 2000 introduced legislation for opening the French electricity market to competition. Previously Electricité de France (EDF) had both sought tenders for wind installations and subsequently decided which would be selected. The Law thus effectively brought Eole 2005 to an end: it was only in 2003 that the wind sector in metropolitan France began to grow substantially. In both 2003 and 2004 annual growth was around 60% and 2005 saw a near doubling of capacity installed. By the end of the year capacity stood at 723 MW. There was a similar doubling during 2006.

The French Environment and Energy Management Agency (ADEME) estimates that France has an onshore potential of 26 GW and 30 GW offshore.

In September 2005 France's first offshore wind farm was authorised to proceed. The 105 MW plant will be located off the coast of the Seine-Maritime Department. An invitation to tender has been issued for this project. In addition, bids have been invited for seven onshore plants totalling 278 MW.

EDF stated that at end-September 2005, out of a total of 3 251 MW renewable energy sources applying for connection to the national grid, 3 121 MW or 96% concerned wind.

In the context of the long-term plan for investments in electricity generation, an Arrêté of 7 July 2006 specifies the following targets for onshore wind energy: an additional 13 000 MW capacity by end-2015, of which 12 500 MW should be met by 2010; for offshore wind, the comparable targets are 4 000 MW by end-2015, of which 1 000 MW should be met by 2010.

During 2006 the French electricity tariffs for onshore wind and for offshore wind were revised in an Arrêté issued on 10 July.

Germany

The Electricity Feed-in law (Stromeinspeisungsgesetz) was the progenitor of German wind power development in 1991. But the country's growth in wind capacity from just 110 MW at end-1991 to the present day, when it ranks as world leader, is due to further legislation in the subsequent years. In 1997, the Federal Building Code included wind turbines as 'privileged building projects'; April 2000 saw the adoption of the Renewable Energy Sources Act (EEG); March 2001 saw the feed-in tariff model complying with the European State Aid and Competition Law, while in August 2004 the EEG was amended.

The wind industry has been so successful that the German Wind Energy Association (BWE) estimates that with over 64 000 people, it now employs more than the German coal-mining industry.

By end-2005 capacity stood at 18 428 MW, representing 17 574 turbines, and provided approximately 6% of Germany's electricity generation. By end-2006, capacity reached 20 621 MW, with the federal state of Niedersachsen leading with 5 283 MW. Although all states possess capacity, the northern states of Brandenburg, Bremen, Hamburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Sachsen-Anhalt and Schleswig-Holstein constitute over 80% of installed wind power.

To date, various constraints - physical (deep water), financial and administrative - have prevented the same growth in offshore projects as has occurred onshore. There is currently one 4.5 MW offshore wind farm operating in the North Sea and two (2 MW and 2.5 MW) operating in the Baltic Sea. However, over 30 projects are either in the first phase of construction, approved or planned. Financial concerns over the repowering of older, lower-capacity turbines and finding locations for the siting of new turbines are among the problems facing the onshore wind sector.

However, in early-2007 BWE stated that development of the wind resource should see 30 000 MW capacity installed by 2010 and 48 000 by 2030. Of these figures, onshore (including repowering) would account for 24 500 MW and 28 000 MW respectively and offshore the remainder.

The EEG has provided the main motivation for the development of the German wind resource. For turbines installed in 2005, owners are paid € 0.085/kWh up to a reference output level, with reducing payments for amounts in excess. For turbines installed in subsequent years, the basic rate reduces by 2% each year, so that the price of wind energy gradually approaches the market price for electricity.

Additionally, the Environment Ministry has proposed that the German Renewable Energy Law be revised so that offshore projects would receive a payment (€ 0.091 per kWh) for their electricity output over 12 years instead of the current 9 years. At the present time the payment is restricted to those installations which started operating before 2006 but an amendment would extend this date to 1 January 2008. Further amendments would reduce payments to some onshore wind turbines.

Greece

Greece has a substantial wind resource. The areas of highest potential are the Aegean islands, southern Euboea, eastern Peloponnese and Thrace. Wind power's penetration in the autonomous grid of Crete is, at greater than 10%, amongst the highest in the world (with strongly increasing trends). However, the windiest areas tend to be sparsely populated and to have inadequate transmission facilities.

During the 1990s, deployment was slow, with capacity only growing from about 19 MW in 1992 to 40 MW in 1998.

Until the late 1990s the majority of the wind power capacity was owned by the Public Power Corporation (DEI). The Liberalisation of the Electricity Market Law together with the EU Directive for Greece to supply 20.1% of its electricity from renewables by 2010 have helped to provide the impetus that the development of the wind sector needed.

The years 1999 and 2000 saw high growth in the rate of installation (175% and 107% respectively), since when growth has averaged some 22% per annum. By end-2005 installed capacity had risen to 573 MW and by end-2006, to 746 MW, representing 1 028 turbines. However, as the Hellenic Wind Energy Association suggests, there is much room for improvement and a long way to go before meeting the Government's current target of 3 372 MW by 2010.

The bureaucracy and delays in constructing the grid connections are gradually being overcome with the help of legislation. Law 2941 passed in 2001 removed restrictions on many of the locations for renewable energy projects, simplified licensing procedures and ensured the easier construction of nationwide grid connections. Following the start of liberalisation of the electricity market in 1999, acceleration of the process was enshrined in Law 3175 of 2003. Also during 2003, Law 1726 defined the process for the approval of environmental conditions for renewable developments. A new law (3468) appertaining to the procedure for licensing of renewable energies was passed in mid-2006. Regarding wind, it set out Feed-in tariffs for the wind energy projects in the interconnected grid, wind energy in the non-interconnected grid and offshore wind. Additionally, it listed a three-stage process for licensing: the Production Licence stage which incorporates wind measurements; the Installation Licence stage to cover the relevant administration (including Environmental Impact Studies) and the Operation Licence stage.

Currently, the largest share of capacity is located in eastern Macedonia and Thrace with 29%, followed by Sterea Hellas and Euboea with 27%. Crete represents 17%, the Peloponnese 14%, while the north and south Aegean, Thessaly, Ionion and Attica together account for the remaining 13%.

Wind power R&D is promoted by the Ministry for Development and by a number of public bodies (technical universities, the Centre for Renewable Energy Resources - CRES) and, to a lesser extent, DEI. The MEGAWIND research project, coordinated by CRES and co-funded by the European Commission under the Fifth Framework Programme, is concerned with the development of megawatt-size turbines for high-wind complex-terrain sites.

Hong Kong, China

The land-based wind resource of Hong Kong has been studied by a number of organisations. An interactive wind resource map will soon be available at the Institute for the Environment website at the Hong Kong University of Science and Technology. There are about four hilly areas with average annual wind power densities of more than 550 W/m^2 at a hub height of 60 metres.

