SUCCESS OF WIND POWER – A QUESTION OF STATE AND FEDERAL SUBSIDIES?
DÉVELOPPEMENT DE L'ÉNERGIE ÉOLIENNE:UNE QUESTION DE SUBVENTIONS NATIONALES?

DIETER SCHWANKHAUS
ERNST & YOUNG AG, HAMBURG, GERMANY
ERNST & YOUNG AG, HAMBOURG, ALLEMAGNE

1. Introduction

1.1 Objective of the paper
Objectif de ce rapport

Responsible use of energy and security of supply issues, the implications of nuclear power and the consequences of greenhouse gas emissions have been on the agenda of industrialised nations for many years. The Kyoto and subsequent climate conferences have substantially influenced and changed energy policies in many countries. Last year several major events such as the electricity blackouts in the US, Canada, and subsequently also in Europe, the heat records in Europe last summer and the Iraq war brought the whole range of energy issues even more to the attention of the public. Energy will stay at the top of the agenda as worldwide consumption is expected not to diminish but rather grow substantially over the next decades, the main reasons being world population growth from approximately 6 billion in 2001 to around eight billion in 2005 and ongoing economic growth and industrialisation of China, India and major developing countries.[1] Increased energy production will mostly be needed for the electricity sector. Based on the EIA International Energy Outlook 2003, total world net electricity consumption will increase from 13,934 billion KWh in 2001 to 24,673 billion KWh in 2025, with the highest average annual percentage change 2001–2025 in Developing Asia of 3.7 percent (China 4.3 percent, India 3.4 percent) compared to total annual average of 2.4 percent. [2]

Consequently, it will be of utmost importance for policy-makers in their countries to achieve a balance of various key objectives. They will have to secure an ongoing energy supply at a reasonable cost, as well as achieve an energy mix which assures that the ecological objectives and commitments are met and ensure that energy production and distribution facilities are socially acceptable (for example, acceptance of nuclear power on the one hand and large wind parks on the other). Existing hydrocarbon resources need to be used more efficiently and more effectively not only from an economical point of view, but also, and in particular, from an ecological point of view. Hydrogen – fuel cells – will eventually come into play and it remains to be seen whether the pollution-friendly nuclear power will eventually die out or survive and/or even be revived. Greenhouse gas emissions and security of supply issues are closely linked to the growth of renewable energies. Renewable energy sources have gained wide support for being environmentally friendly (typically low or no emission). They are also seen to have a valuable part to play in ensuring diversity of supply. Almost everyone agrees that renewable energy is 'a good thing'. In this context, there is an emerging consensus that, for renewables to make an appreciable difference, it is wind power that will have to deliver its potential. Presently, this is one of the 'new' renewables technologies, if any at all, that can be relatively cost competitive with fossil fuels and undergo rapid expansion to a significant scale in the near future.[3]

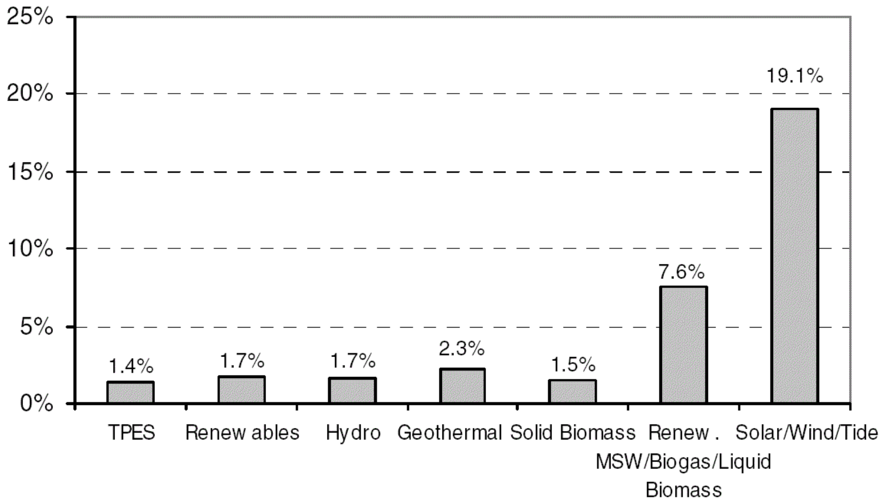
Today, the wind power industry in Europea is the leading one and wind power has experienced a growing market share in many European countries. Although there are clear market-driven activities in India, China and Japan, to establish a solid and cost-effective wind energy market, sizeable wind projects in other countries also need to be developed, and soon, if this nascent industry is not to be condemned to stagnation. Apart from technical (offshore development) and additional onshore location availability aspects, one key factor for the future success of wind energy seems to be political support via state and federal subsidies. Various subsidy models that have been developed and which are still in place including feed-in or pricing laws, as well as quota and certificate regulations will be discussed in this paper. For example, state-supported loans are offered at low interest over long repayment periods in some countries, as well as direct capital subsidies to the investor of a power plant or exemptions from carbon or CO_2 tax on electricity production. In our paper different support mechanisms will be examined and their effect on the market penetration of wind energy will be compared and evaluated.

1.2 Wind energy in the context of the renewable energy development
Place de l'énergie éolienne dans le cadre du développement des énergies renouvelables

First of all, we believe, that the present role of wind energy needs to be seen realistically within the context of total energy consumption. According to the International Energy Agency ('IEA') renewables accounted for 13.5 percent of total primary energy supply in 2001, compared to oil 35.0 percent, coal 23.4 percent, natural gas 21.2 percent and nuclear energy of 6.9 percent. The IEA definition of renewable energy sources includes combustible renewables and waste (for example, solid biomass, charcoal, gas from biomass and liquid biomass), hydro, solar, tide and wind energy. The majority of worldwide renewables stems from solid biomass due to its widespread use in developing countries.

In contrast, the contribution of 'new' renewables such as solar, tide and wind only accounted for less than 0.1 percent of the global primary energy supply or 0.5 percent of the world renewables supply in 2001. [4] Despite their still comparatively modest market share, however, the 'new' renewable energy sources have enjoyed an average annual growth rate of 19.1 percent since 1990.

Table 1: Annual growth rates of world renewables supply from 1990–2001.
Taux de croissance annuelle des énergies renouvelables dans le monde entre 1990 et 2001.



(Source: IEA5)

Looking at OECD countries as a whole, in 2001 renewables contributed 15 percent to total OECD electricity production, with hydro again dominating at 13 percent. It is nonetheless interesting to note, that since 1990 renewable electricity generation has been growing at significantly lower average annual rates than total electricity generation (0.8 percent versus 2.1 percent), the reason primarily lying in hydropower capacities, which were already at a high level in 1990. However, in the European OECD countries, the renewables contributions to total electricity production grew from 17.7 percent in 1990 to 18.9 percent in 2001 according to the IEA.[6] This was primarily due to the implementation of attractive laws and policies by European Union member states to support the renewables energy production. In 2001, wind power became the fourth largest renewable contributor for electricity generation surpassing municipals solid waste for the first time. Wind power grew in the OECD from 3.8 TWh in 1990 to 34.0 TWh in 2001 (average annual growth 21.9 percent). Again, the largest part related to the EU with average annual growth of 38.1 percent. [7]

1.3 Measurement of success
Critères de réussite

Most common measures of success of wind power development are installed wind power capacity, actual power output and contribution to total electricity production, as well as to total energy consumption. For country comparison purposes installed capacity per area (KW/km2) and per capita (Watt/capita) are also often used. The European Union, for example, has set a target to generate 22 percent of its electricity from renewable sources by 2010 (EU Directive 2001/77/EC of 27 September 2001). The EU definition of renewables is not as broad as the IEA definition cited above, but includes wind, solar, geothermal, wave, tidal, hydropower, biomass and certain gases (Article 2 of the Directive). Based on the 22 percent target specific goals are set for the individual member countries. But despite these ambitious objectives of the EU member countries, we have also seen negative developments in the wind power growth over the last two years in various countries. And, as shown in Table 2 below, the number of countries with sizable installed wind energy capacity is still low. In our opinion, the success of wind power implies that market penetration is increased to an extent that significantly supports environmental protection and sustainable development and which at the same time is commerically acceptable to both investors and consumers. From a national economy viewpoint, positive impacts on security of supply, job creation/employment and domestic manufacturing capacity, as well as technology development are often also included in the definition of success.[8]

2. Selected country overview
Panorama de pays sélectionnés

2.1 Summary of installed wind power capacity
Aperçu des capacités éoliennes installées

At the end of 2003 the worldwide cumulated installed wind power capacity was 39,294 MW (2002: 31,228 MW). Europe at 28,706 MW had a global market share of 73 percent. Three of the four largest wind power countries are members of the European Union, namely Germany, Spain and Denmark, all of which have also signed the Kyoto Protocol. The fourth country (presently number 2 worldwide) is the US, which has decided not to join the Kyoto community. Yet taking into consideration the size of the US and its total population, installed capacity must be seen in the right perspective. Germany alone accounts for more than one third of the worldwide installed wind power capacity. To date, the most important wind energy markets outside Europe have been the US and India.

