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PROMOTION OF WIND ENERGY : LESSONS LEARNED FROM INTERNATIONAL EXPERIENCE AND UNDP-GEF PROJECTS

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ACRONYMS & **ABBREVIATIONS**

BNDES	Banco National de Desenvolvimento Econômico e Social – Brazilian National Economic and Social Development Bank
CDM	Clean Development Mechanism
CDM M&P	CDM Modalities & Procedures
CER	Certified Emission Reductions
CO2	Carbon Dioxide
COP	Conference of the Parties (of the United Nations Framework Convention on Climate Change – UNFCCC)
CWET	Center for Wind Energy Technology (India)
DPRK	Democratic People's Republic of Korea
GEF	Global Environment Facility
GWEC	Global Wind Energy Council
IPP	Independent Power Producer
IRR	Internal Rate of Return
JI	Joint Implementation
JV	Joint Venture
PDF	Project Development Facility
PIR	Project Implementation Review
PPA	Power Purchase Agreement
Prodoc	Project Document
PROINFA	Program de Incentivo às Fontes Alternativas de Energia Elétrica Brazilian Support Programme for Alternative Sources of Electricity
R&D	Research & Development
RE	Renewable Energy
ROE	Return on Equity
RPS	Renewable Portfolio Standards
SWERA	Solar and Wind Energy Resource Assessment Programme
TSO	Transmission System Operator
UNDP	United Nations Development Programme
WWEA	World Wind Energy Association

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EXECUTIVE **SUMMARY**

Although wind energy is a rapidly growing technology its use remains geographically concentrated, with more than 75 percent of global installed capacity found in just five countries. These countries, and others wishing to develop wind energy have implemented various supportive policies covering areas as diverse as tariffs, technical R&D, administrative procedures, or education and communication, and range from direct project subsidies to general awareness raising.

Experience shows that good wind resources are not on their own sufficient to ensure strong wind energy development and reductions of the cost of wind energy. Even fair pricing is not necessarily enough. Only countries that have set up an adequate enabling environment and long-term stable comprehensive public policies, with strong political commitment, have succeeded in developing wind power. Their policies have been focused, not only on reducing costs and improving revenues to increase profitability, but also on reducing risks.

Policies giving market access to wind energy are the most critical. Feed-In laws – the main instrument used in Europe to promote wind energy – have the advantage of giving developers long-term stability and predictability and have helped create three of the world's largest wind energy producers. In the European context, they have been more cost-effective than Quotas. However, apart from Canada, large industrial countries in the rest of the world (USA, Japan, and Australia) have chosen Quota-based instruments, combined with subsidies or tax credits. Some of these Quota-based systems have been effective in giving rise to new wind capacities but only when carefully designed, and in countries using them, it has not been proven that Quotas effectively provide the lower costs that theory credits them for. China and India have, like Canada, in theory chosen to mix Feed-In tariffs and Quotas, even if, in practice, the Chinese Feed-In pricing system will actually be based on tendering results. Tender-driven policies have major drawbacks and until now, there has been no successful experience of tendering as the sole instrument of a nationwide ambitious wind dissemination policy. The same conclusion can be reached for voluntary policies, such as green pricing.

Whatever policies are chosen, in most countries the development of wind energy will require specific financing, generally through public subsidies and/or an increase in electricity prices, however small. In almost all countries, policies such as Feed-In laws and Quotas are combined with tax credits, subsidies or soft loans.

The necessary public or private money is not always available, especially in developing countries. Available funding should be first allocated to creating an adequate general environment for wind projects, removing barriers, and activities of this kind. The Clean Development Mechanism (CDM) can potentially bring additional revenues to specific wind energy projects.

Wind energy projects will generally be able to comply with the CDM eligibility rules.

CDM and Joint Implementation (JI) can be useful by financing projects in a country for the first few years and help them reach a volume where national competence can develop. As more and more projects are developed, local skills in designing, planning, maintaining and operating wind farms will increase, paving the way for private investor-based projects. In small countries, the financing of these projects can rely mainly on CDM. However, because of the administrative burden linked with the international assessment of individual projects, it is doubtful that CDM or JI could by themselves be the basis for long-term wind energy development in large countries.

CDM often needs to be combined with other policies designed to bring additional revenues and remove non-economic barriers. Feed-In laws are the easiest of the market access policies to combine with CDM revenues. Such a combination would be most adequate for medium to large-sized projects in countries with medium wind energy potential.

Policies on permitting and licensing and grid issues are also critical. To meet wind energy penetration targets in a cost-effective way, it is necessary to create a process that will facilitate increased generation in a timely and simple manner. If obtaining all the necessary permits and licenses is a complex, costly and uncertain process, investors can be deterred and project profitability jeopardized. Grid access is of course critical to wind energy development, but even when regulations giving grid access to wind farms are in place, many critical issues related to grids can remain – including connection delays and charges, transmission charges and grid stability and ancillary services. Electric grids in most countries were designed to bring electricity from large production centers to urban areas. They were not made for distributed generation.

Both issues – permitting/licensing and grid issues – have been among the focuses of European policy in the past few years and are beginning to be considered in China and India.

Many countries have also implemented policies on national industry promotion, wind resource assessments, technology development, standards and testing, education and awareness-raising because they reduce risks and bring solidity and confidence to a business plan. This is even more important in countries that are seen in themselves as risky for investors, whatever the type of investment.

Setting up an effective and comprehensive wind energy policy requires dealing with a large number of various, often complex, issues. However, much experience has been gained in developed countries, and more recently in some developing countries such as China or India. This should help make things easier, and also faster, for countries wishing to promote wind energy.

To help governments transform the markets for wind energy by implementing enabling policies, the GEF has financed, or is considering financing, 14 projects through UNDP, of which only one has been completed. These projects are generally located in countries with good wind resources and some experience with liberalization/privatization. Electricity prices are very diverse in the different countries.

In order to remove barriers to the development of wind energy, the design of the projects integrates some of the lessons learned from existing successful wind policies. These include the necessity of reviewing the regulatory environment to offer developers clear and expeditious procedures, the importance of giving developers access to data on wind resources and the need to increase awareness of public authorities, companies and the public through education and training programmes.

Demonstration sites are included in all projects but efforts towards enhancing the replicability of these demonstrations need to be continued.

The most recent projects increasingly emphasize the need to have defined, stable, business models and financing schemes with guaranteed market access at the end of the project rather than concentrating essentially on financing the demonstration plant. This should be generalized. Education or wind assessment policies, however important, will not lead to effective wind farms if there is no profitable economic model for developers. The importance of grid-related issues seems generally underestimated.

For future projects, some guidelines can be offered.

Concentrating projects in countries where they stand the best chances of success because of the country's wind energy policies can help maximize the effectiveness of the money available. Wind energy generally has better chances of being successfully developed in countries with the following characteristics:

- A real commitment by policy-makers to develop wind energy;
- A legitimate public authority to set rules and obligations and enforce them in a way that will appear credible to investors;
- Some privatization/liberalization of the electricity market and some experience with Independent Power Production;
- A grid that has enough capacity and technical stability to accept large amounts of wind energy without jeopardizing its security;
- High electricity prices compared to which wind energy will be more easily competitive; and
- A large enough commercial wind energy potential. One strategy for UNDP could be to start working systematically on countries that have successfully participated in the Solar and Wind Energy Assessment Programme (SWERA).

Some public action on energy efficiency/energy savings should also be a prerequisite for initiating a wind energy project.

In order to be successful in each country, wind energy policies should :

- Be long term and consistent;
- Include legally binding targets or obligations;
- Offer wind energy producers standardized long-term contracts with secure payment mechanisms and an acceptable rate of return;
- Provide fair and open grid access and development;
- Provide good governance and appropriate streamlined procedures; and
- Create strong public acceptance and support.

In terms of market access policies, a Feed-In system is probably the safest overall policy choice for any country really committed to developing wind energy. Feed-In systems have provided good results and experience for replication is widely available. However, design and adequacy with national specificities and economic culture are critical to a successful policy. The Conference on Grid-Connected Renewables, hosted by the World Bank in Mexico in February 2006, highlighted the fact that many developing countries are still searching for the most appropriate mix of regulation, market incentives and tendering process to attract private wind energy developers without requiring unacceptable subsidies from ratepayers or the public treasury.The different types of policies can be more or less adequate

	Strong free market philosophy	Competitive electricity market	Significant number of existing wind farms	National industry objectives	Strong regional policies	High level of government expertise
Yes	Quota or Tender	Quota or Tender or Feed-In with cost-sharing mechanism	Any	Feed-In	Depending on local circumstances Any	Any
No (or limited)	Feed-In or Tender	Feed-In or Tender	Feed-In	Any		Feed-In

depending on local circumstances as summarized in the table above.

All policies should be designed in a way that makes them easy to understand and to use for wind energy developers. They should be kept as simple and stable as possible. Geographic distribution of projects is also an issue that needs to be given consideration, whatever the type of policy.

For each type of policy some key issues require special attention.

FEED-IN LAWS

The key elements of a successful Feed-In law are:

- A stable policy applicable over a long period of time;
- A long-term contract allowing for guaranteed prices until developers have recouped their costs;
- A reasonable rate of return;
- Enough flexibility to capture effective cost reductions; and
- A cost-recovery mechanism for monopoly utilities and a cost-sharing system for utilities in competitive markets.

QUOTAS

The key elements of a successful Quota system are:

- A long-term obligation (at least 10 years or even 15 years) with strong enforcement;
- Realistic target levels (that can be reached at reasonable cost but significantly exceed existing capacities);
- A level of penalty at, or above, compliance costs;
- A regulator to monitor the system;
- Long-term power purchase contracts; and
- Clear rules and limitations regarding eligibility (existing/new plants) and compliance flexibility (banking/borrowing).

TENDERS

The key elements of a successful tendering policy are:

- Long-term objectives and planning of tenders made public with regular rounds;
- Sufficiently large tenders to achieve economies of scale;
- High penalties for plants not built and:
- Choice of projects, based not only on price, but also technical and financial capacity to avoid committing resources to projects that will not materialize.

When setting up on-grid wind energy barrier removal projects, using these guidelines to choose priority countries and to select key issues that will be dealt with during the project can help concentrate funds and resources on those countries and projects which have the best chances of success with their wind energy policy.

INTRODUCTION

Growing concerns over climate change, rising energy prices and access to electricity helped renewable energy grow faster than non-renewable energy in 2004 and 2005. The fastest growing renewable energy technology over the last ten years has been wind energy, which grew by an average of 18.4 percent per year between 1995 and 2005. In 2006 14,900MW of wind energy were installed worldwide to reach a total installed capacity of 73,904MW.

With the growth of wind energy markets and technological improvements to turbines, costs have been steadily decreasing. The cost of wind energy dropped from a 1980 pre-market level of about US$ 0.70/kWh, to about US$ 0.05/kWh in 1998. In the last decade, costs at the most efficient sites have dropped even further – to about US$ 0.035 – 0.04 per kWh.

However, wind energy remains concentrated in a few countries. At the end of 2006 just five countries accounted for more than 75 percent of total installed capacity.

RANKING 2006	COUNTRY	Additional Capacity 2006 [MW]	Growth Rate 2006 [%]	Total Capacity End 2006 [MW]	Ranking 2005
1	Germany	2,194	11.9	20,622	1
2	Spain	1,587	15.8	11,615	2
3	USA	2,454	26.8	11,603	3
4	India	1,840	41.5	6,270	4
5	Denmark	8	0.3	3,136	5
6	China	1,145	90.9	2,405	8
7	Italy	405	23.6	2,123	6
8	United Kingdom	610	45.1	1,963	7
9	Portugal	628	61.4	1,650	11
10	France	810	106.9	1,567	13
11	Netherlands	336	27.5	1,560	9
12	Canada	768	112.4	1,451	14
13	Japan	354	34	1,394	10
14	Austria	146	17.8	965	12
15	Australia	238	41.1	817	15
16	Greece	183	31.9	756	16
17	Ireland	147	29.6	643	18
18	Sweden	54	10.6	564	17
19	Norway	55	20.4	325	19
20	Brazil	208	729.6	237	34
	Rest of the world	730	48.4	2,238	
Worldwide		**14,900**	**25.3**	**73,904**	

TABLE: 20 COUNTRIES WITH THE LARGEST WIND ENERGY INSTALLED CAPACITY AT THE END OF 2006 — SOURCE: WWEA

The objective of the GEF Operational Programme number 6 (OP6) is to promote the adoption of renewable energy by removing barriers and reducing implementation costs. Grid-connected wind energy is one of the technologies targeted by this programme and 14 wind energy projects have been financed through UNDP to help national governments implement favorable and efficient public policies which can transform energy markets and mainstream wind energy.

This document draws on the experience of these 14 projects in countries that have already adopted successful wind energy policies. The lessons learned should be useful in designing future UNDP-GEF wind energy projects and wind energy policies.

CHAPTER I – Public Policies – examines the various types of public policies that have been implemented to support wind energy and their results. Special attention is given to policies in Europe and North America, the areas with the largest installed wind energy capacity, but also to fast-rising wind energy countries such as India and China, the first developing countries to implement and substantially consolidate comprehensive wind energy policies and which have become major wind energy actors in the last few years. Brazilian policy choices are also discussed.

Among the most recent policy instruments, the Clean Development Mechanism (CDM) emerges as a possible way of increasing revenues of wind energy projects. This document also examines how wind energy projects can comply with CDM eligibility rules and which public policies can most easily be combined with CDM.

CHAPTER II – A review of the active UNDP-GEF wind energy portfolio – looks at the design, costs and efficiency of existing projects.

CHAPTER III – New projects: Choosing and designing the best mechanism for each country – offers recommendations for future projects on prioritizing countries, choosing types of policies and designing mechanisms.

Since this document deals only with the most important volumes of wind energy today, only grid-connected wind energy is considered. Most policy measures focus on grid-connected wind energy. Some of the issues and barriers discussed can also apply to off-grid wind energy but its main driver lies with electrification policies. Offshore wind energy, which is still in its early years, is also not dealt with in this document.

I. Public **POLICIES**

I.1. Setting Up Comprehensive Policies Supported by Strong Political Commitment

MANY DIFFERENT POLICIES IN THE AREAS OF FINANCING, TECHNOLOGY, REGULATIONS, EDUCATION, ETC HAVE BEEN IMPLEMENTED AROUND THE WORLD TO PROMOTE WIND ENERGY. SOME HAVE BEEN MORE EFFECTIVE THAN OTHERS. HOWEVER, EXAMPLES AROUND THE WORLD SHOW THAT NO SINGLE INSTRUMENT CAN BE SUCCESSFUL ON ITS OWN. ECONOMIC CONDITIONS ARE OF COURSE PARAMOUNT TO THE PROFITABILITY OF PROJECTS, BUT OTHER ISSUES, SUCH AS GRID ACCESS CONDITIONS, LICENSING, QUALITY OF EQUIPMENT, AVAILABLE TECHNICAL KNOWLEDGE, CAN ALSO DETERMINE THE SUCCESS OR FAILURE OF A WIND ENERGY PROGRAMME. BARRIERS TO THE DEVELOPMENT OF WIND ENERGY ARE NUMEROUS AND COMPLEX AND NEED TO BE DEALT WITH PROPERLY BEFORE A REAL INDUSTRY CAN EMERGE.

Policies also have to be seen by potential investors as stable and showing a long-term strong political commitment. Changing regulations and support schemes mean more risks for investors, leading to higher financing costs, the need for higher rates of return on investments or rejection of projects. For developers, there are high costs linked to setting up in a new country that has little wind energy experience. Developers need to become familiar with the country's regulatory system and sometimes wait until initial regulatory imperfections are corrected. They need to assess a country's technical environment, find and/or train contractors and many other things. It is only worth developers investing in wind power if they can make it pay over the long term on several projects. The high costs of "one-shot" investments are one of the reasons why tendering programmes have not been as successful as expected.

Countries such as Germany or Spain, which have been successful in developing wind energy, have set long-term political targets and have drawn up structured action plans supported at the highest political level to reach them. As shown in Figures 1 and 2 for Germany and France, setting up a strong wind energy industry in a country always takes a few years even when adequate policies are in place. There is a "national learning curve" during which stakeholders need to be informed of the technology and its benefits; secondary regulations need to be adapted on subjects like land planning or permitting; experience has to be gained on the environmental impacts of wind farms and their minimization; and companies need to learn to install, operate and maintain wind farms. It is therefore essential that the government should be committed to long-term support for wind energy.

In 2003 **CHINA** began the process of setting up a comprehensive wind energy policy by creating the Energy Bureau of the National Development and Reform Commission to oversee renewable energy projects. In 2005 the Energy Bureau announced a reevaluated target of 30GW of renewable energy in 2020 and adopted "the renewable energy law of the People's Republic of China" effective as of January 2006. This law provides for the setting, and release to the public, of middle and long-term targets for the development and utilization of renewable energy at the national and regional level, and for the establishment of a national renewable energy development and utilization plan. In practice, secondary legislation is still needed for some aspects of the law to become effective.

INDIA which has one of the broadest policies on wind energy, created the Commission for Additional Sources of Energy (CASE) in 1981. A year later it became the Department of Non-conventional Energy Sources (DNES) and in 1992, the Ministry of Non-conventional Energy Sources (MNES). In 2006, it was again renamed as the Ministry for New and Renewable Energy (MNRE), as evidence of the growing political attention given to renewable energy. India's wind energy programme includes wind resource assessment activities, R&D support, fiscal and financial incentives, Feed-In tariffs, renewable portfolio standards, technical standards and testing facilities, demonstration projects, as well as development of capacity to manufacture, install, operate and maintain wind electric generators. However, the industry is still waiting for a specific renewable energy law.

BRAZIL has adopted a general target of supplying 10 percent of energy from renewable sources over a period of 20 years. Brazil's electric system went through a series of power shortages in 2001 which led to the creation of a new programme – PROINFA – a renewable power incentive programme, which was initiated in 2002 partly as a way to avoid further power shortages, but also to favour wind energy and other renewable sources. PROINFA offers market access, soft loans and reduced transmission charges for small projects, but still needs development on some issues. No clear policy is in place to follow the first phase of PROINFA tenders.