Hongkong Electric's (HEC) 800 kW wind turbine at Tai Ling on Lamma Island, which is Hong Kong's first commercial-scale grid-connected wind turbine, was put into operation on 23 February 2006. The 71 m tall, triple-bladed wind turbine is expected to produce about one million kWh annually. It can supplant the need to burn 350 tonnes of coal annually and avoid the emission of 830 tonnes of CO_2.

An important component of HEC's vision for 'Lamma Winds' is heightening public awareness of using wind as renewable energy for power generation. To this end, HEC has created an exhibition centre at the site that provides a wealth of information on the nature of wind and other sources of renewable energy, their benefits and limitations, and examples of their application worldwide.

The pilot project provides valuable insight into the benefits as well as the limitations of utilising wind as renewable energy for power generation in the context of Hong Kong's unique environment. The experience gained is of vital importance for HEC in its pursuit of wider application of renewable energy.

CLP Power Hong Kong plans to install a commercial-scale wind turbine in 2007.

Due to the scarcity of suitable land in Hong Kong, both CLP and HEC are conducting feasibility studies for offshore wind power in Hong Kong waters. The potential total capacity for both projects is 250 MW.

Hungary

The Hungarian wind resource data are only partly known, since measurements were only taken at a height of 30-50 m. The average potential in the central area of the country (Alföld) is around 70 W/m^2 and in the northwest, around 160/180 W/m^2.

Historically there has been little development of wind power in the country but the preferential feed-in tariff (23.8 Ft/kWh) encourages investors. However, as the market is small and the components necessarily imported, the costs of wind energy are high. Furthermore, the national grid has certain limitations on wind power (2005: 200 MW, 2010: 300 MW, 2015: 800 MW) and would need expansion prior to a high growth in grid-connected turbines. Also, the most economic utilisation for wind power in Hungary is for the technology to be combined with pumped-storage hydro plants but it has been found that this solution would need financial assistance from the European Union. It is for all these reasons that to date, energy production from biomass, rather than wind, has been favoured.

Nevertheless, by March 2006 the Hungarian Energy Office had granted licences for 330 MW. Originally, applications for more than this capacity had been received but many were cut back owing to the constraints of the grid.

India

The Indian wind power programme was initiated in 1983-1984 and a *Wind Energy Data Handbook* published in 1983 by the Department of Non-conventional Energy Sources (now the Ministry of New and Renewable Energy, MNRE) served as a data source for early government initiatives. In 1985 an extensive Wind Resource Assessment was launched, which also signalled the beginning of concentrated development and harnessing of renewable sources of energy and, more specifically, of wind energy. To date, seven volumes of the *Handbook on Wind Energy Resource Survey*, containing a huge volume of accumulated wind data, have been published. It is being implemented through the state Nodal Agencies and the Centre for Wind Energy Technology (C-WET). C-WET, an autonomous R&D institution, established by the Ministry and based in Chennai, acts as a technical focal point for wind power development in India.

Estimates of the Indian wind resource have put it at about 45 000 MW (assuming 3% land availability for wind farms requiring 12 ha/MW, at sites having a wind power density in excess of

250 W/m^2 at 50 m hub height). Potential locations with abundant wind have been identified in the following 10 states: Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal.

In terms of currently installed wind turbine capacity, India ranks fourth in the world behind Germany, Spain and the USA. At end-2005 the figure stood at 4 434 MW. Tamil Nadu possessed over 57% of the commercial plants. By end-September 2006 installed capacity had already grown to 6 018 MW.

Demonstration projects, which began in 1985, are being implemented in areas not already possessing projects but where commercial developments could follow. In early 2006, demonstration capacity totalled 68 MW.

Use is being made of wind-diesel hybrid projects where an area is dependent on diesel fuel. A project with a capacity of 2 x 50 kW has been commissioned in the Sagar Islands in West Bengal. Phase II (8 x 50 kW) is expected to be commissioned shortly.

The strong growth in the Indian wind energy market is expected to continue, and even accelerate, as a result of a range of Government and State-led financial incentives.

Ireland

Ireland's prevailing south-westerly winds from the Atlantic Ocean give a feasible wind resource that has been estimated to be as high as 179 GW, or some 40 times the country's current generating capacity.

This abundant wind supply began to be utilised, albeit rather poorly, in the early 1980s with several demonstration schemes. The detailed investigations that followed included the establishment of the Irish Wind Atlas and, in 1996 the Government's Alternative Energy Requirement (AER I) competition. The market support mechanism of AER I in which 15-year power purchase agreements were awarded to renewable electricity generators has been repeated in further programmes – AER II to AER VI. In 2005 it was announced that the support mechanism to follow AER VI would be based on a fixed feed-in tariff system over a 15-year period but only applying to new capacity projects.

The Government's Renewable Energy strategy, as contained in the 1999 Green Paper and subsequently the 2000 National Climate Change Strategy, specified a target of an additional 500 MW of installed renewable electricity generating capacity to be in place in the period 2000-2005.

The country is also working with the 2001 EU Directive of meeting 13.2% of its electricity generation from renewables by 2010. No target has been specifically set for wind power but it is considered that this resource will make the greatest contribution and the Government has agreed with the relevant parties to work to a figure of 1 100 MW of installed capacity.

By end-2005 capacity stood at 496 MW, a total of 676 MW of capacity was already contracted to be grid-connected by 2011 and some 3 000 MW had been applied for and was in the process of being assessed. By end-2006 installed capacity had climbed to 745 MW.

At the present time, the majority of installed capacity relates to onshore wind turbines but the first phase of the Arklow Bank offshore plant became operational in June 2004. The 25 MW (7 x 3.6 MW) plant, located off the east coast of Ireland in the Irish Sea was co-developed by GE Energy and Airtricity as a demonstration plant. Testing of this first phase will take place for approximately two years, after which a much larger plant may be developed. In 2003 Airtricity agreed with GE Energy to purchase the plant following the testing phase. A new company, Zeusford (50% Airtricity, 50% EHN of Spain) has proposed the expansion of Arklow Bank to a 200 turbine wind farm with a nominal capacity of 520 MW. Some 10% of national electricity demand could be met if the plan comes to fruition.

Italy

The Italian wind resource is most prolific in the southern regions of Campania, Puglia and Molise and on Sardinia, Sicily and the minor islands. Technically exploitable capability for onshore wind farms has been assessed at around 7 000 MW for wind velocity higher than 5 m/s and 90 m hub height. There is a limited potential for offshore development owing to the considerable depth of the coastal waters, although there are possibilities in the seas surrounding Sicily.

Despite the Government's considerable amount of legislation supporting the introduction of renewable energies into the national energy balance, the introduction of wind power capacity has not been as rapid as might have been thought possible. Nevertheless, progress in recent years has been positive, with 789 MW being added between 2003 and 2005. By end-2005 installed capacity stood at 1 639 MW. To date most turbines have been installed in southern areas of the country and the main islands.