Table 2: Total installed wind power capacity at end 2003 and 2002 (MW).
Total capacités éoliennes installées en fin d'année 2003 et 2002 (en MW).

	2002		**2003**	
	MW	**percent**	**MW**	**percent**
Germany	11,994	38.4	14,609	37.2
Spain	4825	15.5	6202	15.8
US	4685	15.0	6374	16.2
Denmark	2889	9.3	3,110	7.9
India	1702	5.5	2,110	5.4
Italy	788	2.5	904	2.3
Netherlands	693	2.2	912	2.3
UK	552	1.8	649	1.6
China	468	1.5	568	1.4
Japan	414	1.3	686	1.7
Greece	297	1.0	375	1.0
Sweden	345	1.1	399	1.0
Portugal	195	0.6	299	0.8
France	148	0.5	239	0.6
Ireland	137	0.4	186	0.5
Austria	140	0.4	415	1.1
Australia	105	0.3	198	0.5
Other countries	851	2.7	1,059	2.7
Total worldwide	31,228	100.0	39,294	100.0

(Source: EWEA9 and Bundesverband Windenergie e.V.) [10]

Showing the installed wind power capacity in relation to country area and to population the extraordinarily high positioning of Denmark and Germany becomes even more evident. If all countries listed in Table 3 had the same wind intensity as Denmark – measured by an average installed wind capacity of 72.2 KW per km2 – the installed wind capacity would be around 45 times higher in those countries. Instead of about 35 GW in total, the installed wind capacity of the above mentioned countries would come to about 1600 GW.

Table 3: Total installed wind power capacity 2003 in relation to area and population.
Capacité éolienne installée 2003 rapportée à la superficie et à la population.

	Total installed capacity MW)*	**Area in km2****	**Installed capacity per area KW/km2**	**Population (in million)****	**Installed capacity per capita Watt/capita**
Germany	14,609	357,021	40.9	82.4	177.3
Spain	6202	504,782	12.3	40.2	154.3
US	6374	9,629,091	0.7	290.3	22.0
Denmark	3110	43,094	72.2	5.4	575.9
India	2110	3,287,590	0.6	1049.7	2.0
Italy	904	301,230	3.0	58.0	15.6
Netherlands	912	41,526	22.0	16.2	56.3
UK	649	244,820	2.7	60.1	10.8
Greece	375	131,940	2.8	10.7	35.0
Australia	198	7,686,850	0.0	19.7	10.1

*(*Source: EWEA – see Table 2.)*
*(** Source: CIA11, population estimate at July 2003.)*

Table 4 shows additions to installed wind capacities in the selected countries from 2000–2003. In absolute terms, Germany and Spain have been the fastest growing countries. On average 2500 MW were installed in Germany and around 1250 MW in Spain per year. Total capacity increase for Germany 2000–2003 of 10,184 MW corresponds to 38.2 percent of worldwide additions for the four years (Spain: 4944 MW or 18.5 percent).

Table 4: Additional/installed wind power capacities from 2000–2003.
Capacités éoliennes installées/supplémentaires de 2000 à 2003.

	Installed capacity year end 2003 MW*	**Additional installed capacity per year**				**Total additions 2000–2003 MW**
		2003* MW	**2002** MW**	**2001*** MW**	**2000**** MW**	
Germany	14,609	2645	3247	2627	1665	10,184
Spain	6202	1377	1493	1050	1024	4944
US	6374	1687	429	1635	165	3916
Denmark	3110	243	530	115	603	1491
India	2110	408	220	236	169	1033
Italy	904	116	106	276	147	645
Netherlands	912	226	219	52	40	537
UK	649	103	55	107	63	328
Greece	375	78	104	84	116	382
Australia	198	93	32	41	22	188
Total	35,443	6976	6435	6223	4014	23,648
Other countries	3851	1157	796	601	481	3035
Worldwide	39,294	8133	7231	6824	4,495	26,683

**Total year end 2003 and additions 2003 – Source: EWEA (see Table 2 and Reference 9)*
***Additions 2002 – Source: C. Ender12*
****Additions 2001 – Source: C. Ender13*
*****Additions 2000 – Source: C. Ender14*

In the following overview we will put the main emphasis on the most successful European countries in terms of installed wind energy capacity i.e. Germany, Spain and Denmark.

Furthermore we will cover important aspects in The Netherlands, Italy, UK and Greece, as well as in the US, India and Australia. Due to specific issues in these countries, significant success factors for wind power development can be identified.

2.2 Australia

Australie

Australia has not ratified the Kyoto Protocol, but has committed itself to meeting its original obligation to reduce total greenhouse gases by eight percent by 2010. Due to strong economic growth, greenhouse gas emissions have continuously increased over the last years. By 2010, the contribution of renewable energies to the Australian electricity production is to be increased by two percent from the 1997 level of 10.5 percent (mainly hydro, wind only 0.2 percent). But only one state – New South Wales – has published definite plans for the expansion of wind energy.

Australia is one of the first countries in the world to create a national renewable energy market using tradeable certificates, Renewable Energy Certificates or RECs. This is based on the Mandatory Renewable Energy Target (MRET) which requires the generation of an additional 9500 GWh of electricity per annum from renewables by 2010. Certificates are registered (Office of the Renewable Energy Regulator) and traded online (Green Electricity Market). Each electricity supplier has to fulfil a federal imposed quota of RECs based on annual electricity sales. In 2004, electricity suppliers will have to underlay 1.25 percent of their electricity production with RECs (2002=0.24 percent). A non tax-deductible penalty of A$40 per MWh must be paid if the target is not reached. The amount of the penalty has acted as a price limit for certificates as previous years have shown. At present it is discussed to increase the wind power targets to support further growth potential.

Insufficient net capacities in coastal regions and non-uniform procedures for public permits in the various regions hinder any significant and rapid growth of wind energy. In the deregulated Australian electricity market both public and private electricity producers invest in wind energy. The risks due to the various contracts, which have to be signed with the electricity supplier and the net operator, are significant hurdles for other private investors. According to a HSH Nordbank wind energy study, compensation uncertainties for wind energy also tend to prevent private project funding.15

2.3 Denmark

Danemark

As a consequence of the Kyoto Protocol and the subsequent EU Burden-Sharing Agreement, Denmark has accepted the obligation to reduce average annual emissions of total greenhouse gases by 21 percent in 2008–2012 compared to 1990. Regarding carbon dioxide, Denmark has set the national target for a reduction of 20 percent by 2005 compared to 1988. The contribution of renewable energies to the total Danish electricity production is to be increased from around 19 percent in 2003 to 29 percent in 2010.

Denmark initiated its federal support of wind energy in 1992 with a feed-in law providing guaranteed prices. Being one of the first countries to facilitate the mass introduction of wind power, this has led to the emergence of the world´s leading turbine manufacturers. Under the original pricing system, electricity produced by wind was compensated by up to around 0.08 Euro/KWh (85 percent of the grid operator´s own average electricity generation and distribution cost plus a federal bonus). In 1999, the government changed the law and decided to replace the feed-in system with a quota system based on green certificates for renewable energies. This political change led to a substantial reduction in new installations. However, the new quota system faced massive opposition and has been delayed until 2005. Because of this development, various compensation schemes are currently in effect for onshore and repowering installations. In general, compensation is lower than in 1999 except for repowering projects. More than 1300 old and smaller wind power stations with an accumulated nominal capacity of 110 MW were repowered in 2002. In addition to the compensation rules Denmark has provided certain tax incentives (changed over the years) to owners of wind parks. Just recently (March 2004), the Danish government and the coalation parties have agreed to support the additional expansion of larger onshore and offshore wind parks.

The Danish grid system basically consists of two main parts (west and east) and is heavily de-centralised. It is becoming saturated with intermittent generation which will limit the additional construction of new capacity without major infrastructure investment.[16]

The great acceptance of wind energy within the Danish population has led to a broad shareholder structure. Some 150,000 Danish families are shareholders of wind power stations. Even for households with a minimal income, wind energy is an attractive investment due to tax incentives that exempt earnings from the first 5000 KWh sales. Future larger onshore repowering and, in particular, offshore projects are expected to be primarily financed by the large Danish utilities and institutional investors. For example, Elsam AS, the largest Danish utility, operates the largest offshore wind park world wide, Horns Rev, with a capacity of 160 MW. [17]

2.4 Germany

Allemagne

As part of the European Union greenhouse gas reduction objectives, Germany has accepted the obligation to reduce total greenhouse gas emissions by 21 percent by 2008–2012. At the end of 2003 a reduction of about 19 percent was already achieved. Regarding carbon dioxide, Germany has set the national target for a reduction of 25 percent by 2005 compared to 1990. The contribution of renewable energies to total German electricity production is to be increased from around eight percent in 2003 to 12.5 percent in 2010 and 20 percent in 2020.