Wind Energy in Germany

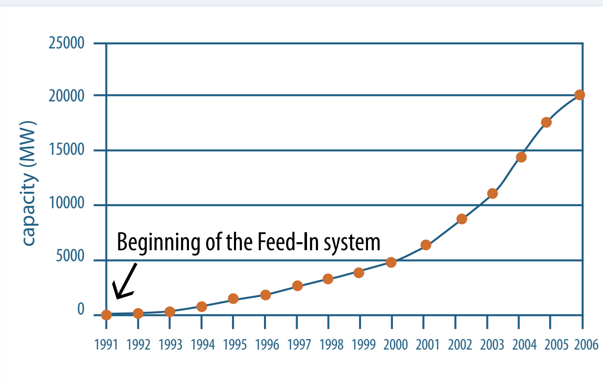


FIGURE 1: EVOLUTION OF INSTALLED WIND ENERGY CAPACITY IN GERMANY FROM 1991 TO 2006

Wind Energy in France

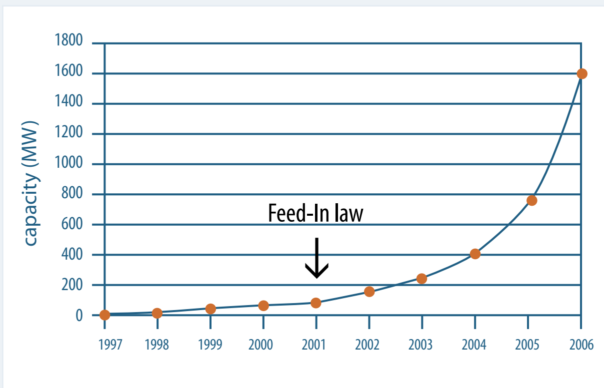


FIGURE 2: EVOLUTION OF INSTALLED WIND ENERGY CAPACITY IN FRANCE FROM 1997 TO 2006

I.2. Giving Market Access to Wind Energy

THE KEY ISSUE FOR RENEWABLE ENERGY DEVELOPERS IS TO GAIN ACCESS TO A CONSUMER MARKET, EITHER DIRECTLY, OR INDIRECTLY THROUGH GRID OPERATORS OR SUPPLIERS. MARKET ACCESS, HOWEVER CAN BE DIFFICULT FOR WIND ENERGY GIVEN THE FLUCTUATING, NON-CONTROLLABLE NATURE OF WIND ITSELF. A WIND FARM ON ITS OWN CANNOT GUARANTEE TO MEET SPECIFIC CONSUMPTION REQUIREMENTS.

In many countries the development of wind energy has been limited by the existence of monopoly companies, which were the only possible energy producers, suppliers, and grid operators. These companies were not interested in small, non-traditional, energy projects of which they had no experience, and instead preferred to continue investing in traditional energy production sources. Other companies had no access to the electricity markets.

Even when governments tried to provide national utilities with a mandate to develop wind energy, there was generally little progress, as was the case in the Netherlands and in Denmark during the 1990s.

Today there are more possibilities for wind energy with the liberalization or privatization of energy markets and the development of independent power producers (IPPs). However, in many countries liberalization is still a recent process.

Three main types of policies have been used to provide market access for wind energy: Feed-In tariffs, Quotas and Public Tenders. The first two types of policy are generally not financed by public money but by consumers themselves, who pay through the utilities supplying them. Tenders can be either directly financed by the organizing public authority or by consumers, through the utility buying the electricity. In all types of schemes, success is linked to some form of public obligation or mandatory target and some financing, direct or indirect, public or private, from the local or national community. Grid access is, of course, a prerequisite for all policies.

These policies often have two goals: guaranteeing that wind energy producers can sell their electricity and, at the same time, ensuring the profitability of projects. Although it is best when policies can pursue both goals, the issue of market access is the most critical since profitability can also be increased by other means such as tax credits, reducing grid access costs, or through public wind resource assessment programmes.

I.2.1 Feed-In Laws

Examples of Feed-In Laws

Under the system of Feed-In Laws, wind energy producers are given guaranteed access to the grid and utility companies are obliged to buy the electricity produced by wind energy at minimum published prices, which are generally higher than electricity market prices. The price can be a set fixed price, or result from a premium over the usual electricity price or a percentage of the market electricity price. Prices can vary according to size and location or wind resource. Prices for new projects need to be reviewed regularly (as they are every three years in Germany) but for one given project, the price needs to be guaranteed over a given period, generally long enough to allow cost recovery. The additional cost is generally passed on to consumers through price increases (as in Spain, Germany as of 2000, or France).

Large active electricity spot markets could also bring similar benefits to Feed-In tariffs in terms of access to the market by giving wind energy producers a place to sell their production. However, the existing markets often have penalties for fluctuant production and the price is generally lower. Revenues from the spot market then need to be completed by subsidies linked to the amount of wind energy produced (production incentives).

In some countries, instead of there being only one tariff for all wind energy projects, different tariffs exist depending on wind resources. This can help avoid giving good sites excessively high profits, allowing locations with moderate wind resources to suffer insufficient returns. Different tariffs can also help avoid all projects becoming concentrated in the areas with the best wind resources, a situation which can generate local opposition to wind energy.

Feed-In mechanisms were first implemented in California in the 1980s through an interpretation of the American national PURPA law (Public Utility Regulatory Policies Act - 1978). Wind farms benefited from 15 to 30 year contracts with high prices fixed for all or part of the contract duration.

This, combined with tax credits and state-funded resource assessments, allowed California to press ahead in developing wind energy, which accounted for over 90 percent of all new generating capacities installed in the state during that decade.

In the early 1990s, the first European renewable energy laws in Germany and Denmark also made provision for Feed-In tariffs. In these two countries, tariffs were not only stable over long periods, allowing investors to plan their projects with confidence, but were also set quite high for the first years. In Denmark the rules were later modified and the level of subsidies reduced, but by 2002 almost 2,900MW of generating power had been installed and a strong industry built. Denmark's main focus is now on re-powering existing onshore wind farms and on developing offshore projects.

Spain has also based its wind energy policy on a Feed-In law that allows producers to choose between a fixed tariff or a premium over electricity market prices.

In 2002 Canada set up the Wind Power Production Incentive (WPPI). This gave wind energy producers a guaranteed payment for each kWh produced and covered about half of the cost premium of wind energy over traditional electricity. The mechanism was applicable for 1,000MW until March 2007 when it was replaced by the Ecoenergy Renewable Power Programme, which uses a guaranteed premium to secure generation of 4,000MW of wind energy from 2007 to 2010.

Results

Feed-In tariff policies have been very effective in Germany, Spain and Denmark, leading to the world's first, second and fifth installed wind energy capacities. France and Portugal have also used Feed-In tariffs to become fast growing wind energy countries with 810MW and 695MW installed in 2006, bringing them to 10th and 9th place in terms of installed capacity.

Feed-In tariffs have the advantage of giving developers long-term stability and predictability. Developers know right from the start that, if their projects conform to national regulations, they will be able to go forward. Developers can draw up business plans, knowing what price they are going to get.

> Feed-In tariffs have the advantage of giving developers long-term stability and predictability

Although the level of the tariff is important, other subsidies, tax credits or soft loans can also be used, provided their durability is ensured by setting up adequate financing schemes such as dedicated funds, fuel or carbon taxes.

Feed-In laws have sometimes been criticized for not being market-based and possibly leading to higher costs because prices are not established through a competitive process. However, tariffs that decrease over time as costs are reduced can avoid this pitfall. Experience has not confirmed that Feed-In laws lead to higher costs. Conversely, in its December 2005 communication on "The support of electricity from renewable energy sources", the European Commission said that: "In the case of wind power, the green certificate systems show a big gap between generation and support. The three quota systems in Belgium, Italy and the UK, currently have a higher support level than the feed-in tariff systems. The reasons for the higher cost may be found in the higher investment risk, with such schemes and probably in the still immature market for green certificates. ... For wind energy, ... all countries with an effectiveness higher than the EU average use Feed-In tariffs. This type of system currently has the best performance for wind energy." (cf. Annex 1).

Hoping to combine the advantages of regulatory and market-based systems, some countries, such as Spain and Denmark, have chosen to design Feed-In tariffs at a premium over electricity market prices. This can prove expensive when market prices rise, as they did in 2006 in Spain. This induced the Spanish government to interrupt the system because of unjustified profits for developers and soaring costs of the wind energy support scheme. A new system was implemented in May 2007 with maximum and minimum limits set on the price a producer can receive.

It must be emphasized that Feed-In tariffs in themselves are not sufficient to ensure strong development of wind energy, if the system is poorly designed, or is not part of a comprehensive energy policy and other barriers are not removed. For instance, in 2001 France introduced a system of Feed-In tariffs for wind farms under 12MW that did not lead to the expected wind energy development, even though prices were generally deemed sufficient. Authorization procedures, especially land authorizations and building permits, were inadequate and burdensome for developers. Grid connection conditions and ancillary services requirements were variable and expensive, while strong local opposition to projects led to long development times and uncertainty. Wind energy capacity only picked up when these issues had been dealt with.

Policies in Developing Countries

The renewable energy law of the People's Republic of China effective as of January 2006 provides that: "Grid enterprises shall enter into grid connection agreements with renewable power generation enterprises that have legally obtained administrative license or for which filing has been made, and buy the grid-connected power produced with renewable energy within the coverage of their power grid, and provide grid-connection service for the generation of power with renewable energy" (article 14) and that: "Grid power price of renewable energy power generation projects shall be determined by the price authorities of the State Council in the principle of being beneficial to the development and utilization of renewable energy and being economic and reasonable, where timely adjustment shall be made on the basis of the development of technology for the development and utilization of renewable energy. The price for grid-connected power shall be publicized" (article 19). This law could have been the base for a strong Feed-In tariff mechanism and was received very positively by the wind energy industry.

However, a later text[1] states that: "The on-grid tariffs of electricity generation projects using wind power shall be subject to government guiding prices, and the tariff rates shall be determined by the State Council's pricing department based on the price determined from invitations of bids." This proviso has caused many in the industry to worry that prices driven by bidding processes will be too low to attract private developers. In these circumstances, CDM financing represents a very good opportunity to complement tariffs that are too low, but where grid connection and market access are guaranteed. The government of China is also currently considering creating a fund to finance renewable energy projects through an increase in consumer prices.

In India, Feed-In tariffs are also a part of the country's comprehensive federal and state policies in favor of wind energy. Feed-In tariffs were first set-up in the 1990s although many were later discontinued. After implementation of the 2003 Electricity Act state policies were reviewed and, once the government of India announced a new national tariff policy in early 2006, seven states set or confirmed buy-back rates for wind energy.

[1] Trial Measures for the Administration of the Pricing of, and the Sharing of Costs in Connection with, the Generation of Electricity Using Renewable Energy Resources 4310/06.01.04 Issued by the National Development and Reform Commission on January 4, 2006 and effective as of January 1, 2006

I.2.2 Quotas or Renewable Portfolio Standards

Examples of Quota Systems

Quota systems (also called Renewable Portfolio Standards or RPS) are the second type of policy instruments used to give market access to wind energy. Electricity suppliers, generators or consumers have to reach a certain share of renewable energy in the energy they sell, make available or buy. The government sets targets but lets the market decide prices.

Generally there is a fine or penalty to pay if the target is not reached, but this fine is often in full discharge of the obligation, i.e once suppliers have paid the fine they do not have to meet their obligation anymore.

Proof of compliance is often made through green certificates or certificates of origin. Producers receive credit for all renewable energy produced and the certificates are passed on to those to whom the electricity is sold. The suppliers can then use the certificates to prove they have met their obligation.

To make the system more flexible, green certificates can be traded by themselves independently from the electricity. Suppliers can meet their obligations simply by buying certificates and not changing the way in which they supply electricity. In this way suppliers will have contributed to the development of renewable energy through the price of the certificate.

The UK has had such a system since 2002. Known as the Renewables Obligation, the system requires suppliers to source an annually increasing percentage of their sales from renewables (four percent at the end of 2005, 15 percent by 2015). Suppliers can meet their obligation by acquiring certificates, paying a buy-out price or a combination of the two. When a supplier chooses to pay the buy-out price, the money is put into the buy-out fund and, at the end of the obligation period, the buy-out fund is distributed among electricity suppliers holding certificates.

Italy also has a similar quota system and in the USA, 20 states and the District of Columbia have set up Renewable Portfolio Standards with binding goals for electricity providers. Arrangements in the various states show important differences with obligations ranging from four percent to 25 percent, target dates from 2009 to 2025. Some Canadian provinces have also begun using similar types of obligations, ranging from five percent of new renewable energy in 2007 in Ontario to 20 percent in 2013 in Nova Scotia. In British Colombia, 50 percent of new generation must come from clean energy sources.

Quota policies are a more recent development than Feed-In policies but are expanding at the state/provincial level in the USA, Canada and India.

Results

In the UK, the system has started to produce results (+635MW in 2006) but has been under much criticism. In July 2006, the Carbon Trust[2] said that "not only are targets being missed, but the cost of installed renewable energy is higher than necessary." The Trust added that it "believes that the Renewables Obligation (RO) should be reformed or replaced." In his 2006 review of the economics of climate change, Sir Nicholas Stern stated that: "Both sets of instruments have proved effective but existing experience favors price-based support mechanisms. Comparisons between deployment support through tradable quotas and feed-in tariff price support suggest that feed-in mechanisms achieve larger deployment at lower costs."

As stated previously, the European Commission has recognized the higher cost of Quota mechanisms in its communication on "The support of electricity

[2] The Carbon Trust is an independent company funded by the British Government. Its role is to help the UK move to a low carbon economy by helping businesses and the public sector reduce carbon emissions and capture the commercial opportunities of low carbon technologies.

from renewable sources". Other drawbacks of Quota systems include a tendency to promote only the lowest cost technology if obligations are for all renewables, and not technology by technology. Specific rules can be set up to make sure all technologies will be supported but split markets carry a higher risk of low liquidity because of their smaller size.

Because prices are uncertain, there is also a higher risk for developers (which is one of the reasons for the higher cost observed) and increased difficulty in getting access to low-cost financing. Even where long-term contracts exist, they have to be negotiated for each plant and there is no guarantee for new developers on the price they can get. In the absence of long-term contracts, wind energy producers are subject to short-term variations of the green energy markets. In Europe, very volatile prices are often observed due to the small number of market players and low liquidity.

Finally, in cases where the payment of a fine can discharge the utility from its obligation, if the fine is not high enough, there is no guarantee that the objectives will actually be reached. In the UK Renewable Obligation policy, some suppliers have chosen a 100 percent buy-out option. If the penalty is too high, it can lead to overpaying renewable energy and may not be the best policy design. In the UK, the "recycling" of the penalty back to green certificate holders was designed to be an additional incentive, but actually brought more volatility and short-term speculation to the market.

The fact that they are still relatively new instruments could account for some of the lower performance of Quota systems.

On average, RPS obligations, combined with very favorable tax credits, have been successful in the US in increasing the number of wind farms, even though results vary substantially between states. Successful states are generally those where the relations between producers and utilities are based on long-term contracts that provide stability and visibility. RPS state policies, combined with tax credits, are estimated to have helped create about half the 4,300 MW of wind power installed in the US between 2001 and 2004.

However, it is uncertain how much of this was due to the RPS and how much to the tax credits and whether the increase of installed wind energy was obtained at the lowest possible total cost for the community. In the 1980s, Federal and State tax credits amounted to 50 percent to 55 percent of investment costs for wind energy.

A review of international experience with renewable energy obligation support mechanisms was done for the Energy Research center of the Netherlands (ECN) in 2005. It states that: "The system employed in various US states, where obliged suppliers offer long-term contracts to producers in competitive tenders, seems to have the benefit of combining effectiveness and cost efficiency. Without the use of some of the mechanisms described above, and absent careful design, international experience shows that obligation systems will not lead to cost-effective outcomes". The conclusion of the report is that: "The evaluation of international experiences with the obligation system gives rise to a mixed picture. Although an obligation in theory is effective and cost-effective, it seems too early to conclude that the system delivers these promises in practice. On the one hand this is due to the limited period of implementation that makes it hard to distinguish between the direct effect of the system and some teething problems that will be solved in due time. On the other hand, the conclusion can be drawn that the obligation is a complex system, which will only function well if designed carefully."

Quotas are generally considered more difficult to implement successfully than Feed-In systems and have higher transaction costs. The ECN study showed that, in Sweden, less than half of the money paid for certificates reached the renewable energy producers.

Policies in Developing Countries

Both China and India have chosen to combine Feed-In tariffs with additional national or regional quota obligations on suppliers.

China has set an obligation for large utilities to source at least five percent of their electricity from renewable sources in 2010 (and 10 percent in 2020). Utilities appear to be preparing to comply with this obligation by getting control of land rights in areas where they could develop new wind farms.

In India, the 2003 Electricity Act (art86) provides that: "The State Commission shall discharge the following functions, namely: ... promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licence." Since the act was passed, six Indian states have adopted minimum renewable obligations for utilities ranging from 0.5 percent to 10 percent.

Moves such as these could be the start of a new model which combines the advantages of Feed-In and Quota systems. It is comparable to what Canada has been implementing with the Wind Power Production Incentives and regional RPSs.

Brazil has made it mandatory for utilities to invest a percentage of their returns in renewable energy or energy conservation, either for R&D or direct supply projects.

I.2.3 Tenders

Examples of Policies Based on Tenders

Another type of instrument in which the government sets targets, but not prices, is the Tendering system in which a public authority organizes bids for the construction of specific volumes of wind energy generation. The winner is chosen according to the future price of the electricty and, in some cases, technical and financial capacity. The electricity is then sold through power purchase agreements similar to those in the Feed-In system.

France is the only country in the EU-15 (the 15 EU countries before the 2004 expansion) to still use a tendering scheme for large onshore wind projects. Ireland replaced its previous tendering scheme by a Feed-In tariff scheme in early 2006 and the UK phased out its Non-Fossil Fuel Obligation system in 2002.

In Quebec, the government asked HydroQuebec in 2003 to launch a tender for 1,000MW of wind energy. A second tender was launched in 2005 for 2,000MW and a third has been announced for municipal projects. However there has been a great deal of controversy over the projects selected in the first tender, especially concerning their environmental impact.

Tendering is used in most countries for offshore wind projects, which can still generally be considered as demonstration or pilot projects.

Results

In its first ten years, 1,150MW of projects were selected under the British Non-Fossil Fuel Obligation, but only 151MW were actually built.

Tender-driven policies have major drawbacks. When the tenders are not part of a programme, they can be seen by investors as stop-and-go policies, giving no long-term visibility on prices and even quantities. Investors have to pay preparation costs for all the projects for which they bid, even if they only win a few. Experience also shows that prices resulting from Tenders are often brought down by very low, and unsustainable, bids. These low bids can come from various sources – from new companies wishing to enter the market at all costs; from companies with insufficient wind energy experience that have under-rated some of the costs (often maintenance) or over-rated wind resources; or from public companies which have access to cheap financing or can recover their costs in other ways than just the project's profits. A high rate of projects that do not go on to construction is often observed.

This was for instance the case with the British Non-Fossil Fuel Obligation and Eole 2005, the first French wind energy Tender programme. In all cases it is price volatility and uncertainty that harm wind energy development.

International Tenders can have a role to play in the earlier stages of a wind energy policy as a way to start demonstration or pilot projects. However, there has not yet been any successful experience of tendering as the sole instrument of a nationwide ambitious wind energy dissemination policy.

