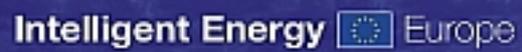


WINEUR

Wind energy integration in the urban environment

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*Country profiles: the current wind energy situation
in a selected number of countries worldwide*



AUSTRALIA

Over the past four years, Australia's wind capacity has undergone an average growth rate of 120%. This rapid growth rate is expected to continue until about 2007, as requirements for electricity retailers to source more renewable energy increase towards the current legislated Mandatory Renewable Energy Target (MRET) of 9,500 GWh of renewable energy by 2010. In the absence of a higher MRET, it is highly likely that the rate of investment in wind energy projects will quickly drop off after 2007.

Wind energy projects in Australia so far have all been land-based. Australia is sparsely populated, and several states have extensive private coastal farmlands that possess good wind regimes. Over the past three years, the trend has been toward larger wind projects. Table 1 below gives the total wind energy capacity installed in the country in 2004.

Table 1. Summary of Australian wind capacity

	Capacity (MW)
Operating	380*
Under Construction	366
Under Tender	351
Planning Approved	918
Feasibility	4262
Completed and Pipeline/Proposed	6277
* includes 0.6 MW installed in 2005 (Bremer Bay, WA)	

Source: AUSWEA May 2005

Australia does not have a preferential feed-in tariff for wind or other renewable energy technologies.

Grid-interconnection may be accepted, provided appropriate inverters and protection equipment are used (generally agreed on a case by case basis with the relevant Distribution Network Service Provider). Net metering agreements are commonly available for small solar photovoltaic generators and are therefore likely to be available also for urban wind generation systems.

The main measure supporting electricity generation from renewable energy sources is the Federal Government's MRET which commenced on 1st April 2001. The Renewable Energy (Electricity) Act 2000 requires the generation of 9,500 GWh of extra renewable electricity per year by 2010, enough power to meet the residential electricity needs of four million people.

The obligation falls on wholesale purchasers of electricity (predominately retailers) in direct relation to their total purchases (e.g. if retailer A purchases 10% of total Australian electricity generation in 2010, they would need to purchase 950 GWh of that electricity from renewable energy sources). Interim targets for the period to 2010 have also been established.

Liabile parties demonstrate their compliance through the purchase and surrender of Renewable Energy Certificates, 1 REC equivalent to 1 MWh of renewable electricity generation. Currently REC value is in the order of AU\$30 to \$35 per unit, effectively creating an incentive of 3 to 3.5 c/kWh (less transaction costs) for renewable electricity generation.

Theoretically urban wind turbines connected to eligible grids are eligible to create RECs and so benefit from the incentive. Systems under 10kW capacity, generating <25 MWh pa qualify as 'Small Generation Units', thereby benefiting from marginally lower accreditation fees (registration as an accredited generator), and also enabling up-front 'deemed' claims for RECs in five year blocks.

The annual number of RECs from such small wind generation units is calculated by multiplying the rated power output (in kW) of the system by 0.00095, multiplied by the wind resource availability of the system, e.g. 8kW x 0.00095 x 2000hours/year = 15.2 MWh or 15 RECs. The generating party could create five years worth – i.e. 75 RECs - up-front, theoretically equivalent to \$2250-\$2650 system revenue, if sold at the current market value. (Note 2000 hours per year is the default availability assumed in the absence of site-specific audit reports.)

To date (May 2005), only 322 deemed RECs from small wind generators have been created throughout the whole of Australia, 31 of which have subsequently been deemed 'invalid'.

Note that the majority of the MRET target is anticipated to come from (large-scale) wind developments. The current pipeline of large-scale wind energy projects, if taken to completion, is effectively adequate to achieve the MRET target, which will clearly saturate the RECs market and remove this theoretical revenue stream from further new-build renewables generation. The target remains at 9500 GWh until 2020. There is evidence that market value for RECs is falling due to the impending saturation.

Urban wind energy in Australia

According to AUSWEA's project directory, there are very few small-scale wind energy projects, let alone urban wind turbines. The only small-scale project reported by AUSWEA is Harbour Point, near Ceduna in South Australia. This is effectively a stand-alone application (not urban environment), though the 10kW system (2 x Flowtrack, BEST 5kW turbines) feeds a Microgrid spreading over 1km and serving 9 consumers.

The Registry of Renewable Energy Certificates for small wind generators as noted above (291 eligible RECs created) also indicates that experience of grid-connected small-scale wind is rather limited, though there may well be a number of such systems for which the owners have not opted to take or have been unaware of the opportunity to create RECs (certainly this is the case for numerous small solar generation units).

However, a number of demonstration urban wind turbines are known to exist, including an Air-300 (300W) turbine mounted at a height of 7 metres above ground level on top of the Apace teaching building in Fremantle WA, and a similar unit installed at Taronga Zoo in Sydney (exact model and grid-connection status unconfirmed).

There is no obvious system in Australia that would encourage the development of urban wind turbines, although support may be available through various Federal (Australian Greenhouse Office) or State programmes for ad-hoc demonstration units. For example, in Victoria, demonstration urban wind energy projects >20kW may be eligible to qualify for up to 20% capital grant under the \$8m Renewable Energy Support Fund (RESF).



AUSTRIA

Austria already had the highest share (70 %) of renewable electricity production in terms of gross national electricity consumption in the whole of the European Union in 1990. This share is planned to rise to 78, 1 % by the year 2010.

Installed wind capacity in Austria

Table 1 and Figure 1 below give the current situation for wind energy installations in Austria.

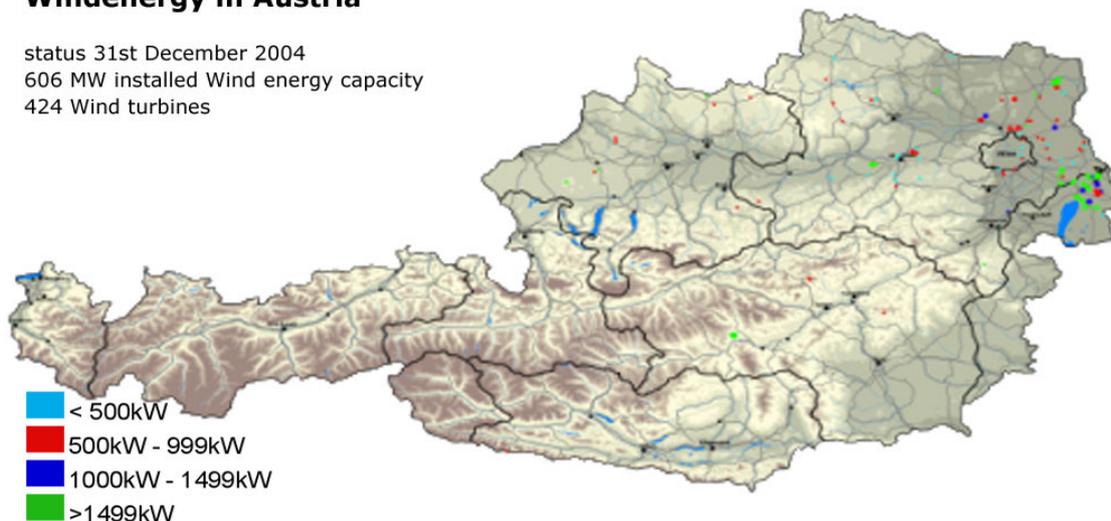
Table 1. Installed wind capacity in Austria in May 2005

Turbines	MW
431	620

Source: IG Windkraft

Windenergy in Austria

status 31st December 2004
606 MW installed Wind energy capacity
424 Wind turbines



www.igwindkraft.at

IG WINDKRAFT
Austrian Wind Energy Association

Figure 1. Austrian wind energy capacity installed in 2004

Promotion instruments for wind energy in Austria

In July 2002, the Austrian Parliament adopted new legislation to comply with the European RES-E directive, the Ökostromgesetz or Green Electricity Act. This Act implements a feed-in tariff system for renewable energy sources (RES) and makes it mandatory to purchase "green" electricity. In addition to the purchase-obligation the Green Electricity Act sets a target for the share of RES-Electricity, in the year 2008 the share (without small hydro) in the public grid has to reach at least 4 %.

The feed-in tariff for one kWh of wind energy is 7,8 Eurocents and the tariff is guaranteed for 13 years. However, only turbines authorised before the 31st of December 2004 can claim these tariffs.

There are no other types of support for grid connected RES and only innovative projects can obtain small investment subsidies.

In Austria, a fast-track planning procedure for producers of renewable electricity does not exist. The provincial governments are in charge of the procedure, and many different approvals (protection of landscape, regional development plan, security of aviation, etc.) have to be obtained. Only projects with a size of more than 20 MW benefit from a centralised planning procedure at the provincial government level.

At the beginning of 2005, the Austrian wind industry finds itself in a difficult situation as feed-in tariffs have only been guaranteed for turbines which have completed the authorisation process before the 31st of December 2004. It is not clear whether the new projects proposed after this date or projects proposed but which have not yet received authorisation will receive any payment for their green electricity.

The reason for this uncertainty is that the Austrian government intended to amend the Renewable Energy Act (Ökostromgesetz) by the end of 2004 but failed to reach the necessary 2/3 majority vote. Now there are two possibilities for a resolution of the problem:

1. The Minister of Economics enacts a follow-up feed-in tariff decree ;
2. The Government starts new negotiations with the opposition party to change the Ökostromgesetz.

The uncertainty and delay in clarifying the legislative situation is not an encouraging sign for the Austrian wind industry.

Perspectives on small scale wind

There are some small urban wind turbines installed in Austria but they are usually not grid connected and the national wind energy organisations do not have any information about them. Furthermore, installing a wind turbine with a power output greater than 10 kW close to inhabited areas is not permitted. In Lower Austria the distance between houses and wind turbines must be at least 1200m and it must be 750m in the rest of Austria.

Despite this, several urban wind turbine projects exist. The following are some examples:

- St. Polten (capital city of Lower Austria – turbine model: Seewind 20 (110 kW);
- St. Polten – turbine model: Lagerwey LW30 (250kW);
- Vienna/Vosendorf at the Vienna animal welfare association – turbine model: Bonus 33 (300kW).



CANADA

Interest in wind power as a promising source of electricity has grown significantly over the past few years. As of December 2004, Canada's installed wind energy capacity was 476 MW. At least another 150 MW are planned for 2005. The states of Quebec and Alberta are at the forefront of wind energy production, with 102 MW and 172 MW installed respectively. Taking into account Canada's estimated wind resources and based on experience from other countries it is possible for Canada to achieve 20% of its electricity needs from wind energy, which would be 50,000 MW of wind energy capacity.

Wind Power Production Incentive (WPPI)

The Government of Canada's Wind Power Production Incentive (WPPI), announced in the December 2001 budget, is intended to encourage electric utilities, independent power producers and other stakeholders to gain experience in this emerging and promising energy source. WPPI provides financial support for the installation of 1,000 MW of new capacity over five years (up till 2007). To be eligible for the incentive, the prospective producer must negotiate and sign a contribution agreement with Natural Resources Canada (NRCan). The agreement contains the following criteria, among others, for setting up a wind farm:

- the wind farm must be commissioned between April 1, 2002, and March 31, 2007;
- the wind farm must be independently metered at the point of interconnection with the electricity grid; and
- the wind farm must have a minimum nameplate capacity of 500 kilowatts. In northern and remote locations, the minimum capacity is 20 kilowatts.

To encourage regional participation, the program has set a minimum and maximum capacity for every province and territory, which will be reviewed on an ongoing basis. The amount of the incentive is about half of the current estimated cost premium for wind energy in Canada for facilities with good wind sources. The incentive is structured to reflect the decline in premiums for wind energy over time. The incentive can be claimed for every kWh of net production during the first ten years of production as shown in Table 1 below. The WPPI is expected to motivate provincial and territorial governments, electric utilities, retailers and power consumers to act and participate in similar programs.