Since 1 April 2000, the so-called *Renewable Energy Sources Act* (*Erneuerbare Energien Gesetz, 'EEG'*) has been in effect and replaced the previous electricity feed-in pricing law of 1991. This law provides the legal framework for the feed-in and compensation of electricity generated from renewables such as wind, hydro, solar/photovoltaic, biomass and geothermal sources. Grid operators are obligated to connect wind electricity generation installations to their grids and to compensate the suppliers of this electricity in accordance with the pricing provisions of the law. The minimum price for electricity generated by wind energy was set at 0.091 Euro/KWh for a period of five years from the date of commissioning. Thereafter the compensation depends on the output of the wind mill in relation to a defined reference output. Wind energy installations that, during the first five years, meet 150 percent of the reference yield are entitled to a price of 0.0619 Euro/KWh. The ultimate price basically depends on the difference between the actual output and the reference output and may stay at the level of 0.091 Euro/KWh for a maximum of 20 years if actual output is significantly below the reference model. Accordingly, investments in wind mills may not only be attractive in wind-rich locations near the sea with a high output, but also in more central locations with weaker wind conditions as they are entitled to a higher feed-in price. For offshore installations the initial price of 0.091 Euro/KWh is to be paid for nine years if the installations are commissioned no later than 31 December 2006.The minimum price was fixed until 31 December 2001 and since then has been and will be reduced by 1.5 percent per year until 31 December 2020 for newly installed wind mills to an eventual 0.072 Euro/KWh. This decrease is meant to reflect cost economies of scale and efficiency improvements to be realised over the years by turbine manufacturers and wind park developers.

For German grid operators, an important aspect in accepting their obligation to connect the wind mills to their grid has been the new nationwide equalisation scheme for the additional costs incurred by grid operators since April 2000. According to § 11 of the German EEG, grid operators have to document quantities and prices paid for renewable energy taken over and to share equally the related extra costs according to the relation of renewables quantities to total quantities supplied to end consumers. The higher costs are then charged to end consumers via the utility companies delivering the electricity to the consumers.

Since the introduction of the EEG in 2000 the total wind energy capacity in Germany has grown substantially from over 4000 MW at the end of 1999 to around 12,000 MW in 2002 and about 14,600 MW in 2003. 2002 wind energy accounted for 2.9 percent of the German electricity generation, compared to hydro 4.5 percent, coal 50.6 percent, nuclear 28.4 percent, gas 9.3 percent and other sources 4.3 percent. [18] Taking into consideration that nuclear energy is to be phased out in Germany over the next 20 years (based on the agreed maximum operation time of 32 years), wind energy could step in to a certain extent if the legal and financial framework is kept at a consistently high level. This is clearly the political objective of Germany´s Green Party which is in coalition with the Social Democrats and it remains to be seen if they can realise their concept against growing scepticism in Germany regarding the environmental impact of large numbers of onshore wind parks (visual impact etc.) and the total cost of wind energy (articulated for example in a long article in the German magazine *Der Spiegel* in March 2004).[19]

At present, the EEG is being revised and it is expected that the amended version will become effective 1 July 2004. The new rules are to avoid potential excess support for onshore wind installations and to exclude any support for locations with insufficient wind conditions (below 65 percent of the reference yield). The base compensation rate for 2004 is to be reduced by 0.5 cent/KWh compared to 2003, the initial rate by 0.1 cent/KWh. Installations going into operation in 2004 will receive an initial minimum compensation of 8.7 cent/KWh and a final compensation of 5.5 cent/KWh. Increased focus is on offshore wind parks. Offshore installations are to receive an initial price of 9.1 cent/KWh for the first 12 years (with a possible extension depending on the distance to the coast and water depth). This applies if they go into operation by 2010 (compared to 2006 previously). Reduced initial offshore rates will only commence in 2008.

As described above, under the rules of the German EEG, grid operators are obligated to connect wind mills to their grid. The costs of connecting a wind mill to the technically and economically most suitable grid connecting point are to be borne by the wind park developer. Costs associated with upgrading the grid for feed-in purposes are to be borne by the grid operator. The construction of wind mills is, inter alia, subject to permits under the so-called Federal Immission-Protection Law and the German Construction Law ('Baugesetzbuch'). In general, this has not hindered timely construction of planned wind farms as the approval process normally has worked efficiently. Yet, as described above, increased resistance against additional onshore locations has been experienced recently.

Wind farms in Germany are predominantly operated by project developers in the form of individual partnerships for each wind farm. They are organised in the legal form of a German limited partnership ('Kommanditgesellschaft' or 'KG') with one partner – the general partner – with unlimited liability ('Komplementär'), typically a limited liability company (a 'GmbH') and a number of private capital contributors as limited partners ('Kommanditisten'). The 'Kommanditisten' can subscribe for partnership interests of as low as 5000 Euro to up to several million Euro. This flexibility has supported the enormous growth in the number of wind park partnerships over the last few years, the second and definitely most important reason lying in the tax attractiveness of these constructions. Typically, the partnerships incur tax losses in the initial phase that are allocated to the partners and are tax deductible for the partners´ personal income tax. A 'Kommanditist', who for example subscribes for a partnership interest of 100,000 Euro and who may be allocated a loss of 30,000 Euro in the first year would therefore be entitled to a tax refund of 14,250 Euro (assuming a 47.5 percent income tax rate in 2004, including the 5.5 percent solidarity surcharge) for that year. This means that 14.2 percent of the partnership interest would be financed by the tax refund. In previous years, the tax advantage was generally a lot higher as wind park developers operated on the basis that initial losses could be as high as 90,000 Euro, which in our example would lead to a tax refund of 45,000 Euro in the first year (assuming a 50 percent income tax rate including solidarity surcharge before 2004). Such advantages have been reduced by tax regulations and tax jurisdiction.

The equity share of the wind park 'KG' is usually between 30–50 percent of total capital, the remainder being financed through banks, often under preferable financing conditions. Preferable conditions have been available through the federal environmental and energy saving European Recovery Programme, so-called 'ERP-loans' which have to be approved by the German 'Deutsche Ausgleichsbank'. The same process is to be followed for the so-called 'Dta-loans' which, based on a federal environmental programme to support energy savings and the use of renewables, are also administered by the Deutsche Ausgleichsbank.

2.5 Greece

Grèce

Under the EU Burden-Sharing Agreement, Greece may increase total annual greenhouse gas emissions by 25 percent by 2010. At the end of 2001, emissions increased by 23.5 percent.

The share of renewable energies in the total Greek electricity production is to be increased from around six percent in 2002 to 20 percent in 2010.

The Greek government is promoting wind energy with very attractive incentives. For investors investment grants of up to 40 percent of costs are available. In addition feed-in prices based on consumer prices are paid. Wind parks connected to the national grid receive 90 percent of consumer prices, i.e. presently around 0.06 Euro/KWh. So called autoproducers not connected to the national grid receive 70 percent of the relevant consumer price. In addition, there are various tax incentives depending on the project location.

Today, Greece is behind schedule in increasing its share of renewable energies. The target of 12 percent for 2003 was not achieved. Main barriers for success have been the insufficient grid capacity as well as bureaucratic inefficiencies (more than 35 national, regional, district and local institutions have to agree to a permit).[20] Two leading Greek project firms have built up nearly 50 percent of the installed wind energy capacity. Since the liberalisation of the electricity market in 2001 external project developers have discovered the Greek market. The largest projects completed in 2003 are co-owned by major Greek companies.

2.6 India
Inde

India has stated the objective to achieve a 10 percent share of electricity generation capacity from renewable sources by 2012. Today, India is the biggest market for wind energy in Asia and ranks number five in the world for wind energy capacity installed with around 2100 MW at the end of 2003. India aims to increase its wind capacity to 10,000 MW by 2012.

In 1991, the Indian government opened the electricity grid to private producers, allowing them to build and operate power plants. Facilitated access to the grid, combined with financial support instruments such as investment tax credits, accelerated depreciation and financing assistance, led to a wind energy boom in India for a certain period. Additions to its wind capacity during the years 2000–2002 (see Table 4 above) were significantly below those of the leading wind capacity countries but ongoing market deregulation under the *Electricity Act 2003* in addition to energy supply shortages and supportive national and selected regional policies (by way of feed-in tariffs and tax incentives) may contribute to continuous growth. Support instruments at federal and regional level include investment tax credits, accelerated depreciation (up to 100 percent in some states) soft loans and customs and excise duty relief. Some states have also implemented feed-in tariffs with different guaranty periods.