The Italian White Paper for the exploitation of renewable energy sources states that the target for wind energy is 2 500 MW for 2008-2012. This position is unchanged since 1999 when the target was established. However, if the present trend continues, it could be expected that between 4 000 and 5 500 MW capacity could be installed by end-2010. These levels are necessary if the country is to comply with the terms of the Kyoto Protocol's CO_2 emissions reduction.

In the past it was thought that problems arose because of difficulties in dealing with an incentive scheme based on Green Certificates and also opposition to the installation of wind turbines from some of the Italian regions and a small number of the environmental groups. However, whereas the Certificates have proved popular with investors and are working well, there is still a certain amount of opposition.

Italy has a wind turbine manufacturing industry. The principal global manufacturer is Vestas Italia, producing medium-size machines. During

2005 the Vestas plant exported 225 turbines not only to other European countries but also to China and the USA. The demand for larger turbines (1-2 MW) continues to increase steadily but policy changes favourable to small turbines will also be likely to boost demand.

Japan

Although the wind resource of Japan is large, located mostly in the far north and far south of the country, there are impediments to utilising it to the full. The areas of high wind (Tohoku, Hokkaido and Kyushu regions) do not match the areas of high population density and the national, privately-owned grids each has a wind capacity limit, ranging from 3.5% to 5% of the grid capacity. Additionally, to date offshore installations have been precluded owing to the deep waters surrounding the country.

Nevertheless, as a result of the UN Climate Change Conference in Kyoto in 1997, Japan agreed to reduce its output of GHG by 6% by 2010, compared to the 1990 level. In order to meet this target, the Government set an objective of 3 000 MW wind capacity in its latest Primary Energy Supply Plan.

April 2002 saw the Government passing further legislation (the Renewables Portfolio Standard - RPS) so that the renewable energy contribution to total electricity supply (1.35% by 2010) would be met.

By end fiscal-year 2001, total installed capacity stood at 139 MW and at end fiscal-year 2005, 1 078 MW. A further 316 MW was added during April-December 2006 to bring the total to 1 394 MW. This high rate of growth has been possible because of Governmental support in the form of field tests, promotional subsidy programmes and the RPS.

Following the results of COP3, the Government must set a further target for 2030. The Japanese Wind Power Association has proposed wind capacity of 11 800 MW by 2030 and the NEDO (New Energy and Industrial Technology Development Organization) suggests that 10 000 MW could be in place by 2020 and 20 000 MW by 2030.

Jordan

Studies on Jordan's wind potential have been conducted over a period of years and have shown that the country has a rich wind energy resource. The average annual wind speed exceeds 7 m/s in some areas. A wind atlas has been prepared based on an assessment of the available resource which demonstrates the existence of a potential for several hundred megawatts of wind-power installations.

There are two operational wind farms in Jordan: Al-Ibrahimiya, with a capacity of 320 kW (4 x 80 kW), established in 1988 in co-operation with a Danish firm and considered as a pilot project; the other, in Hofa, has a capacity of 1 125 kW (5 x 225 kW), established in 1996 in co-operation with the German Government under a programme called Eldorado. Both wind farms are operated and maintained by the Central

Electricity Generating Company (CEGCo). The Ministry of Energy and Mineral Resources (MEMR) has reported that feasibility studies are being undertaken on the possible expansion of both plants. Beginning in August 2005, data were being collected over the course of a year for the site at Al-Ibrahimiya. Subsequent analysis will demonstrate whether the plan will proceed.

The MEMR plan in place during the first years of the 21st century for the development of an IPP wind project was halted. However, having now obtained the necessary agreements and finance from the Global Environment Facility and the World Bank, the MEMR is again preparing studies in readiness for issuing tenders for the construction of a suitable wind plant.

In June 2005 the MEMR contracted with COWI of Denmark to undertake the collection and study of wind data at 15 sites with a view to building a wind project. The 5 most suitable sites will then be further studied, prior to a full feasibility (economic, technical and environmental) study on one of them.

Korea (Republic)

Until a few years ago, Korea concentrated on industrial development goals rather than the advancement of renewable energy utilisation. However, following the Government's establishment of the Basic Plan for New and Renewable Energy (NRE) Technology Development and Dissemination in December 2003, the situation is now changing. A target of 5% of total primary energy supply to be met from renewable energy by 2011 has been set.

Until the end of 2004 implementation of wind power capacity had been extremely slow, totalling only a cumulative 28 MW. However, by end-2005, installed capacity had risen to 99 MW. The NRE goal specifically for wind energy has been put at 2 250 MW installed capacity by 2012. A feed-in tariff for NRE-generated electricity, put in place during May 2002, undoubtedly helps with growth in the wind sector. One particular problem with the future siting of turbines is the lack of suitable locations. The mountainous countryside beyond the centres of population lacks the necessary infrastructure and has other constraints, thus causing capital costs to be higher; moreover obtaining authorisation to build in such areas is often impossible.

An R&D programme was instituted in 2001 and there are now four indigenous turbine manufacturers, mainly working on 750 kW to 2 MW systems. In order to meet the 2012 target, it will be necessary to develop 3 MW class wind systems. In December 2005, a demonstration offshore wind project (two 2 MW systems) was launched.

Latvia

Latvia has favourable conditions for exploiting wind energy: the average yearly velocity of winds blowing over the western coasts of the Baltic Sea is 5.7 m/s.

The Institute of Physical Energetics of the Latvian Academy of Sciences compiled a wind atlas for the country in 1990. It was found that the windiest areas are on the coast of the Baltic Sea (Ventspils to Liepāja) and on the eastern side of the Gulf of Riga (Ainaži). The width of the territory along the former is 50-70 km and of the latter (as far as Ainaži), about 10 km; the total area involved is approximately 10 600 km^2.

Inland, the wind regime is also suitable in the vicinity of Riga, Bauska, Rēzekne, Saldus, Cēsis and Dagda, as well as the windy, hilly areas in Kurzeme, Vidzeme and Latgale (but not on the leeward side of the hills in Jūrmala, Kurzeme, Vidzeme and Latgale).

The tradition of using wind energy in Latvia was revived in 1989, when the first wind power plant (WPP), with a capacity of 16 kW, was installed. Initially, the WPPs operated in the offline mode, with their output used for heat production. Two plants, on the northwest coast of Latvia in the Ainaži region, with a total capacity of 1.2 MW, were connected to the power grid in 1995.

Three WPPs (Nordex turbines) of 3.0 MW were installed on the coast in the neighbourhood of Ventspils between 1999 and 2002.

Also during this period, construction of a wind park began in the Liepaja district. It consisted of 33 directly-driven WPPs of the E-40 type (Enercon turbines) with a total capacity of 22 MW, constituting the largest such park in the Baltic States. The cost of construction was estimated to be US$ 22 million. Generation began in December 2002.