Policies in Developing Countries

China has been organizing bids, called wind concessions, for construction of plants over 100MW since 2002. One of the conditions of the bids was that 50 percent (later 70 percent) of the equipment must be made locally. Prices were driven down by Chinese state-owned power companies and experts fear that many projects will not recover their costs. The actual operation of the wind farms will need to be scrutinized. The two first plants were to begin production at the end of 2006.

In April 2002, the Brazilian government passed Law 10.438 (or PROINFA – Program de Incentivo às Fontes Alternativas de Energia Elétrica – Support Programme for Alternative Sources of Electricity). PROINFA is an energy programme designed to stimulate development of biomass cogeneration, wind energy and small hydro-generators by guaranteeing power sale contracts to the first 3,300 MW of projects using these technologies. Under the programme, Electrobrás, the Brazilian utility, will buy electricity produced from the different renewable sources under contracts for up to 20 years. The first phase of the programme is due to be followed by a second phase which aims to reach 10 percent of national consumption over a period of 20 years, although there is still uncertainty over the design of the second phase.

The first phase's goal for wind energy was 1,100MW. However the programme was slow in starting and Brazil only had 29MW of wind power by the end of 2005. It now seems that the programme could finally be picking up, with 208MW installed in 2006 and 1,400MW of wind power purchase agreements signed. The years 2007 and 2008 will be critical in demonstrating whether these projects actually materialize or not.

I.2.4 "Voluntary Market" Mechanisms and Self-Use

A completely different business model to those already described supposes that renewable energy producers can find their own market and allows them to use the grid to supply consumers.

Consumers can be industrial concerns which have set up wind farms for their own use, generally because they fear instability and increases in electricity prices. India is one country where this has been observed, thanks to adequate wheeling conditions and banking possibilities[3]. General awareness-raising activities and the amount of technical know-how available in India have also been critical in persuading industrials, which were not energy specialists, to commit themselves to wind power.

Potential consumers can also be organizations or individuals wishing to purchase green energy on a voluntary basis, generally for environmental or marketing reasons. These voluntary markets exist in many European countries and in the United States. Even though there is a growing demand from companies and public entities, the corresponding volumes of green energy bought remain small in most countries. Public procurement, at the national, regional or city level has generally been the main driver for voluntary markets in their first years, as governments tried to set an example, but companies now account for an increasing share of the demand.

In the United States, green power (from all renewable sources) accounted for less than 0.2 percent of all electricity sales in 2005 (wind energy represented 61 percent of the green power sales). However, green power purchasing accounted for about 2,000MW of installed wind energy capacity between 1997 and 2005 representing 22 percent of the total new installed renewable capacity of about 9,000MW. However, due to tax credits, electricity from wind energy is, or has been, actually sold in some areas cheaper than regular electricity and it is not clear what conclusions can be drawn from this trend.

Although offering investors the choice of various possible business models, as has happened in India, increases the chances of successful wind energy development the possibility of creating a strong wind energy sector through voluntary instruments alone has not yet been demonstrated.

Experience with electricity sector liberalization all over the world shows it takes a long time for electricity consumers to actually get into the habit of comparing offers from electricity suppliers and changing suppliers. However, comparing suppliers is necessary in order to get con-

[3] Wheeling conditions set the rules for use of an electricity grid by an independent producer selling electricity directly to a consumer. Under banking arrangements, the consumer can "bank" the electricity produced by wind turbines that he doesn't need at one time and take it from the grid later, in a one year period. Banking offsets some of the disadvantages linked with the impossibility to control the output of wind turbines.

sumers interested in green electricity offers. In developing countries where markets have only recently been liberalized, voluntary markets seem even more difficult to rely on.

The choices made from the types of instruments already described by the top 20 wind energy producing countries are summarized in the table below.

Feed-In laws are the main instrument used in Europe to promote wind energy. They have helped create three of the world's largest wind energy producers and, in the European context, have been more cost-effective than Quotas. Other than Canada, large industrial countries in the rest of the world (USA, Japan, and Australia) have chosen Quota-based instruments, combined with subsidies or tax credits. Cultural reasons seem to be the main driver of this choice. Some of these Quota systems have been effective in giving rise to new wind energy capacities but need careful design. In these countries, it has not been proven that Quotas effectively provide the lower costs that theory credits them for. China and India have both, in theory, chosen to mix Feed-In tariffs and Quotas, as has Canada. In practice, the Chinese Feed-In pricing system will actually be based on tendering results.

However Tender-driven policies have major drawbacks and until now, there has been no successful experience of tendering as the sole instrument of a nationwide ambitious wind energy dissemination policy. The same conclusion can be reached for voluntary policies, such as green pricing.

RANKING 2006	COUNTRY	INSTRUMENT
1	Germany	Feed-In
2	Spain	Feed-In
3	USA	Regional Quotas (+tax credits)
4	India	Feed-In + Regional Quotas
5	Denmark	Feed-In
6	China	Feed-In + National Quota
7	Italy	Quota
8	United Kingdom	National Quota
9	Portugal	Feed-In
10	France	Feed-In +Tenders
11	Netherlands	Feed-In
12	Canada	Production incentive + Regional Quota
13	Japan	National Quota
14	Austria	Feed-In
15	Australia	National Quota
16	Greece	Feed-In
17	Ireland	Tenders to be replaced by Feed-In
18	Sweden	National Quota
19	Norway	Tenders
20	Brazil	Tenders

Table 2: Wind energy support schemes in the 20 major wind energy countries

I.3. Providing Public Economic and Financial Support

IN ADDITION TO THE POLICIES ALREADY DESCRIBED, MANY COUNTRIES OFFER DIRECT PUBLIC ECONOMIC AND FINANCIAL SUPPORT SCHEMES TO WIND ENERGY DEVELOPERS IN ORDER TO INCREASE THE PROFITABILITY OF PROJECTS. THE EFFICIENCY OF THESE SCHEMES GENERALLY DEPENDS ON THEIR STABILITY AND ON HOW EASY THEY ARE TO USE.

I.3.1 Tax Credits and Accelerated Depreciation

Tax credits have been one of the main drivers for the increase in the US wind energy capacity. Since 1992, a production tax credit has been offered to wind energy developers (0.019$/kWh in 2005) as well as income tax credits. Many European countries, such as Finland, France, Germany, Ireland, Spain and the UK, also offer tax incentives.

India offers wind energy investors various exemptions from central sales tax and general sales tax (depending on the State), exemption on income tax from earnings for 10 years, exemption from excise duty on manufacture of most of the finished products and reduced customs duty for capital equipment and most of the materials and components.

In China, value added tax of 17 percent was cut by half for wind energy in 2002. In the early years, most Chinese wind energy development came from projects built by subsidiaries of local utility companies, from technological or dissemination demonstration projects financed by national or international subsidies, or from specific local opportunities resulting, for instance, from very high electricity prices such as in the Guandong region.

The value added tax reduction was one of the measures that marked China's transition to a model of policy measures of general application broadly stimulating private national and international investment in wind farms. The 2005 Chinese renewable law also allows preferential tax treatment for authorized renewable energy projects. Many countries also offer wind energy developers accelerated depreciation as another way of improving project profitability without increasing public spending. In India, projects can benefit from 80 percent to 100 percent accelerated depreciation in the first year of the installation of systems.

One major drawback of tax credits or equivalent instruments is that they are generally investment-based rather than production-based. Production-based subsidies, which have to be calculated every year, have high administrative costs which means they are seldom implemented. Because they are investment-based, tax credits are generally efficient in creating new capacity but not necessarily in ensuring a high level of production from these investments.

Another risk of these instruments is related to their volatility, whether real or assumed. Their effectiveness depends on the level of confidence that developers starting to work on a project can have that the tax credit will still be effective when the wind farm begins operations.

This is especially true in United States where the extensions of the Production Tax Credit in 1999, 2001, 2003 and 2005 created much uncertainty and instability. Unfortunately in many countries, when a scheme starts to be effective and its cost rises, there is pressure to terminate it.

I.3.2 Direct Subsidies

Direct subsidies are often provided for projects when a country is at the beginning of its wind energy learning curve. Direct subsidies allow demonstration or pilot projects to be implemented.

In the EU-15, many smaller wind energy countries, such as Finland, Greece, Luxembourg and Sweden, still have investment incentives. Spain has regional investment incentives linked to local manufacturing requirements set up by regional authorities seeking to attract jobs related to the manufacturing of components and turbines.

Some countries have created specific funds to invest in wind energy (or in renewables in general). The 2005 Chinese renewable law provided for the creation of such a fund.

I.3.3 Removal of Subsidies to Conventional Energy

High local electricity generation costs and prices help make wind energy projects profitable. In many countries, electricity generation from fossil fuels has been subsidized for social or industrial reasons. A policy of more cost-transparent prices is favorable for all renewable energies as it reduces the gap in terms of costs between conventional and non-conventional energy sources, even if some social subsidies directly allocated to end-users remain.

In the same way, power shortages can often lead to increased policy attention and development in the wind energy sector. Brazil suffered such shortages in 2001 and China in 2003.

Another way of leveling the field between renewable and conventional energy is to explicitly value the positive externalities of renewable energy. When comparing the costs of renewable and conventional energy production, a more balanced result is achieved when the benefits of wind energy – such as reduced local pollution, job creation, energy security of supply, price stability, decentralized production and lower grid losses – are taken into account.

I.3.4 Low Interest Loans and Loan Guarantees

In countries that are beginning to develop wind energy, it can be difficult or very expensive for investors to secure financing, even for good projects, because the technology is perceived as risky in itself. Furthermore, some developing countries do not have an established practice of project financing and local banks do not offer long-term financing to match the long pay-back period of wind energy.

Some countries have set up low interest loans or loan guarantee mechanisms to facilitate access to financing and this can have a very strong influence on resulting electricity costs. A 1997 study on "Financing Investments in Renewable Energy: The Role of Policy Design and Restructuring" from Berkeley University showed how sensitive overall renewable costs are to financing inputs. With the study's assumptions, a change in the ROE from 18 percent to 12 percent was estimated to reduce the 20-year levelized cost by approximately 22 percent for wind power. Increasing the debt repayment period from 12 to 20 years was shown to reduce wind power costs by 12 percent.

In 1987, the Indian government established the Indian Renewable Energy Development Agency (IREDA Ltd), a government company which provides soft loans for up to 70 percent of the investment costs to manufacturers and users for commercial and near commercial technologies. The Chinese 2005 renewable law provides that financial institutions may offer preferential loans, with financial interest subsidy, to some renewable energy development and utilization projects.

In Brazil, BNDES offers a credit programme for wind farms that features a special interest rate for a maximum of 70 percent of the national products component of the investment.

I.3.5 Using CDM

CDM and JI can be useful to help finance wind energy projects in a country for the first few years and help reach a level where national competence can be developed. As more and more projects are developed, local skills on designing, planning, maintaining and operating wind farms will increase, paving the way for private investor-based projects. However, it is doubtful that CDM or JI could, by themselves, be the basis for long-term wind energy development in large countries.

Meeting the Additionality requirements

CDM rules require that for a project to be eligible it has to be additional. The Kyoto Protocol states that: "reductions should be additional to any that would occur in the absence of the certified project activity." For wind energy, this would seem to be often the case. No non-Annex I countries have yet achieved a situation where wind energy is the most likely option to produce electricity.

This is sometimes understood as meaning that the project could not have taken place without the CDM mechanism.

This can appear to be in contradiction with the setting up of national action plans and policies to enable the development of renewable energy. If local conditions allow wind energy projects to develop can it still be considered additional? Does a country need to design an inefficient wind energy public policy in order for the projects to remain eligible for CDM? The CDM Executive Board was aware of this difficulty in its 11th meeting (16-17 October 2003) as shown by the meeting report. "The Board requested the Methodology Panel to develop, at its next meeting, recommendations for the consideration of the Board at its 12th meeting, on how, in accordance with paragraph 45 (e) and Appendix C of the CDM modalities and procedures, national and/or sectoral policies and circumstances should be taken into consideration when establishing baseline scenarios. In doing this work, the Methodology Panel shall bear in mind that taking into account relevant national and/or sectoral policies when establishing baseline scenarios is not to create perverse incentives which may impact the host country Parties in contributing to the ultimate objective of the Convention."

The CDM Executive Board finally decided in its 22nd meeting in November 2005 that: "National and/or sectoral policies or regulations under paragraph 6 (b) (i.e National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programmes) that have been implemented since the adoption by the COP of the CDM M&P (decision

17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place)."

For the first few years of a wind energy policy, this should allow projects to be considered additional.

The CDM-Executive Board has adopted a tool for the demonstration and assessment of additionality. This tool presents three types of methodologies that can be used: Investment analysis, Barrier analysis and Common Practice analysis.

Investment analysis or Barrier analysis should be conducted first. Investment analysis aims at demonstrating, through sensitivity analysis, that "the proposed CDM project activity is unlikely to be the most financially attractive or is unlikely to be financially attractive". Other than in countries with very mature wind energy industries, wind energy will rarely be the most financially attractive option. Even if public policies have been implemented, risks related to wind resources, operating conditions, technical know-how, etc will often remain higher than risks associated with conventional electricity generation technologies.

Barrier analysis determines whether the proposed project faces barriers that prevent a widespread implementation of the proposed activity, but do not prevent a widespread implementation of at least one of the other alternatives for producing electricity that the country could choose instead of the wind energy project. This is often the case for wind energy.

After Investment or Barrier analysis, the Common Practice analysis checks that: "No similar activities can be observed, or if similar activities are observed, but essential distinctions between the proposed CDM project activity and similar activities can reasonably be explained. " The tool specifies that: "If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive or faces barriers". The precise market share of new electricity generation plants that has to be reached for wind energy to be called "widely observed and commonly carried out" is a matter for discussion but it is clearly far from the current situation in most regions of non-Annex 1 countries especially since other CDM projects do not have to be taken into account for Common Practice analysis.

In any case, because of its technical characteristics, wind energy can never become the dominant generation technology of an electric system. Wind energy projects should be considered additional, at least for the next few years.

It can be noted that, up to now, only two wind energy projects (by the same company) have been rejected by the CDM Executive Board.

Combining Public Policies and CDM

When only limited public financial resources are available for wind energy, CDM can bring supplementary revenues to projects. However, in order for a significant number of projects to be carried out, major risks and barriers, such as regulatory and administrative barriers and grid connection rules, need to be dealt with. It is also necessary to set up a policy guaranteeing that the wind energy producers can find a buyer for their energy, even at low prices. Analyses of the first CDM wind energy projects have shown that, in many cases, the additional revenue stream may not be sufficient to ensure, alone, the profitability of projects. (Cf Table 3). A combination of policies is then necessary.

Feed-In laws are the easiest of the market access policies to combine with CDM revenues. CDM is a complex instrument and entails intricate administrative

INCREMENTAL IRR - CARBON FINANCE						
Renewable Energy						
ER Prices	Purchase period					Impact per Unit
	5 years (2007-2012)	7 years	10 years	14 years	21 years	
$5	0.5%	0.6%	0.8%	1.0%	1.2%	$3.16/MWh
$8	0.8%	1.1%	1.4%	1.6%	1.9%	$5.06/MWh
$10	1.0%	1.4%	1.7%	2.1%	2.3%	$6.33/MWh
Source: WB-PCF Financial Module, Nov 2006						

Table 3: Impact of carbon finance on the IRR of renewable energy projects

procedures and high costs. It also creates some uncertainty, even if the number of projects rejected has been small up to now. Wind energy support policies should be based on the simplest options if they are to be easily combined with CDM, without reaching an unmanageable level of complexity.

Feed-In laws are the easiest of the market access policies to combine with CDM revenues

A Feed-In mechanism can be set up with tariffs a little below the required level for the project to be profitable and still generate projects if project proponents can make up the revenues they are missing because of lower tariffs from sales of Certified Emission Reductions (CERs). The drawback in such cases is that only projects that can go through the CDM process can be implemented. Countries with a very large wind energy potential, such as China, would need several hundred projects to reach their wind energy development objectives. Passing several hundred wind energy projects for just one country through the CDM process does not seem very realistic, given the level of the transaction costs. CDM requires an additional individual assessment of each project at the international level and is governed by specific rules different to the national rules applicable to wind energy. It also has high information, cost and delay barriers, especially for small developers.

Therefore, relying on a low Feed-In tariff combined with CDM would only be an option for countries with medium to small wind energy potential, or countries which use the process as a way of initiating a trend of wind energy projects before going to a higher Feed-In tariff.

Schemes that do not require a project-by-project review should be used for countries with very large wind energy potential. If possible, Feed-In tariffs that do not need to be complemented by CDM should also be offered to small projects where the proportionally higher transaction costs of CDM present problems.

I.4. Providing an Adequate Regulatory Environment

AS ALREADY STATED, THE FIRST EXPECTATION OF AN INVESTOR IS GENERALLY STABILITY IN GOVERNMENT POLICIES AND REGULATORY ENVIRONMENT IN ORDER TO REDUCE RISKS. INADEQUATE REGULATIONS CAN PRODUCE HIGH RISKS AND EXCESSIVE COSTS FOR WIND ENERGY DEVELOPERS. PERMITS AND LICENCES, AS WELL AS GRID ISSUES, ARE MAJOR AREAS WHERE ADEQUATE POLICIES NEED TO BE IMPLEMENTED.

I.4.1 Permitting and Licensing

To meet wind energy penetration targets in a cost-effective way, it is necessary to create a process that will facilitate increased generation in a timely and simple manner. If obtaining all necessary permits and licences is a complex, costly and uncertain process, investors can be deterred or project profitability jeopardized. This is why the European Union directive on the promotion of electricity from renewable energy sources made it mandatory for member states to review their legislative and regulatory frameworks to reduce barriers and streamline and expedite procedures.

Wind energy projects generally have to obtain numerous permits and licences (for electricity generation, for land use, for safety regulations and others). Often the procedures for obtaining permits were set up without thinking of wind energy and therefore they can prove to be inadequate for the size and characteristics of wind energy projects. In some cases no clear authorization procedures exist for issues specific to wind energy. According to the European Commission, authorization procedures for onshore wind energy projects in Europe may take two to seven years to complete. Also some countries have little or no experience of IPPs and need to design corresponding legislation. This can be a major drawback for wind energy since IPPs have been, and will probably remain, the dominant business model for wind energy development.

Clear guidelines for authorization procedures are highly recommended and obligatory response periods for the authorities involved should be incorporated in such procedures. When different levels of authority are involved, it is necessary to have clear attributions for each one. A co-ordination agency overseeing the whole process is also useful.

The example of European countries shows that clear guidelines on the assessment of the environmental impact of wind energy farms can be especially useful. As soon as wind energy becomes visible in a country, some form of opposition generally appears. The environmental impact of wind farms is usually one of the first arguments voiced by any opposition group. Guidelines can help avoid the kind of environmentally negative projects that give wind energy a bad reputation, but also help avoid rejection of projects on purely subjective criteria, as is often the case with visual impact and degradation of landscapes.