Public procedures and permits differ from state to state in India, with many states not following official guidelines for grid interfacing, tariffs etc. published by the Ministry of Non-Conventional Energy Sources (MNES). An important factor for increasing wind energy capacities has been the improvement in grid connections, which had previously slowed down the development of wind power in India. Over 80,000 villages in India are currently without electricity.

At the beginning of the wind energy boom in India, investment-based subsidies and lack of turbine standards or production requirements led wealthy investors to use wind farms as tax shields. A later decline in investment credits led to reduced growth rates for wind energy investments, with more and more commercial and institutional investors financing wind energy projects. It remains to be seen whether major banks will continue to invest to a large extent in the wind industry in this market.

2.7 Italy
Italie

Italy is obligated to reduce greenhouse gas emissions compared to 1990 by 6.5 percent by 2008–2012. As yet, no reduction has been achieved. No ambitious national targets have been announced. Total wind power capacity is to be increased to 2500 MW by 2010 and the total share of renewables in the electricity generation is to increase to 25 percent by 2010 (mainly hydropower), according to the EU Directive 2001/77/EC.

Italy's old feed-in tariff (CIP-6), which stimulated early wind projects, was replaced in 2002 by an obligation on suppliers to purchase two percent of their electricity from renewable energy sources or to buy green certificates for an equivalent amount. Additional installations under the new mechanism have been slow. The establishment of long-term power purchasing agreements to facilitate project financing has been hindered as the old CIP-6 capacity alone already exceeded the number of certificates required for the trading market, and as the green certificate value is set annually. The compensation for wind generated electricity is currently around 0.12–0.14 Euro/KWh (total of the price for the green certificates plus the market price for electricity). The new renewable energy decree, in force since February 2004, increases the target annually by 0.35 percent to 2006. Whether this will establish long-term revenue security for developers has yet to be determined.

Grid and planning issues have traditionally caused extensive project delays. The renewable energy decree aims to simplify and harmonise these processes. For example, the number of permits required from local and central authorities etc. for an onshore project has been reduced from 20–30 to one single document. Three companies have been responsible for the majority of the capacity developed under the previous CIP-6 tariff, namely IVPC as well as the major Italian electricity providers Edison and Enel (both via subsidiaries).[21]

2.8 Spain

Espagne

As part of the Kyoto emission reduction objectives of the EU Spain is entitled to increase greenhouse gas emissions by 15 percent by 2010 (compared to 1990). Actual emissions are already significantly higher and therefore the expansion of renewables has a certain priority. By 2010 the renewables contribution to electricity generation is to be increased to 29 percent according to the EU Directive 2001/77/EC. The target for total installed wind capacity is 13,000 MW by 2011.

Under the Spanish feed-in pricing law the fixed compensation is only applicable to wind farms with a total capacity of up to 50 MW. Basically the Spanish regulations foresee two pricing options, either a fixed price per kilowatthour or a price which has two elements, a bonus which is independent of the energy source and a variable element which is based on the average electricity tariff. In 2002 and 2003 the fixed price was 0.063 Euro/KWh and 0.064 Euro/KWh respectively and the bonus on the variable element, the so-called poolprice, 0.029 Euro/KWh and 0.026 Euro/KWh in 2002 and 2003. Currently these stand at 0.061–0.068 Euro/KWh and 0.025–0.033 respectively. The tariff is fixed for five years.

The national grid operator Red Eléctrica de España and the utilities must allow connection to the grid. Developers are liable for the costs of connection and technical compliance. As new capacity is added the issues and costs of system security and grid capacity, especially in the low-populated areas, are gaining in significance. This, as well as the sometimes time-consuming and bureaucratic approval and permit process for new projects, has been a barrier to faster expansion of installed wind capacity. [22] Spanish wind farms are being developed by Spanish and also increasingly by German investors following the German partnership model. At a national level finance support is available similar to the ‘Dta-loans’ administered by the German Deutsche Ausgleichsbank (see chapter on Germany above). In addition financing support is available at a regional level.

2.9 The Netherlands

Pays-bas

The Netherlands are included into the EU Burden-Sharing Agreement and obligated to reduce greenhouse gas emissions by six percent by 2010. The contribution of renewable energies to total Dutch electricity production is to be increased to nine percent by 2010. Wind energy will play an important role in achieving this target. According to the Dutch national plan total installed wind energy capacity is to reach 3000 MW by 2010 (1500 MW for both onshore and offshore).

Between 1989 and 2002, the Dutch support mechanisms were significantly changed quite often. In 2001, the first European trading system for green certificates was introduced. Due to the frequent changes investments in new wind energy projects were moderate in 2000 and 2001 (see Table 4 above). The support structure has undergone major change since 2002, from being largely driven by a range of fiscal incentives that stimulated high demand for green power (resulting in the need to import green power) to the current subsidy-based system

(MEP). The MEP subsidy is paid over the grey power price at 0.049 Euro/KWh for onshore wind and 0.068 Euro/KWh for offshore wind. The subsidy is limited to the earlier of 10 years operation or 18,000 full load hours. Critics argue that basing the tariff on full load hours encourages fraud and sub-optimal turbine selection. During the transitional phase to the MEP, some fiscal incentives have been made available including investment subsidies and support for the research and development of wind technology.

The grid infrastructure and planning regime have not hindered project developments to date. However, emerging offshore developments are presenting new challenges, as they require both grid reinforcement and a new licensing regime. Most projects in The Netherlands to date are small in size, and are consequently suited to local participation/ownership. The large offshore developments are owned by the large Dutch utilities, which have the option to balance sheet finance.

2.10 UK
ROYAUME-UNI

The UK has accepted the obligation to reduce total greenhouse gases by 12.5 percent by 2010. By the end of 2001 a reduction of 12 percent had already been achieved. Substantial efforts have also been made to reduce carbon dioxide. The UK has set the national target for a reduction of 20 percent by 2010 compared to 1990. In 2002 the share of renewable energy in the total electricity production was around three percent. A target has been set to increase this to 15 percent by 2015. The UK government is aspiring to reach 20 percent from renewable energy by 2020.

The new federal support scheme for renewable energy in the UK, based on Renewable Obligation Certificates (ROCs), came into effect on 1 April 2002, replacing the former Non Fossil Fuel Obligation (NFFO). By switching to a quota scheme based on Renewable Obligation Certificates (ROCs) electricity suppliers were obligated to supply three percent of their electricity sales from renewables in the year to March 2003. If the suppliers missed this target they had to pay a buy out premium of 0.03 GBP/KWh. This is then paid to the companies that have submitted ROC’s to honour their obligation. The target for each year is increased and the buy out premium increased with the Retail Price Index. The increase to 15 percent by 2015 has provided comfort to UK suppliers for a longer term.

Electricity producers receive income from the following sources: from selling ROCs, from the recycled ROC payments, from the so-called Levy Excemption Certificates (a Climate Change Levy of 0.0043 GBP/KWh has to be paid on electricity not produced by renewables; this is passed on in part to the producer of electricity from renewables) and from the market price for electricity. For electricity produced using renewable energies a total of 0.084 to 0.091 Euro/KWh is attainable on short term-contracts. This figure is likely to be less when long-term contracts are signed, which may impact the ability to raise project finance.

In the past grid access has not been a major problem for developers in the UK. Recently, however, several large clusters of wind farms or large onshore and offshore wind farms have highlighted the need for additional investment in infrastructure. There is a potential that this issue may delay receipt of the grid connection agreement for certain proposed projects. Obtaining planning permission for UK projects has been problematic in the past due to public resistance and the power of local planning authorities. Pressure from central government has reduced this resistance and there are now more projects awaiting construction (post planning) than are currently operating in the UK.

Several British electricity companies including National Wind Power, Scottish Power and PowerGen have a substantial share of the British market. To date, these companies have balance sheet financed their wind farms although in early 2004 Innogy re-financed its wind farms using external equity and debt. Other developers have used project finance in the UK. Despite the disappointing development over the last four years (see Table 4) high investments are expected for the coming years, due to the current government support and excellent climate conditions.

2.11 US
États-unis

The US has not signed the Kyoto Protocol and is accordingly not obligated to reduce greenhouse gas emissions. Carbon dioxide emissions in the US increased by around 20 percent through 2002 compared to 1990. Under the Kyoto Protocol a reduction of seven percent by 2010 would have been required. At present no ambitious federal renewables targets have been announced in the US.

The Production Tax Credit ('PTC') of 0.18 US$/KWh has been at the core of the US renewable capacity growth in the years. The wind industry is a good example, as over a quarter of the country's current capacity was added in 2003, being the last year with the PTC in effect. Covering wind power and closed loop biomass PTC is guaranteed for the first 10 years of the project life and is actually attached to the project which makes project finance potentially easier. Although long expected, no prolongation of the PTC has been decided yet, but is still expected for 2004. In addition, there are various programmes initiated by individual states that are vital support mechanisms for the wind power development. Grid capacity and permit regulations depend on the individual states but have not usually been cited as being a pro or con for the wind energy development.