The sole purchaser of wind-generated energy is the state joint-stock company, Latvenergo.

At the present time about 100 MW of WPP is planned for installation over a period of 15 years.

The Institute of Physical Energetics has undertaken research into the construction of directly driven low-power WPPs with the aim of producing inexpensive and optimally designed plants.

Lithuania

The first wind plants were constructed in Lithuania in 2004. Installed capacity of 0.9 MW generated output of 1.2 GWh during the year.

The aggregated planned capacity of wind power plants to be constructed by 2010 is about 200 MW. The Lithuanian Government approved regulation No 1474, ‘Procedure for the Promotion of Purchasing of Electricity Generated from Renewable and Waste Energy Sources’ on 5 December 2001. This regulation promotes wind generation, with a feed-in tariff (€ 0.0637/kWh) being applied to the purchase of electricity generated by wind power plants.

Mexico

The present resource estimate is of the order of 5 000 MW with the main area of interest being the Isthmus of Tehuantepec where 2 000 MW or more could be installed with a utilisation of about 40%. Other areas of potential are located in the

States of Yucatan, Zacatecas, Baja California Sur, and Tamaulipas.

It has been estimated that Mexican electricity consumption will grow at 5.2% per annum between 2005 and 2014. To satisfy this demand some 22 GW of additional generating capacity will be required. There is thus an opportunity for the country's wind resource to contribute a portion of this new capacity in the coming years.

The national electric utility CFE has plans for 404 MW of new wind capacity for installation during the next 10 years, in groups of 101 MW. There are also private projects of more than 400 MW which have already received a permit from the Mexican Energy Regulatory Commission. With funds from GEF, administered through the UNDP, a large project is being carried out through the Instituto de Investigaciones Electricas to assess the wind potential in certain areas of Mexico and to build a Regional Wind Technology Centre. Wind-based water pumping is widely used, mainly in the north of the country.

By end-2006, the second phase of La Venta wind plant was operational. The 83 MW (98 x 850 kW) La Venta II brought Mexican installed capacity to 85 MW.

Morocco

Study has shown that the best wind resources in Morocco are found in the north (particularly in the Atlantic coastal regions) and in the south. The former experiences annual average wind speeds of between 8 m/s and 11 m/s and the latter of between 7 m/s and 8.5 m/s. The wind potential can be utilised for both grid-connected electricity production and also water production by desalination.

The Centre for Renewable Energies (CDER) has stated that its objectives are that by 2012 20% of electricity and 10% of energy consumption should be supplied by renewable energy. The harnessing of Morocco's excellent wind potential began in 2000 with the 50 MW El Koudia El Baida at Tétouan. This was followed in 2001 by a 3.5 MW plant at the same location. During 2005, output from the two wind farms totalled 208 GWh. In September 2005 a 10 MW plant attached to the cement factory in Tétouan became operational. The grid-connected turbines are expected to produce 38 GWh/yr and provide 50% of the factory's consumption.

In the short term two new wind farm projects are planned by the Moroccan Office national de l'électricité (ONE). It is foreseen that a 60 MW system at Cap Sim, 15 km south of Essaouira, will be operational in 2007-2008. Invitations to tender for a 140 MW (165 x 850 kW) project, split between Dhar Saadane, 22 km southeast of Tanger and Beni Mejmel, 12 km east of Tanger were issued in early 2007. It is foreseen that the project will be operational by 2009-2010.

Many other sites for both large and small projects are currently under development, undergoing feasibility studies or awaiting approval. One desalination project quoted by CDER is a grid-connected wind farm at Tan-Tan city, some 900 km south of Rabat. It is forecast that the plant would begin with 5.6 MW of capacity, rising to 8.8 MW and then to 11.2 MW. By 2015 over 11 000 m^3/d of water could be produced.

Namibia

A full study has been conducted in order to determine the feasibility of wind farms situated on the coastal areas of Namibia. At Luderitz the average wind speed is 7.5 m/s while at Walvis Bay it has been found to be slightly above 7.5 m/s.

A 220 kW wind turbine was installed at Walvis Bay in late 2005 and is to date the largest such installation in the country. There are several other stand-alone 1 kW turbines located around the country used for electricity generation and water pumping for farms, totalling in the region of 70 kW.

The Ministry of Mines and Energy state that at the present time no wind energy projects are planned but with a plentiful wind resource available, there are opportunities for investment.

Netherlands

During 2001 the Dutch Government set new renewable energy targets in order to comply with its obligations under the Kyoto Protocol. These targets were confirmed during 2005, namely that renewable energy should provide 5% of total energy supply in 2010 and 10% in 2020, and 6% of electricity generation in 2005 and 9% in 2010.

In 2001 renewable energy had only a 1.3% share of overall energy consumption and 2.8% of electricity generation and it was felt that without further action future targets could not be met. Taking this into account, government policy attached a higher priority to those renewable energies which it was felt could make the greatest contribution: namely, offshore wind and biomass.

Until 2001, wind capacity had been increasing only slowly, with just 485 MW being installed by year-end. Thereafter, additions to capacity accelerated: 2002 and 2003 saw increases of 38% and 35% respectively and, although the rate of growth was lower in 2004 and 2005 (18% and 14% respectively), the turbines operational at end-year 2005 totalled 1 224 MW.

Study has shown that the available part of the Netherlands Exclusive Economic Zone (NEEZ) could support up to 6 000 MW of offshore wind capacity. The Government has built this figure, along with 1 500 MW of further onshore capacity, into its target that wind power should generate approximately 20% of domestic electricity demand by 2020. In the shorter term, the Ministry of Economic Affairs has agreed with the Dutch parliament that a maximum of 700 MW of offshore wind capacity should be in place by 2010.

Early in 2002 the consortium Noordzeewind (Nuon Renewables and Shell Wind Energy) was chosen to build a demonstration Near Shore Wind Farm (NSW) off the coast at Egmond aan Zee. The NSW is designed to have a life span of

20 years, at the end of which it will be dismantled. The intention is that the experience gained will greatly assist the development of further offshore installations, both larger in size and located in deeper waters. Construction of NSW began during 2005, the final turbine was erected in August 2006 and the first electricity supplied in October 2006. The research programme will last until 2012.

Construction began on the 120 MW Q7 wind farm, some 23 km offshore from Ijmuiden, in late 2006. The project is being developed by Econcern, Energy Investments Holding and ENECO. It is expected that the first electricity from Q7 will be generated in early 2008.

In January 2007, it was announced that the EIA for WEOM's (Wind Energy Development Company) 270 MW offshore wind farm, Den Haag II, had been issued and was open for inspection.

Along with Germany and the UK, the Netherlands is part of the European Offshore Supergrid® project. Initially 10 GW, the Foundation Project is designed to test the feasibility of interconnecting 2 000 wind turbines and supplying electricity to the national grids of all three countries. Ultimately, it is proposed that the system could cover the Baltic Sea, the North Sea, the Irish Sea, the English Channel, the Bay of Biscay and the Mediterranean.