Table 1. WPPI financial incentive according to commissioning date

Commissioning Date	Amount of Financial Incentive for the ten- year period
April 1, 2002 to March 31, 2003 inclusive	1.2 cents per kilowatt-hour (¢/kWh)
After March 31, 2003 and on or before March 31, 2006	1.0 ¢/kWh
After March 31, 2006 and on or before March 31, 2007	0.8 ¢/kWh

Source: NRCan April 2005

Small scale wind energy

Small wind turbines (between 0.1 and 100 kW) are used primarily for remote applications, localized grids, or to displace utility grid power. Grid-connected systems are primarily in the 10 to 100 kW range. With improvements in technology, small wind turbines have become increasingly reliable while decreasing in cost. This has created substantial small business and consumer interest

in small wind turbine technology (Recommendations for Small Wind Systems Development in Canada, CanWEA, April 2003). Sales of small wind turbines totalled 1 MW in 2003, with most of these being 1 kW or under. The small wind total installed capacity is 4.5 MW (Windpower Monthly, May 2005).

However, the low price of grid-supplied electricity in most of Canada has put energy from small wind turbines at a cost disadvantage. Limited uptake due to this cost disadvantage is challenging small wind turbine manufacturers to lower cost while facing significantly limited production runs preventing economies of scale. Except for remote applications, grid connected small wind turbine is a niche market with poor economic return in Canada, although the potential for grid-connected systems to become an important market has been recognized. If 1% of Canadian homes offset their purchases of electricity from the grid with their own generation, it would represent a market of approximately 4.9 billion Canadian dollars.

There is no coordinated national policy for small wind turbines at the moment. Direct incentives, such as grants or tax breaks would help reduce costs (Whittaker, CanWEA, Windpower Monthly, May 2005). Other barriers to grid-connected small wind include the need for an effective net metering policy, consistent across all states. At the moment proposed limits on net metering range from 10 to 500 kW.

In spite of these obstacles, there is a strong interest in small systems according to the Canadian Wind Energy Association (CanWEA). The main interest remains in using these systems for the 400 remote communities in Canada that would benefit from wind-diesel systems.



FINLAND

Finland is committed to maintain its greenhouse gas emissions at or below the 1990 levels by the period 2008–2012. The objective of the National Climate Strategy is to further increase the use of renewable energy sources and their share of energy consumption.

Finland's indicative target for the share of electricity produced from renewable energy sources is 31,5 % of gross electricity consumption in 2010. Between 1998 and 2003 electrical power from power plants using wind power only increased by 30 MWh, whereas it increased by 500 MWh for the power plants using bio-energy. Comparing the trend with the target laid down for Finland in the RES-E Directive, it is fair to say that recent developments are not moving in the direction of achieving this target.

Wind energy statistics in Finland

The installed wind capacity in Finland was 82 MW in 2004 and wind power production provided 0.1 % of Finnish electricity generation. The target for 2010 set in the national action plan for renewable energy sources is 500 MW from wind energy. Today the wind technology business in Finland includes component manufacturing and is slowly expanding through to turnkey installations of wind turbines and wind farms. Table 1 gives the latest numbers for installed capacity in Finland. Figure 1 shows the development of wind energy over the last 12 years and Figure two on the following page shows the location of turbines.

Table 1. Installed wind capacity in Finland in May 2005

Turbines	MW
93	83

Source: Finnish Wind Power Association - May 2005

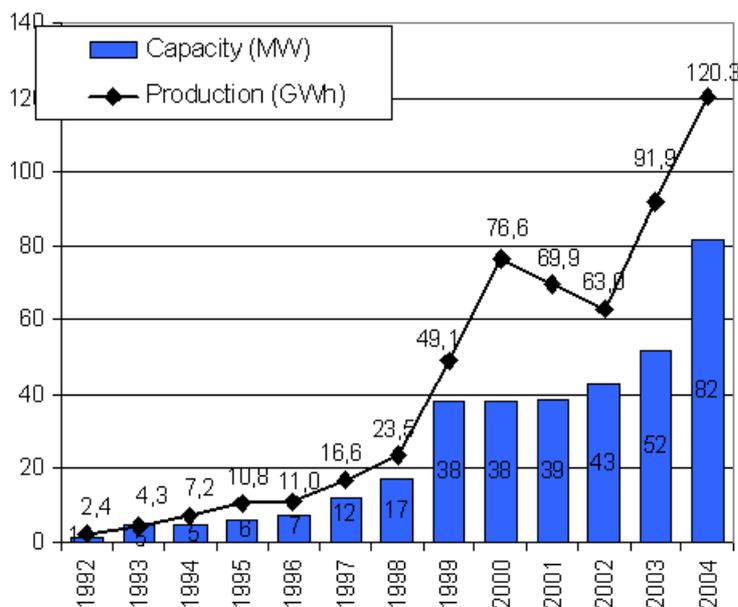


Figure 1. Progression of wind turbine capacity and production in Finland



Promotion instruments for wind energy in Finland

Promotion of renewable energy sources is based on a specific action plan, which was completed in 1999.

On 5 September 2002 the Ministry of Trade and Industry set up a working group for preparing the revision of the action plan for renewable energy sources.

Amongst the planned actions, are development and commercialisation of new technology and financial steering instruments, such as energy taxation, investment aid and subsidies for the production chain of forest chip, but there is no real promotion instrument for wind energy.

In Finland, there is no feed-in tariff, or Green Certificates, or mandatory quota system for wind energy.

According to the national energy and wind energy organisations, the only supporting measures for wind are:

- the existence of a 30 to 35 % subsidy on investment costs for professional companies willing to invest in relatively big wind energy projects, provided by the Ministry of Commerce and Trade;
- a 0,007 Euro cent/kWh tax return on electricity; and
- an easier procedure to get to the local grid.

Perspectives on small scale wind

Under the circumstances presented above, the context for the development of small urban wind turbines is not very favourable. Nevertheless, the Finish wind turbine manufacturer Oy Windside is one of the main European actors in the vertical axis small wind turbine market.

Wind turbines in Finland 2004
Capacity 82 MW, 92 turbines

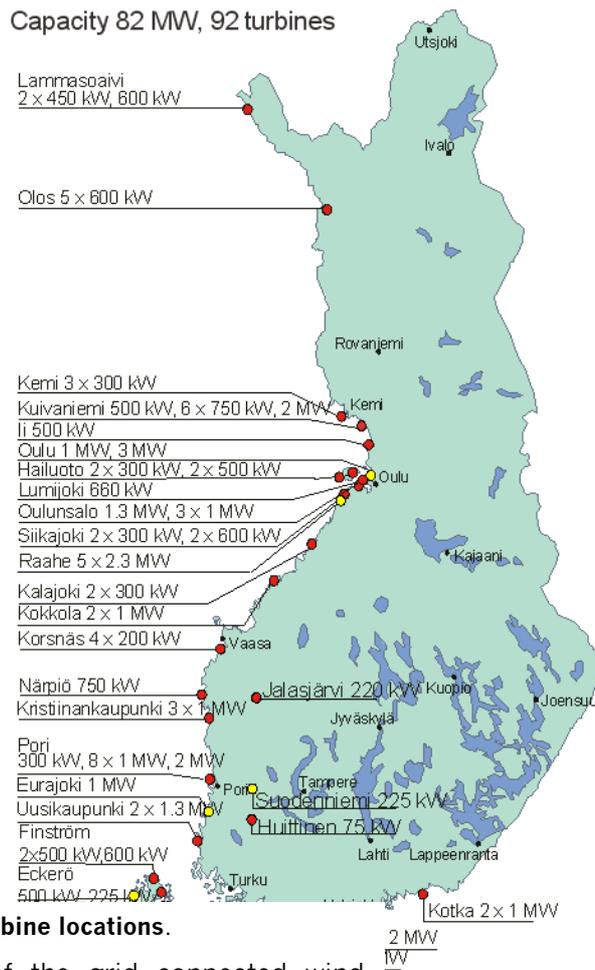


Figure 2. Turbine locations.

Locations of the grid connected wind turbines in Finland that participate in the compilation of production statistics. Latest installations are shown in yellow.

Updated January 2005. (source VTT).

connected

FRANCE

The history of wind energy development in France can more or less be divided into two main steps: The "early ages", from the late 60s to the mid 90s, were characterised by missed opportunities in a deficient system of unregulated tariffs and absence of contractual terms. Despite this unfavourable context, dedicated wind energy pioneers succeeded in connecting the two first wind turbines to the grid in Dunkerque and Port-la-Nouvelle, in 1991 and 1993 respectively.

On 10 February 2000, the Electricity Law (Loi relative à la modernisation du service public de l'électricité) was published including amongst other principles a fixed tariff for electricity generators and a purchase obligation of power for projects up to 12 MW. Official documents called "arrêtés tarifaires" were progressively issued for each renewable energy source and on the 8th of June 2001, a feed-in tariff for electricity generated from wind energy power plants was adopted.

Installed wind capacity in France

Table 1. Installed wind capacity in France in 2004

Total wind power installed	398 MW*
Number of wind farms	80
Number of wind turbines installed	641
Yearly power production	589 GWh*

* 2004
Source: ADEME 2005

Promotion instruments for wind energy in France

The feed-in tariff conditions are linked to the installed capacity. If this is lower than 36 kVA, the producer may benefit from the tariff conditions defined by the decree of 13 March 2002 at 10,4 Eurocents HT/kWh.

Table 2. French feed-in tariffs breakdown

Operating hours (h/year)	Feed in tariff year 1 to 5 (c€/kWh)	Feed in tariff year 5 to 15 (c€/kWh)
from 2000 to 2600	8.38	8.38
From 2600 to 3600	8.38	5.95
More than 3600	8.38	3.05

Perspectives on small scale wind

A few examples of small or medium power wind turbine installations exist in France in an urban or semi-urban environment. These are mainly for educational purposes. They provide part of the electricity for a community or public building with a high cost per kWh produced, normally higher than the tariffs of purchase currently in force. A couple of examples are listed below.

Community Town Hall - Bobigny (January 2004)

Three 5 kW wind turbines (Fortis horizontal axis) were installed at the beginning of January 2004. The electricity produced by these wind turbines is stored locally to feed energy needs for internal and external lighting. These wind turbines are on 9m masts. A switch makes it possible to feed the national grid if necessary. Accurate figures for the energy production are not yet available. These wind turbines are placed approximately 10 to 20 m from the reception hall of the building.

High School "Léonard de Vinci" – Calais (2000)

The wind turbine installed at the school is rated at 132 kW (horizontal axis). The objective is to produce a considerable share of the yearly consumption of the site and to play a teaching and training role. The wind turbine is installed near the classrooms and there have been no complaints about noise or other harmful effects. The project was largely subsidized by the Nord Pas de Calais Regional authority.

Regulatory constraints on small scale wind

Any turbine that exceeds 12m in height requires a building licence. For building mounted turbines, the restrictive interpretation of the general rules of town planning makes it necessary to include the height of the building. This administrative position means that many impact studies must be undertaken, which dramatically increase the implementation costs and time to obtain a building license.

This constraint is very unfavourable for the installation of small or average power wind turbines on large buildings and the situation is not aided by the grid-connection procedures which are also long and complex.



GERMANY

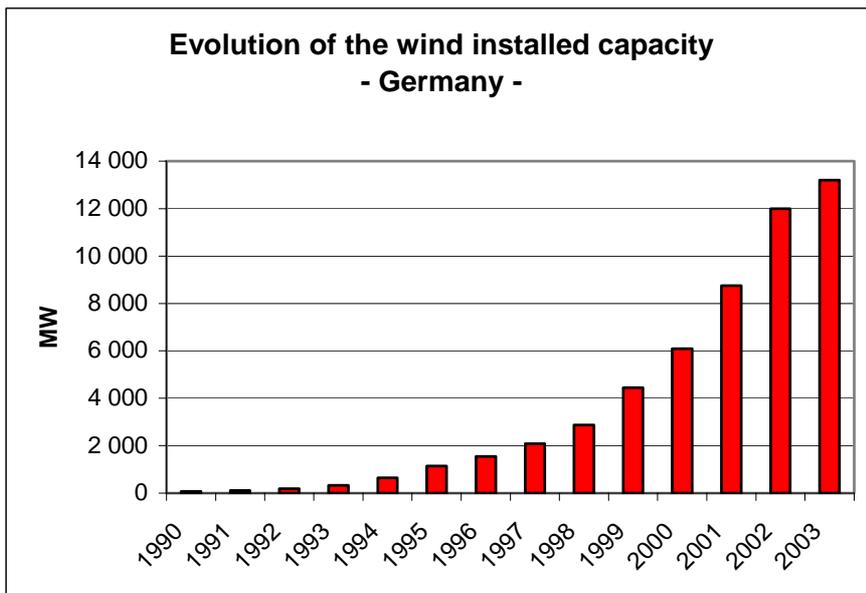
Germany developed its windy coastline at the beginning of the 90s and then pushed inland to develop sites with lower wind regimes as the decade progressed.