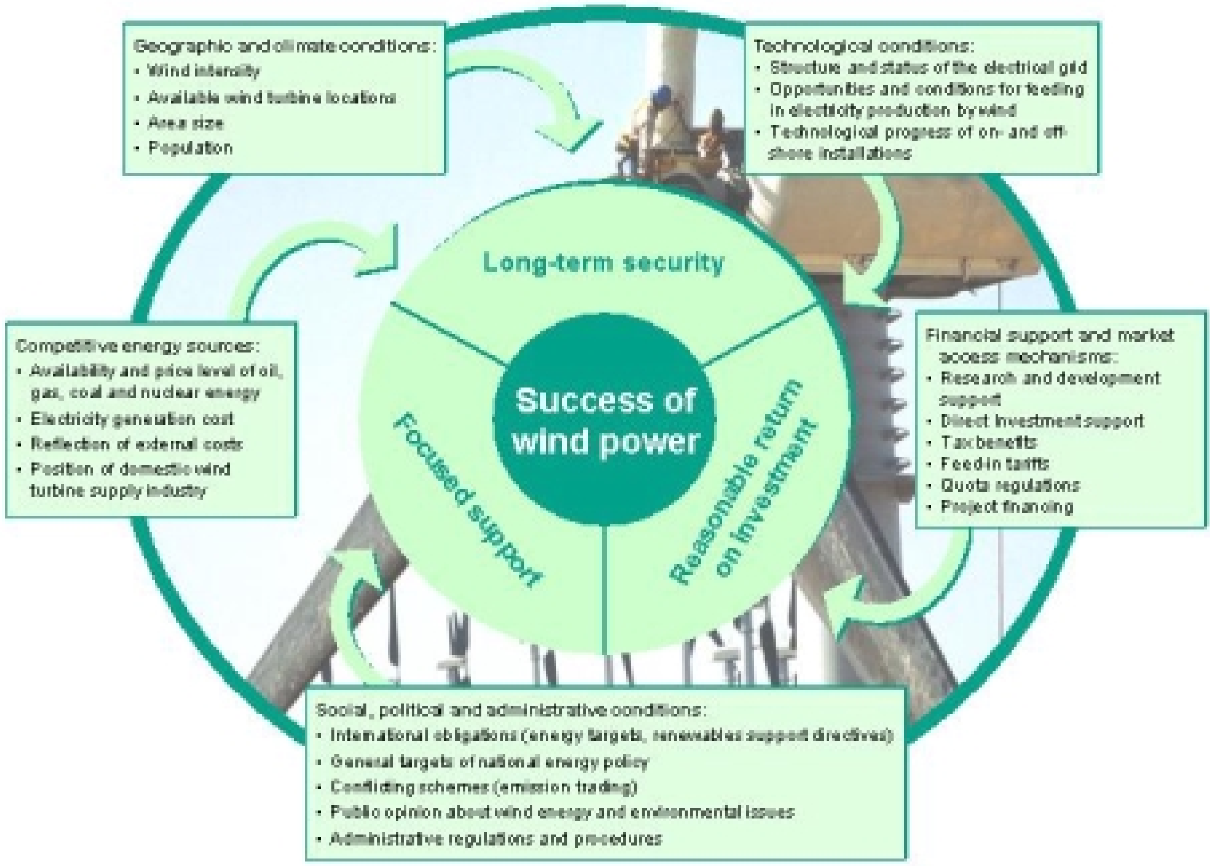
Wind farms in the US have been developed by both domestic and foreign investors, as well as by the major electricity suppliers. The main wind farm asset owners are major corporates that due to their tax position can take advantage of the PTC. An interesting means of financing support has been the introduction of renewable energy funds at a state level. This involves collecting around four billion US$ between 1998 and 2012 in 15 states as so-called 'Systems Benefit Charges' (SBC) on conventional electricity billings and pooling the money in SBC funds to support renewable energy projects. [23]

3. The success framework and key success factors
Cadre adéquat et principaux facteurs de réussite du développement

3.1 The success framework
L'encadrement adéquat

In our selected country overview we have shown that the development of installed wind power capacity over the past years has been quite diverse. Large countries with excellent wind conditions, for example, are not necessarily leading the field and even countries with basically very similar state or federal support mechanisms have still developed differently. In our overview we have already highlighted a number of critical success factors for the wind energy development. In the following chart (see Table 5) we have summarised the most important conditions and key success factors in main categories and tried to show the interrelationship between the factors and conditions. This is discussed in more detail below. A similar classification has been developed by Bechberger, Körner and Reiche. [24]

Table 5: The success framework for wind energy development.
Cadre favorable au développement de l'énergie éolienne.

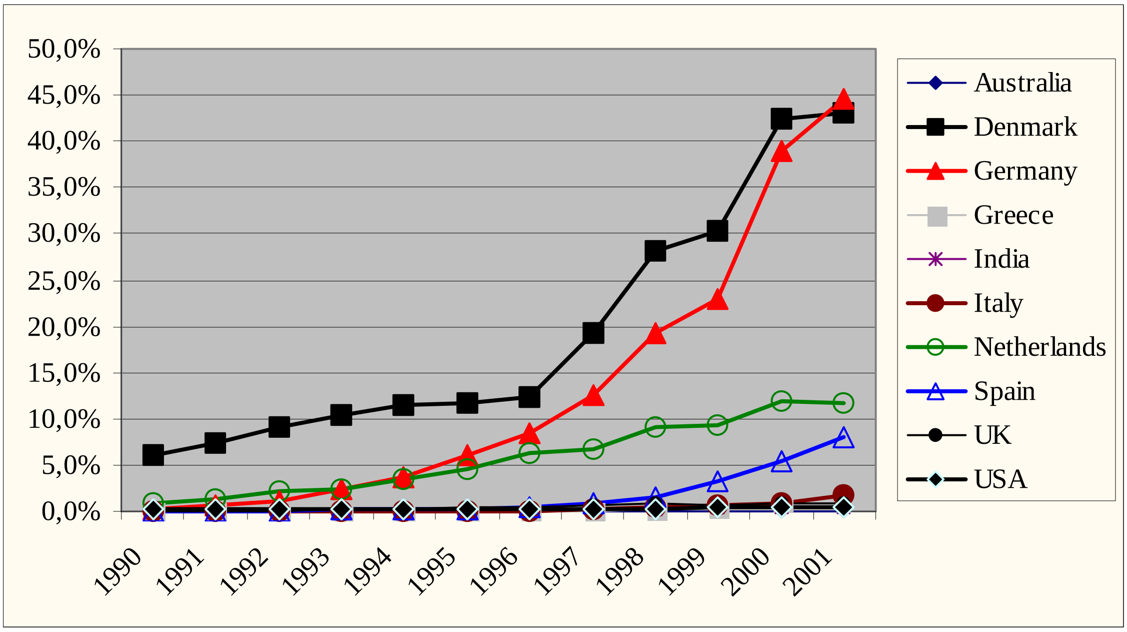


3.2 Geographic and climate conditions
Critères géographiques et climatiques

Important conditions for the development of wind power capacity are wind intensity, population density, area size, availability of locations for wind turbines and water depth near the coast. One of the most critical success factors for a wind turbine obviously lies in the weather, especially the wind conditions which make a tremendous difference to electricity output. This seems too obvious to even mention. However, looking at the actual distribution of wind parks, in particular in Europe, it is immediately clear that wind potential and intensity do not necessarily tally with the number/frequency of wind energy projects. Countries like the UK, Ireland, France and Greece are far behind Germany in installed wind parks although wind potential is by far higher. And in Germany, many wind parks are even built in areas with only moderate wind conditions because of the financial support guaranteed under current German law.

The technical wind potential of wind energy worldwide has been analysed in several studies. According to a study conducted by A.J.M. van Wijk and J.P. Coelingh based on a worldwide wind resource map[25] the technical potential for the US is 562 GW or 1124 TWh/year and for Germany 12 GW and 24 TWh/year. The actual electricity output from wind power in 2001 was 10.7 TWh for Germany and 5.8 TWh for the US. [26] This means, that Germany exploited about 45 percent and the US only 0.5 percent of their technical wind potential in 2001. Table 6 shows the development of the ratio of actual wind generated electricity to technical wind potential in the selected countries between 1990 and 2001.

Table 6: Ratio of actual wind energy generated to technical wind potential.
Part d'énergie éolienne réelle rapporté au potentiel technique éolien.



Ernst & Young calculations based on: A.J.M. van Wijk/ J.P. Coelingh [27] and S. Espey [28]

Comparing the wind energy potential with the actual output and market share of wind energy, the 'success' of wind energy in some countries has to be seen in the right perspective. Bearing in mind that calculations of wind energy potential are all rather uncertain, Denmark and Germany are the only two countries to have utilised a considerable share of their technical wind potential. Spain seems to be on the right track, The Netherlands appears to be in a phase of stagnation, but all other countries including US or India have only utilised a marginal share of their technical wind potential to date.