New Zealand

A wealth of indigenous renewable energy (in particular hydro and geothermal) already supplies about 30% of total energy demand and about 70% of electricity supply. However, owing to its location, New Zealand also has an excellent wind resource that will be increasingly harnessed in the future. The Government's National Energy Strategy and Domain Plan for Energy Sector 2006-2016 acknowledge the importance of the country's wind resource amongst the renewable energies in helping to provide a sustainable source of energy and security of supply in the coming years.

At end-2003 total installed capacity stood at just 36 MW but during 2004 three wind farms (Te Apiti, Tararua 2 and Hau Nui 2) came online bringing total capacity to 168 MW. With just one 100 kW turbine becoming operational during the following year, capacity effectively remained unchanged at end-2005. Five of the planned 97 turbines at Te Rere Hau wind farm were added during 2006 bringing the total to 171 MW.

The situation is set to improve in 2007 with the 58 MW White Hills and 93 MW Tararua 3 wind farms being completed. Furthermore, projects representing over 1 500 MW are in various stages of authorisation – an indication that the NZ wind sector has ambitious plans for growth.

Norway

Norway's electricity production is virtually entirely based on hydropower but as there are physical limitations to new schemes, attention has turned to wind energy, albeit with some major obstacles to overcome (financing, public acceptance, etc.).

Although the country has a tremendously high wind resource, in some remote areas the prohibitively high cost of grid connection would make installation of wind turbines uneconomic. Until 2002 installed capacity was extremely small but during the year two 40 MW projects (on the island of Smøla and near the town of Havøysund, close to the North Cape) became operational, bringing total capacity to 97 MW. Further growth occurred during 2004 and 2005 bringing the total to 270 MW. However, as electricity generated from wind was only about 500 GWh in 2005, it represented a very minor part of the total electricity generation of 138 TWh.

Enova, an enterprise owned by the Norwegian Ministry of Petroleum and Energy came into operation on 1 January 2002. Its mission is to ‘contribute to environmentally sound and rational use and production of energy, relying on financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals’. One of Enova’s goals is to install 3 TWh of wind power by 2010. This target represents approximately 1 000 MW of capacity. By end-2005 Enova had signed contracts for 12 projects totalling approximately 500 MW and 68 MW were under construction. Also by end-2005 there were plans for 8 000 MW wind turbines but it was felt that the price for electricity had not risen to a level high enough to provide the incentive for development.

Following the 2005 general election and the establishment of a new Government, a period of uncertainty regarding the continuance of a green certificate scheme came to an end. The Ministry of Petroleum and Energy presented a new support scheme for renewable energy in November 2006 but it will not become effective until 2008. Wind power will receive a feed-in support of 8 Norwegian øre/kWh for 15 years in excess of the marked price (approximately € 10/MWh). For every øre above a marked price of 45 øre, the feed-in will decrease by 0.6 øre.

An indication of the increased drive towards the development of wind power was the formation of the Norwegian Wind Energy Association in April 2006.

Peru

The Peruvian WEC Member Committee reports that the compilation of maps and a wind atlas has been planned for the year 2007.

At the present time there are two grid-connected pilot wind generators: Malabrigo (250 kW), located 750 km north of Lima, and Marcona (450 kW), located 600 km south of Lima. ADINELSA (Empresa de Administración de Infraestructura Eléctrica), considers that it is feasible to install wind farms at Malabrigo (30 MW) and Marcona (100 MW) in due course.

Although wind energy is used for water pumping in various locations, no data are available.

The National Rural Electrification Plan, 2005-2014 contains a programme for the installation of 124 wind generators of 50 kW each, that can vary with the demand. It has been estimated that an investment of US$ 16.5 million would be required for 62 MW of capacity, benefiting 136 000 inhabitants.

Poland

The highest wind velocities in Poland are found along the Baltic coastal region (5-6 m/s annual average wind speed at 30 m above ground level) and in northern and central areas (4.0-5.5 m/s): it is therefore these areas that are the most favoured for development. Wind turbines have been installed in various parts of the country but they are all less than 1 MW capacity. To date it has only been in the north that wind farms of between 1.2 MW and 50 MW have been installed.

Prior to 2001 Polish wind energy capacity stood at a very low level, but the start of operations at the Barzowice (5 MW) and Cisowo (18 MW) plants brought end-2003 capacity to 57 MW. Further development brought the installed capacity to 123.5 MW at end-2005 and to 175 MW at end-2006.

The Polish Wind Energy Association has reported that many wind projects are either planned, under construction or nearing completion (some with participation by Danish, Dutch, Japanese and Spanish companies). The Polish Government plans that by 2010 wind energy capacity will total 2 000 MW and wind power will contribute 2.3% of energy consumption.

Portugal

Despite Portugal's considerable technical wind potential - estimated to be approximately 700 GWh/yr - the country has been slow to utilise it for the production of electricity. However, in recent years, because of a lack of indigenous energy resources and a high dependence on imported fuels, the Government has legislated for electricity to be increasingly produced from renewable energies and in particular wind. The targets for wind power to supply electricity generation are 3 750 MW by 2010 and 5 100 MW by 2013.

The Atlantic archipelagos of the Azores and Madeira both have a high wind energy potential and it was in these islands that the first wind parks were established at the end of the 1980s/beginning of the 1990s.

With the favourable climate that has been created by the new policies, installed operational wind capacity in mainland Portugal and the islands at end-2005 stood at 1 063 MW, a quadrupling of the 2003 capacity. A majority (some 98%) is located on the mainland but the Azores and Madeira have a small number of wind turbines. A significant increase was again demonstrated in 2006 with capacity growing by over 60%. Whilst a proportion of capacity is grid-connected, the Government mounted a drive for more grid-connection of wind farms in 2005.

A measure to promote competition in the power market, the Iberian Market on Electric Energy (MIBEL) – linking the power systems of Portugal and Spain – has experienced many delays since the protocol was signed by the two countries in 2001. Originally, operation of MIBEL was scheduled for January 2003 but the electricity derivatives market finally began to operate only on 1 July 2006.

Study of the country's offshore wind resource is currently being undertaken, as although it does not have the same potential as in northern Europe, it is nevertheless considered that further research is warranted.

Romania

The wind energy potential of Romania has been shown to be significant. A wind map for the country has been developed taking into account the wind source at an average height of 50 m, based on meteorological and geographic data. The wind potential has been estimated at 8 000 GWh/yr.

The planned projects and research programmes are designed to promote investment projects aimed at providing optimum conditions for the development of medium and long-term applications.