On the surface, Germany's success is partially due to the technological advantage it derived from its relatively late start. When California and Denmark were developing their best sites in the 80s, average turbine size was 55 kW. When Germany began to develop wind energy in the early 90s, it benefited from the rapid increases in turbine size and was able to install larger and more efficient turbines from the outset.

As an illustration of this, Germany and Denmark had the same number of turbines installed by 1995, but Germany had 1,132 MW of installed power, while Denmark only had 630 MW. Though this may help Germany's raw numbers, Germany's success is primarily attributable to a decade of progressive and targeted legislation.

Installed wind capacity in Germany

Installed wind capacity in Germany was over 13 000 MW in 2003. Figure 1 below shows the evolution of installed wind capacity over the last decade.



Source: BWE

Promotion instruments for wind energy in Germany

The Stromeinspeisungsgesetz or Electricity Feed-in Law (EFL) was passed through the German Bundestag in 1990 and came into force in January 1991. The EFL ignited the German wind industry by guaranteeing grid connection and a Renewable Energy Feed-In Tariff (REFIT) to RES generators. Under the law, hydropower, landfill gas, sewage gas and biomass producers were guaranteed at least 80% of the retail consumer price for the electricity they produced. Wind and solar producers, meanwhile, were given a guarantee of 90% of average consumer prices from 1991 until 2000.

In April 2000 the Renewable Energy sources act (EEG) came into force. Fixed tariffs were regulated independently from electricity prices. Tariffs for wind are defined by wind conditions on site with respect to a reference site. Two fixed tariffs of 0.09 € / kWh and 0.06 € / kWh according

to the quality of site yields, are granted for 20 years of operation. The duration of the higher first tariff is dependent on site conditions. Both tariff levels are reduced yearly by 1,5 % for new installations.

Access to the grid and costs for grid connection are regulated. Grid reinforcement costs have to be born by the grid operators.

Perspectives on small scale wind

In Germany the choice of development for wind energy is primarily related to development of large wind farms. However several small turbines (horizontal axis, range 20 to 50 kW) have been installed in some suburbs located in the north of the country, and on certain public buildings such as laboratories and universities.

The technology of vertical axis wind turbines remains poorly disseminated and relatively unknown even though some manufacturers have carried out significant technological developments. Generally speaking, wind energy in urban environment remains little developed in Germany.



GREECE

European Union guidelines mandate that member states increase their percentage of renewables in electricity production to 12% by 2005. As a result, renewable electricity generation projects are on the rise in Greece. The government-established Centre for Renewable Energy Sources (CRES), housed under the Development Ministry, was created to promote renewable energy. CRES estimates that 15% of the country's electricity needs can be produced by wind farms, with installed wind power capacity possibly expanding from 417 MW at present to a national target of 2,000 MW by 2010.

Wind farms are already located on a number of Greek islands (Crete, Evia, Andros, Samos, etc.). The annual growth rate of wind installations (24%) is currently among the highest of the European countries. It shows that the market has received a significant boost, part of which is due to the Power Purchase Agreements (PPAs) and feed-in tariffs applied. The other important factor that contributed to the increase of installed capacity was the existence of the investment subsidy schemes under the Operational Programme for Energy (1999-2000) and the Operational Programme for Development (2000-2006). These programmes offered investment subsidies up to 35% of the initial installation cost and therefore have considerably increased the profitability of the investments.

Installed wind capacity in Greece

Table 1. Installed wind capacity in Greece at the end of 2004

Wind energy potential	In operation	Under construction	New Projects	Total
(end 2004)	417 MW	139 MW	3120 MW	3676 MW

Source: hellasres

Promotion instruments for wind energy in Greece

Electricity legislation changed in 1999 due to the liberalisation of the electricity market. Law 2773/99 set the rules for the liberalised market and introduced all the favourable conditions for renewable electricity (PPAs and feed-in tariffs). Although in the new law the feed-in tariffs that were set are considered as a ceiling and could be lowered by a ministerial decision, this has not happened so far, and it is most unlikely that it will happen.

The law makes a basic distinction between Autoproducers, who produce electricity to cover their own needs and sell only the surplus to the network and Independent Power Producers, who sell all their electricity production to the network:

- For Autoproducers the buy-back rate is set at 70% of the utility's low-voltage (domestic) consumer tariff for renewable electricity produced and sold in the non-interconnected Greek islands, and at 70% of the utility's consumer tariff corresponding to the actual grid connection voltage of the renewable energy installation (be it low, mid, or high-voltage) for renewable electricity produced and sold in the Greek mainland.
- For Independent Power Producers, the buy-back rate for RES electricity is set at 90% of the utility's low voltage (domestic) consumer tariff (in the non-interconnected Greek islands), and at 90% of the utility's mid-voltage (commercial) consumer tariff (in the Greek mainland).

Table 2: Average Feed-in tariffs in Greece in 2003

Interconnected system	Autoproducers (70% of kWh selling price)	Independent Power Producers (90% of kWh selling price)
Low voltage	0.05826 €/kWh	-
Medium voltage	0.04712 €/kWh	0.06059 €/kWh
High voltage	-	0.06059 €/kWh
Non-interconnected islands	0.05826 €/kWh	0.07491 €/kWh

Source: hellasres

Perspectives on small scale wind

Small wind turbines (between 0.1 and 100 kW) are used primarily for remote applications. Grid-connected systems are primarily in the 10 to 100 kW range. This trend is encouraged by a regulatory framework fixing feed-in tariffs for autoproducers.

This legal framework should support development of wind in the urban environment, particularly in the small and medium sized cities of the non inter-connected islands.

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 about 40 times the country's current generating capacity. However, the accessible resource is about 2 190 MW and, in reality, the practicable resource is estimated to be 812 MW.

Bellacorrick in County Mayo saw the construction and commissioning of the first commercial wind farm in Ireland in 1992. Today there are 35 on-shore and one offshore wind energy projects in operation in Ireland with a total installed capacity of 230 MW (SEI, September 2004). Installed capacity for 2004 alone was 148 MW of which 25 MW were offshore. This shows the recent acceleration in wind energy installations in Ireland.

Ireland has set a renewable energy target of 13.2% consumption coming from renewable generated electricity by 2010. It is envisaged that wind power will make the most significant contribution to the achievement of this national target.

Wind energy development process

The development of renewable based electricity, including wind, was based until very recently on a competitive tendering system, the Alternative Energy Requirement (AER) Programme. The programme gives wind energy companies a guaranteed market to sell power. Prospective generators are invited to make a formal application to build, own and operate new wind farms and to supply electricity from these to the Electricity Supply Board (ESB).

Under the AER, winning bidders are entitled to a 15-year power purchase agreement whereby the ESB buys the electricity output of the winning facility at the bid price. The additional cost of electricity procured under the AER schemes is spread across all electricity consumers. The prices paid by the ESB are increased annually in line with the Consumer Price Index. Winning bidders were also entitled to apply for a capital grant under the ERDF Economic Infrastructure Operational Programme 1994-1999.

Since the Programme was launched in 1995, six AER competitions have been held. Wind energy has been included in four of the six competitions. The sixth competition (AER VI) was launched in February 2003 and offered support for the first time to offshore wind energy. In the period that the AER competitions have been held the bid prices have decreased significantly. In 1995, the AER I bid price per kWh for all technologies was capped at 4 pence. In 1998, the weighted average bid price for AER III was 2.748p/kWh, a drop of 31%. The average price after AER V was 3.2p (4.8 Eurocents) / kWh. This is by far the lowest price for green electricity in Europe.

In April 2005, the Irish Minister for Communications, Marine and Natural Resources, Noel Dempsey, announced that the government would be switching from the current competitive tendering system to a fixed feed-in tariff system. This system is under development and has not been implemented yet. The new support system will be designed specifically to encourage new capacity development and will only apply to newly built projects. The Irish government feels that a feed-in tariff system should give wind energy developers some insurance in terms of an energy market, and encourage the full development of wind energy projects.

Favourable measures to wind energy development

The *National Development Plan* will reinforce investment in three key areas: reinforcement and up-grading of electricity grid to accommodate increased use of renewable energy; supporting delivery of additional renewable energy supply (including the AER programme); and encourage new entrants to the renewable energy market by support for small-scale projects.

Fiscal measures: Tax relief is permitted under Section 62 of the Finance Act, 1998 for corporate equity investments in certain renewable energy projects, including wind power. The relief takes the form of a deduction for tax purposes from a company's profits for an investment in new ordinary shares in a qualifying company. The relief is capped at 50% of all capital expenditure (excluding land), net of grants, on a single project up to £7.5 million. Investment by any one company or group of companies in more than one qualifying energy project is capped at £10 million per annum.

Removal of market restrictions: The Electricity Regulation Act, 1999 provides for the establishment of the Commission for Electricity Regulation. The Act enables the issuing of supply licences for supply to all final customers of electricity produced from renewable, sustainable or alternative sources of energy. In effect, this will permit renewable energy producers to source customers (both domestic and commercial) to purchase the electricity generated. Certain regulatory and technical issues need to be resolved in order to facilitate this activity. These include connection arrangements and the trading mechanism.

Following the announcement of the first Alternative Energy Requirement (AER) competition in 1995 the then Department of the Environment, in consultation with the then Department of Transport, Energy and Communications, prepared *Guidelines for Planning Authorities on Wind Farm Development*. These guidelines were intended to facilitate planning authorities in dealing with such planning applications and in making appropriate provision in development plans for possible future proposals.

Off-Shore Electricity Generation Potential: It is the policy of the Minister for the Marine and Natural Resources to encourage the maximum beneficial use of national off-shore resources, including the harnessing of enormous resources of wind and wave power for electricity generation.

Small-scale wind energy

Small-scale wind installations in Ireland are used almost exclusively in rural and remote locations where farms and dwellings have limited access to the national grid or for marine application on yachts. There are only a couple of Irish manufacturers of small wind turbines with all other manufacturers being European (Danish, German, British). There is little evidence of the market expanding into the urban domestic sector in the near future, although one of the two Irish manufacturers are aiming their product at the urban sector. All other manufacturers seem to be concentrating on the rural off-grid sector.

It is hard to say whether the small-scale sector will diversify into the urban sector in the future. It is clear that the current mechanisms put in place by the government favour large scale on-grid development, with few incentives for development of small scale wind energy in the urban environment.



ITALY

In June 2002, the Italian parliament ratified the Kyoto Protocol on Climate Change and in December 2002 the Interministerial Committee for Economic Planning (CIPE) approved a National Plan for Greenhouse Gas Reduction issued by the Ministry of the Environment, with the aim of complying with the objectives on gas emissions.

Italy has confirmed the target of 76 TWh/yr set for 2008 through 2012 by the National White Paper for Exploitation of Renewable Energy Sources (RES), approved by CIPE in 1999, in order to increase the contribution of RES to gross electricity consumption from 16% in 1997 to **22% in 2010**. At the same time this target, in addition to other specific measures, should guarantee the achievement of Italy's Kyoto engagements (6.5% reduction of annual greenhouse emissions by 2008-2012 from the 1990 level). In this context the estimated contribution coming from wind is 5 TWh, corresponding to a capacity of approximately 2500 MW.

Installed wind capacity in Italy

Total installed wind capacity in Italy was 1386 MW in 2005. Tables 1 and 2 and Figure 1 below give some detail on the evolution of wind energy in Italy and the wind turbine models that are prevalent.