As far as availability of locations for new wind parks is concerned it is to be noted that onshore locations are already limited in various countries such as Denmark and Germany and future success in these countries will depend on major offshore developments as well as efficient onshore repowering (i.e. replacement of small wind mills by new larger models).

From the above we can conclude that geographic and climate conditions have not been the most important success factors in the past, yet they will gain in importance once political and support frameworks become more comparable from country to country and once installed capacity has reached a critical level regarding ongoing expansion in a given country.

3.3 Competitive energy sources
Sources d'énergie concurrentes

Availability of competitive energy sources, in terms of both price and quantity support has an impact on the economic and political feasibility of wind energy support. The UK and The Netherlands, for example, have had the benefit of substantial oil and gas reserves over the last years but do see the limits now. France, that so far has not shown up in the premier league of installed wind power capacity, on the other hand has relied for many years heavily on nuclear energy. As of 31 December 2002 France had 59 nuclear plants with a total capacity of around 63,000 MW surpassed only by the US with 104 plants and around 98,000 MW total capacity. Over the past few years nuclear energy has accounted for more than 75 percent of total electricity production in France. [29] Germany has large coal resources and cutting-edge coal power plants in terms of efficiency and CO_2 emissions. Also, financial support of fossil energy sources has influenced the price structure and competitiveness. Germany, for example, has substantially subsidised the coal industry for many years to secure the employment in this industry which has been of particular relevance to certain parts of the country.

In addition to these subsidies external costs caused by fossil and nuclear power plants but not reflected in their production cost calculations prejudice wind energy parks which do not create external costs to such an extent. External costs are social costs that are caused by electricity generation but which are not incurred within the power plants and therefore are not included in their internal production cost calculations. External cost definitions do vary quite considerably but in general include the consequences of environmental, climate and health damages, the public costs of extracting fossil energy resources and also the security costs of nuclear waste transport etc. These costs are borne by the total community and therefore do not show up in cost comparisons between fossil and renewable energy power companies. In this respect the non-recognition of external costs in economic cost comparisons between fossil and renewable energy may be considered a kind of subsidy granted by national economies to fossil and nuclear energy producers. In Germany, this issue has been partly dealt with by the so-called Eco Tax on fossil energy sources as well as by the feed-in price and equalisation scheme for wind energy.

3.4 Technological conditions
Critères technologiques

Wind parks are predominantly built at wind-friendly locations that are not necessarily easy to connect to the grid system. Yet it is not only the distance from but also the capacity and technical status of the grid that determines accessibility for wind generated electricity. In France, the national grid system, for example, was designed to meet the requirements of centrally produced electricity and there are several other countries, including Australia, Greece, Italy and Spain, which do not have appropriate feed-in installations. [30]

The technological development of wind turbines is also of great importance. Today onshore installations are much more efficient than they were years ago boasting greater capacity and lower production costs per MW capacity. The increase in new projects has led to economies of scale and the necessary framework for the further technological development of turbines has also been put in place. Today, turbine manufacturers in Denmark, Germany and Spain dominate the world market (with related positive impact on employment in these countries), and these are exactly the same countries that have been most successful in wind power generation. Regarding offshore turbines the development has not been as fast as expected and the cost effectiveness of deep water installations has yet to be proven.

3.5 Social, political and administrative conditions
Critères sociaux, politiques et administratifs

As the historical development in the reviewed wind power countries has shown, significant federal intervention in the energy markets is required to substantially increase the renewables share in the energy mix. A reliable and transparent political framework is considered to be of utmost importance for the successful expansion of wind energy. This includes ambitious political targets regarding the future role of renewable energy such as the targets of a 12.5 percent contribution to electricity production in Germany by 2010 or 15 percent in the UK by 2015. Only if investors can rely on political support will they be prepared to invest their capital in this industry. The same is true for financing. Banks and private equity contributors will not stay in this business if they have to be concerned that their invested capital will not generate sufficient returns or even that their capital will be at risk because of a deterioration in the political framework. In Germany this became very apparent in the last quarter of 2003 and in early 2004. The political wrangling over the revision of the German EEG between the German Ministers of Environmental Protection and of Economics caused significant uncertainty within the industry as to future support, especially, for onshore wind farms. This, together with the disappointing wind conditions for many wind farms over the last two to three years certainly caused a certain reservation of German banks and private investors for additional onshore projects. As shown in Table 4 total capacity increase in Germany in 2003 was 2645 MW, on a par with 2001, but below 2002 (3247 MW).

France, although not reviewed in detail in our paper, is a country with substantial wind potential and is also considered by the wind industry to become a major market in the foreseeable future. [31] However, the country has been slow to liberalise the electricity sector concentrating for many years on nuclear energy instead. Only since 2001 have wind energy-related laws and regulations been improved, which has upped expectations for future development.

The political and administrative framework is also influenced by approval proceedings, issuance of construction permits etc. for new wind farms. The more burdensome and time-consuming the process becomes, the more investors will look for other opportunities in other areas or countries. Based on available publications, this seems to have been the reason for the disappointing growth recorded over the past years in Greece, Italy and certain parts of the UK. On the other hand it appears that one of the reasons why Shell has built its first wind farms in the US 'is because on the whole, the regulatory process is much faster there than in Europe'. [32]

In summary, the role of governments and policy-makers is one of the critical factors for the future wind power success. If governments set clear objectives for renewables development and commit their countries to these objectives there will be a reliable framework for power companies and wind park investors. Consumers will also be a lot more accepting if political support is credible and transparently conveyed to the public.

3.6 Financial support and market access mechanisms/
Aide financière et mécanismes d'accès au marché

3.6.1 Research and development and direct investment support
Aides à la recherche, au développement et à l'investissement
Despite their CO_2 reduction effect, onshore wind farms are often criticised for not really being environmentally friendly due to their impact on animals' living conditions, as well as the visual impact on certain beautiful landscapes, for not being reliable electricity producers because of the unpredictability of wind conditions and the consequent need to keep or build expensive alternative power stations and for not really supplying sufficient energy in relation to investments needed. Large offshore wind farms could be the long-term solution if the technical, logistical and financial challenges are met. Again, considering the substantial research and development cost, it appears that state and federal subsidies are necessary to proceed. Only once a representative number of offshore installations have been successfully built, will production costs go down and enable additional developers to invest in more offshore wind farms.

Significant research and development grants have been received by a Shell Wind Energy and Nuon Joint venture in The Netherlands and by similar offshore projects in Denmark and Scotland. [33] And looking at actual offshore projects that have already been started or completed it is clear that research and development subsidies have been one of the key factors.

3.6.2 Tax benefits
Réductions d'impôts
Tax benefits including investment tax credits reduce the investment cost of wind developers. As shown in the selected country overview they have been used in India and the US, as well as in European countries. Experience gained in the early 1980s in California, as well as in India in the 1990s, shows that tax relief that is not linked to certain technological and output targets may fail as far as ongoing development is concerned because investors may just be interested in tax reductions. [34] This only goes to underline how important it is that tax benefits are clearly focused and specifically related to their objectives.

A significant impact has been achieved in the US by the production tax credit programme (PTC), particularly, in states with additional support mechanisms. As described above the PTC is currently not in effect but is expected to be renewed in 2004. In general, tax benefits can be granted via direct or indirect taxes either at the level of the wind energy developers/operators, the grid operators/utilities or the consumers. In Germany, financing through the 'KG'-model has been very much influenced by the tax deductible initial loss allocations to partnership interests (see part 2.3 above). Overall, tax regulations in most countries have had a supportive complementary effect but have in many cases not been the most critical of success factors on a 'stand alone' basis. [35]

3.6.3 Feed-in tariffs

Réglementation sur les prix d'achat

Under laws governing access to a country´s grid system at defined prices (short: feed-in tariffs) grid operators are obligated to allow for the connection of renewable energy power plants, in this case wind parks, to the grid system. Generally the electricity distributor has to purchase the wind generated electricity at prices which are set at a higher level than the regular market price. Specific tariffs may depend on wind power output, location and start of operations and last but not least on government decisions as to the scope and length of support. Therefore, fixed prices may but need not be directly related to the generation costs of the wind park. Such models are found in the most successful European countries such as Germany (since 1991), Denmark (1992–1999) and Spain (since 1994) but also in others such as France (since 2001), Austria (since 1998, revised 2003), Portugal (since 1988) and Greece (since 1994).