For the utilisation of the wind energy resource, a series of investment projects have been proposed aimed at ensuring:

- wind potential utilisation in highly energy-efficient conditions;
- promotion of the technical and functional performance of grid-connected wind turbines;
- creation of prerequisites for the transfer of non-conventional technology and equipment from EU Member States and countries with advanced experience in this field;
- implementation of applied management programmes and technology transfer for wind generators, thereby attracting representatives from the private sector and encouraging them to participate both economically and financially.

Current applications comprise wind power plants; rural electrification; hybrid PV/wind small off-grid public & private systems; and hybrid PV/wind for telecommunications.

It will be necessary for the Romanian Government to promote financial mechanisms to encourage the development of renewable energy and, in particular, commercial wind energy projects.

Russian Federation

Russia has used its high wind resource for many hundreds of years, mainly mechanically for water pumping. However, despite an enormous potential, commercial, large-scale utilisation has never occurred and development has generally been restricted to agricultural uses in areas where a grid connection was infeasible. The areas of greatest resource are the regions where the population density is less than 1 person per km^2.

The coastal areas of the Pacific and Arctic Oceans, the vast steppes and the mountains are the areas of highest potential. In 1935 the wind resource was estimated at 18 000 TWh for the USSR as a whole. More recently, estimates suggest that the European part of Russia has a gross wind energy resource of 29 600 TWh/yr (37%) and the Siberian and Far East part, 50 400 TWh/yr (63%). The technical resource for each is reported to be 2 308 and 3 910 TWh/yr, respectively.

It has been suggested that large-scale wind energy systems might be applied in areas where the resource is particularly favourable and there is an existing power infrastructure and major industrial consumers. These would include various locations in Siberia and the Far East (east of Sakhalin Island, the extreme south of Kamchatka, the Chukotka Peninsula in the Magadan region, Vladivostok), the steppes along the Volga river, the northern Caucasus steppes and mountains and the Kola Peninsula. Additionally, offshore wind parks could be considered in some of these areas, especially in the Magadan region and in the Kola Peninsula where existing hydropower stations could be used to compensate for the intermittent wind power.

During the past decade, Russia's economic constraints have not assisted in the development of large renewable energy projects. However, in 2000, the European Union and Russia began the mutually beneficial Energy Dialogue dealing with a wide range of energy issues, from security of supply to energy efficiency to discussions regarding an interconnected electricity network. Soon after Russia's ratification of the Kyoto Protocol in October 2004, the EU began providing technical assistance through its TACIS programme. The Kyoto Protocol requires the promotion of renewable energy and, as far as wind is concerned, the manufacture of wind energy equipment and the development of wind plants in Russia.

At end-2006, total installed wind capacity stood at 15.0 MW. The main wind power stations are: Kalmickaya, 2.0 MW (Kalmykia); Zapolyarnaya, 1.5 MW (Komi); Kulikovskaya, 5.1 MW (Yantarskaya region); Tyupkildi, 2.2 MW (Bashkiriya) and on Observation Cape, 2.5 MW (Chukotskaya autonomous region).

Feasibility studies are being carried out on the 50 MW Kaliningradskaya and the 75 MW Leningradskaya wind power projects; European and US companies are considering participation in their construction.

Spanish and German companies are considering involvement in 100 MW of wind projects in Kalmykia and in the Krasnodar region.

The Russian Association of Wind Industry (RAWI) was established in the early years of the

21st century and the first of its stated aims is to help the formation, growth and development of the wind power market in the Russian Federation.

South Africa

In recent years South Africa has embarked on a more formal wind exploitation programme. Between August 2002 and February 2003 Eskom erected a small experimental wind facility with a total of 3.2 MW. The purpose of the wind farm at Klipheuwel in the Cape is primarily to gain experience in different turbine technologies.

A privately owned facility in the Darling district in Western Cape has received a licence and will shortly begin construction, subject to procurement of turbines. The first phase is expected to have a capacity of 5.2 MW (4 x 1.3 MW). A second phase incorporating a further 6 x 1.3 MW turbines may be installed later, bringing the total to 13 MW.

A Baseline Study on Wind Energy completed in February 2003 provided the following estimates of annual national electricity output from wind at that point in time: national grid 5 000 MWh; rural mini-grid 111 MWh; off-grid 1 117 MWh; and borehole windmills 26 000 MWh, giving a total of 32 228 MWh.

Spain

Estimates have shown that the country has a technical wind potential of 15.1 GW, which has provided the wherewithal for an ambitious wind energy policy. From a capacity of just 75 MW in 1994, the end-2005 level was 10 028 MW. By then Spain was second in terms of global installed power, lying behind Germany and ahead of the USA (a position retained at end-2006, with an installed capacity of 11 615 MW).

Incremental wind capacity added since 2000 has resulted in historical programmes and forecasts being outstripped. The main impetus behind wind energy's strong position in the Spanish energy market has been the Spanish Renewable Energy Plan 2005-2010, issued by the Instituto para la Diversificación y Ahorro de la Energía (IDAE) in July 2005. The Plan specified that renewable energy (including large hydro) should supply 29.4% of electricity demand by end-2010 and at least 12% of total energy use. The target for wind capacity which had been set at 13 000 MW, was raised to 20 155 MW by end-2010.

Additionally, through a new support scheme for renewable energy, there is a strong incentive to connect wind farms to the electricity market: the price - related to the Average Electricity Tariff (AET) - paid for wind-farm generated electricity is guaranteed for the life of the installation.

Almost all of the Spanish autonomous communities possess wind capacity, from Valencia on the east coast with 20 MW (at end-2005) to Galicia in the north-west with 2 452 MW; only three mainland regions have none.

Although the market has experienced some delays in recent years, owing to administrative difficulties, the autonomous communities have ambitious plans for installations to total some

37 000 MW between 2010 and 2012, of which Andalusia plans 4 000 MW; Catalonia 3 000 MW; Castilla Leon 6 700 MW; Galicia 6 300 MW; Castilla La Mancha 4 450 MW; Aragón 4 000 MW; Canary Islands 890 MW and Valencia 2 400 MW. Several regional governments are also favouring the promotion of small wind farms of less than 5 MW.

Indigenously-owned manufacturers account for over 70% of wind turbines installed in the country. Whilst there are several foreign manufacturers in the market, the national company Gamesa has 50% of the home market. Since 1992 the average size of turbine has been on a rising trend and by 2005 stood at approximately 1.3 MW. However, the size favoured by the developers has grown to 2 MW, in order to maximise the use of land and minimise the environmental factors.

Sri Lanka

A large section of the Sri Lankan population is without access to electricity and whilst hydropower provides the majority of the generated power, this dependence is vulnerable to drought. In order to increase electricity coverage as well as to satisfy the rapidly growing demand for power, much extra capacity will be required.

In June 2003 a USAID-funded solar and wind mapping survey was presented to the Sri Lankan Government. The survey, conducted by the US National Renewable Energy Laboratory, identified various locations along the northwestern coast and the central hill areas for further exploratory work.