Furthermore, in many countries and regions, the future development of wind energy projects is not taken into account in drawing up land use, or spatial plans. This means that spatial plans have to be modified before a project can be approved in a specific area. This process can be very long and it is much better for wind energy developers when authorities can anticipate the development of future wind energy projects by allocating suitable areas in advance.

I.4.2 Grid Related Issues

Grid access is critical to wind energy development but even when regulations giving grid access to wind farms are in place, many critical issues can remain. These centre around the fact that in most countries electricity grids were designed to bring electricity from large production centers to urban areas and were not made for distributed generation.

Connection Delays and Charges

Wind farms are often set up in areas where grid connections are not directly available because wind turbines are more acceptable to the public if far enough from dwellings. Also high electricity consumption zones are not generally found in high wind areas. Extensions and/or reinforcements to the grid system are then necessary. The time taken to make these extensions or reinforcements, and their cost to wind energy developers are critical to a project's profitability. Providing new transmission lines can be difficult due to planning barriers and land use rights and it can also be a long and expensive process. When developers don't know how long it will be, or how much it will cost, before projects can be hooked up, their business projections are uncertain.

This was a major issue in the first years of the French wind energy programme. It also seems to have been one of the issues delaying the PROINFA projects in Brazil. Conversely, one of the advantages of the Chinese concession programme is that it made power grid companies responsible for the transmission line to the wind farm's substation. More recently, following the 2005 Chinese renewable law, it has been decided that the cost of grid extensions for renewable energy developments will be included in the scope of nationwide cost-sharing and that the power grid company will be responsible for building the transmission lines.

Transparent rules for bearing and sharing the necessary grid investment costs are necessary. They should take into account the benefits of distributed generation and not put an excessive burden on renewable energy producers compared to conventional electricity producers. Many European countries have chosen a "shallow" cost approach, under which direct grid connection costs are borne by project developers requesting connection or shared with grid operators, while costs related to the necessary grid extensions and reinforcements are covered by the grid operators, and passed on through the grid tariffs.

Considering the delay necessary to build new power lines, especially at the transmission level, wind energy development plans need to be integrated beforehand in network planning.

Transmission Charges and Wheeling Arrangements

On top of connection charges, charges for use of the electric grid can also be crippling when they have not been adapted to the specificities of wind energy – for example when there are transmission penalties for intermittent generation.

Conversely, positive wheeling arrangements can help promote the business models of self-suppliers or producers selling directly to large consumers. Some countries, such as India or Japan have introduced such arrangements, including banking arrangements by which a producer can, to some extent, supply consumers at a different period from the period at which the electricity is really generated. However, banking arrangements can also have some negative effects by generating fluctuations and uncertainty in small electricity markets. They should therefore be introduced carefully in those markets that have already reached some level of maturity.

Grid Stability and Ancillary Services

Wind farms can have a negative impact on the stability of the grid and the quality of energy supplied. Because they are intermittent, they increase the need for additional short-term system balancing actions and the need to install or maintain capacity to ensure reliability of supplies.

However, risks are often overestimated and the contributions of distributed energy underestimated by grid companies who do not have the training or experience to manage intermittent production and do not wish to change the way they operate their grid. Consequently, the maximum amount of wind energy that can be connected to a given grid is often underestimated.

A review of the existing literature on the costs and impacts of intermittency was made by the UK Energy Research Center in 2006. It showed that: "Additional system balancing reserves represent no more than 5-10 percent of installed wind capacity in the vast majority of cases" and indicated that "all these studies conclude that intermittent generation does have a capacity credit value greater than zero." The studies reviewed showed capacity credit[4] varying from 11 percent to 20 percent at 15 percent penetration level, and 15 percent to 20 percent at 20 percent penetration level. Costs tend to decrease when there is an increase in the geographical dispersion of generators and in the number of flexible generation units connected to the grid.

Case-to-case studies remain necessary for each country, depending on the geographical pattern of wind resources and the specificities of the grid, especially in countries where the grid is already not very strong or overloaded.

Wind energy producers should contribute to ancillary services[5] like other producers although their contribution should be adapted to their characteristics and possibilities. Public regulations are needed in this area to avoid excessive or impossible requests and/or excessive constraints made on wind energy producers. Rules for charging balancing costs or early gate closure times[6] can be very penalizing for wind energy.

[4] Capacity credit is a measure of the amount of load that can be served on an electricity system by intermittent plants with no increase in the loss-of-load probability (lolp) or the conventional thermal capacity that an intermittent generator can replace. It is often expressed as a percentage of the installed intermittent generation.
[5] Ancillary services are services provided by grid users (producers and consumers) to the grid operator to help him control key technical characteristics of the grid such as voltage and frequency.
[6] The closing time for power markets for receiving bids from electricity producers.

I.4.3 National Industry Promotion

Among the benefits of wind energy are the creation of local employment opportunities and support to the economy. As well as the jobs and revenues created from installing and maintaining wind farms, extra benefits can come from establishing a local industry for component manufacture or wind turbine assembly. Local production and assembly can also help reduce costs by transportation savings, and in some countries, because of lower raw material costs or labour costs.

The size of the national market is a key driver in the creation of a national industry but specific public policies have also been set up for this purpose. Local production requirements can persuade international companies to set up local production facilities. When the objective is the creation of an independent local industry, it is generally combined with strong R&D technology programmes.

In the 1990s, manufacturers naturally located in Germany and Denmark, as these countries represented their main outlet. Complementary support policies included R&D financing, specific financing of projects using local turbines (Danish Wind Turbine Guarantee) and direct grants and project development loans to qualified importing countries for use of national turbines (through the Danish International Development Agency DANIDA).

When Spain started promoting wind energy, the benefits in terms of jobs were a strong argument to balance rejection of projects and the 'nimby' (not in my back yard) syndrome. For a long time Spanish regional government agencies have mandated the incorporation of local content in wind turbines installed on Spanish soil. Local content requirements are still effective in several Spanish regions such as Castille and Leon, Galicia and Valencia which require local assembly and manufacture of turbines and components before development authorizations are granted. This policy has been one of the drivers in the creation of Gamesa, the world's third largest producer of wind turbines.

Quebec also introduced local content requirements through the calls for tenders managed by HydroQuebec in 2003 and 2005.

China has tried to increase the national content of wind energy generation through various initiatives including the "Ride the wind" programme initiated in 1996 to import technology from foreign companies and to establish a Chinese wind turbine generator sector. "Ride the wind" led to two joint ventures with Nordex (Germany) and Made (Spain). These joint ventures effectively introduced manufacturing technology for 600kW turbines into China.

The Chinese government later implemented the "National Debt Wind Power Programme" that required the purchase of qualified, locally-made wind power components for new generation projects. Wind farm owners were provided with bank loans with subsidized interest as compensation for the risk of using locally-made wind turbine generators. These loans funded construction of demonstration wind farms. More recently, China made it a condition of its concession programme that a large part of equipment (50 percent and later 70 percent) was manufactured in China. In 2005, the market share of Chinese suppliers reached almost 28 percent (mainly Goldwind) although this is concentrated on turbines smaller than 750kW. Nordex, Gamesa, Acciona, Suzlon, GE Energy all began to invest or operate new plants in China in 2005.

In Brazil, the PROINFA legislation requires 60 percent of the total cost of a wind plant's goods and services to be sourced in the country.

In India, at least 15 domestic companies are manufacturing wind power turbines and components, either in joint venture or under licence from international companies. Turbine blades, as well as electric generators, are being manufactured locally. The Indian company Suzlon was the country's largest supplier in 2003, with 34.6 percent of the domestic market. The size of the potential wind energy market in India, along with customs duty rules in favour of importing wind turbine components over importing complete machines, has been the main driver for localization.

While the employment and economic benefits of a national wind manufacturing industry have been well documented, more research is necessary on the actual cost reductions it creates.

I.5. Improving Technology and Information Dissemination

TO REDUCE RISKS AND COSTS ASSOCIATED WITH WIND ENERGY PROJECTS, GOVERNMENTS OVER THE WORLD HAVE INSTITUTED POLICIES TO IMPROVE WIND RESOURCE ASSESSMENTS, AVAILABLE TECHNOLOGY AND GENERAL KNOWLEDGE OF WIND ENERGY. THIS HAS OFTEN BEEN DONE THROUGH THE CREATION OF WIND ENERGY RESOURCE CENTRES.

I.5.1 Wind Resource Assessments

Project development, especially on-site wind measurements, is expensive and time-consuming. Having access to reliable wind resource mapping before developers commit financial resources to pre-feasibility or feasibility studies allows them to limit these costs to projects with a high chance of success. A good vision of a country's wind potential is also useful to convince developers that the investment they are making to set up activities in a new country will be worthwhile because the potential is large enough.

This is especially important in regions such as Asia or Africa where wind resources have not been studied in the same detail as in Europe or Northern America.

The UNEP Solar and Wind Energy Resource Assessment Programme (SWERA) has been very useful to confirm the presence of significant wind resources, often higher than initially estimated, in countries such as Nicaragua, Mongolia and Vietnam, or to demonstrate low resources as was found in Bangladesh. The first pilot countries for SWERA assessment included Brazil and China along with Bangladesh, Cuba, El Salvador, Ethiopia, Ghana, Guatemala, Honduras, Kenya, Nepal, Nicaragua and Sri Lanka

A more local organization, the Indian Center for Wind Energy Technology (CWET), which was established in 1998, has set up 540 wind monitoring stations and publishes lists of identified windy sites.

I.5.2 Technology R&D

In Denmark, a combination of early well-targeted R&D programmes along with stringent certification standards were strong policy drivers in developing a large wind turbine manufacturing industry. The Danish government funded significant R&D programmes in the early stages of wind turbine technology development focused on reducing the cost of large-scale wind systems. These early R&D studies focused not only on wind turbine technology but also on site investigations, grid integration studies, and wind resource assessments.

The United States and Germany have been by far the main contributors to wind energy R&D since 1974. Between 1990 and 2002, wind energy accounted for 5.9 percent of the German energy R&D budget compared to 1.1 percent on average for IEA countries. In both the US and Germany, efforts were concentrated on large wind turbine R&D and bringing down costs. These programmes were quite successful and are one of the major reasons for the reduction of wind energy costs (costs have been reduced by 80 percent over the past 20 years).

To help Chinese manufacturers develop wind turbine products and technologies, the Chinese Ministry of Science and Technology funded research to develop technologies for 600 kW turbines between 1996 and 2000.

A prototype machine developed through this research was approved at the national level, and was used successfully. Chinese manufacturers also produce key components of 600 kW turbines, such as blades, gearboxes, generators, and control systems. China has been supporting R&D programmes to develop megawatt-size wind turbines since 2000.
However, unless they have very large markets and technical capacities, most developing countries should use commercial technologies when setting up a wind energy programme and would be advised to concentrate their R&D efforts on wind measurements, local adaptation, demonstration projects and wind turbine test centers, rather than on technological R&D.

I.5.3 Standards and Testing

To avoid the risk of low performance caused by inadequate components and turbines, it is necessary to have technical standards, testing facilities, and certification processes. Such standards already operate in Europe, even if a few accidents have shown that there is still is room for improvement.

In countries that aim to develop, offering emerging companies access to a certification and testing programme that meets international standards is also a way to help them promote the quality of their products and helps countries develop an independent national turbine manufacturing industry.

Denmark was the first country to strongly promote wind turbine quality certification and is still a reference point in this field. In order for wind turbines to be set up in Denmark or in Danish waters, they, and the foundations used, must first be approved according to the Danish Energy Authority's technical approval scheme. This scheme, which has been in place since the beginning of the 1980s, is intended to ensure that wind turbines and their foundations are constructed and installed in agreement with regulations governing safety and quality.

The US National Renewable Energy Laboratory's National Wind Technology Center has been providing certification for wind turbines since 1998. Until then, the lack of certification possibilities disadvantaged US manufacturers in the international market.

In India, CWET acts as standards and certification information center and wind turbine test station. China has also set up basic standards and a certification system that is being expanded.

The Brazilian Wind Energy Center created in 1996 undertakes performance assessments of wind turbines in real operating conditions and elaborates technical specifications and standards along with R&D of wind turbine components and systems.

I.5.4 Demonstration programmes

Demonstration and pilot projects are an important step in the development of wind energy in a country. They can prove that wind energy is a viable technical and economical option locally and demonstrate to hesitant bankers and developers the wisdom of investing in wind energy. Pilot projects provide useful feedback for developers on issues such as wind resources, or real investment and maintenance costs which enables them to reduce their risks and bring their projects forward faster and cheaper. Pilot projects can also help provide the authorities with the necessary data to choose the level of a Feed-In tariff or other type of subsidy or support scheme.

As more and more projects are developed, local skills in designing, planning, maintaining and operating wind farms will increase, paving the way for private investor-based projects.

The very first pilot or demonstration projects in a country are often completely special and unique because the necessary environment in terms of policy, regulations, finance, technical capabilities, etc is not yet in place. However, to be effective in generating confidence for new projects, the conditions of demonstration projects must, at some time, become close enough to what "real" projects will be confronted with.

I.5.5 Education and Training / Communication

Developers need locally-trained personnel to design, install, and maintain their wind farms. Training programmes and the creation of a national expert database are important for success. Many countries have set up their own training centers and programme. In 2005, seven universities or learning centers in Brazil, Canada, China, Cuba, Denmark, Egypt and Russia launched a decentralized network to provide a common training and education programme for postgraduate students.

More generally, education and communication on wind energy and its benefits are necessary for policies to be adopted by authorities and accepted by local populations.

It is critical that public authorities reach a good level of understanding of wind energy and its many benefits if they are to decide strong favorable policies. However public bodies also need to be able to understand and deal with a range of technical issues brought by wind energy development. These include environmental impact assessments, impact on electric grids, security and safety requirements, and others.

The attitude of the general public is also an important aspect of the policy framework, and has, for example, been a major contributor to the continuation of the Feed-In tariff policy in Germany, despite resistance from utilities. Supportive public opinion towards renewable energy is beneficial for the implementation of policy for renewable energy, and the continuity of that policy. Supportive public opinion can also influence the market – either directly through building up private demand, or indirectly by stimulating demand and supply by the commercial sector wishing to communicate on its environmentally-friendly attitude.

In order to create a positive attitude towards renewable energy, countries have set up awareness and promotion campaigns, created institutions that provide access to information, and started education, sometimes as early as elementary school. In 2005, the British Wind Energy Association set up its first billboard advertising campaign to encourage people to show their support for wind energy. The first European Wind Day, took place on June 15th 2007 with events in 22 countries.

Setting up an effective and comprehensive wind energy policy requires dealing with a large number of various often complex issues. However, much experience has been gained in developed countries, and more recently in some developing countries such as China or India. This should help make things easier and faster for countries wishing to promote wind energy.

II. REVIEW OF THE ACTIVE UNDP-GEF **WIND ENERGY PORTFOLIO**

As of February 2007, the UNDP-GEF PIMS portfolio of projects contained 34 projects specifically related to wind energy. Twelve of these projects had been discontinued for various reasons and eight more had in practice, if not officially, been abandoned. This left 14 completed or active projects (cf. list in Annex 3).

Other projects related to renewable energy in general have implications for wind energy. They were not all systematically screened but a few were included in this analysis.

The information used to screen the projects in the portfolio derives mainly from the project documents (prodocs) as they are included in the PIMs database. The prodocs may not be exhaustive but they do show which aspects of wind power the developers thought necessary to emphasize as they were trying to get their project approved.

II.1 Distribution of Projects by Phase

MOST PROJECTS ARE STILL IN THE DESIGN OR IMPLEMENTATION PHASE. ONLY ONE WIND ENERGY PROJECT HAS BEEN COMPLETED (ALIZES ELECTRIQUES IN MAURITANIA (PIMS # 3316) WHICH WAS FINISHED IN 1998). ALL OTHERS ARE PENDING, WITH FIVE PROJECTS IN PHASE 3, THREE IN PHASE 2, FOUR IN PHASE 1 AND ONE IN PHASE 0.

THE PRODOCS FOR THE FIVE PROJECTS IN PHASE 3 WERE SIGNED IN 2004 AND 2005.

II.2. Distribution of Projects by Country

II.2.1. Projects in All Regions

The 14 projects are located in all regions.

AFRICA	ASIA & THE PACIFIC	EUROPE & THE COMMONWEALTH OF INDEPENDANT STATES	ARAB STATES	LATIN AMERICA & THE CARIBBEAN
Mauritania (2 projects)	Korea DPR	Kazakhstan	Tunisia	Uruguay
Eritrea	Pakistan	Azerbaijan		Mexico (2 projects)
South Africa	Iran	Ukraine		

II.2.2. Generally Good Wind Resources

Most projects are logically located in countries with good or very good wind energy resources. South Africa, Mauritania, Eritrea and Tunisia have been identified among the 15 most promising countries for wind energy in Africa by a study conducted for the African Development Bank.

Mexico and Uruguay are two of the 10 countries from Latin and South America identified by the Global Wind Energy Outlook 2006 as having good wind resources, with Mexico being one of the two best.

Pakistan, however does not have very good demonstrated wind resources, leading to the highest wind energy production costs among phase 2 and phase 3 projects. However, among the countries concerned by the projects, Pakistan is also the country with the highest current electricity production costs. By comparison, wind energy still remains an economically possible option for the country.

A number of countries that may have significant wind energy potential do not appear in the list of potential projects.

II.2.3. A Context of Liberalization /Privatization

Liberalization/privatization often offers new opportunities for the development of wind farms. Most projects are introduced in a context of some liberalization of the electricity sector and/or privatization of public utilities, although at different stages. Many public utilities do not wish to finance wind energy projects on their own as they are unfamiliar with the technology and often have no real incentive to switch from their usual ways of generating electricity. In such a context, the only possibility is the arrival of private developers. The project in Uruguay (PIMS # 2292) is the only one to explicitly rely on the public sector to develop wind farms. As discussed previously, this approach has not been successful in most cases.

Liberalization, with its train of legal and regulatory measures, is also a time to question and re-evaluate the national electric system and this can make it easier to introduce reforms concerning renewable energy. Since the whole electric system generally needs to be redesigned when liberalized, wind energy can be included from the start in the new design which is a more favourable scenario than when an existing system has to be adjusted to fit the specificities of wind energy.

The actual experience of different countries with IPPs is quite varied. It is limited in Mexico, almost nonexistent in Uruguay but stronger in Iran or Kazakhstan.

II.2.4. Various Electricity Prices

Electricity prices are very different in the various countries considered. South Africa, one of the world's major coal producers, is one of the countries with the lowest electricity prices, with production costs around 0.02$/kWh. Prices are also very low in Kazakhstan (0.025 to 0.035$/kWh) and Iran, both important oil-producing countries, even if they are expected to rise in all three countries. On the contrary, prices are very high in Pakistan, especially in some remote areas where they can reach 0.52$/kWh. The economics of developing wind farms are therefore different in each country. Low electricity prices make it harder to compete with "traditional" electricity production except where wind resources are very good.