Table 1. Installed wind capacity in Italy in May 2005

Projects	Turbines	MW
163	2 069	1 386

Source: ENEA - May 2005

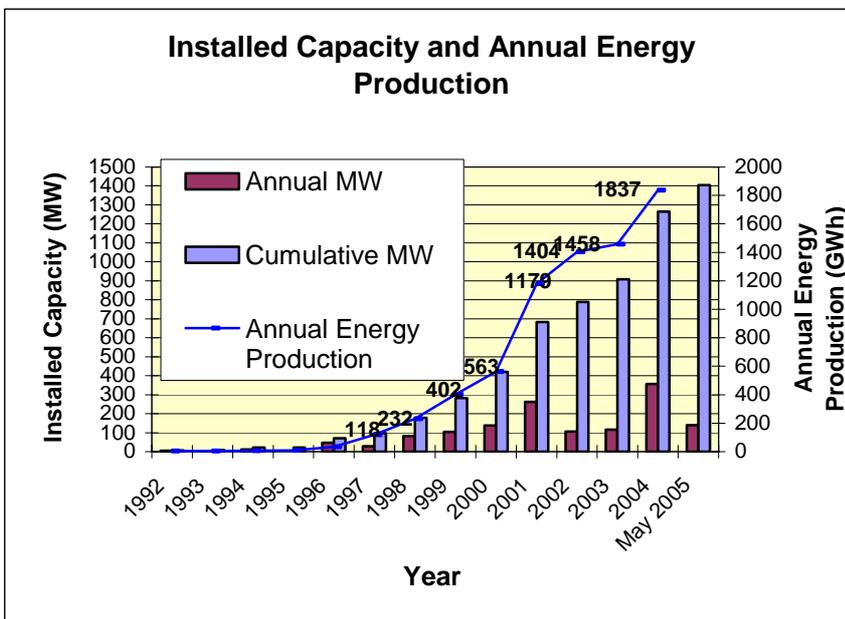


Figure 1. Installed capacity and energy production

Table 2. Cumulated and 2004 capacity of wind farms installed in the Italian regions (MW)

Regions	Cumulated Wind power	2004 Wind power	Wind turbines installed in 2004
Sicily	178	116	Vestas V52, Gamesa G52
Sardinia	241	120	Gamesa G80, Vestas V52, GE 1.5
Campania	286	24	Vestas V52, Fuhrlander SL,
Basilicata	85	9.35	Vestas V52
Apulia	253	32	Vestas V47, Repower RE MM82
Lazio	9	4.2	Enercon E40
Molise	35		
Abruzzo	157	50	Enercon E40, Vestas V47, Gamesa G52-58

Promotion instruments for wind energy in Italy

To promote wind energy, the Italian system is characterised by a green certificate mechanism, connected to the mandatory quota of renewable energy source (RES) electricity.

Green Certificates (GC) are issued by the Transmission System Operator (GRTN) on the basis of producers' reports of electricity generation from renewables in the previous year or expected generating capability in the current or following year.

Article 11 of Legislative Decree 79/99 stipulates that, beginning in 2002, producers and importers of electricity from non-renewable sources shall yearly feed a given share of electricity from renewables into the power system. This share shall be equal to 2% of the electricity from non-renewable sources generated or imported in the previous year and exceeding 100 GWh/year.

Producers and importers may also fulfil their RES obligation by purchasing Green Certificates which have been issued in respect of electricity from renewables generated by other producers. From 2004 through 2006, the minimum share of electricity from renewables to be fed into the power grid in the following year shall be increased by 0.35% per year. In 2005, the mandatory quota therefore will be 2,35 %.

The total price per kilowatt-hour a wind energy investor can currently get is the sum of the GC value and the electricity selling price. Both these prices are determined by the market. The first is close to the reference price fixed by GRTN (0.09739 euro/kWh). The second depends on a variable fuel price and other parameters, and could be given a 2004 weighted average value of about 0.056 euro/kWh.

In addition to the instruments described previously, the main measures of Legislative Decree No. 387/03 that should have a positive impact on wind energy are:

- exchange at the point of production of the electricity produced by small RES plants, of a maximum 20 kW in capacity (net-metering basis). Selling of the excess electricity produced is not allowed. This article of the law has to be supported by a regulation issued by the Regulatory Authority for Electricity and Gas.
- a permit for renewable plant construction has to be released by the region concerned, through a single authorisation involving all parties concerned, within 180 days.
- national targets are to be allocated among regions.
- work on construction of RES plants and related infrastructures is to be considered in the public interest, urgent, and not deferrable.
- RES electricity is granted the right of priority in use and dispatching.



As a consequence of delays in issuing the regulations and applicative decrees necessary to make this law effective the expected results have not yet been achieved. (Source: L. Pirazzi - ENEA and C. Casale – CESI).

Perspectives on small scale wind

Compared to other European countries, in Italy the activity of actors in the field of urban wind turbines looks to be above average. There are a number of manufacturers, such as Jonica Impianti or Ropatec, showing dynamism and growth. There is also evidence that there are some existing projects, although it is difficult to find detailed information on these.



JAPAN

In Japan, where natural resources are scarce, 80% of energy supply comes from overseas, and 50% of Japan's energy requirements are dependent on oil. Despite this, a dramatic increase in energy demand is expected and the mid/long term stability of oil supplies is of considerable concern.

In the context of the Kyoto agreement, Japan has assumed an international obligation to reduce the greenhouse gas emissions such as carbon dioxide by 6% of 1990 levels by 2008-2012. Japan adopted the Basic Guideline for New Energy Introduction in 1994. The Basic Guidelines sets the following target for the introduction of new and renewable energy by 2010: 19,1 billion litres of oil equivalent or 3 % new and renewable energy share of the total primary energy supply. In the specific case of wind energy, the objective is to multiply the wind power generation of 2002 (300 MW) by ten, to bring it to 3 000 MW by 2010.

Installed wind capacity in Japan

In Japan, the introduction of wind power generation systems began in the 1980s with testing and research. In recent years, wind power generation has made significant progress with about 160 MW installed in 2001 and 300 MW in 2002. As in the case of photovoltaic power generation, a system has been established whereby any excess electricity produced using wind power generation systems can be sold to a power utility. Figure 1 shows wind capacity evolution in Japan.

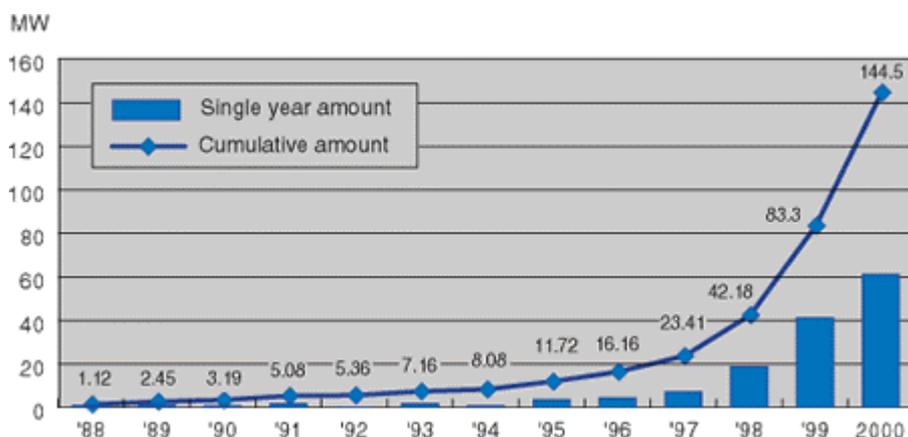


Figure 1. Wind power generation trends in Japan Source : New Energy Foundation

Simultaneously, R&D efforts were made on, amongst other things, the adoption of a blade design aimed at lowering the cut-in wind speed to utilize weak-winds and turbulences (in urban areas, for example), improvement of aerodynamic design to reduce noise and computerized real-time operation control. R&D is also under way for a 100 kW class wind power generator for islands with difficult wind conditions.

Promotion instruments for wind energy in Japan

In June 1997, a law was enacted to facilitate the introduction of new and renewable energy. The basic standpoint of that law is that "any person involved in energy has an obligation to strive for the introduction of new and renewable energy," and on that basis the Government has been implementing policy measures geared towards accelerating the introduction and popularization of new and renewable energy. The law paved the way for the introduction of low-interest loans for the establishment of new businesses, subsidies and loan guarantees.

Perspectives on small scale wind

Small-scale producers of electricity should get a big lift from the ongoing deregulation of electricity retailing. Stores, office buildings, and plants may wish to construct and operate wind turbines on their own, since they can sell any surplus electricity after they have met their own needs. The introduction of windmills can enhance the image of a business as an environmentally conscious one and provide it with backup electricity in case of power outages. Construction may also make sense as a pilot project for the future. Small-scale wind generators with an output under 10 kilowatts can be set up in places where they have a display effect. Since their blades are only a few meters long, installation is possible on the roofs of buildings or in fields next to plants. These small units also happen to represent a field where Japan's own manufacturers are making a good showing by tailoring wind turbines to the specific requirements of the Japanese setting.

Small turbines can now be found here and there in office-building and commercial districts, and occasionally in residential neighbourhoods or on downtown high-rise rooftops. They are built with special considerations in mind. For instance, they must be able to withstand exposure to typhoons in the summer and autumn, and their spinning blades must not make too much noise at night. A low start up wind speed is also a big advantage.

Also important is to connect this small-scale generation unit to the regular power supply so that consumption of commercial electricity is offset when the wind is blowing. With deregulation of the power industry proceeding hand in hand with technological progress in wind power generation, the demand for wind turbines is likely to expand in overall terms even as it diversifies to meet various needs. Visitors to Akihabara, Tokyo's electronics Mecca, may chance to notice a single wind turbine high in the sky, perched on top of one of the buildings. The day may not be long off when we will be seeing such sights all across Japan. Manufacturers such as Zephyr Corp, Toshiba Engineering, Matsushita Ecology system, Torishima Pump or Fuji Heavy Industries Ltd Eco technologies company are all active actors in the dynamic market of urban wind turbines in Japan.

Table 3. List of main urban turbines < 200 kW built in Japan between 1987 and 2002

Start of operation	Name of generator	Installation location	Rated energy output (kW)	Number of units	Total energy output (kW)	Manufacturer	Application
March, 1987	Mechanical Technology Research Laboratory, Agency of Industrial Science and Technology	Ibaraki Pref. Tsukuba City	15	1	15	Yamaha Motor	Test research
Feb., 1990	NEDO / Rokko New Energy Center, Kansai Electric	Hyogo Pref. Kobe City	16.5	2	33	Yamaha Motor	Test research
March, 1991	Seto Town	Ehime Pref. Seto Town	100	1	100	Mitsubishi Heavy Industries	Power source for greenhouses etc.
March, 1992	Izumo City, Shimane Pref.	Shimane Pref. Izumo City.	16.5	2	33	Yamaha Motor	Power source for a human-waste treatment plant
Aug. 1992	Suttsu Town, Hokkaido	Hokkaido Suttsu Town	16.5	5	82.5	Yamaha Motor	Power supply for a junior high school
March, 1993	Matsuto City	Ishikawa Pref. Matsuto City.	100	1	100	NEG-Micon	Power source for the facilities in a seaside park.
May, 1993	Tachikawa Town	Yamagata Pref. Tachikawa Town	100	3	300	Kenetech	Power source for a nature practice hall.
March, 1994	Mechanical Technology Research Laboratory, Agency of Industrial Science and Technology, Ministry of Economy, Trade and Industry	Ibaraki Pref. Tsukuba City	16.5	1	16.5	Yamaha Motor	Test research
March, 1994	Nuclear Power PR Center of Tohoku Electric Power Co., Inc.	Miyagi Pref. Onagawa Town	16.5	1	16.5	Yamaha Motor	Demonstration test
March, 1994	Hokuriku Electric Power Co.	Fukui Pref. Mikuni Town	16.5	1	16.5	Yamaha Motor	Demonstration test
May, 1994	Mikamo Village, Okayama Pref.	Okayama Pref. Mikamo Village.	16.5	1	16.5	Yamaha Motor	Power source for a view and display hall