At the present time a 3 MW pilot wind project is operating at Hambantota in the south of the country and various small village projects for powering computers, televisions and radios are being implemented. Further projects have been proposed for Bundala, Kirinda and Palatupana.

It has been reported that the Ceylon Electricity Board ultimately hopes to have 200 MW grid-connected wind capacity in the south-eastern quarter of the island.

Sweden

Although Sweden was one of the early pioneers in modern wind power development, embarking on a wind energy programme in 1975, bureaucratic procedures have meant that deployment has been fairly slow.

In 2002 the Parliament set a national planning target of 10 TWh for electricity production from wind power (4 TWh onshore and 6 TWh offshore) by 2015. The Swedish Energy Agency (SEA), in an effort to simplify the administrative procedures, apportioned this target regionally with both the available resource and the region's electricity consumption taken into account. During 2005 information received from 19 of the 21 counties suggested that some 1.5 TWh of capacity was planned.

Three programmes to encourage the growth of wind power have been set for the country: 1) quota-based green certificates (favourable to wind power), 2) production support or ‘environmental bonus’ (declining each year until zero is reached in 2009 for onshore wind) and 3) the SEA has designated 49 areas in 13 counties as being of national interest from the point of view of wind power. Decisions on permit applications will judge this aspect against other national interests (environmental, etc.).

By end-2005 installed capacity totalled 493 MW with 760 turbines generating 936 GWh during the year. By end-2006 capacity had grown to around 570 MW.

The Invest in Sweden Agency stated in August 2006 that: a total of 128 turbines, capable of generating 2 TWh/yr will be built at a site known as Kriegers Flak, 30 km south of the coast at Trelleborg; that four wind power coordinators had been appointed by the Ministry of Sustainable Development in order to facilitate future investment; and that the Environmental Protection Agency had identified 12 offshore sites, suitable for wind power development.

Taiwan, China

On land there is an area of over 2 000 km^2 with an annual average wind speed of 5-6 m/s, an estimated wind power potential of 3 000 MW and an exploitable potential of at least 1 000 MW. With regard to offshore wind energy, it is estimated that the exploitable potential is approximately 2 000 MW. Thus the country’s total exploitable wind energy is some 3 000 MW.

The Bureau of Energy reports its R&D wind projects as:

- the Overall Development and Promotion of Wind Energy (2006-2008);
- development of Interconnection Technologies for Distributed Generation (2006);
- development of key components of wind power system (2006-2008).

Taiwan Power Company reports its wind power projects as:

- First Phase (Jan. 2003-Dec. 2006): 60 units to be installed with a total capacity of 98.96 MW;
- Second Phase (Jan.2005-April 2008): 63 units to be installed with a total capacity of 126 MW;
- Third Phase (Jan. 2007-June 2011): 52 units to be installed with a total capacity of 104 MW.

Tanzania

The WEC Member Committee for Tanzania reports that based on the available information, much of the wind resource is located along the coastline, the high plateau regions of the Rift Valley, on the plains and around the Great Lakes. Currently wind energy is used to pump water for irrigation and to meet domestic and livestock water needs. More than 120 windmills have been installed to provide mechanical power for water pumping.

Microscale electricity generation from wind has been reported in a very few locations, while several studies on wind are being carried out in order to establish dissemination strategies for wider application, including power generation. By 2003 more than 8.5 kW of wind-powered electricity generating capacity was in place.

At present the proven potential of wind is 0.9 – 4.8 m/s. At some locations the spot measurements are as high as 12 m/s.

There has been limited success, even in areas with a good wind regime, owing to:

- a lack of reliable wind resources data for siting of wind turbines;
- poorly designed or expensive prototypes;
- a lack of trained local support personnel and maintenance.

There have been few attempts made to utilise wind power, which could be a viable alternative source of energy. However, it has been proposed as an alternative source of electricity, and thus wind-speed data from a site called Setchet is being used to illustrate the possible utilisation for electricity generation. The windy season (July to November) coincides with the dry season. The annual average wind speed during this period is 8.3 m/s, quite high enough for electricity generation via wind turbines.

Tunisia

Two small experimental wind projects: Aquaria (10 kW) and Jabouza (12 kW) (both now closed) had been commissioned during the 1980s by SEN (Société d'Energies Nouvelles). STEG (Société Tunisienne de l'Electricité et du Gaz) took over the wind turbines when SEN closed in 1994. An early 1990s feasibility study undertaken by STEG led to the 10.56 MW grid-connected wind plant at Sidi Daoud becoming operational in August 2000. An 8.72 MW expansion to Sidi Daoud became operational in 2003 and a further expansion of 34 MW is scheduled.

It has been estimated that the wind potential of Tunisia could support 1 000 MW nationwide. Exploratory studies in the north of the country are further advanced than in the remaining territory and three projects totalling 120 MW (Metline, Kechabta and Ben Aouf in the Bizerte region) are due to be operational there in 2009.

Turkey

The wind potential of Turkey has been estimated to be as high as 88 GW but to date very little utilised. At end-2005 total installed capacity stood at only 20.1 MW. However, in mid-2005, one year after the Turkish Parliament approved a first draft law on the use of renewable energy for electricity production, a further law permitting a feed-in tariff was adopted. The tariff will provide renewable energies a purchase guarantee of the average wholesale electricity price for seven years and in particular favour the development of wind energy.

Turkey's installed wind power more than doubled in June 2006 with the commissioning of the 30 MW Bares II plant at Bandirma on the coast of the Sea of Marmara.

Capacity totalling approximately 100 MW is under construction. A further 1 286 MW of capacity has been licensed and 4 076 MW has licence applications in progress.

Ukraine

The wind power potential in Ukraine, whilst very large overall (estimated at some 30 TWh/yr), is considerably higher in the south than in the northern areas. It is considered technically feasible and advisable to use 15-19% of this inherent wind energy. Study has shown that this potential could support up to 16 000 MW (and possibly as much as 35 000 MW).

In line with other European countries Ukraine plans to restructure its energy sector, incorporating a higher utilisation of renewable energies. The Ukrainian Renewable Energy Agency, using the basic assumptions from the draft Energy Strategy of Ukraine for the period to 2030 and the work of INFORSE (V*ision 2050* - energy sector scenarios for European countries), has formulated its own set of scenarios and restated targets that should be met by 2050.

Whilst Ukraine has indigenous fossil fuel resources, it is apparent that they cannot completely satisfy either current or future energy demand. The long-term plan is to utilise the country's varied renewable resources. With regard to wind power, although the present level of installed capacity is quite low, an average wind velocity of 5–5.5 m/s at a height of 10 m available in many regions could lead to a considerable increase in capacity.