Looking at the legal framework in successful countries it appears most important that connection to the grid is ensured through related obligations of the grid operators, that guaranteed prices are above market and cover the wind parks´ costs and that the guaranteed prices are paid over a sufficiently long period as the 20 years in Germany. Also important is the German and Spanish regulation that the price differential for renewables to be paid by the grid operators/utilities is covered by an equalisation scheme under which all consumers have to pay an extra KWh charge according to their electricity consumption. [36] It is important to note that guaranteed prices alone do not ensure automatic success as can easily be seen from several of the above mentioned countries with pricing laws. Apart from the effects of various other factors discussed in this paper it is the combination of the aforementioned factors which makes the difference.

3.6.4 Quota regulations

Reglementations en matiere de quotas

Feed-in tariffs, as described above, regulate access to the grid at guaranteed prices which means that from a developer´s point of view both the sale of wind electricity as well as the related prices are fixed. Under quota systems, governments typically set a quantity target (in absolute quantity or as a percentage share of total electricity generation/consumption) and leave the price-fixing to the market. The quota obligation can either be defined according to actual physical quantities or to tradeable certificates. Utility companies/grid operators who do not meet their obligations would be subject to specific fines or buy out premiums. Adherence to the quota obligations obviously requires strict control and government involvement and makes the system more difficult to administer than feed-in tariffs.

In the US, the Renewables Portfolio Standard ('RPS') has been used in several states. Under the RPS a target for renewables is set and electricity producers and investors can determine how to meet this target. Producers of electricity from renewable energy sources receive credits in the form of certificates for their production. Utility companies that accumulate too many certificates can sell them, while those that have not used enough renewable energy can buy certificates. Denmark has decided in 1999 to change to a quota system (with negative consequences as described above) and the UK, Italy and Australia have also followed that route to renewable or green certificates. [37]

A special feature of quota systems is the tendering system under which the government or the regulator sets a target quantity and a maximum price per KWh. The wind energy generators/developers are then requested to submit bids for specific contracts with defined quantities and prices. The bidders with the lowest prices would be accepted and would then be entitled to sell accepted quantities at the specified price to the regulator. The government/regulator would subsequently sell the electricity at lower market prices and the difference would be covered through a special tax or by an equalisation scheme to be allocated to all electricity consumers. Tendering models were used in the UK (until 2002), in Ireland and in France (1996–2001).

Quota systems appear to have the advantage that government targets can be directly built into the system and political objectives thereby more easily achieved. However, compared to feed-in tariffs the quota systems pose a great disadvantage for wind park developers, particularly, the smaller ones, namely price risk. Under tendering systems this is excluded for specified contracts but usually only after a competitive bidding process at comparatively lower prices. Because of the inherent price risk of quota systems and the trend toward lower prices it can be reasonably assumed that developers would not be equally as interested to invest in additional wind parks as under guaranteed compensation schemes. Past experience in the countries reviewed supports this conclusion. At the end of 2003 (see Table 2 above) Germany, Denmark and Spain together accounted for 60.9 percent of total installed wind capacity worldwide and for 83 percent of total installed capacity in Europe. [38]

3.6.5 Project financing

Financement de projets

Because of the high initial investment cost of wind energy projects financing is obviously one of the key critical success factors for wind energy growth. Yet a solid and financially attractive expansion of wind farms would create sufficient interest among capital providers to fund additional projects. Denmark and Germany have been very successful in attracting private investors making even small capital contributions. The German limited partnerships model (‘KG’ model) appears to strike a perfect balance between financing by banks and private investors. Private investors-contributions to wind park KGs benefit from the flexibility of capital contributions (a range of capital interest from around 5000 to several million Euro or even exclusive financing of wind parks by one individual investor) and the tax benefits resulting from tax allocations in the initial project phase. Bank loans are facilitated via public support funds such as the European Recovery Programme or the German Ausgleichsbank programmes for environmental protection and energy savings. These funds also allow for the focused support of specific investments, for example, primary support could be given to offshore development or to increased onshore repowering.

However, the success of the German KG model in terms of past onshore projects is limited for offshore developments. Investment costs are substantially higher and not comparable with the historical partnership models. Business risk from offshore projects is also a lot higher. Accordingly, new financing models will have to be developed, and it remains to be seen to what extent global energy players will be willing to invest in the future development of these projects as they are doing in the UK for example. Needless to say that the global players will only do so or continue to do so if they see clear potential for profitability and long-term political reliability.

3.7 Impact of emission trading

Influence du marché des droits d’émission de CO_2

The member states of the EU have decided to start with the first three-year period of emission trading on 1 January 2005. The second term is to run from 2008–2012. Certain industries including power generation fall under the provisions of the new regulations. National allocation plans for the allocation of emission rights (certificates) to the enterprises/plants concerned were due to be submitted to the EU by the end of March 2004 and the final allocation and distribution to the companies is to be made in the second half of 2004. Basically the objective of the emission trading scheme is the same as that of most of the EU member states´ regulations for the support of wind energy, for example, the *German Renewable Energy Sources Act* (EEG), namely to reduce CO_2 emissions within agreed limits. It remains to be seen whether the historical feed-in or quota regulations will be maintained or eventually be given up as the overall emission trading scheme may prove to fulfill the CO_2 reduction targets at lower cost from a national economy viepoint.

The Scientific Advisory Board of the German Ministry for Economics and Labour, for example, has come to the conclusion that the impact of the German EEG on CO_2 reduction will be zero once the European emission trading scheme has been implemented and is functioning properly. It would have no more ecological benefits but rather be a costly instrument for the German economy as a whole. [39] If that opinion were accepted by the German government and parliament and eventually lead to the abolishment of the EEG, it would most likely have a substantial impact on the future development of renewable energy in Germany. However, the same considerations would also apply to the other European Union member countries and any consequences would depend on action taken at a European level.

4. Conclusion – the common key drivers of success

Facteurs principaux de réussite des projets

In various parts of the world, particularly in Europe, we have seen considerable growth in wind energy in recent years. It is interesting to note that the related turbine manufacturers and project developers industry is still very optimistic as to future growth potential. According to a recent survey of representatives of this industry conducted by DEWI [40] on behalf of the Hamburg Messe, an increase in worldwide installed capacity of 110,000 MW from around 40,000 MW today to 150,000 MW by 2012 is predicted. This would be almost four times today´s capacity and appears very ambitious. EWEA has come up with a similar estimate called 'Conventional Scenario' (in comparison to another much higher 'Advanced Scenario') of 80,000 MW by 2007 and 160,000 MW by 2012. [41] Both the DEWI and the EWEA estimates are considerably higher than an estimate of HSH Nordbank, which forecasts approximately 72,000 MW by 2007 and 122,000 MW by 2012. [42] Still, even considering that the results of the previous DEWI 2002 survey were too optimistic in various respects we do believe that the optimism of the industry representatives is an important indicator of the present and expected future framework.

Now, what are really the key drivers of successful growth based on our review? Is the success of wind power a question of state and federal subsidies? The answer is yes and no. Yes, state and federal subsidies and government initiated support mechanisms do play a major role, but what really makes the difference are the complementary effects and the interrelationship of various factors as described in Chapter 3 above.

The most important factors of success are the level and continuity of financial support and market access mechanisms. Historical experience has shown that remarkable wind power developments depend on focused political intervention. In Germany, before 1991, (introduction of the first electricity feed-in law) wind power was minimal (68 MW). With the 1991 law additions, it increased steadily to over 4,000 MW in 1999, but the big push has been experienced over the last four years since the implementation of the new *Renewable Energy Sources Act* in 2000, with total additions of 10,184 MW for the years 2000–2003 to a total capacity installed of 14,609.43 This means that 70 percent of total 2003 year end capacity has been built up over the last four years. Similar successful developments have been realised in Spain and Denmark. Over the past years several countries have introduced, or are in the legal process of introducing, similar feed-in and compensation regulations as Germany (for example, France, Austria – with a high number of additional installed capacity of 275 MW in 2003 equalling 196 percent of its beginning 2003 balance – Portugal, Spain, Czech Republic). [44] The German Federal Minister for Environment, Jürgen Trittin, has stated several times that the German Renewable Energy Sources Act (EEG) has become an 'international export hit' [45] and the German Wind Energy Association has also stated that this law 'is seen by many as the new model for European and global energy policy'.46 Past development appears to clearly strengthen the argument that feed-in laws with guaranteed prices do outperform quota systems which only in theory seem to better support the realisation of political energy targets. On the other hand the UK – only accounting for 649 MW or 1.6 percent of worldwide installed capacity at year end 2003 – is expected by various parties to become one of the more important markets in the future, particularly regarding offshore projects. This is mainly due to clear and firm objectives of the UK government to expand wind energy and the expected long-term planning security combined with excellent climate conditions.

Research and development, as well as direct investment subsidies, have helped to initiate and increase wind power capacities in various countries, but not necessarily on an ongoing basis. They are, however, considered of great importance regarding the future growth of offshore installations – as the developments in Denmark, The Netherlands and the UK have shown. The technological development of offshore installations is lagging behind original estimates and investors will need ongoing assurance and trust that policy-makers will support the development and place high priority on it.