Countries with projects in phase 3 or 4 can very roughly be divided in two categories:

Countries with significant fossil resources and which generally have high CO_2 emissions and historically low electricity prices. Wind energy projects can be profitable only with very favourable wind conditions and public support. Part of the revenues from energy exports could be used for renewable energy.	Countries with no significant fossil resources and which generally have lower CO_2 emissions and rather high electricity prices. Wind energy projects can compete with other energies even with average wind conditions although public support is necessary for all energy development projects. There are no specific identified revenues that can be allocated to renewable energy development.
KAZAKHSTAN, MEXICO, SOUTH AFRICA, IRAN AND, TO SOME EXTENT, TUNISIA	PAKISTAN, MAURITANIA, ERITREA, DPRK

Table 4: Countries with wind energy projects

II.3. Type of Projects

II.3.1. A Majority of On-Grid Projects

Out of 14 completed or active projects, more than three-quarters (11) aim at developing grid-connected medium to large-size wind farms (5MW or more).

Only projects in Mauritania (PIMS # 386) and DPRK (PIMS # 751) specifically focus on off-grid rural electricity supply while one project in Eritrea (PIMS # 179) aims at developing both off-grid and small, local grid-connected wind turbines. These three projects emphasize the positive consequences to well being and development that rural electrification brings to areas that previously had no or insufficient access to electricity.

The quite small number of wind power projects in this group could be explained by the fact that photovoltaic power generation is the primary source used in the large rural electrification programmes implemented in countries, such as South Africa, Brazil, India or Morocco.

II.3.2. A Main Emphasis on Barrier Removal through Public Policies

To some extent all projects include actions on the removal of barriers to the development and implementation of wind energy. The most common barriers can be listed in the following categories :

POLICY BARRIERS	The benefits of wind energy are not assessed and not taken into account for energy policy-making, resource and spatial planning.
INSTITUTIONAL, LEGAL, REGULATORY BARRIERS	There is no public body with adequate means and powers clearly responsible for developing wind energy; the legal framework for decentralised production is not available or is inadequate; procedures (licensing procedures, environmental impact assessments) entail inordinate burden; projects have no access to the grid and the market.
ECONOMIC AND FINANCIAL BARRIERS	Projects can not be profitable without fiscal or/and economic incentives that are not in place (exemption from payment of income tax, tax credits, exemption from import duties and taxes, allowance for accelerated depreciation, Feed-In tariffs, green premiums); projects are seen as too risky and can not find financing (soft loans; guarantee mechanisms, protection against foreign currency risks); fossil energy benefits from favourable conditions and/or subsidies; there are no PPA model contracts.
INFORMATION AND TECHNOLOGY BARRIERS	There is a lack of information and awareness on wind energy among policy makers and regulators as well as the general public; a lack of information on supply and demand for energy at dispersed level; a lack of data on wind resources; a lack of technical standards on components and turbines to control quality; a lack of local capacity to design, build, operate and maintain wind farms; a lack of national expertise in the design and manufacturing of wind plant components.

Table 5: The most common barriers to the development of wind energy

All categories of barriers are found to some extent in every country considered although they are not given the same attention. Only the project in Democratic People's Republic of Korea (PIMS # 751) is somewhat different from the others in that its main emphasis is really on enhancing the national capacity to design and develop, build and market small wind energy systems locally. It does plan for some barrier removal through capacity building in energy planning and policy-making, project management and evaluation and economic feasibility analysis, but that is not the bulk of the project.

To remove the barriers identified, the projects make use of the various public policies discussed in Chapter I. Most barriers are well addressed but others appear to be generally underestimated.

Comprehensive policies, strong political commitment and long-term targets

The project in **PAKISTAN** (PIMS # 624) which is the most recently signed project, is a good illustration of the need for a comprehensive policy that includes an adequate legal framework, tariff regime and incentives, wind resource assessments, national production possibilities and information and training. An overall wind energy policy package must be in place before going onto the second phase of implementing a wind farm and this condition was satisfied in Pakistan with the adoption of policy measures in December 2006. However, the need for quantified wind energy targets is not explicitly mentioned. The Ukraine project (still at the PDF stage) also proposes a regional plan with quantified targets.

In **CHINA**, the project "Capacity building for the rapid commercialization of renewable energy" (PIMS # 557) was also an important input for the design of the 2005 Renewable energy law mentioned in Chapter I.

Giving market access to wind energy

Developers, especially those working in risky countries with little IPP experience, will be looking for guaranteed long-term purchase agreements whether from Feed-In laws, Tenders or mandatory Quotas. Standardized contracts will make them even more comfortable. Whatever the level of the electricity buying price , international experience demonstrates the importance of long-term contracts to attract investors.

This key issue – ensuring stable, long-term financing – does not seem to be given the necessary attention in some projects and is not always an explicit objective. The different possible business models (public sector, IPP, self-supply, rural areas) are not always analyzed and well clarified in project proposals.

There is then a risk that even if a UNDP-GEF project achieves all its planned outcomes, wind energy will still not develop in the target country because of the lack of a stable scheme giving wind energy developers guaranteed access to the market and an acceptable rate of return. As shown in Figures 1 and 2 in Chapter I, it can take a few years before policies supporting wind energy produce their full effect. Therefore, it is important to start working on policies as early as possible and before committing extensive resources to other aspect of wind energy support.

In **KAZAKHSTAN** (PIMS #125), for instance, the PIR 2006 states that existing regulations for power purchase require a utility to purchase power through a bidding process on a least-cost basis. Therefore wind energy producers cannot be given a guarantee of selling their electricity. This major barrier was not discussed in the prodoc and its removal is not listed as one of the project's aims. The project, which only seeks to negotiate an exemption for the pilot wind farm, seems to be relying on increased electricity prices and better awareness of the negative environmental impacts of conventional power generation to make wind energy competitive.

In the **MEXICAN** project (PIMS #2222), with a similar background of least cost purchasing, the "introduction of appropriate financial mechanisms to encourage commercial wind power development" only occurs in phase II (which will probably never materialize). This surprising distribution between phases may however be explained by the fact that the project had to be divided into two phases at the last minute due to GEF funding shortages.

In the **KOREAN** project (PIMS # 751) local marketing activities are planned to promote Korean-made, improved, small wind energy systems. However, the target of these marketing campaigns is not clearly identified and neither is the potential decision-maker for the implementation of the wind turbines. If the wind energy policy is to be implemented by public bodies, marketing does not seem necessary in Korea's centralized economy, but if the project relies on private investors, support schemes will probably be necessary, although they are not scheduled.

As time goes by, more attention seems to be given to this issue.

The **IRANIAN** project (PIMS # 747), which is the most recent full-size project approved, shows more focus on ensuring the implementation of a long-term scheme with benefits continuing after the lifetime of the project. There is a clear objective of setting a production-based incentive scheme and finding how to finance it.

In the **UKRAINE** project (PIMS # 3136), still at the PDF phase, developing methods to determine tariffs for wind-based electricity is proposed as one of the five activities of the full-size project. The documents relating to the Azerbaijan project (PIMS # 3313), which is also still at the PDF stage, identify portfolio standards or fixed Feed-In tariffs as issues which "may form part of the project".

Permitting and licensing

Almost all projects include some form of review and adaptation of the institutional, legal and regulatory framework on grid-access and dispatch, and the construction of wind farms. These include spatial planning issues, environmental impact assessments, building approval processes, technical standards for performance, reliability and safety, among others. Legislation regarding the operation of wind farms, such as licences for electricity producers, or power purchase agreements, is also reviewed. However, it is not always clear from prodocs how extensive such reviews are intended to be and how far the project will go in actually drafting amendments and helping to get them implemented.

This key issue – ensuring stable, long-term financing – does not seem to be given the necessary attention in some projects and is not always an explicit objective

This topic is surprisingly missing in the South African project (PIMS # 1637).

Grid related issues

Only a small number of project documents mention grid-related issues such as connection charges, ability of the grid to accept intermittent production, grid stability, ancillary services, dispatching rules and other issues of this kind. This is quite surprising since some of the projects will actually lead to connecting wind turbines to small local grids where wind energy will account for a quite high proportion of total electricity supply . The possibility of

accepting all this fluctuant supply on the grid should always be checked before the beginning of the project.

The **UKRAINE** project (PIMS # 3136) does plan to "procure computer hardware and develop/adapt necessary software to undertake wind penetration factor studies to ensure the maximum wind penetration ratio that the grid will bear, without giving rise to electro-mechanical transients/instability that will cause the system to trip" and to "provide on-the-job training to local technical staff on the use of the various simulation tools."

The **TUNISIAN** project (PIMS # 2129) also includes "a study on the technical wind absorption capacity of the electricity grid, and identifying measures to reduce the impact of wind intermittency on the country's electricity grid" and "drafting specifications for wind farm operators and industrial wind producers to interconnect to the electricity grid, including minimum design standards and maintenance requirements for wind equipment" as well as providing "the necessary capacity building support and technical training ... to the STEG (which must be ready to accept independently produced wind energy onto its grid)".

The need to emphasize these issues should be considered in future project design.

National Industry Promotion

Few projects, apart from the one taking place in the DPRK, have objectives relating to the creation of a national industry for the production of wind energy components. This is not surprising, considering the size of some of the countries and their potential wind energy markets. In the Pakistan project there is provision for an assessment of the potential for local fabrication of some components, and in Uruguay, capacity building among local companies interested in entering the wind energy technology markets it is one of the project's expected outputs. However, the means used to identify and work with these local companies are not described.

Wind assessments

Wind assessments are generally well-planed and properly financed in the projects, both in terms of assessing resources at the national level and giving developers more detailed information on wind energy resources at the local level.

More advanced projects include providing equipment and training so that the wind resource assessments can go on after the end of the UNDP-GEF project.

Demonstration programmes

After, or in parallel to the barrier removal actions, all projects plan for the development of demonstration or pilot wind farms, which are designed to demonstrate the viability of commercial wind farms in the country and "test" the efficiency of the barrier removal programme. Pilot or demonstration wind farms can also help reveal any barriers that have not been removed and provide feedback for future developers.

Pilot projects generally range in size from 750kW to 100MW. The small ones are generally included in the project's initial workplan and budget. Larger ones (10MW or more) will have to be re-presented as a separate project or a second phase. for three countries (Mexico three farms of 15-to 30MW each), Pakistan 15MW, second pilot in South Africa 45MW) but are included for three countries (Iran: 20MW+28.4MW, Tunisia: 100MW, Uruguay: 10MW). The reason for these differences is not obvious in the project documents as neither higher risks nor higher costs seem to account for the two categories. The two-phase structure seems efficient in waiting to check that barriers have been removed and that a pilot wind farm is still necessary before committing extensive resources to financing a specific investment. It does however generate higher administrative costs which would justify reserving its use for larger projects.

In most of the projects, the conditions under which the demonstration projects are being developed are very specific, especially on economic aspects, and cannot be replicated. This low replicability potential is a strong limitation on the effectiveness of the demonstration project and to its impact in terms of market transformation. However, the most recent projects appear to take this issue into account better.

↘For **PAKISTAN** (PIMS # 624) which is the last prodoc signed, there is a two phase structure where one of the triggers to go on to the demonstration project for the second phase is that "it is determined that the demonstration plant could operate on a self-sustaining and financially profitable basis over its lifetime under the existing power generation and pricing regime without additional 'one-off' concessions (that would not necessarily be available to other commercial WE developers)."

The low replicability potential is a strong limitation on the effectiveness of the demonstration project and to its impact in terms of market transformation

↘In the **IRANIAN** project, even if there is some specific GEF financing for the first five years of the planed wind farm, the production bonus is mainly financed by the government of Iran, thus demonstrating some acceptance of this type of solution from the start.

Education and training

Most projects focus strongly on enhancing awareness on wind energy and its benefits among policy makers, building the capacity of developers and increasing technical skills of local firms.

II.4. Cost of Projects

II.4.1. GEF Funding and Co-Financing

Total cost of projects (excluding PDF) for projects in phases two, three and four ranges from US$ 1.42 million (DPRK) to US$ 124 million (Tunisia) with most projects (all but three) between US$ 3.8 million and US$ 11.8 million. GEF funding ranges from US$ 0.725 million to US$ 5.35 million, with leveraging co-financing from US$ 0.695 million to US$ 122 million.

	Mauritania – I	Eritrea	DPRK	Pakistan	Kazakhstan	Mexico	South Africa	Iran	Tunisia
GEF financing (US$ millions	2.195	1.951	0.725	3.1	2.55	4.736	2.0	5.35	2.0
Total cost of projects (US$ millions)	4.391	4.820	1.42	3.82	7.274	11.812	10.38	55.75	124

Table 6: GEF financing and total cost of wind energy projects

The size of the pilot wind farms, and whether or not they are included in the budget, are the most obvious explanations for the differences that can be observed. GEF is often the main contributor for the barrier removal part of the project while pilot wind farms are generally mainly financed by the private sector.

When one looks only at the capacity building and barrier removal actions, which could be called "public policy actions", without taking into account the cost of pilot wind farms, the cost is more stable but still ranges from US$ 1.3 million to US$ 4.75 million.

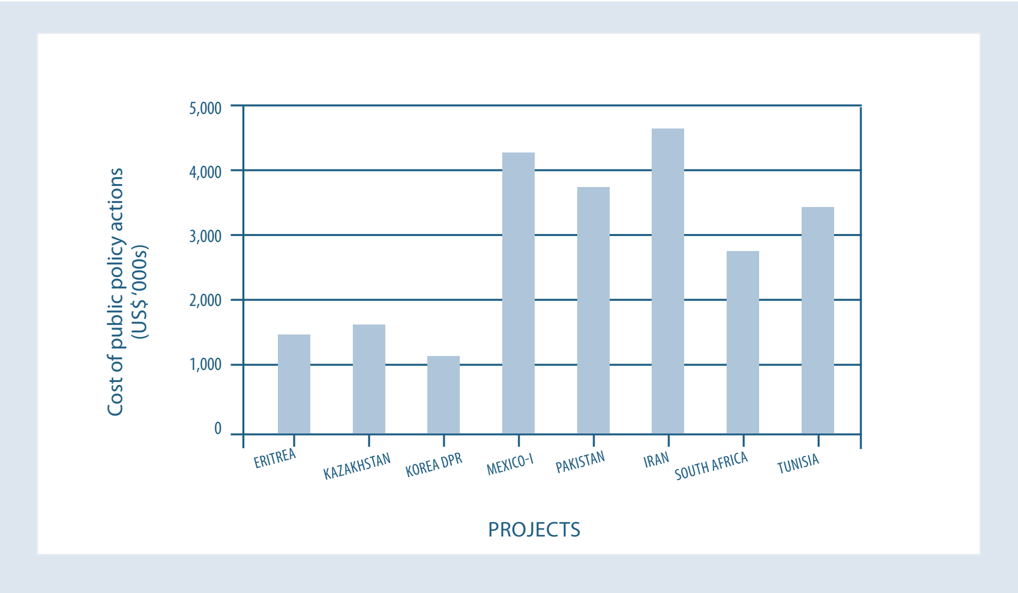


Figure 3: "Public policy actions" costs

II.4.2. Ex-Ante Cost Effectiveness

Unfortunately, the data needed to do cost-effectiveness analysis is not always available. With as few as five projects for some of the ratios calculated below, it is difficult to draw definite conclusions. One recommendation would be to choose a small number of indicators and ensure they are calculated and clearly presented for each project.

To look at cost effectiveness of projects, two ratios have been analysed.

II.4.2.1. Cost of "Public Policy Actions" over Expected Installed Capacity (k$/ MW)

The first ratio is the cost of "public policy actions" compared to the expected mid term (2015-2020) wind energy installation figures as they are presented in the project documents (cf. Figure 4 below). This ratio shows what investment has been necessary to create the public policies and enabling environment that will bring the installed wind energy capacity to grow in the mid-term.

This figure ranges from US$ 1/W to US$ 4/W for most of the countries where the data is available. Two countries stand out: Eritrea with a ratio of 50 and South Africa with a ratio of 14.

The high number for Eritrea can be explained by the small objective for wind energy (30MW) in relation to the small capacity of the electricity system (156MW). Barrier removal costs are not in proportion to the size of the electricity system, so it is quite natural that the ratio should be higher for smaller countries. (In a lesser way, this also applies to Kazakhstan). Also, the Eritrea project has high local sustainable development impact by providing increased access to electricity where about 95 percent of the rural population are currently without such access.

In South Africa, the current mid-term objectives are also relatively small. Until 2013, wind energy will not be the cheapest renewable energy and barrier removal efforts are aimed at preparing further wind energy developments after that date. The government has not yet committed itself to higher targets after 2013.

The lower figure for Tunisia could be explained by the amount of work that had already been done before the project began (including in the PDF) to promote wind energy and make it better known.

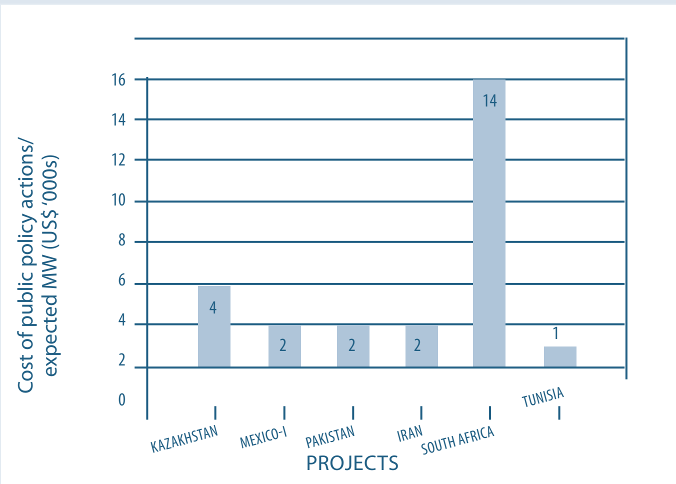
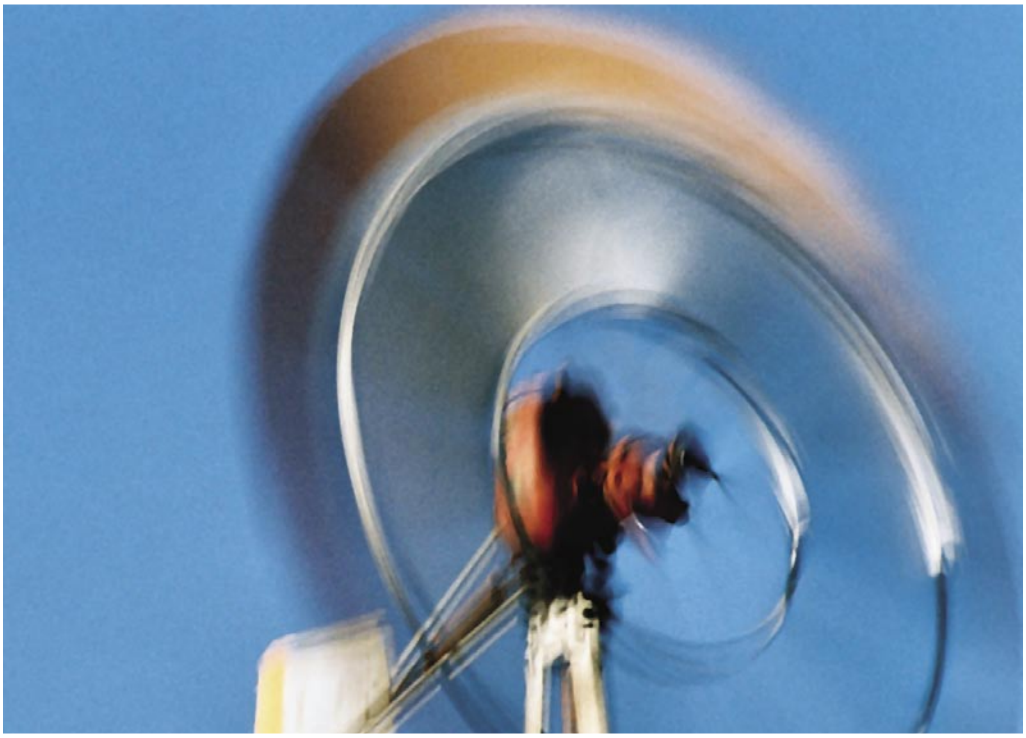


FIGURE 4: COST OF "PUBLIC POLICY ACTIONS"/MID-TERM EXPECTED INSTALLED CAPACITY (THE ERITREAN PROJECT WITH A RATIO OF 50 IS NOT INCLUDED FOR REASONS OF READABILITY).