At end-2005 total installed capacity stood at 72 MW of which the main plants were: Donuzlavs'ka, 10.9 MW; Sudaks'ka, 5.4 MW; Novoazovs'ka, 20.4 MW; Saks'ka, 18.4 MW; Tarkhankuts'ka, 11.1 MW. It has been predicted that by 2030 over 11 000 MW of capacity will have been constructed and that wind power generation could rise from nearly 25 TWh in that year to around 42 TWh in 2050.

United Kingdom

The Utilities Act (2000) made substantial changes to the regulatory system for electricity in Great Britain. The Act replaced the Non-Fossil Fuel Obligation Orders (NFFO), by the Renewables Obligation and the Renewables Obligation (Scotland), which came into force in April 2002. These impose an obligation on all electricity suppliers to supply a specific proportion of electricity from renewable sources. The target began at 3% in 2003, will rise gradually to 10% by 2010, to 15% by 2015 with the eventual aim of a 20% contribution. In the short term it is likely that wind energy will be the major contributor to meeting these targets, but in the longer term other technologies will come into play.

The Energy Act of 2004 has provided the impetus for the development of wind energy in the UK. It established a comprehensive legal framework for all offshore energy projects, extended the boundary for projects to 200 miles beyond the country's territorial waters, created a Renewable Energy Zone (REZ) adjacent to the territorial waters in which projects could be installed and provided a framework for the execution of the British Electricity Trading and Transmission Arrangements (BETTA). BETTA came into effect on 1 April 2005 and provides sets of rules both for trading electricity across Britain and for access to and charging for the transmission network,

Thus in recent years great progress has been made in the growth of the UK's wind energy sector. From just 427.2 MW - 423.4 MW onshore, 3.8 MW offshore - at end-2001, the 1 GW mark was passed in June 2005 with end-year capacity standing at 1 565 MW - 1 351.2 MW onshore, 213.8 offshore. The four operational offshore wind farms in 2005 consist of three in England; off the north east coast at Blyth (3.8 MW), off the east coast (East Anglia) at Scroby Sands (60MW), off the south east coast at Kentish Flats (90 MW) and one off the north coast of Wales at North Hoyle (60 MW). A 90 MW offshore wind farm in the Irish Sea off the north west coast of England at Barrow was officially opened in September 2006.

The UK Department of Trade and Industry reported that as at July 2006, plans for a further 6 200 MW of onshore wind capacity and 3 900 MW of offshore capacity had been published, although it was unlikely that all projects would obtain the necessary permissions to proceed. In early 2007 the British Wind Energy Association (BWEA) listed four offshore projects as under construction, totalling 294 MW and a further ten, totalling 2 484 MW, as having received approval.

The commissioning of the 72 MW Braes of Doune wind farm in Scotland in February 2007 saw total UK installed capacity pass the 2 GW mark.

Along with Germany and the Netherlands, the UK is part of the European Offshore Supergrid® project. Initially the 10 GW Foundation Project is designed to test the feasibility of interconnecting 2 000 wind turbines and supplying electricity to the national grids of all three countries. Ultimately, it is proposed that the system could cover the Baltic Sea, the North Sea, the Irish Sea, the English Channel, the Bay of Biscay and the Mediterranean.

The White Paper *Meeting the Energy Challenge* (May 2007) announced the Government's intention to strengthen the Renewables Obligation (RO), increasing the RO to 'up to 20% as and when increasing amounts of renewables are deployed' and introducing banding of the RO in order to provide differentiated support to the various renewable technologies. In this latter connection, particular mention was made of the need to bring forward offshore wind and biomass.

United States of America

The Energy Information Administration (EIA) estimates that the raw wind resource potential of the US is in excess of 3 000 GW. This estimate excludes offshore areas, areas with poor wind potential (average annual wind speeds less than 7 m/s), areas with specific legal or technical restrictions on development for wind use (such as areas with high slope, environmentally restricted areas and urban areas), and areas greater than 20 miles from existing transmission lines. However, most of the land included in this estimate is likely to be precluded from wind development for economic reasons not explicitly accounted for in the estimate, such as high land costs, rough terrain, lack of site access, aesthetic or environmental limitations, the need to upgrade or expand existing transmission capacity in order to accommodate remote wind capacity, or the need to provide energy storage or back-up generation in order to maintain grid reliability.

The American wind power industry has shown remarkable progress, increasing by an average 29% each year between 2000 and 2005. By end-2005 capacity stood at 9 149 MW and by end-2006, the American Wind Energy Association estimates that it stood at 11 603 MW. Of the states that had installed capacity at end-2005, 15 possessed more than 100 MW each. New capacity added during the year represented about 52 projects in 22 states (averaging 1.5 MW per turbine). The Department of Energy's (DOE) Wind Powering America project aims, by 2010, to have at least 30 states with more than 100 MW.

The Advanced Energy Initiative launched in February 2006 is providing the stimulus to sustain and further the progress of the US wind power industry. Whilst wind power currently only supplies approximately 0.3% of total electricity generation, the Initiative states that 'areas of good wind resources have the potential to supply up to 20% of the electricity consumption in the United States'.

The Federal production tax credit (PTC) has had a significant role in the growth of wind power. There has been a distinct correlation between the years when the US$ 0.019/kWh credit (for the first 10 years of production) was applied and the expansion of capacity. In those years when the credit lapsed (2000, 2002 and 2004) there was only a small incremental amount of capacity. The 2005 Federal Energy Policy Act (EPAct) extended the PTC to end-2007 when it is due to expire again.

Other federal incentives (depreciation deductions, loans, grants, financial and technical assistance) and state programs (renewable energy purchase mandates, green pricing, tax and investment incentives, net metering etc.) are all designed to ensure the continued growth of the industry. Looking forward, the DOE's Wind Energy Program has three aspects to its R&D: it is studying firstly, low-wind-speed turbines for deployment in the vast areas of US territory that possess less than optimal wind speeds; secondly, the areas suitable for wind installations sited, initially in shallow offshore waters and then in deeper offshore waters. It has been estimated that the US has in excess of 1 000 GW offshore potential lying between 5 and 50 nautical miles from the coastlines (including the Great Lakes), with about 810 GW in waters that are 30 m or deeper; and thirdly, the launch (in 2006) of SeaCon. The SeaCon (sea-based concept studies) initiative will concentrate on innovative technologies such as combining wind turbines with electrolysers to produce hydrogen, combining wind and hydropower technologies and the use of wind energy to provide power for municipal water and wastewater operations.

Uruguay

At the present time the country utilises its wind resource for water pumping in rural areas isolated from the electricity grid.

Uruguay plans, with international cooperation, to evaluate its wind resource potential. The project is waiting for the final approval of the GEF.

Another project, in collaboration with Spain (within the framework of a debt conversion agreement between Uruguay and Spain) and with strong public support, covers the installation of 10 MW capacity and also the measurement of the resource.

The Government passed a decree in March 2006 which as a first stage will attempt to encourage the installation of up to 20 MW of electricity generation, with up to 10 MW provided by IPPs.