March, 1995	Electric Power Development Company	Fukuoka pref. Kitakyushu City	15	1	15	Isobe Iron Works, Ltd.	Test research
Oct., 1995	Yamaha Motor	Aichi Pref. Gamagori City	16.5	1	16.5	Yamaha Motor	Test research
March, 1996	Kansai Electric Power Co.	Hyogo Pref. Ikuno Town	150	1	150	IHI-NORDEX	Demonstration test
May, 1996	Chugoku Electric Power Co.	Yamaguchi Pref. Heki Town	107.5	1	107.5	Kenetech	Demonstration test
Oct., 1996	NTT Marine Talk Setouchi, Ltd.	Hiroshima Pref. Ogaki Town	16.5	1	16.5	Yamaha Motor	Power source for training facilities
March, 1997	Tahara Plant, Toyota Motor Corporation	Aichi Pref. Tahara Town	16.5	1	16.5	Yamaha Motor	For display
March, 1997	Hitachi, Ltd.	Ibaraki Pref. Hitachi City	225	1	225	Vestas	Examination of linked test systems
May, 1997	Hamaoka Nuclear Power Museum, Chubu Electric Power Co., Inc.	Shizuoka Pref. Hamaoka Town.	16.5	1	16.5	Yamaha Motor	For display
Sept., 1997	Hokkaido Regional Development Bureau	Hokkaido Ishikari City (Shinko Minami)	80	1	80	TACKE	Power sale business
July, 1998	Okinawa Electric Power Company	Okinawa Pref. Urasoe City	80	1	80	Lagerwey	Demonstration research
July, 1998	Okinawa Electric Power Company	Okinawa Pref. Urasoe City	170	1	170	WindWorld	Demonstration research
July, 1998	Okinawa Electric Power Company	Gushikawa City	150	1	150	IHI-NORDEX	Demonstration research
Sept., 1998	Okinawa Electric Power Company	Okinawa Pref. Ishikawa City	130	1	130	Fuhrlander	Demonstration research
Nov., 1999	Shizuoka Plant, Rock Field Co., Ltd.	Shizuoka Pref. Toyooka Village.	100	3	300	Fuhrlander	Power source for the plant
Oct., 2000	Fuji Heavy Industries	Tochigi Pref. Utsunomiya City	40	1	40	Fuji Heavy Industries	Test research
Feb., 2001	Mie University	Mie Pref. Hisai City	30	1	30	Under investigation	Research facilities

Source : Agency for Natural Resources and Energy – ANRE Japan



LUXEMBURG

Luxembourg has limited renewable resource potential, explained partly by the country's small land area and lack of a coastline.

Installed wind capacity in Luxembourg

In 1997, the first 3 MW of wind power capacity was installed, and the most recent figures indicate 22 MW for total installed capacity (end 2004).

Promotion instruments for wind energy in Luxembourg

In 1994, Luxembourg passed legislation to support generation of electricity from renewable energy and cogeneration. This legislation provides subsidies on the price of electricity received by the generator and also on capital cost. In addition to this there are further premium payments available for electricity generated from wind. In February 2004, the national Parliament approved a modification to the Framework Law for transposing Directive 2001/77. Renewable energy policy is overseen by the government's Energy Agency, which was created in 1991. RES electricity promotion in Luxembourg is based on a combination of feed-in tariffs, fiscal incentives and investment subsidies. There is a different feed-in tariff for producers with outputs of up to 500 kW and for those operating in the 501 to 1500 kW range.

Wind Energy feed in tariff

The basis of the feed-in tariffs is the framework law of 5 August 1993. Tariffs are paid by the public utility CEGEDEL and the local distributors. There are two classes of feed-in rates for producers, depending on their size and technology:

- Class 1 renewables (Wind, Biomass or Photovoltaic) 1 to 500 kW: 10 Eurocents /kWh
- Class 2 renewables 501 to 1500 kW: 5.8 Eurocents/kWh (day tariff) and 3 Eurocents/kWh (night tariff)
- Bonus for Wind energy and PV: in addition, average peak load deliveries during the three principal annual peak load periods leads to an extra bonus of 11.2 Eurocents/kWh.

Perspectives on small scale wind

So far there has been no experimentation with wind energy in an urban environment or in the field of small-scale wind turbines. However, the renewable energy agency is following the Dutch experiments in the field of urban wind turbines with interest and plans to conduct its own soon.



NETHERLANDS

The targets for renewable energy in the Netherlands are set at 5% in the year 2010 and 10% in the year 2020. The increasing of energy efficiency at 7% a year is also one of the measures from this package. The renewable energy and energy efficiency targets were defined in the Third Energy Act of the Dutch Parliament in 1996 (Derde Energienota, Tweede Kamer, 1996).

Renewable energy and energy savings are part of the package of measures which should lead to a reduction of 25 million tons of CO₂ by 2010. By ratifying the Kyoto Protocol the Dutch government committed itself to additional CO₂ savings of 6% during the period 2008 – 2012. To reach these goals the Ministry of the Housing, Spatial Planning and Environment (VROM) has defined the limits for the CO₂ emissions per sector. The urban surroundings have a 30% share in the total energy demand. Therefore it is a very important sector for energy and emission savings. The target for CO₂ savings in urban surroundings is 5,5 million tons a year in 2010.

The targets for wind energy in The Netherlands are 1500 MW on land in 2010 and 6000 MW off-shore in 2020. The 1500 MW is known as BLOW target (Bestuursovereenkomst Landelijke Ontwikkeling Windenergie), which was agreed in 2001 by the national, regional and local governments. The majority of the Dutch wind parks are installed along the coast, because that is the region with the best wind regime (see the wind map in Figure 1). Nowadays, with turbines being installed high off the ground, the other parts of the country are also becoming interesting for the exploitation of wind energy.

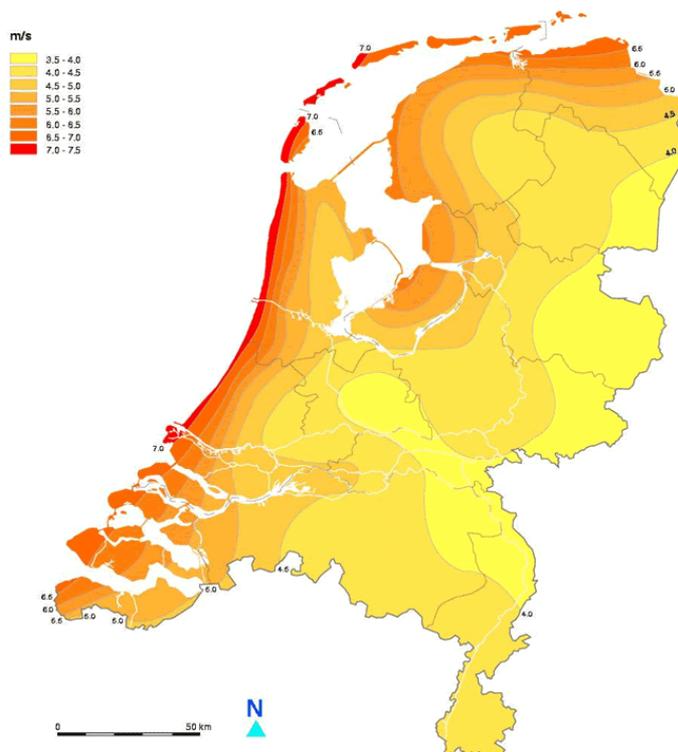


Figure 1. The wind map of the Netherlands

There are no doubts that the targeted capacity for wind on land will be realized, but there is a lot of scepticism about reaching the goals for off shore installations. This is because these installations were abruptly excluded from the subsidy Programme, MEP (as described below) a month ago (June 2005), after about eighty proposals for off shore projects were submitted. Only two

proposals have been granted the MEP subsidy before it was stopped for the off shore wind installations and large biomass installations.

Just years ago, the national government decided to stimulate large installations like large biomass and wind parks. Now the focus is on energy savings and innovation as the most important issues in the transition process towards the sustainable energy supply.

Installed wind capacity in the Netherlands

In 2004 about 4,45% of the total electricity demand was supplied by renewable electricity from the installations in the Netherlands and about 9,44% of electricity demand was covered by imported renewable energy (CBS Statline, 2004). By 2004 about 1100 MW on land wind was installed. The very first projects contained just one turbine, but the majority of the installed capacity is in large wind parks with a capacity of about 10 MW each. At this moment it is sure that the target for 2010 will be reached. Figure 2 shows wind capacity evolution.

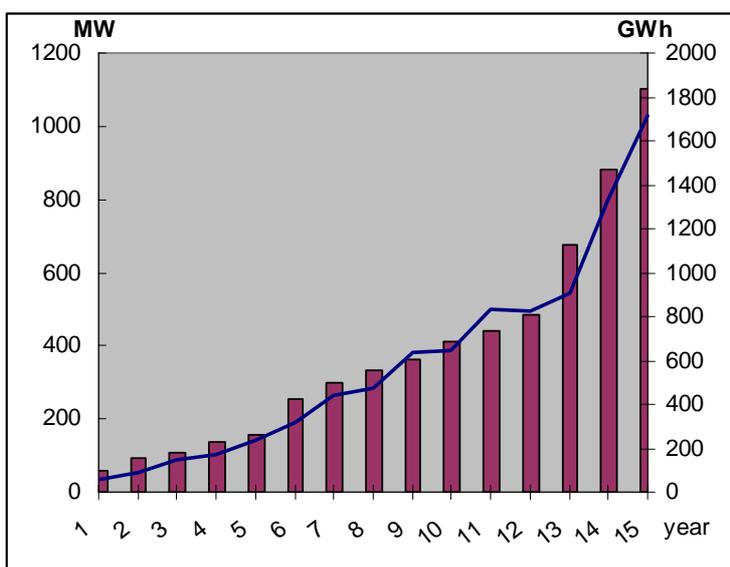


Fig 2. Installed capacity and wind production between 1990 and 2004

The majority of Dutch provinces have clear policies regarding the wind parks. For example, solitary turbines are no longer permitted and turbines with two blades are also forbidden due to visual disturbances. The first two off-shore wind parks are now in preparation. The initiators of these projects are consortia of utilities, oil companies, and large energy consultancies.

Promotion instruments for wind energy in the Netherlands

Investors in renewable energy can utilise fiscal measures and the MEP subsidy. The fiscal regulation is named EIA (energie investeringsaftrek). It makes it possible to reach a tax reduction of about 14% (44% reduction on 31,5%). The only subsidy available for renewable energy installations at this moment is the MEP (milieukwaliteit elektriciteitsproductie) feed-in tariff. The MEP gives wind energy on land a subsidy of 0,77 euro/kWh and off-shore wind 0,97 euro/kWh. The subsidy period is 10 years. Each year the Ministry of Economic Affairs reconsiders this tariff. Once contracted, the tariff stays constant for 10 years.

The renewable energy can be used directly by the producer or traded via long term contracts or at the energy spot market APX (Amsterdam Power Exchange). For each 1000 kWh of wind electricity the producer gets a certificate of origin which he can freely trade. The certificate of origin is valid for one year. This system is equal to the international Renewable Energy Certificate System (RECS). Figure 3 illustrates how the MEP system works.