II.4.2.2. Cost of Direct CO2 Emission Reductions

A second ratio is the total cost of the project compared to the direct CO2 emission reductions it has generated. Once again, for the Eritrean project, the ratio is much higher than for the other projects because of "fixed costs". The better results for Kazakhstan can be explained for about two-thirds by the country's higher rate of CO2 emission reductions per MW of wind farm (4,000tCO2/MW instead of 1,600 to 2,000 for Iran, South Africa, and Tunisia). This is related more to the structure of Kazakhstan's electricity production than to the efficiency of the project.

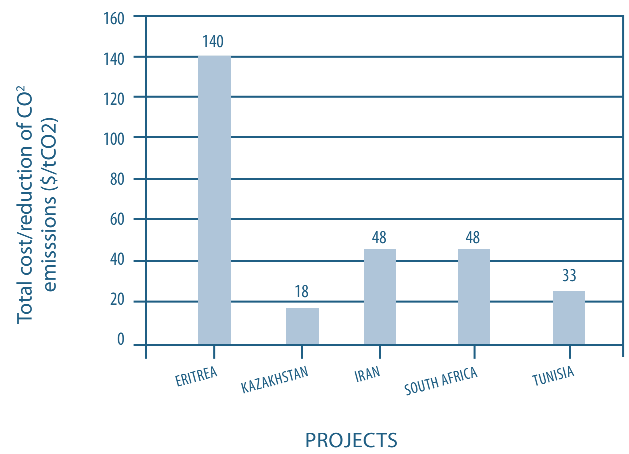


Figure 5: Cost of projects/CO2 emission reductions

II.5. Project Impact

ONLY ONE OF THE PROJECTS IS COMPLETED AND NONE OF THE OTHERS SEEM TO BE SUFFICIENTLY ADVANCED FOR CLEAR CONCLUSIONS TO BE MADE ON THEIR SUCCESS, ESPECIALLY REGARDING POLICY ISSUES.

The Mauritanian project (PIMS # 386) was completed eight years ago and should have produced results in terms of replication. However this does not seem to be the case. As recommended in the project evaluation, the UNDP-GEF project has been followed by a second phase financed by the French Development agency and the French Development Fund. An evaluation conducted after this second phase in 2004 showed mediocre results with many of the wind turbines that had been installed during the project not working anymore. The results of this evaluation should be closely scrutinized before another wind energy project is designed in Mauritania, even if it is more urban. This is the case with a new project (PIMS # 3316) currently in the PDF phase.

Only three projects have a project implementation report (PIR) for 2006. These documents analyze whether the programme is being implemented as planned but not if it is successful in generating results in terms of wind energy development. The projects were rated as follows:

ERITREA (PIMS#179): Satisfactory, although an increase in prices of turbines has led to a need to reevaluate the budget.

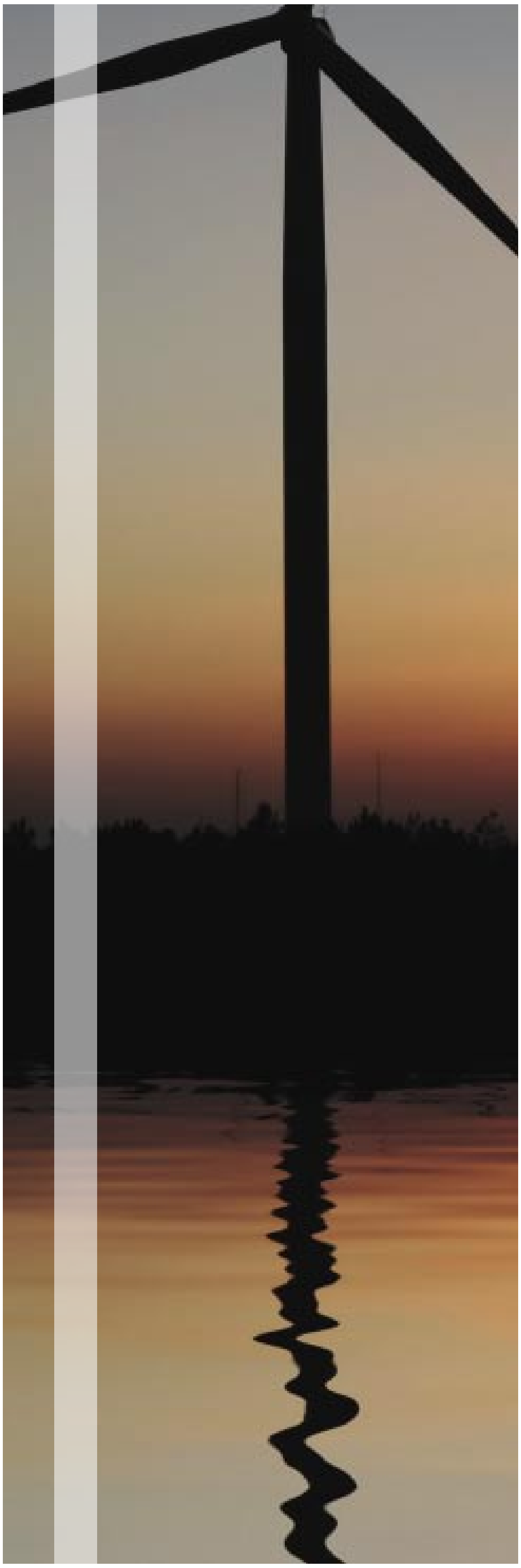
KAZAKHSTAN (PIMS # 125): Marginally satisfactory. There have been delays in implementation and lower than expected participation from the government.

MEXICO (PIMS#2222): Satisfactory. A law has been passed; wind resource assessments have been made at the most promising areas; after a delay the land tenure has been secured for the regional wind technical centre.

Indeed, for Mexico, the barrier removal programme started early in 2004 and the Mexican government prepared measures in favour of renewables in 2005, including a “renewable energy utilization law”, a contract for the connection to the grid of intermittent sources and accelerated depreciation. A target was set for eight percent of renewable electricity production (without large hydroelectricity) by 2012. These measures have not yet resulted in a clear trend of wind energy projects (wind energy’s share actually decreased in Mexico in 2005) but could be the beginning of a new policy.

In Pakistan, a new comprehensive set of policy measures for renewable energy was adopted in December 2006 with mandatory purchase of renewable electricity from renewable sources by the utility, models of PPA contracts, defined permitting and licensing procedures with limited processing times by the authorities, and fiscal exemptions. Producers are given a choice between set or negotiated tariffs. When buy-back tariffs still are negotiated on a case-by-case basis, they are to be calculated according to general published rules. Even if some problems remain (among which might be the cost of registration and licensing) this policy is a major step forward for renewable energy in Pakistan. The adoption of such a policy was a condition for proceeding to the second phase of the GEF project and this tactic seems to have worked well.

III. NEW PROJECTS - CHOOSING AND DESIGNING THE BEST MECHANISM FOR EACH COUNTRY



As shown in Chapter II, the design of UNDP-GEF wind energy projects already incorporates some of the conclusions from the analysis of the successes or failures of public policies implemented around the world. An even more systematic approach can be adopted regarding the choice of priority countries and recommendations on the choice and design of the policies to be implemented.

III.1. Choosing Priority Countries

WIND ENERGY SUPPORT POLICIES, AS DESCRIBED IN THIS DOCUMENT, WILL BE MORE OR LESS DIFFICULT TO IMPLEMENT DEPENDING ON COUNTRY SPECIFICITIES. CONCENTRATING PROJECTS IN COUNTRIES WHICH HAVE THE KIND OF ENVIRONMENT THAT OFFERS THE BEST CHANCES OF SUCCESS FOR WIND ENERGY CAN HELP MAXIMIZE THE EFFECTIVENESS OF THE MONEY AVAILABLE.

In all cases, before beginning to support the design and implementation of a wind energy policy in a particular country, it should be demonstrated that, at the same time as it is promoting wind energy, the government of that country is also working on energy efficiency and energy savings. Otherwise, the benefits of the renewable energy policy can be more than written off by the increase in energy consumption. In EU-15 for instance, despite the efforts on renewable energy policies, the share of renewables actually decreased (slightly) between 1995 and 2005 (from 20.7 percent to 20.5 percent). Pushed by constantly growing energy consumption, conventional energies grew faster than renewables despite strong policies in favour of renewable energy at the European and national levels.

Wind energy generally has better chances of being successfully developed in countries with the specificities described in this section.

A real commitment from policy makers to develop wind energy. Policy-makers should be ready to set mid-term public quantified targets. If the necessary data to do so is not available at the beginning of the project, one of the key project objectives should be to make the data available so that a public commitment can be reached as early as possible.

A legitimate public authority to set rules and obligations and enforce them in a way that will appear credible to investors. However well-designed a policy may be, if it is not enforced it will bring no benefits to wind energy developers and may even put them at risk.

Some privatization or liberalization of the electricity market and some experience with Independent Power Production. A model which is only public-based will generally only bring about limited wind energy development and, if there is little experience with private electricity producers, the learning curve will be longer.

A grid that has enough capacity and technical stability to accept large amounts of wind energy without jeopardizing its security. The level of expertise of the company operating the grid is also critical. If grid operators do not feel that they can deal confidently with the technical issues created by connecting wind farms to the grid, they will most likely try to block wind energy developments from the start.

High electricity prices against which wind energy will be more easily competitive. Even if enabling public or public funds are still necessary, their cost will be much smaller and thus easier to finance.

A sufficiently large commercial wind energy potential (which means a much larger technical potential) to compensate for the costs of designing and setting the policy and removing barriers. Since these costs are not directly linked to the wind potential, the cost-effectiveness will be greater in countries with larger resources (cf. Figure 4). An indicative threshold of 1,500MW to 2,000MW can be considered. This potential does not need to be precise but the range needs to be demonstrated with reasonable confidence. Refining wind potential analyses should otherwise be the first priority before significant financial resources are committed to a country. One strategy for UNDP would be to start working systematically on countries that have successfully participated in the SWERA programme.

A reasonable wind energy potential is also necessary to attract private investors, who also have to bear transaction costs, to set up a new wind energy activity in a country.

However well-designed a policy may be, if it is not enforced it will bring no benefits to wind energy developers and may even put them at risk.

III.2. Choosing the Best Policies for Each Country

WIND ENERGY SUPPORT POLICIES, AS DESCRIBED IN THIS DOCUMENT, WILL BE MORE OR LESS DIFFICULT TO IMPLEMENT DEPENDING ON COUNTRY SPECIFICITIES. CONCENTRATING PROJECTS IN COUNTRIES WHICH HAVE THE KIND OF ENVIRONMENT THAT OFFERS THE BEST CHANCES OF SUCCESS FOR WIND ENERGY CAN HELP MAXIMIZE THE EFFECTIVENESS OF THE MONEY AVAILABLE.

In order to be successful wind energy policies should:

- Be long-term and consistent;
- Include legally-binding targets or obligations and the means to enforce them;
- Offer wind energy producers standardized long-term contracts with secure payment mechanisms and an acceptable rate of return;
- Provide fair and open grid access and development;
- Provide good governance and appropriate streamlined procedures; and
- Create strong public acceptance and support.

Reviews of the legal and regulatory framework, wind measurements, capacity building will be necessary in all countries wishing to set up a wind energy policy.

There is more choice concerning the type of support scheme used to give producers access to the market. Different types of business models can exist: self-suppliers, isolated areas, development and/or operation by public entities. Specific niches can exist where wind energy is easier to develop. However, up to now, the key to a large wind energy sector has been the independent producer model in all countries.

As stated in Chapter I, a Feed-In system is probably overall the safest policy choice for any country really committed to developing wind energy. It has proved to provide good results and experience is widely available for replication. However, design and adequacy with national specificities and economic culture are critical to a successful policy. The Conference on Grid-Connected Renewables hosted by the World Bank in Mexico in February 2006 highlighted the fact that many developing countries are still searching for the most appropriate mix of regulation, market incentives and tendering process to attract private wind energy developers without requiring unacceptable subsidies from ratepayers or the public treasury.

The main considerations before choosing one mechanism over another are:

Type of economy. In a country with very strongly displayed liberal and market-based values, a government-led Feed-In tariff might be less accepted than in a more centralized economy. Feed-In systems are some times assimilated to subsidies, even though successful Quota policies also lead to long-term power purchase agreements with utilities that are almost identical to those that would result from a Feed-In law, and there is no evidence to show that the cost to the community is lower. In Europe, the cost has even turned out to be significantly higher. In countries with central resource planning, tendering can be a favored option.

Level of competition and maturity in the electricity market. With the Quota system, the price of wind energy is set by the market rather than by a public authority. If there is not enough competition in the electricity market, the utility (or utilities) buying wind energy might be able to use their market power to impose low prices that will limit the interest of developers in the country. It is necessary to involve a sufficient number of actors if there is to be some liquidity in the market. Also, if there is not enough experience with IPPs in general, it will be more difficult for wind energy producers to enter power purchase contracts with utilities. When the Quota system is monitored with green certificates, wind energy producers still have to find a way to sell the electricity they produce on regular wholesale or retail electricity markets. Considering the characteristics of wind energy, especially intermittency, this requires a mature electricity market.

In electricity markets with limited competition, Feed-In tariffs might be more adequate. However, if unbundling of the utilities has not taken place, strong regulation must ensure that electricity buyers do not try to recover some of their costs or set up barriers through the grid that they also operate. Electricity buyers might try to do this to reduce volumes of wind energy bought and corresponding costs. Feed-In tariffs can also work in competitive electricity markets but a cost-sharing mechanism between utilities has to be set up to avoid disadvantaging some of them. This naturally makes the system more complex.

For Tendering processes, the level of competition is not an issue but, as for other policies, national experience with IPPs will make things easier for developers.

↘**Number of existing wind farms.** Countries with very little previous experiences in wind energy are more risky for investors. Business models have not been well demonstrated and barrier removal programmes, even if they have been implemented, have not proved their efficiency. Because they carry additional risks on the level of revenues, Quota systems are generally not very attractive to investors in this situation. Tenders, because they have less continuity, might also not be enough at first to bring developers to invest in a new country by training people or financing wind resource studies and therefore are not an adequate long-term policy for an immature wind energy market. A few Tenders can however be a way of bringing forward first demonstration or pilot projects. For Quotas and Tenders, if there are very few players in the wind energy market, there will not be enough competition to bring down prices, thus missing what is generally seen as the main theoretic advantage of Quota policies and Tenders. Feed-In tariffs are more adequate in this type of situation.

↘**National industry objectives.** Countries with large wind energy potentials will often wish to establish a national wind energy manufacturing industry in order to reduce costs and maximize local benefits. Aside from policies directly aiming at creating a national industry (cf. I.4.3.), Feed-In tariffs probably provide a better environment for building a local industry by providing stable conditions that are the same for all sizes of producers and will lead to long-term cost reductions as the wind energy market grows. With a Quota system or Tenders, wind energy producers need to compete against one another for the power purchase contracts. As they look for immediate price reductions, utilities might be drawn to large international producers with established experience and a wide market base, allowing for savings of scale.

↘**Strong Regional Policies.** Regional Feed-In tariffs can be a way of adapting the level of payments to the wind resources of the region instead of having to resort to more complex calculation methodologies at the national level. However, geographic division of regions does not always match wind maps. Regional Quotas can lead to small markets with few players and higher prices if regions are too small. This can be compensated by allowing "imports" but is rarely the case as regional authorities generally wish to maximize local benefits and avoid paying for energy produced in other areas.

High level of technical expertise at government level. Even though tariffs initially need to be set by a public authority, Feed-In laws are generally considered simpler to administer and enforce. The experience with Quota systems in various American states shows that results depend strongly on the design and enforcement of the system.

In a very simplified way, this analysis can be summarized in the following table.

	Strong free market philosophy	Competitive electricity market	Significant number of existing wind farms	National industry objectives	Strong regional policies	High level of government expertise
Yes	Quota or Tender	Quota or Tender or Feed-In with cost-sharing mechanism	Any	Feed-In	Depending on local circumstances	Any
No (or limited)	Feed-In or Tender	Feed-In or Tender	Feed-In	Any	Any	Feed-In

Table 6: Key questions to choose a wind energy support scheme

III.3. Designing the Mechanisms

ALL POLICIES SHOULD BE DESIGNED IN A WAY THAT MAKES THEM EASY TO UNDERSTAND AND USE FOR WIND ENERGY DEVELOPERS. AS MORE EXPERIENCE ON THE DIFFERENT POLICIES IS GAINED AROUND THE WORLD, SYSTEMS TEND TO GET MORE SOPHISTICATED, BRINGING MORE CERTAINTY TO QUOTAS AND MORE FLEXIBILITY TO FEED-IN TARIFFS.

However, with these benefits also come additional complexity and costs. Those countries which are only beginning their wind energy support policy should not necessarily try to include all these innovations but stick to robust, proven methodologies. Except if major problems are observed, countries should also keep their initial policy designs over long periods. Experience shows that with constant reviews and changes, drawbacks linked with uncertainty often exceed the induced benefits of improving the system.

Geographic distribution of projects is also an issue that needs to be given consideration, whatever the type of policy. While some countries might choose to concentrate wind energy projects in a few well-chosen areas because local specificities allow it, it is often better to obtain some dispersal of projects in order to spread out benefits but also lessen any local inconvenience that wind farms may cause. Concentrating too many projects in the same zone has often proven to lead to rejection of wind energy and creation of a strong opposition to all projects. If dispersal of projects is an objective, it needs to be integrated into the policy design. For Feed-In Tariffs, this often means specific provisions allowing lower wind projects to achieve an acceptable rate of return. For Quotas, this can require specific geographical requirements.