Financing of new projects is another important element in the success puzzle. Germany and Denmark in particular have experienced large numbers of private investors who made significant contributions, in addition to external financing from banks, partly at subsidised terms based on federal programmes for energy efficiency and support for renewables. Private investments, again particularly in Germany, were stipulated by tax law, allowing for income tax deductibility of (previously high) initial loss allocations from wind park partnerships. In this respect, we believe the German experience to be a very good example for the interrelationship of various success factors. Only in combination have these supported the impressive developments which have taken place in Germany, not forgetting the country is not even at the top of the league in terms of wind conditions.

In conclusion to the above comment regarding the relevance of political intervention it has to be emphasised that the long-term security and stability of legal frameworks including reliance on support mechanisms is of utmost importance for the success of wind power. Investors will only be prepared to invest significant amounts of money in wind power if they can reasonably assume sufficient rates of return over their planning horizon. Equally important is focused support. General tax incentives or subsidies that are not clearly related to the continuous development of wind power do not meet their objectives. Focused support also implies that various factors are dealt with in a coordinated manner, such as feed-in tariffs or quota regulations on the one hand and appropriate grid access and project permit processes on the other.

Whereas our conclusions are based on a review of past and present practices in various countries, it is also interesting to see that expectations for the future development of the wind power markets basically go hand in hand with our conclusions. The aforementioned HSH Nordbank and DEWI studies expect the following countries to be in the lead regarding additional installed wind power capacity over the coming years:

Table 7: Expected installed wind power capacity 2004–2007, in MW.
Capacité éolienne installée prévisionnelle en 2004–2007, en MW.

	Total expected additions 2004–2007		**Expected capacity year end 2007*** **	
	HSH*	**DEWI****	**HSH**	**DEWI**
Germany	8200	7068	22,809	21,677
Spain	4500	5511	10,702	11,713
US	3900	4854	10,274	11,228
Denmark	820	1168	3930	4278
India	(a)	1844	(a)	3954
UK	2475	1688	3124	2337
France	1650	1596	1889	1835

**Source: HSH Nordbank47*
***Source: DEWI48*
**** Expected additions 2004–2007 plus year end capacity 2003 per Table 2*
(a) No specific estimate available

Under both estimates, Germany keeps the leading market position. This is also confirmed by the number of new projects installed in the first quarter 2004 (350 MW) which is at the same level as in 2003. The president of the German Wind Energy Association expects additions of 2500 MW in Germany for 2004 [49] which is in line with the expected German additions 2004–2007 in Table 7. Regarding the US the estimates assume extension of the PTC in 2004. France and the UK are ranking higher compared to actual installed capacity to date due to increased expectations resulting from improved legal framework and support mechanisms. The Renewable Energy Country Attractiveness Index (here Wind Index) published by Ernst & Young in the UK in March 2004 [50] has basically the same countries in top positions as shown in Table 7.

As stated in the introduction to this paper, to establish a solid and cost-effective wind energy market, sizeable wind projects in other countries need to be developed. The future of the wind energy industry lies in creating additional markets beyond the traditional big three. We believe that this can be realised over the coming years if governments provide appropriate conditions and take into account the complex success framework for the development of wind power.

[1] Energy Information Administration ("EIA"), International Energy Outlook 2003, Washington, www.eia.doe.gov/oiaf/ieo/index.html, Pages 1-10 and Page 196
[2] EIA, International Energy Outlook 2003, Page 135
[3] Dieter Schwankhaus, Dr. Helmut Edelmann, in: Trading for a secure tomorrow, The Future of European Energy, published by First Magazine in association with the World Energy Council, 2003
[4] International Energy Agency ("IEA"), Renewables Information 2003, Page 3, http: //library.iea.org/dbtw-wpd/Textbase/nppdf/free/2003/renew2003.pdf
[5] IEA, Renewables Information 2003, Page 4
[6] IEA, Renewables Information 2003, Page 12
[7] IEA, Renewables Information 2003, Page 13
[8] Janet L. Sawin, National Policy Instruments, Thematic Background Paper, January 2004, International Conference for Renewable Energies, www.renewables2004.de; Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen von Instrumenten zur Förderung Erneuerbarer Energien im Strommarkt, Berlin, FFU-Report 01-2003
[9] EWEA The European Wind Energy Association, www.ewea.org/
[10] Bundesverband Windenergie e.V., www.wind-energie.de/images/europa/Europa Stand 2003
[11] Central Intelligence Agency ("CIA"), The World Factbook 2003, www.cia.gov/cia/publications/factbook/index.html
[12] C. Ender, International Use of Wind Energy, Status December 31, 2002, Deutsches Windenergie-Institut GmbH ("DEWI"), Magazin 23, August 2003, Page 21, www.dewi.de
[13] C. Ender, DEWI, Magazin 21, August 2002, Page 25
[14] C. Ender, DEWI, Magazin 19, August 2001, Page 46
[15] HSH Nordbank, Branchenstudie Windenergie, August 2003, Page 5
[16] Deutsche-Energie Agentur GmbH, Exporthandbuch Windenergie 2003/04, Band 1, 1. Auflage 2004, Pages 29-30
[17] Deutsche-Energie Agentur GmbH, Band 1, Page 36
[18] Bundesministerium für Wirtschaft und Arbeit, Energiedaten 2003, http://www.bmwi.de/Navigation/Service/bestellservice,did=13782.html, Page 29
[19] Der Spiegel, No. 14, March 29, 2004, Pages 80-97
[20] Deutsche-Energie Agentur GmbH, Band 1, Pages 80-89
[21] Deutsche-Energie Agentur GmbH, Band 1, Pages 130-131
[23] Virginia Sonntag-O'Brien, Mobilising Finance for Renewable Energies, Thematic Background Paper, International Conference for Renewable Energies, January 2004, Page 7, www.renewables2004.de
[24] Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Pages 27-32; see also Danyel Reiche (ed.), Handbook of Renewable Energies in the European Union, Frankfurt 2002, Pages 23-24
[25] A.J.M. van Wijk/J.P. Coelingh, Wind Power Potential in the OECD Countries, 1993
[26] IEA, Energy Balances of OECD Countries 2003 and IEA, Energy Statistics of OECD Countries 2003
[27] A.J.M. van Wijk/J.P. Coelingh, Wind Power Potential in the OECD Countries, 1993
[28] Simone Espey, Internationaler Vergleich energiepolitischer Instrumente zur Förderung von regenerativen Energien in ausgewählten Industrieländern, Bremen, 2001
[29] International Atomic Energy Agency, Nuclear Technology Review 2003 Update, www.iaea.com; Danyel Reiche (ed.), Handbook, Page 16
[30] Danyel Reiche (ed.), Handbook, Page 22; Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Page 26
[31] DEWI, Wind Energy Study 2004, March 2004; also Ernst & Young UK Wind Index, www.ey.com/renewables
[32] Karen de Segundo, A Renewable Energy Future? Challenges and Opportunities, October 2003, www.shell.com/speeches
[33] Karen de Segundo, as above
[34] See also Janet L. Sawin, National Policy Instruments, Page 18
[35] See also Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Page 5
[36] See e.g. Janet L. Sawin, National Policy Instruments, Pages 4 following; Simone Espey, Pages 49-51
[37] Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Pages 6 following; Janet L. Sawin, National Policy Instruments, Pages 6 following

[38] See also Janet L. Sawin, National Policy Instruments, Page 8; Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Pages 19 following

[39] Wissenschaftlicher Beirat beim Bundesministerium für Wirtschaft und Arbeit, Gutachten zur Förderung erneuerbarer Energien, Köln 2004, www.bmwa.bund.de/Navigation/Ministerium/beiraete

[40] DEWI, Wind Energy Study 2004

[41] www.ewea.org/

[42] HSH Nordbank, Branchenstudie Windenergie, August 2003

[43] Bundesverband Windenergie e.V., Zahlen zur Windenergie, www.wind-energie.de/informationen

[44] Themenpapier Windenergie, www.bmu.de/de/1024/js/download/b.themen.wind; See also Mischa Bechberger, Stefan Körner, Danyel Reiche, Erfolgsbedingungen, Pages 2-3

[45] see e.g. www.bmu.de/de/1024/ja/presse/2004

[46] German Wind Energy Association, Wind Energy 2004 Market Survey, ed. by BWE Service GmbH, Osnabrück, 2004, Page 9

[47] HSH Nordbank, Branchenstudie Windenergie, August 2003

[48] DEWI, Wind Energy Study 2004, March 2004, Pages 6 and 9

[49] Bundesverband Windenergie e.V., www.wind-energie.de/aktuelles; Handelsblatt, No. 77, April 21, 2004

[50] www.ey.com/renewables