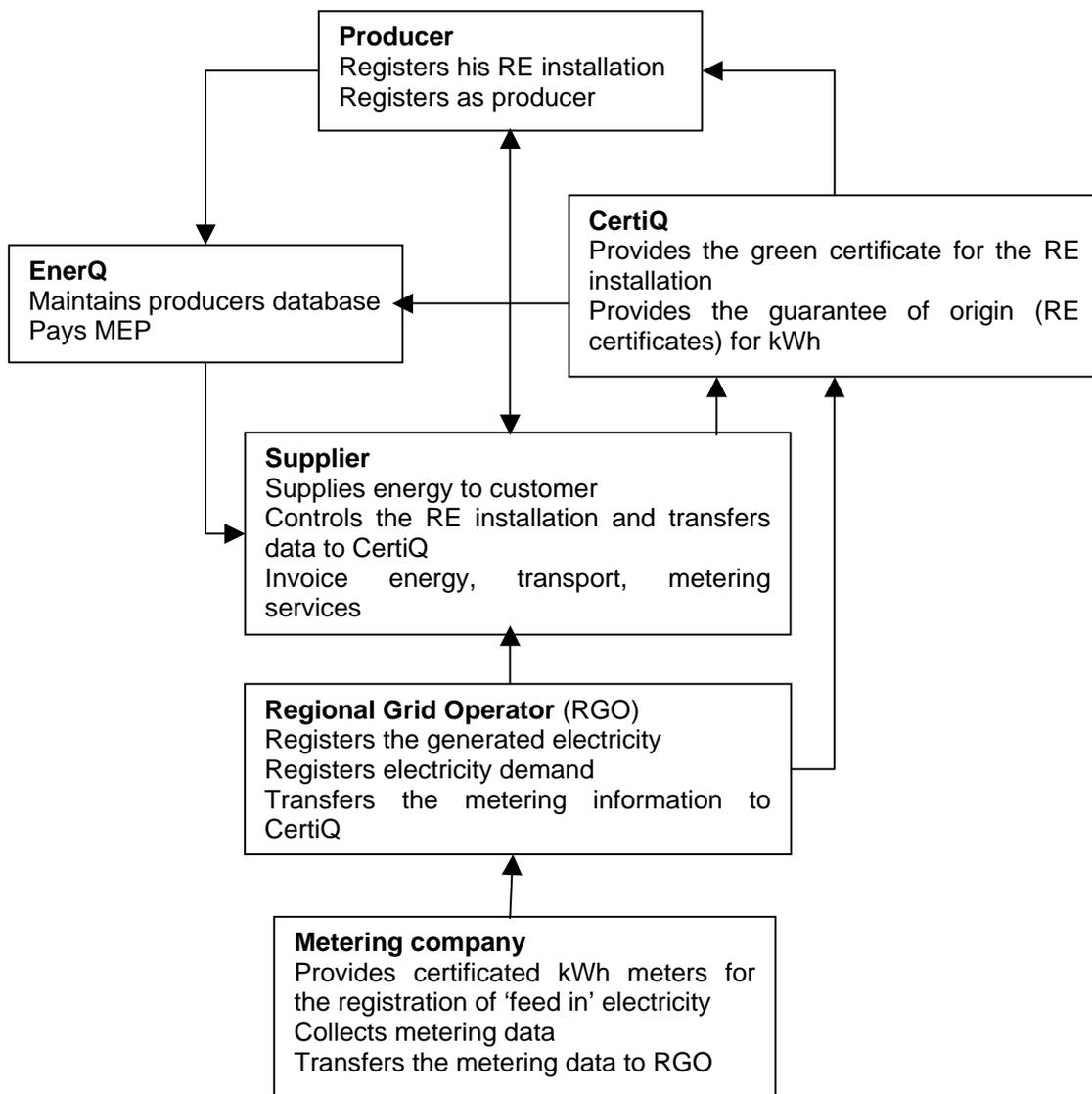


Figure 3. Actors and roles within the MEP-subsidy regulation

The actors involved within the MEP procedures are: the owner of the wind park (the producer), electricity supplier, regional grid operator, EnerQ and CertiQ and the metering company. EnerQ and CertiQ are subsidiaries of TenneT, the national network operator. Together, they make sure that the electricity that claims the MEP subsidy is indeed generated in renewable energy installations and that it is not double traded.

The Dutch energy market is completely liberalized since July 2004. That means that all customers are free to choose their energy supplier. The MEP is financed by all electricity customers who pay € 52/year per connection to the grid.

Perspectives on small scale wind

Small turbines for urban surroundings are a topical issue in The Netherlands. The process started in 2000 when the Dutch utility company, Nuon, presented Tulipo, a 2,5 kW turbine specially developed for urban surroundings, at the roof of the Dutch pavilion at Hannover Fair Expo 2000. The market showed a very big interest for this turbine and this inspired a number of other producers to develop new models of urban turbines. We can say that urban turbines are really an example case where market pull had maximal affect on the technology development.

At this moment there are 11 producers of small turbines in the Netherlands. Amongst these the Tulipo, WindWall, Turby, Neoga, SET and Venturi models are specially developed for urban



surroundings. The companies Fortis Wind Energy, Prowin, TH Rijswijk and Wind Factory make turbines with a 'tail' which are more suitable for rural surroundings.

As of June 2005 a number of pilot projects with urban turbines have been completed around The Netherlands. Some examples are:

- WindWall: Zwolle (technical school), The Hague (public buildings and an office building) and Amsterdam (municipal building);
- Turby: Tilburg (apartment building), Delft (university), along the highway A50 and Amsterdam (municipal building);
- SET: Amsterdam (residential boat), Sexbirem (information centre about wind);
- Tulipo: Zevenbergen and Drutten.

In the three northern provinces of the Netherlands: Friesland, Drente and Groningen a pilot project is now ongoing. Within this project 22 turbines from 5 producers will be installed (WindWall, Tulipo, Fortis, SET and Prowin). The turbines will be placed in urban and in rural surroundings. The main goals are to explore the legal and social aspects and the safety of these turbines.

As a knock-on effect of this project the interest in urban turbines is rapidly increasing in the provinces involved in this project. The producer of Turby is now negotiating the installation of 14 new turbines. In all projects up to now, one turbine has been installed at each location. At this moment the producer of Turby is negotiating about placing of 9 turbines on the municipal office in Zwolle, 3 in Lelystad, 4 in Helden and 4 in Wieche. Neoga and Venturi are in the last stage of prototype testing. The manufacturers expect that they will be able to start pilot projects within a year.

Institutes and networks

The majority of Dutch universities have established a renewable energy department. Some of them have already provided courses on urban wind. One student on the University of Delft is now working on her graduation thesis with a title 'A successful market implementation of urban turbines'. At the Technical University in Delft, one student is has almost finished his study on wind in urban surroundings. This is a broad theoretical analysis of the influences of buildings and other urban 'obstacles' on the wind streams around the buildings. At the Technical University in Rijswijk, students have developed and built a system for measuring and analyzing all relevant wind parameters on the roofs of buildings.

Different institutes are engaged in development and research in the field of urban turbines: the Technical University in Delft provides wind tunnel tests and field tests for a few producers, the Energy Centre Netherlands (ECN) is involved in field tests and certification process, TNO is a technical institute which helps producers with developing the specific technical solutions for urban turbines.

Two consultancy companies have initiated a platform for the information exchange and problem solving for the producers of urban turbines. The members came together three times during last two years. The conclusion is that the producers do not trust each other, but they all agree that they have to cooperate with each other in order to solve their common problems.

Place of urban turbines within the renewable energy policy

At the moment urban turbines are not officially appointed as a renewable energy solution. That means that they are not mentioned in any official document concerning renewable energy. Yet, the owners of the urban turbine installations who are exporting electricity into the public grid are allowed to do so and they can get the MEP subsidy in the category of wind on land.

In contrast to the lack of action from the national government, the regional and local governments are very active with urban turbines. In addition to the pilot project of the three northern provinces, the province of Zeeland has done some research on the possibilities for the placement



of urban turbines. They came to the conclusion that it is necessary to prove the safety and economical feasibility of these turbines.

The municipality of Haarlem has developed a document which defines the conditions in which the urban turbine can be placed without a permit. These conditions are:

- The rotor diameter is smaller than 2m
- The turbine is not visible from the public road
- The turbine causes no vibrations, flickering or shadows
- No roof adaptations are necessary
- The electrical power is smaller than 1,5 kW
- The noise at the nearest building is under 25 dB(A)

If the turbine does not fit the requirements as mentioned above and its nominal power is under 5 kW, then it requires a building permit but no public fee will be charged.

City networks

One more interesting development regarding urban turbines and municipalities is that there is very lively communication among the environmental departments of the different municipalities about urban turbines. When one municipality gets a request for placement of urban turbines, they ask other municipalities if they have experiences with those turbines and if so, how they have handled it. In other words, we can say that there is a kind of urban turbine city network in the Netherlands. The networking among the Dutch municipalities has its roots in the environmental plan, a programme for energy saving in municipalities which operated over 10 years from 1990 to 2000. It is clear that this network is still functioning well, and that it can be used for communication about urban turbines.



PORTUGAL

To reach the 39% target set for Portugal in the European Union Directive 2001/77/EC, the Government established an objective for the installed capacity from renewable sources by the year 2010, firstly through the "E4 Programme" and, on the 28th of April 2003 through the Resolution of Council of Ministers n° 63/2003 (see Table 1 below). From nearly 4 600 MW total capacity installed in 2001, the current target is to reach a global 9 680 MW by 2010 (based on gross national electricity consumption of 56,1 TWh). To reach this target the programme plans more than 4000 additional renewable megawatts, from which nearly 3000 MW is wind power.

Table 1. Portuguese renewable energy targets

RES	In 2001 (MW)	By 2010 (MW)	
		E4 Programme ¹	RCM 63/2003
Wind	122	3.000	3.750
Small hydro	215	500	400
Biomass	10	100	150
Biogas	1	50	50
MSW	66	130	130
Solar PV	1	50	150
Wave	0	50	50
Large hydro	4.290	5.000	5.000
Total	4.603	8.800	9.680

Installed wind capacity in Portugal

Installed wind capacity reached 683 MW in March 2005, as shown in Table 2 below.

Table 2. Installed wind capacity in Portugal

Projects	Turbines	MW
76	546	682

Source: ADENE March 2005

An important majority of the projects are below 10 MW as shown in the Table 3 and almost 50 % of the total wind capacity installed is located in the Northern district of Vila Real (135 MW), Braga (106 MW) and Viseu (98 MW). Figure 1 shows the evolution of installed wind capacity in Portugal.

Table 3. Classification of the wind projects according to their size

Size (MW)	Number of wind parks	Capacity (MW)
[0,1 to 1]	14	8
]1 to 10]	36	185
]10 to 25]	24	374
]25 to 50]	1	35
> 50	1	80
Total	76	682

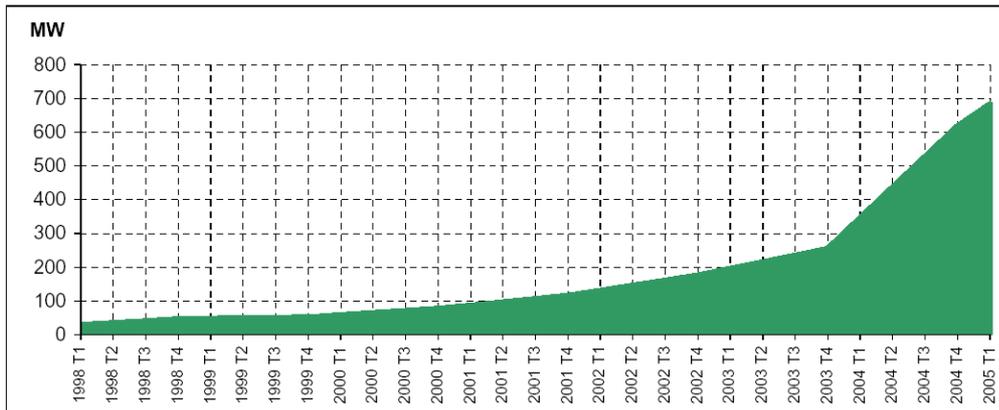


Figure 1. Evolution of installed wind capacity in Portugal

Promotion instruments and support measures for wind energy

The policy instruments that are used in the realisation of the Portuguese energy policy are mainly feed-in tariffs and investment subsidies. Besides these instruments there are also loans and grants covering investment costs. The current feed-in tariff for wind-energy is 0,74 Eurocent/kWh. This tariff is valid for a period 15 years or a production of 33 GWh (whichever comes first) for all size of turbines without any threshold. (Source: Mr. P. Santos, ADENE, June 2005).

The programme MAPE (Ministerial Order n° 26566/2002 of 17th December 2002) targets all renewable energies, energy efficiency technology, natural gas and transport fuels. Its objective is to improve energy efficiency and to increase the use of renewable energy sources. It is the financial tool of the Ministry of Economy to support projects in the energy sector that are being realised under the CSF III (Community Support Framework) between 2000 and 2006. It gives subsidies to firms, municipalities, business and labour associations, schools, health and social action bodies, and civil protection entities belonging to mainland Portugal and the Autonomous Regions for investment projects in four categories:

- Renewables for Electricity Generation
- Energy Management Measures and Co-generation
- Green Fuels for Transport Fleets
- Fuel Switching to Natural Gas

The amount of subsidy given varies with the type of technology and economical feasibility of a project. In general the subsidy is about 40% of the investment.