In all cases, even if they have higher transaction costs, output-based schemes are preferable to investment-based schemes as the later do not give sufficient incentive to generate and maintain performance.

For each type of policy some key issues require special attention.

Feed-In laws

The key elements of a successful Feed-In law are:

- **A stable policy** applicable over a long period of time;
- **A long-term contract** allowing for guaranteed prices until developers have recouped their costs;
- **A reasonable rate** of return;
- **Enough flexibility** to capture effective cost reductions; and
- **A cost-recovery mechanism** for monopoly utilities and a cost-sharing system for utilities in competitive markets.

Quotas

The key elements of a successful Quota system are:

- **A long-term obligation** (at least 10 years or even 15 years ahead) with strong enforcement;
- **Realistic target levels** (that can be reached at reasonable cost but significantly exceed existing capacities);
- **A level of penalty** at, or above, compliance costs;
- **A regulator** to monitor the system;
- **Long-term power** purchase contracts; and
- **Clear rules** and limitations regarding eligibility (existing/new plants) and compliance flexibility (banking, borrowing).

Tenders

The key elements of a successful tendering policy are:

- **Long-term objectives** and planning of tenders made public with regular rounds;
- **Large enough tenders** to achieve economies of scale;
- **High penalties** for plants not built; and
- **Choice of projects** based, not only on price, but also on technical and financial capacity to avoid committing resources to projects that will not materialize.

When setting up on-grid wind energy barrier removal projects, using these guidelines to choose priority countries and to select key issues that will be dealt with during the project can help concentrate available funding and resources on countries and projects which have the best chances of success with their wind energy policy.

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Annex 2 - EUROPEAN COMMISSION : COMMUNICATION ON 'THE SUPPORT OF ELECTRICITY FROM RENEWABLE ENERGY SOURCES' 07 DECEMBER 2005 – (SEC(2005) 1571)

Costs of current support systems and effectiveness

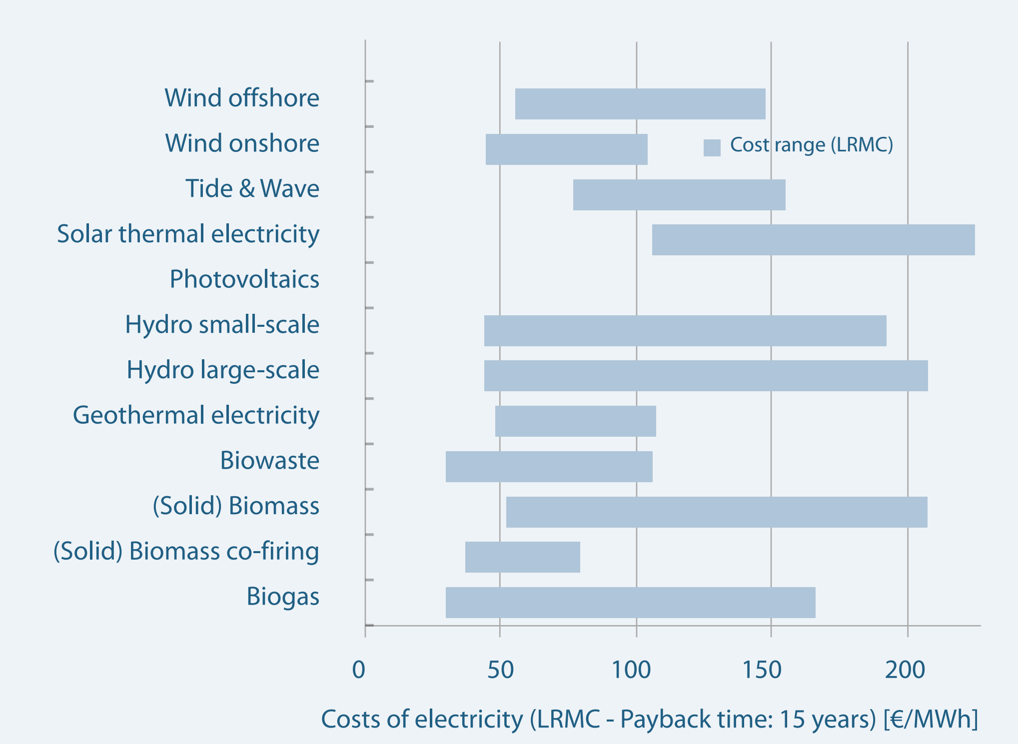

FIGURE 1: COST OF ELECTRICITY GENERATION – LONG-RUN MARGINAL COSTS (LRMC). SOURCES: FORRES REPORT.

The generation cost for renewable energies shows a wide variation (see Figure 1). Any assessment of support schemes should therefore be carried out for each sector.

The current level of support for RES-E differs significantly among the different EU Member States. This is due to the different country-specific cost-resource conditions and the considerable differences in the support instruments applied in these countries. In order to compare the prices paid for the different RES-E generation options with the costs in each Member State, both quantities are analyzed and shown simultaneously for wind onshore, agricultural biogas, biomass forestry, small-scale hydropower and solar photovoltaic.
Before comparing costs and support levels among the countries, we have to make sure we are dealing with comparable quantities. In particular, the support level in each country needs to be normalized according to the duration of support in each country, e.g. the duration of green certificates in Italy is only eight years compared to 20 years for guaranteed feed-in tariffs in Germany. The support level under each instrument has therefore been normalized to a common duration of 15 years. The conversion between the country-specific duration and the harmonized support duration of 15 years is performed assuming a 6.6 percent interest rate.

Only minimum to average generation costs are shown because the readability of the graphs would suffer if the upper cost range for the different RES-E were shown as well.

Effectiveness[7] can be defined in simple terms as the outcome in renewable electricity compared to what remains of the 2020 potential. This means that a country with an 8 percent yearly average effectiveness indicator over a six-year period has been delivering 8 percent of the 2020 potential every year over that period – as is the case for Germany in Figure 5 (wind). Over the complete six-year period, therefore, 48 percent of Germany's 2020 potential has been deployed.

In more complex terms, effectiveness is defined as the ratio of the change in the electricity generation potential over a given period of time to the additional realizable mid-term potential by 2020 for a specific technology, where the exact definition of effectiveness reads as follows:

$$E_n^i = \frac{G_n^i - G_{n-1}^i}{ADD\text{-}POT_{n-1}^i}$$

E_n^i Effectivess Indicators for RES technology *i* for the year *n*

G_n^i Electricity generation potencial by RES technology *i* in year *n*

$ADD\text{-}POT_{n-1}^i$ Additional generation potential of RES technology *i* in year *n* until 2020

This definition of effectiveness is a measure of the available potentials of a specific country for individual technologies. This appears to be the correct approach since Member State targets as determined in the RES-E directive are based mainly on the realizable generation potential of each country.

The yearly effectiveness of a Member State policy is the ratio of the change of the electricity generation potential in that year compared to the remaining additional realizable mid-term potential until 2020 for a specific technology.

[7] The source of the indicators for Annexes 3 and 4 is the work carried out under the OPTRES contract of the European Commission, Contract EIE-2003-073.

Figure 2 below shows the concept of the yearly effectiveness indicator:

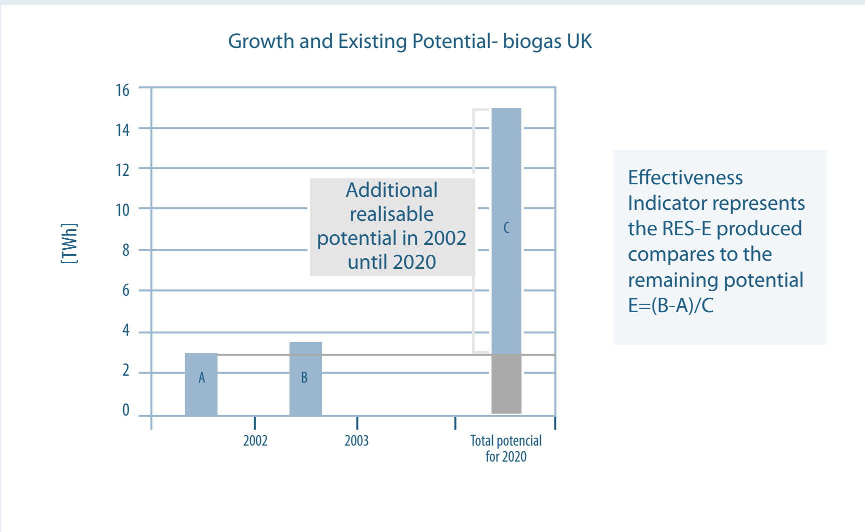

Figure 2: Growth and Existing Potential- biogas UK

The indicators included in this communication are calculated in an average period of six or seven years[8]. In Figure 2, we show the annual effectiveness indicator for the particular example of biogas in UK for the years 1998 until 2003 as well as the average during the period. The interpretation of this indicator can be pursued as follows: if a country has an average effectiveness indicator of 3 percent – as indicated by the dot line in Figure 3 – it means that it has already mobilized a 17 percent of its additional potential until 2020[9] in a linear manner.

[8] The period of seven years applies to the case of wind energy and PV.
[9] As the remaining potential decreases every year that more renewable electricity is generated, the complete figure is 17 percent instead of 18 percent (3 percent x 6 years).

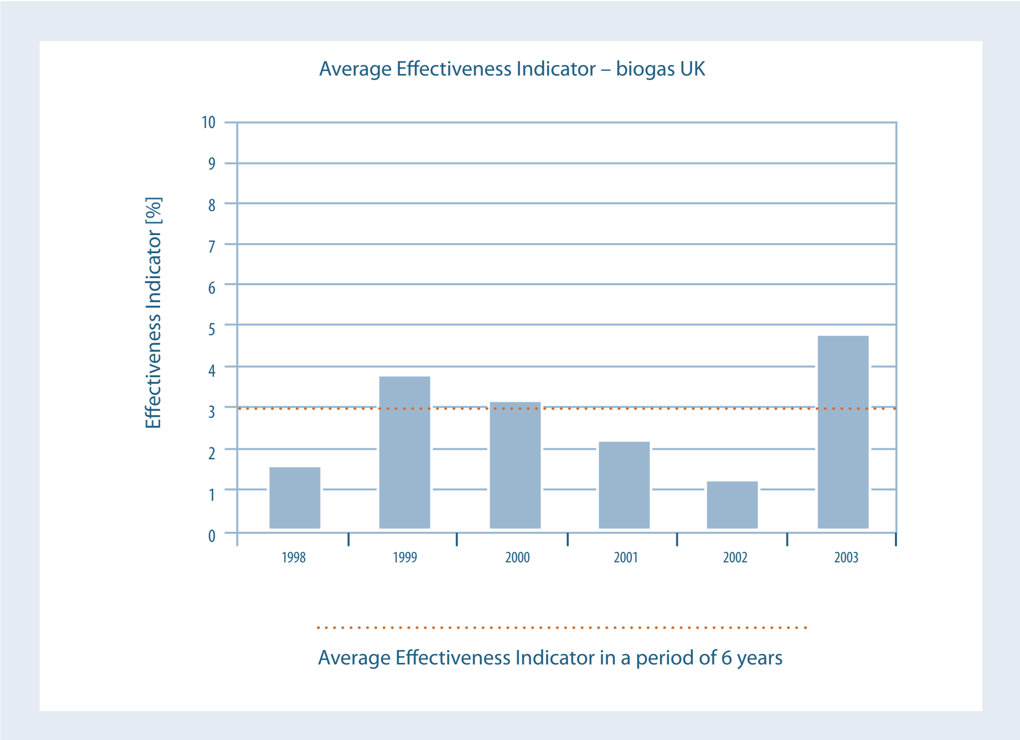

Figure 3: Average effectiveness indicator for the period 1998-2003 – Example biogas in UK

In the following section, effectiveness indicators are shown for the sectors wind onshore and solar photovoltaic for the period 1998-2004, and solid biomass, biogas and small hydro for the period 1998-2003. It must be clarified that in the subsequent section for the period 1997-2003, over which the effectiveness indicator is analyzed, a mixed policy is considered in Belgium, France, Italy, the Netherlands, Sweden and the UK.

Wind energy

Figure 4 and Figure 6 show the generation cost of wind energy and the level of the supported prices in each country. Support schemes for wind vary considerably throughout Europe with values ranging from €30/MWh in Slovakia to €110 per MWh in the UK. These differences – as seen in Figures 4 and 6 – are not justified by the differences in generation costs. Generation costs are shown in a range based – in the case of wind – on the different bands of wind potential.

How effective are these support schemes? The definition of effectiveness has been taken as the electricity delivered in GWh compared to the potential of the country for each technology. (See opposite)

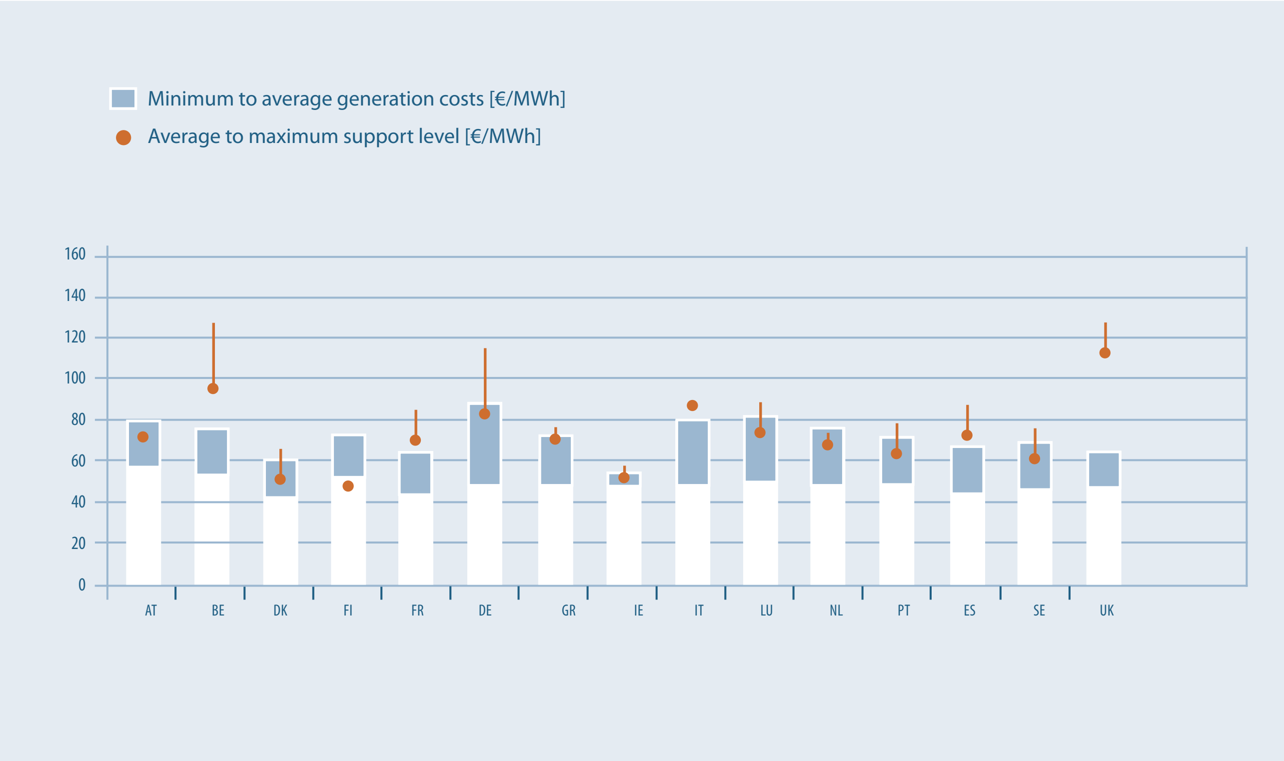

Figure 4: Price ranges (average to maximum support) for direct support of wind on-shore in EU-15 Member States (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Support schemes are normalized to 15 years.

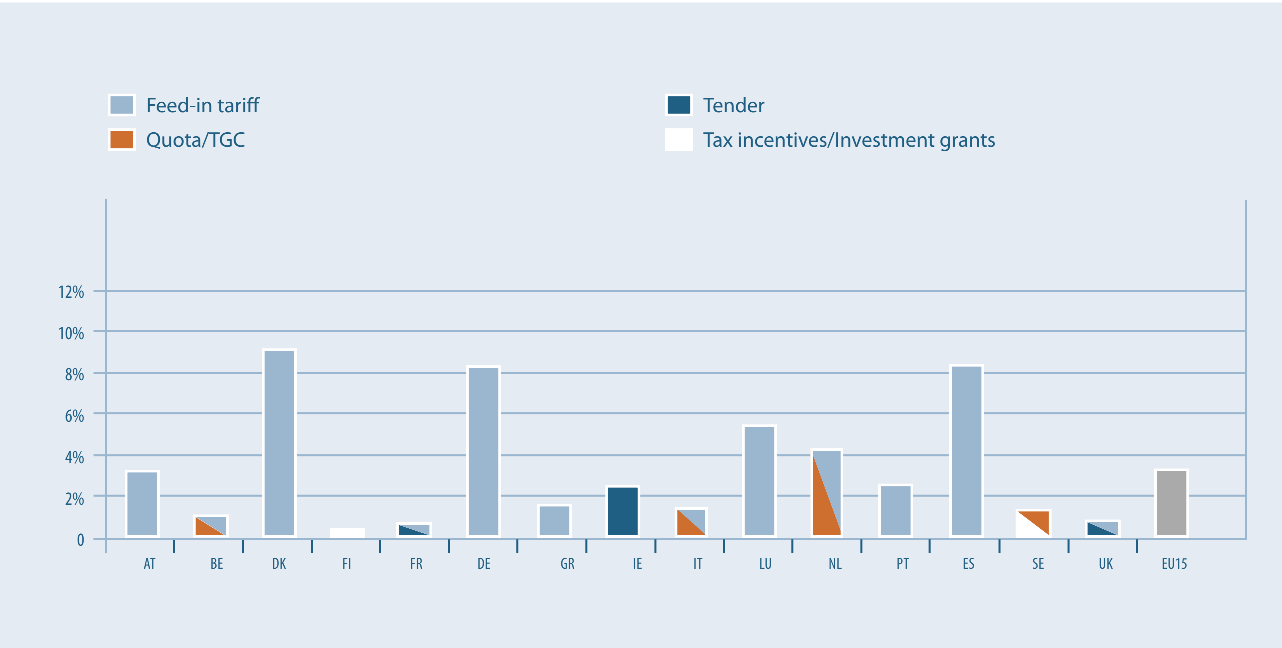

Figure 5: Effectiveness indicator for wind onshore electricity in the period 1998-2004. The relevant policy schemes during this period are shown in different colour codes.