Perspectives on small scale wind

The national agency for energy, ADENE, is not aware of any small urban wind energy projects or national manufacturers of urban wind turbines. Small wind turbines are currently used in stand alone projects and small villages (decentralised off-grid projects). However, the feed-in tariff, as functioning in 2005, does offer the possibility for urban wind turbines to benefit from the feed-in tariff. Amongst the various Portuguese actors interviewed in the field of small wind turbines, Sistemas de Energias Alternativas Portugal does not manufacture wind turbines, but sells wind turbines up to 3 kW which are connected to batteries, Energias Renováveis Lucena (ERL) is working in this field and VENSOL - Energias Renováveis is a distributor of very small wind turbines (maximum 85 W), mainly for sailing boats.

SPAIN

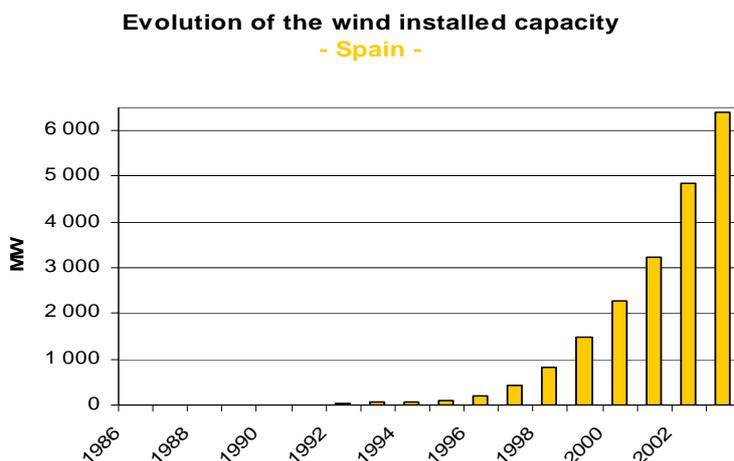
A Special Regime for Electricity was introduced in 1980 by Law 82/1980 on the Conservation of Energy. This Law and its implementing decrees established the legal status of an electricity self-producer. Regulation Law 40/1994 on the electrical system - LOSEN and its implementing decree: RD. 2366/94 updated the standards governing the Special Regime for Electricity Production.

The Electricity Law specifies the Special Regime for electricity generation, improving the inclusion of renewable energy and DSM programs in the Spanish Legislation. The Electricity Law and the Special Regime gives suppliers the right to inject surplus electricity into the grid if the power generation system is based on renewable energy.

This regulatory framework has supported the Spanish Provinces to encourage wind energy development.

Installed wind capacity in Spain

Spain's wind power market is evolving under new conditions providing more satisfactory legibility for investors. The incentive system consists of either a system with a set purchase price or a bonus that is added on to the market price. In the second system, the bonus is set annually as a function of interest rates and the average price of electricity. For the year 2004, the prices set for electricity and the bonus were frozen at their 2003 levels (6.21 c€/kWh for the set price and 2.66c€/kWh for the bonus). A new purchase price calculation method was adopted last March 3rd (Royal Decree 436/2004) with the objective of improving investor confidence (in particular for banks) by increasing incentive system security and legibility. The principle of this new decree consists of a guaranteed payment on the complete duration of wind park lifetimes. This new legislation has brought about an additional capacity of 2064,6 MW, making Spain the fastest growing wind power market worldwide. The country thus supersedes Germany, which had been holding this position since 1993. Spanish total installed capacity amounted to 8263,2 MW at the end of 2004.



Source: Ecoserveis

Figure 1. Evolution of the installed wind capacity

Promotion instruments for wind energy in Spain

All the wind turbines commissioned before 1998 were submitted to the tariff system of the Real Decreto 2366/94 but projects after this date rely on the Real Decreto 2818/98 which offers two possibilities.

A special regime electricity installation can either choose the system which proposes the fixed prices presented in Table 1, or decide to opt for the market price plus a premium price which varies slightly from one year to another. For example, this premium feed-in tariff amounted to 2,89 Eurocents per kWh in 2002 and to 2,66 Eurocents per kWh in 2003, leading to the respective prices presented in Table 2.

Table 1	2002	2003
Fixed price (c€/kWh)	6,28 c€/kWh	6,21 c€/kWh

Table 2	2002		2003	
	Market price	Premium price	Market price	Premium price
	4,48	2,89	4,6	2,66
"Final" price (c€/kWh)	7,37		7,26	

Wind operators are free to change from one system to another each year, if they want to. The market price having been quite high these last two years, 99 % of the wind developers have selected the second solution as it is more advantageous.

Perspectives on small scale wind

Small-scale wind installations in Spain are found almost exclusively in rural and remote locations where farms and dwellings have limited access to the national grid. There is little evidence of the market expanding into the urban domestic sector in the near future, national Spanish policy focusing mainly on solar thermal diffusion in urban areas.



SWEDEN

The liberalisation of the Swedish electricity market provides straightforward access for small independent generators to be connected to the grid. Swedish utilities are obliged to purchase electricity from small generators at agreed prices.

Installed wind capacity in Sweden

The development of wind in Sweden has not been very consistent over the years primarily due to the fact that this country generates a significant amount of its energy from nuclear and hydro power enabling it to provide electricity at a low tariff.

Currently the kWh price for electricity (including all taxes) for industrial use is the lowest for all of the 25 EU Member States. In term of wind capacity development, Sweden is ranked as tenth out of the EU member countries. The total capacity installed is 442 MW, but with a very low annual growth rate (just under 10%) compared to other countries in Europe.

Promotion instruments for wind energy in Sweden

To support electricity from renewable energy sources Sweden has put in place a certificates systems based on Quota obligation imposed on the electricity utilities. In addition to this, subsidies of 15 % and additional FITs ("Environmental Bonus" 18) of 1.9 c€/kWh are available for wind energy investments.

The Swedish certificate market was established in 2003, and the regulations have also been set with an eye to the development of a future European market. Under the scheme, generators using solar, wind, biomass geothermal, wave or small hydro (< 1.5MW) are awarded one certificate for each 1 MWh produced, and all consumers are obliged to buy these certificates to cover a set proportion of their use. This requirement started at 7.4% in 2003, and will rise to 16.9% in 2010.

Energy-intensive industry is exempt from the requirement. There is a floor and a ceiling set on certificate prices. Should generators find no buyers for their certificates; the government is obliged to buy them. The price was SKr 60/MWh (€ 6.6/MWh) in 2003, with the price falling in future years. For consumers who fail to buy enough certificates, there is a penalty of SKr 175/MWh (€ 19.3/MWh) in 2003 and SKr 240/MWh (€ 26.5/MWh) in 2004. The average certificate price in Sweden, from August 2003 to August 2004 equalled 2 cts Euro/kWh.

Perspectives on small scale wind

Small and medium-sized wind technologies are mostly found in quite densely populated islands. Most of the installations are horizontal axis wind turbines. Today over 15% of the islands electrical demand is met by wind power. This places particular demands on the existing island grid which was developed for distribution of power rather than for the integration of decentralised power sources. Techniques to enable the integration of wind power into weak grids have been developed and implemented in remote locations.

UNITED KINGDOM

Wind has been the world's fastest growing renewable energy source for the last seven years. This trend has been reflected in the UK, where over the last three years wind energy costs have fallen steadily and the technology has emerged as a major player in helping to achieve renewable energy targets and reduce CO₂ emissions to prevent climate change. The UK is the windiest country in Europe with over 40% of the available resource - enough to meet the country's electricity needs several times over.

Renewable energy sources in the UK currently generate just over 3% of the total electricity supply, 30% of which comes from wind energy. The 2002 Renewables Obligation set a target on the generation of electricity from renewables of 10% by 2010. This target was revised in 2005 by the UK government to 15% by 2015. Wind energy is one of the best placed technologies to help meet these targets.

Installed wind capacity in the UK

Table 1 below gives the current situation for wind energy installations in the UK.

Projects	Turbines	MW	CO2 reductions
101	1234	979*	2 215 000 tonnes

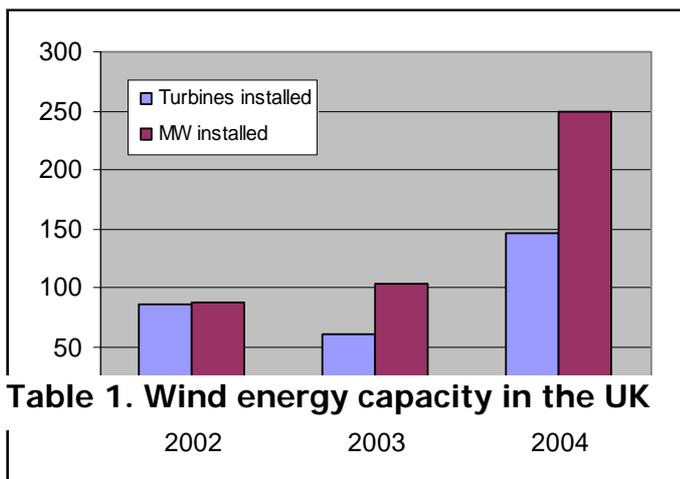
* 123 of which are off-shore

Source: BWEA May 2005

The number of wind farms in the UK has accelerated over the last three years, as Figure 1 below shows, and this growth is predicted to continue into the future. There are already 600 MW worth of wind energy farms under construction which are due to be completed in 2005 and an additional 700 MW (mostly in Scotland) that have planning approval but have not yet started construction.

In addition, there are an estimated 2.2 GW of onshore wind farms in planning and awaiting decision. From the offshore perspective, there are 2 completed projects but over 15 projects totalling 7.2 GW, or 7% of national electricity demand, in the pipeline.

Figure 1. UK annual capacity installed 2002 - 2004



The UK does not have a fixed feed-in tariff scheme for any of the renewable energy technologies. Instead it relies on the Renewable Obligation to create a market based system where renewable energy generation certificates (called ROCs) are bought and sold at market price.

The Renewables Obligation

The Renewables Obligation (RO) requires all electricity suppliers to meet an escalating target for supplying a proportion of their power from renewable sources. The target started at 3% and rises incrementally to 15% by 2015. It is likely to be extended to 20% by 2020.

Each year, all suppliers of electricity in the UK need to supply the set percentage of electricity from renewables, or pay a penalty. For each unit of 1 MWh of electricity produced per month from accredited renewable energy schemes, the generator is awarded a 'renewables obligation certificate' (ROC) which can then be sold to an electricity supplier as evidence of a renewables purchase. Suppliers that fail to purchase sufficient ROCs must buy-out of their obligation. The penalty or buy-out price for 2002 was 0.03 GBP/kWh (or £30/MWh). This has since increased in line with inflation to 0.03139 GBP/kWh for 2004.

All proceeds from buyout payments are recycled to suppliers in proportion to the number of ROCs they present. ROCs can be freely traded and the price varies according to the ratio of ROCs to buy outs (which increase the overall value of the ROCs). ROCs have traded as high as £47/MWh but there is no guarantee that they will remain at this price. ROCs have increased the profitability of renewable energy generation as the certificates can currently sell for more than the power. This is especially true for wind, which was already producing electricity at competitive prices.

To qualify for ROCs generators must generate at least 0.5 MWh per month. This clearly excludes small generators from participating in the ROC market and therefore provides no incentive for small scale systems, such as small scale wind. The review of the RO in 2005 is expected to include measures to make the system more flexible, thereby improving access to ROCs by micro-generators.

The other parts of the income stream that are theoretically available to renewable energy generators include the baseload electricity price (0.017 GBP/kWh in 2002, although higher in 2004) and the levy on electricity consumption, or climate change levy to industrial consumers, at 0.043 GBP/kWh.

Perspectives on small scale wind

The small scale wind market in the UK is just starting to establish itself. In terms of both market actors and economic feasibility, it is at an earlier development stage than large scale wind. However, over the last year there has been some evidence that small scale wind systems are gaining recognition as a viable option for renewable energy supply for domestic and community applications. In particular, there has been interest in building integrated and rooftop applications of small wind turbines and a number of feasibility studies have been carried out and at least 3 projects are currently going ahead, although this type of installation is still very rare.

Grid-connection of small scale wind is accepted, provided appropriate inverters and protection equipment is used (based on Engineering Recommendations G83 and G59). Net metering agreements are commonly available for small solar photovoltaic generators and are therefore likely to be available also for urban wind generation systems.

There are 14 companies manufacturing or in the process of developing prototypes of vertical axis (VAWT) and horizontal axis (HAWT) small wind turbines. A number of these companies have entered the onshore small wind turbine market recently and there is not a lot of experience with many of the technologies available. On the other hand, there are some small HAWT that are tried and tested. Thanks to the increasing number of installations being completed experience in the sector is growing.

The main government mechanism that has provided support to small wind installations has been the ClearSkies programme, which provides grants and access to sources of advice on renewable energy, including wind energy. The fund started in 2003 and will end in 2006. It will be replaced by a new programme which will support a range of small scale renewable energy technologies.



However, there has been no indication whether any of the new funding will be ring-fenced for small scale wind.

At the moment, householders can obtain grants between £400 and £5000 whilst not-for-profit community organisations can receive up to £100,000 (£50,000 from April 2005). ClearSkies supports projects in England, Wales and Northern Ireland. Scottish householders and not-for-profit community organisations can apply for grants through the Scottish and Highlands Community Renewables Initiative.

Many grants have been given for feasibility studies and installations for wind energy and most of these installations could be classified as small scale. Table 2 below shows ClearSkies grants for wind systems. These include installations in both rural and urban areas. The average price for the installations carried out so far is £4800/kW (ClearSkies, April 2005).

Table 2. ClearSkies grants for wind energy systems

Domestic systems	Community systems
116	50

Source: ClearSkies April 2005

There are currently no other incentives for small scale wind installations in the UK.

Planning policy encouraging renewables

Planning Policy Statement 22 (PPS 22) and its Companion Guide were issued in 2004 and encourage the appropriate development of renewable energy at local level. PPS22 will help translate national policy on renewable energy development into local action. It explains what makes a 'good' renewable energy application, how to assess the impact of plans on the landscape and how to give the community greater involvement. The guide provides advice on the broad range of renewable energy technologies, including wind.

Regional policies favouring and encouraging renewables include the London Energy Strategy which requires new developments over 1000m² to obtain 10% of its energy requirement from renewables. In an urban environment such as London, this kind of policy could encourage the use of small wind turbines.

Conclusions

There is a growing interest in small scale wind in the UK. Although the market is currently quite small, there are some experienced companies carrying out an increasing number of installations. Recently, a number of new companies have entered the market but many of these are still at the prototype / testing / small production stage with commercialisation planned for 2005 or later. All the UK manufactured small wind turbines that are ready for market are HAWT. VAWT are still very much at the development and testing stage.

The ClearSkies programme shows that there has been a larger than expected number of installations over the last 2 years but the market has not yet taken off. This could well be due to lack of awareness amongst local authorities, companies and the public of the potential of small wind energy, particularly in an urban setting.

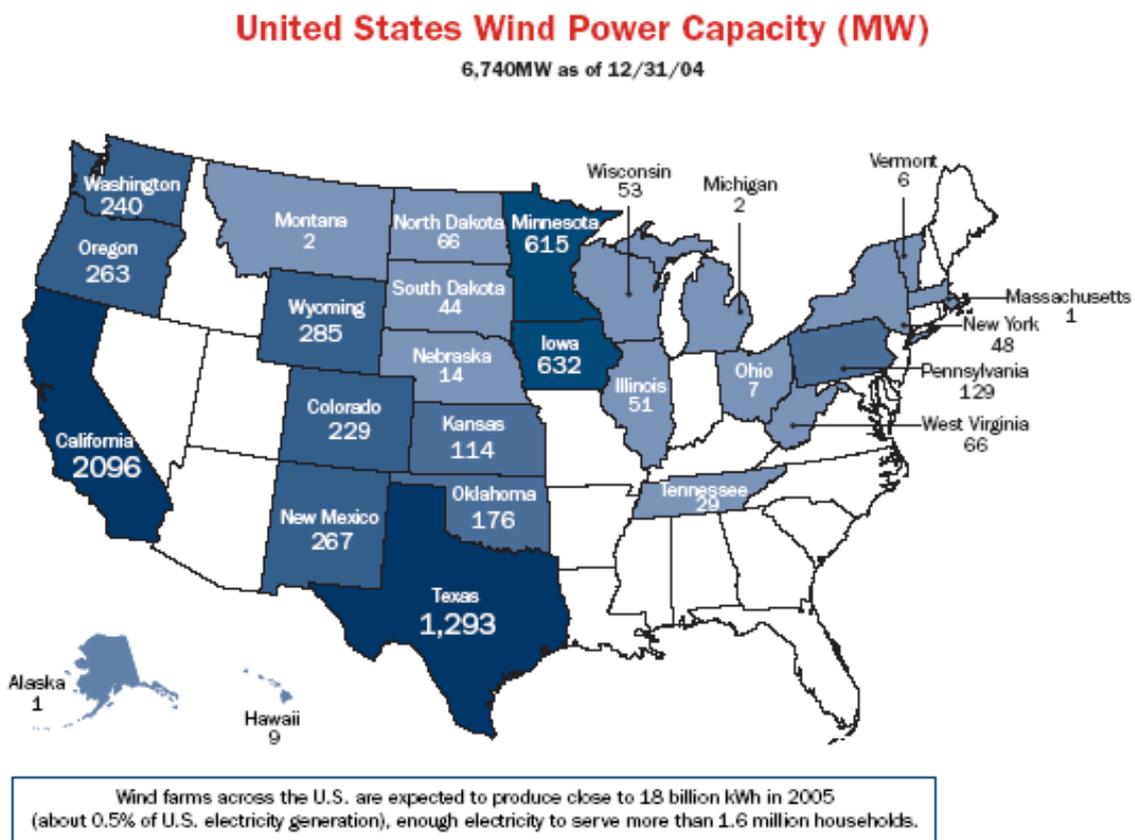


UNITED STATES

Utility-scale wind is growing fast and creating a "buzz" in the U.S. energy market. Wind accounts for less than 1% of the electricity generated in the U.S. today, but installed capacity has been expanding at an average annual rate easily exceeding 20%. The American Wind Energy Association (AWEA) believes that by 2020, with consistent policy support, wind can provide at least 6% of U.S. electricity.

At the end of 2004, U.S. capacity reached 6,740 MW. The AWEA expects 2005 to be a record breaking year for the U.S. wind industry, with up to 2,500 MW of new wind energy generating capacity likely to be installed in the United States.

The U.S. Department of Energy has announced a goal of obtaining 5% of U.S. electricity from wind by 2020. The public demand for clean energy is growing in the U.S. and as the cost of producing energy from the wind continues to decline, it is likely that wind energy will provide a growing portion of the U.S energy supply.



Source: Wind Power Outlook 2005, AWEA, May 2005

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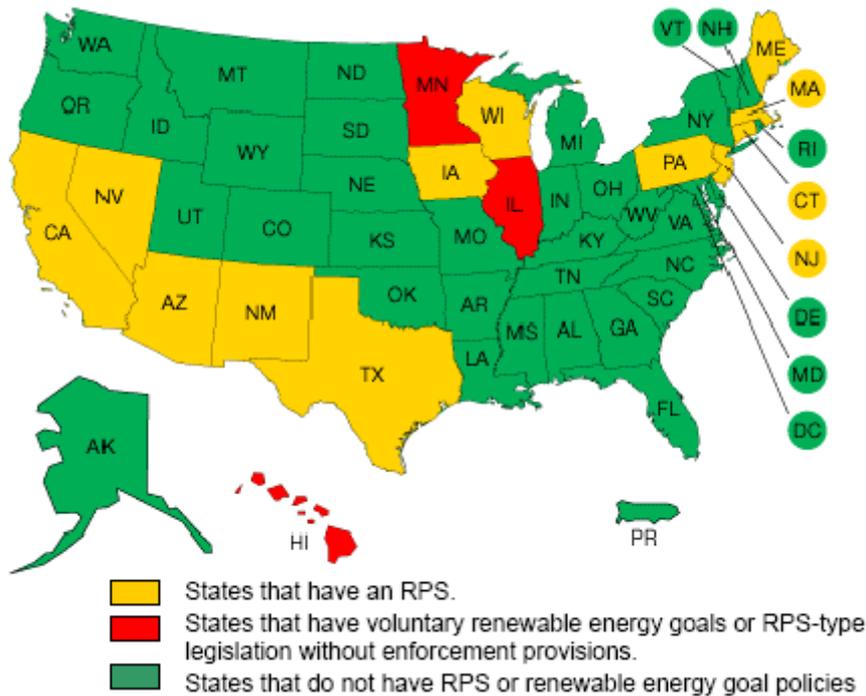
Figure 1. United States wind power capacity

Wind energy policy

In the U.S. there are three main support mechanisms for renewables. These are:

1. the Renewable Portfolio Standard (RPS), a state-by-state requirement;
2. federal tax credits for wind generation; and
3. voluntary market based drivers, such as consumer green premiums.

Not all states have an RPS system. Figure 2 gives a summary of which mechanisms are in place in the each of the states.



Source: PriceWaterHouseCoopers, Stimulating Renewable Investment Through Policy Options, An International Perspective, REGA / ESAA 9th Renewable Energy Conference, 9th June 2004

Figure 2. State support mechanisms for renewable energy

State policy – the RPS

One of the strongest drivers of new wind installations is state policy, and in particular the renewables portfolio standard (RPS), which requires that a minimum amount of electricity be supplied from renewable sources. As of January 2005, 18 states had some form of renewable power requirement, including Arizona, California, Connecticut, Iowa, Maine, Massachusetts, Minnesota, Nevada, New Jersey, Texas, and Wisconsin. Joining these in 2004 were New Mexico, Maryland, Hawaii, Rhode Island, New York, Colorado, and Pennsylvania, as well as the District of Columbia. In early 2005, Illinois Governor Rod Blagojevich called for an RPS ensuring that 8% of the state’s power comes from clean, renewable energy by 2012.

Some of these laws are more effectively designed and implemented than others, but all recognize the public benefit of having a diverse resource mix drawing from domestic, inexhaustible renewable resources.

Production Tax Credit

The Production Tax Credit (PTC), enacted in 1992, provides a 1.8-cent/kWh credit (adjusted periodically for inflation) for electricity produced from a wind farm during the first 10 years of its operation, and is important for financing wind projects.



The problem with the PTC is that it has been set and then continuously renewed for relatively short periods of time, typically 5 years, creating uncertainty each time an expiration date is approached. This has not helped the wind industry really consolidate and has contributed to "cycles" of activity and inactivity.

A 2-year PTC extension (through December 31, 2005) was signed into law by President George W. Bush on October 4, 2004 but the AWEA and large-scale wind industry actors agree that a long-term commitment to the PTC is needed to really boost the wind industry and allow it to expand to its full potential.

Small Wind Turbines

The U.S. small wind turbine industry offers a wide assortment of products for various applications and environments. There are over 20 small wind turbine manufacturers in the U.S. and there is a well developed network of dealers and suppliers. Machines range in size from 400 W for specific small loads such as battery charging for sailboats and small cabins, to 3 – 15 kW systems for a home, to those that generate up to 100 kW for large loads such as a small commercial operation.

In 2001, annual sales of the U.S. small wind turbine industry were about 13,400 turbines; around 50% of these were exported. Recently, the market for small wind turbines has been growing 40% per year. The AWEA estimates that turbine sales will increase, and by 2020, small wind turbines could contribute 3%, or 50,000 MW, to the United States' electricity supply.

There are still some barriers to the full development of small wind turbines as a commercial product, these are costs, reliability, financing and getting installation permits. However, demand for small wind turbines seems to be growing in the U.S. and the AWEA is supporting policy development, such as guidelines for grid-connection.

The long-term industry vision, as described in the U.S. Small Wind Industry Roadmap, June 2002, is to make small wind turbines a major new category of home energy appliance. In order to achieve 50,000 MW the small wind turbine industry will have to grow to over \$1 billion per year and employ over 10,000 people in manufacturing, sales, installation, and support. This is possible due to the sheer number of homes (15 million) and small businesses (1 million) that could effectively use small wind systems if the economics were favorable (AWEA, 2005).

In effect, about 60% of the United States has enough wind for small turbines to generate electricity. At the moment, grid-connected installations in rural areas are on the rise, as well as a steady market in the off-grid sector. Penetration into suburban areas is also taking place where land space is available, as the preferred mode of installation of wind turbines in the US is on adjacent land, not roof or wall mounted. Small wind turbines in inner-city urban areas are, however, rare.