The three countries that are most effective in delivering wind energy are Denmark, Germany and Spain as can be seen in Figure 5.

Germany applies a stepped tariff with different values depending on wind resources. France uses the same system. This stepped support scheme – although controversial as it does not use only the best potentials – is justified at national level in order to extend potential resources in the country and avoid concentration in one region and hence the 'nimby' effect. The values used in Figure 4 consider the maximum tariff for Germany[10].

It is commonly stated that the high level of feed-in tariffs is the main driver for investment in wind energy especially in Spain and Germany. As can be seen, the level of support is rather well adjusted to generation cost. A long-term stable policy environment seems to be the key to success in developing RES markets, especially in the first stage.

The three quota systems in Belgium, Italy and the UK, currently have a higher support level than the feed-in tariff systems. The reason for this higher support level, as reflected in currently observed green certificate prices, can be found in the higher risk premium requested by investors, the administrative costs and the still immature green certificate market. The question is how the price level will develop in the medium and long term.

Figure 4 shows the three countries with the lowest support: FI, DK and IE. The situations in these countries are very different. DK has a very mature market with the highest rate per capita of wind installations in the world and current support is concentrated in re-powering[11], while IE has the best wind potential in Europe but only 200 MW installed capacity, and Finland has chosen a policy of biomass promotion and provides too little support to initiate stable growth in wind.

For the EU-10, the comparison of costs and prices for wind onshore as shown in Figure 6 leads to the conclusion that the supported price level is clearly insufficient in Slovakia, Latvia, Estonia and Slovenia, as the level is below marginal generation costs.

The level seems to be sufficient in at least Cyprus and Czech Republic. For countries like Hungary and Lithuania, support is just enough to stimulate investment[12].

[10] Germany wind onshore: tariff €87/MWh (maximum tariff). Duration of support is 20 years. Interest rate: 4.8 percent (considering the soft loans granted by the German federal government). Wind conditions: 1 750 full load hours (country-specific average).
[11] The DK system is now concentrating on re-powering (replacement of old turbines by more efficient ones) and offshore which is not included in this text.
[12] For Poland no figures are shown since a green certificate price cannot yet be given.

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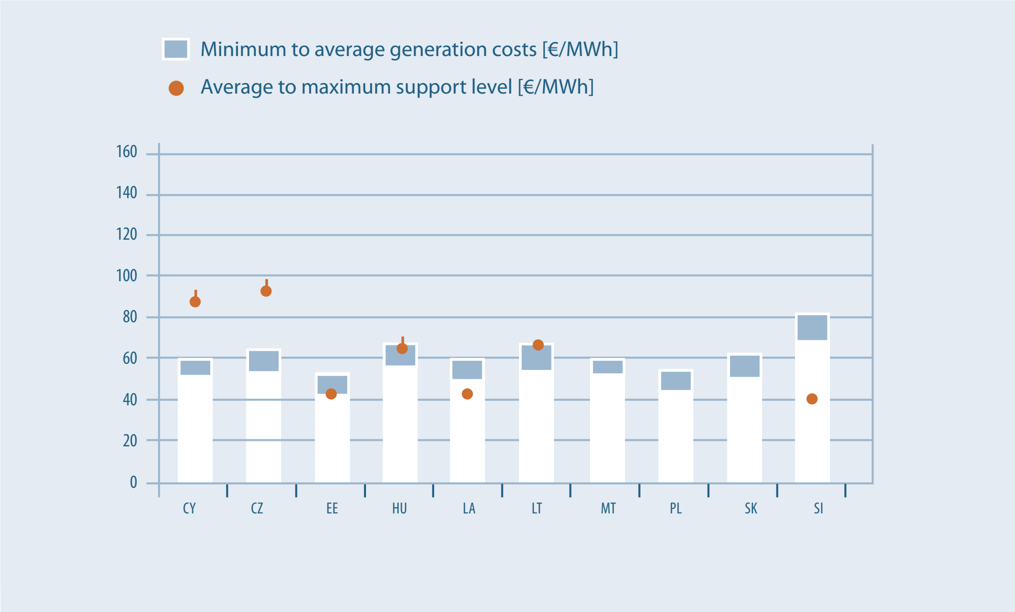

Figure 6: Price ranges (average to maximum support) for supported wind onshore in EU-10 Member States (average tariffs are indicative) compared to the long term marginal generation costs (minimum to average costs).

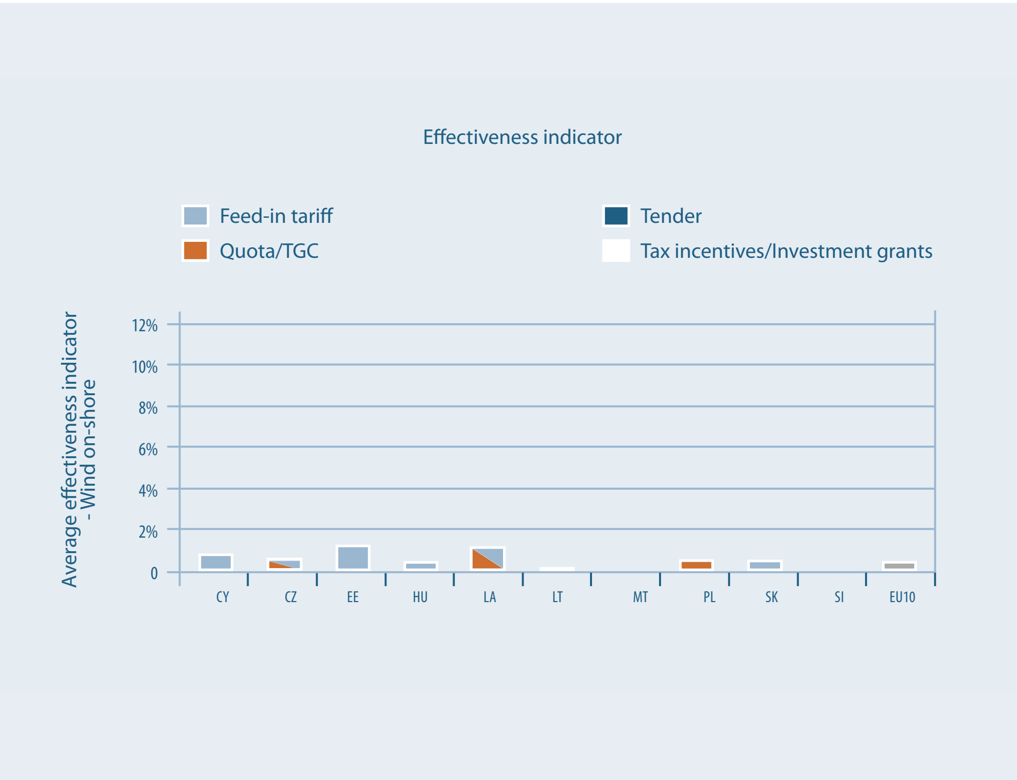

Figure 7: Effectiveness indicator for wind on-shore electricity in the period 1998-2004. The relevant policy schemes during this period are shown in different colour codes.

Annex 3 - LIST OF UNDP-GEF PORTFOLIO WIND ENERGY PROJECTS

PIMS NUMBER	COUNTRY	PHASE	STATUS	TITLE
386	Mauritania - I	4	Completed	Decentralized wind electric power for social and economic development (Alizes Electriques)
179	Eritrea	3	On going	Wind Energy Applications in Eritrea
125	Kazakhstan	3	On going	Removing Barriers to Wind Power Production in Kazakstan
751	Korea DPR	3	On going	Small Wind Energy Development and Promotion in Rural Areas
2222	Mexico - I	3	On going	Action Plan for Removing Barriers to the Full Scale Implementation of Wind Power in Mexico, Phase I
624	Pakistan	3	On going	Sustainable Development of Utility-Scale Wind Power Production
747	Iran	2	On going	Removing Barriers to Large Scale Commercial Wind Energy Development
1637	South Africa	2	On going	South Africa Wind Energy Programme (SAWEP)
2129	Tunisia	2	On going	Development of On-grid Wind Electricity in Tunisia for the 10th Plan
3313	Azerbaijan	1	PDF-A	Removing barriers to Sustainable and Commercial Wind Energy Development in Azerbaijan
1795	Brazil	1	Abandoned	MSP: Aeolic Centers (40 MW) for the Northeast Region of Brazil -CONCEPT
1694	Lithuania	1	Abandoned	Regional Baltic Wind Energy Programme
3316	Mauritania - II	1	PDF-A	Mauritania On Grid Wind Project
1647	Niger	1	Abandoned	Wind energy for water pumping in Niger
3136	Ukraine	1		Power Sector Policy Reform to Support Wind Power Development
2292	Uruguay	1		Uruguay Wind Energy Programme (UWEP)
2676	Dominica	0	Abandoned	Dominica Sustainable Energy Corporation (DSEC) Wind Turbine Pilot Project
2295	Dominican R	0	Abandoned	Grid-Connected Wind Energy Development in the Dominican Republic
2882	Mexico - II	0	Will probably not materialize	Wind Energy Development Phase II
2817	Uruguay	0	Abandoned	Removal of Barriers for the Full-scale Commercial Implementation of Renewable Energy in Uruguay
2732	Vietnam	0	Abandoned	Vietnam: Wind Power Generation in Central Vietnam Coastal Areas
2818	Yemen	0	Abandoned	Creation of a first 10-15 MW Wind Farm in Yemen

Annex 4 - CDM & JI WIND ENERGY PROJECTS

AS THE CDM & JI PIPELINES REPRESENT THE LARGEST AVAILABLE LISTS OF WIND PROJECTS IN DEVELOPING COUNTRIES, IT IS INTERESTING TO LOOK AT WHERE THEY ARE BEING DEVELOPED.

1. CDM WIND ENERGY PIPELINE

1.1 . 196 wind projects

The February 2007 CDM pipeline contains 196 wind projects (with 54 registered). 164 projects are located in China or in India, the two major CDM project providers. The distribution among other countries is shown in Figure 6.

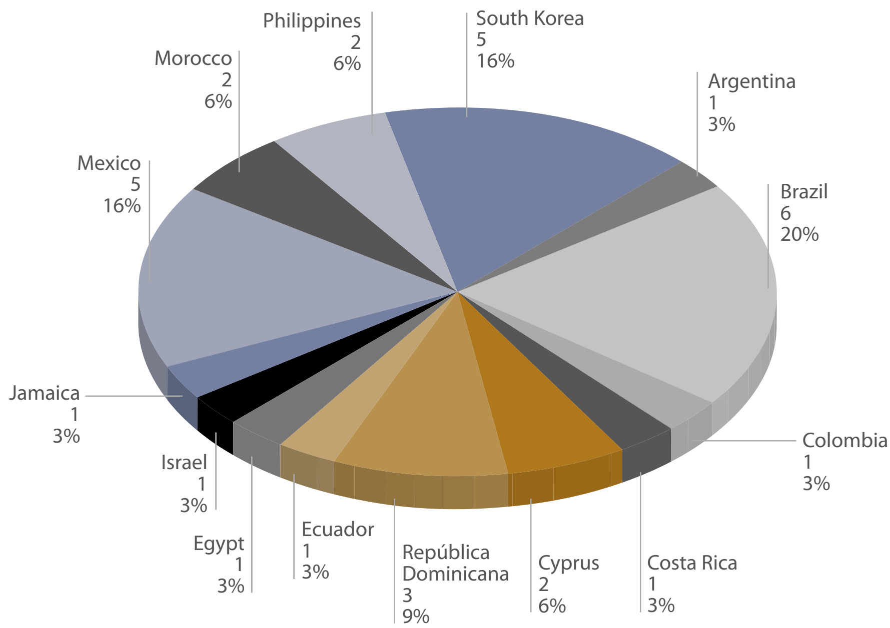

FIGURE 6: CDM WIND PROJECTS BY COUNTRY (WITHOUT CHINESE AND INDIAN PROJECTS)

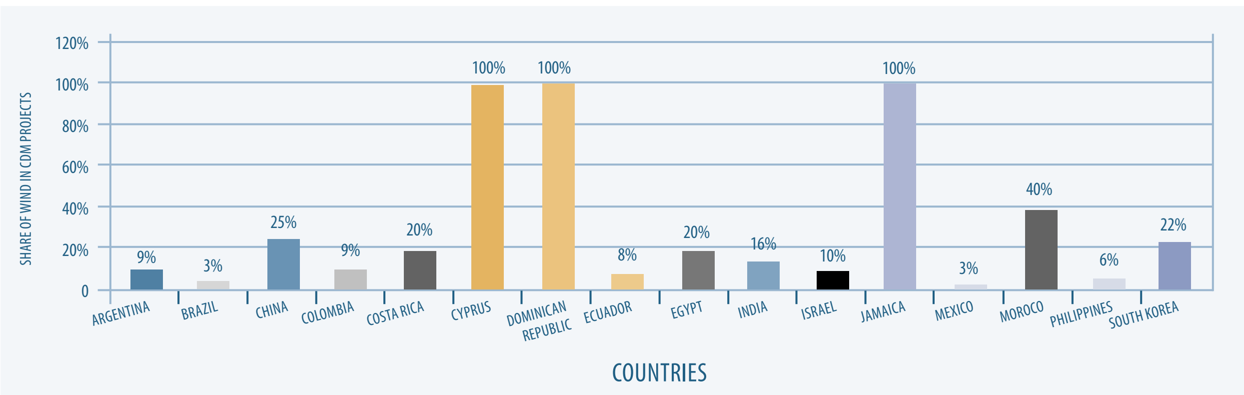

FIGURE 7: PERCENTAGE OF WIND PROJECTS AMONG CDM PROJECTS

Project sizes range from 1.2MW to 473MW with an average size of 43MW. Because of CDM costs, CDM projects tend to be larger than the average wind farm.

This means that CDM is not an appropriate way of financing for most rural electrification projects unless a large number of operations can be bundled together.

1.2. Projects and public policies in favour of wind energy

When there are only a few projects in a country, these are often extraordinary projects that have been set up either by public structures or by international programmes, rather than the beginning of real commercial wind exploitation. This is the case for instance for the Jamaican Wigton wind farm developed by the Petroleum Corporation of Jamaica (state energy corporation mandated to implement the country's energy policy) or the Zafarana wind power plant operated by the Egyptian New and Renewable Energy Authority.

From a wind policy point of view, these projects have a strong value as demonstration projects but are not necessarily the result of a wind-favourable energy policy.

For countries with larger numbers of CDM wind projects, these are first results of a very active CDM policy. India, China, Brazil and Mexico are the four most active CDM players for all technologies. However, as shown in Figure 7, in India and China, wind represents a higher share of CDM projects than in Mexico or Brazil. The long-standing Indian policy in favour of wind energy has indeed brought it to the fourth place in terms of installed capacity. China is catching up and has now the sixth world installed wind energy capacity.

Mexico, even if has started to implement some policy changes, has not yet seen clear results and Brazil has not yet been completely successful with its PROINFA programme.

2. JI WIND ENERGY PIPELINE

There are 22 wind projects in the JI pipeline. They are located in six countries as shown in Figure 8.

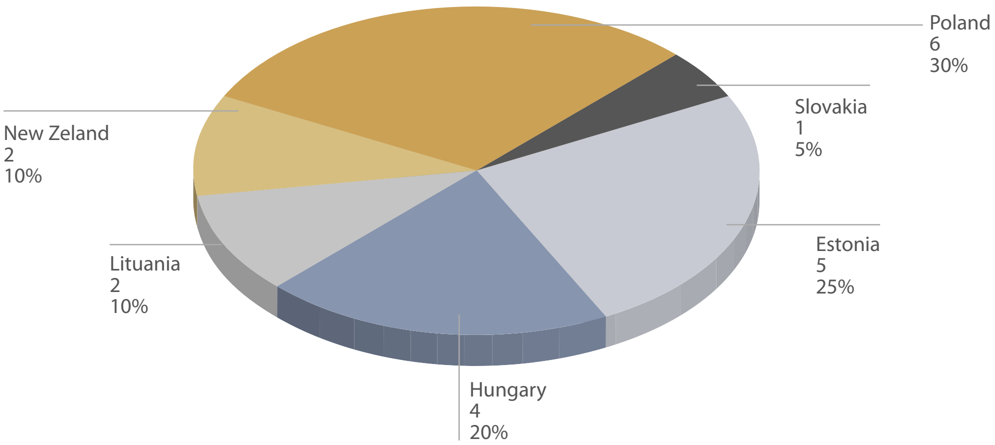

FIGURE 8: JI PROJECTS BY COUNTRY

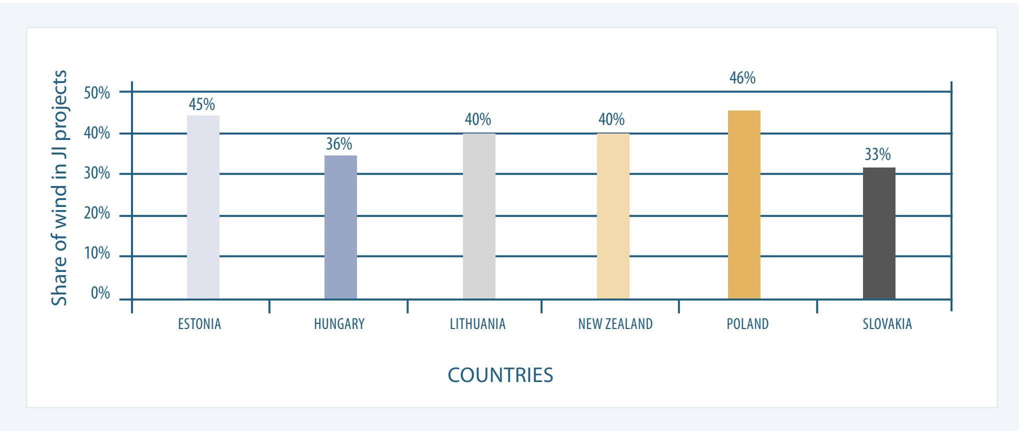

FIGURE 9: SHARE OF WIND ENERGY PROJECTS IN JI PROJECTS

It can be noted that Estonia and Lithuania, which account for nine projects, were part of a UNDP-GEF regional project (PIMS # 1694) which was stopped after the PDF-B study.

Estonia, Hungary, Poland, Slovakia and Lithuania have all introduced plans to increase their share of renewable energy, especially wind energy, from 2003/2004, in their process of joining the European Union. There was no attempt to develop a wind energy industry before that.

Poland, for example, has set up an obligation for power utilities to buy from renewable sources at a percentage (5.1 percent in 2007, which will rise to 10.4 percent in 2010) of the total energy produced and sold.

Estonia, Hungary, Lithuania and Poland have already experienced some increase in wind energy development even if total numbers remain small, but not Slovakia.

Estonia benefits from two European INTERREG programmes on wind and shows rapid growth of its wind capacity. In addition to the existing 56MW, the Estonian wind association counts 262MW under development and 296MW of additional projects.

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