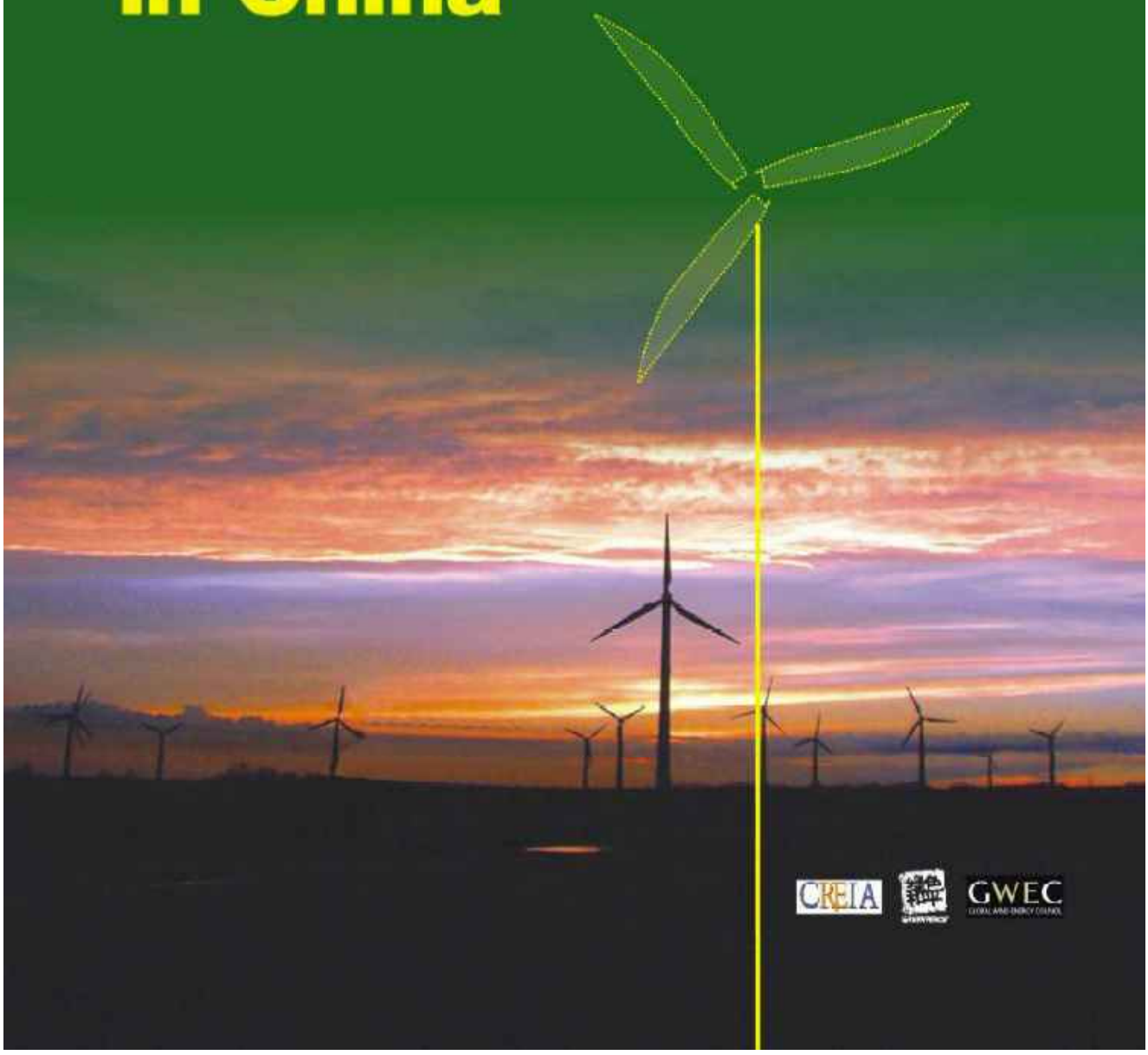
中国风力发电
价格政策分析研究报告

A Study on the Pricing Policy of Wind Power in China



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CREIA

Chinese Renewable Energy Industries Association (CREIA) was set up under the support of NDRC/UNDP/GEF Project of Capacity Building for Rapid Commercialization of Renewable Energy in China. CREIA obtained the formal registration from Chinese Ministry of Civil Affairs in March 2002 as a branch of China Comprehensive Resource Utilization Association (CCRUA). As an industrial association, CREIA enjoys total independence over its programs and operations. It has succeeded in attracting over 100 corporate members and about 160 individual members covering all the sub-sectors of renewable energy in China, such as solar thermal, solar PV, wind, biomass (biogas plant), hybrids, geothermal, small hydro and ocean energy. It provides all-round and qualified services.

Greenpeace is a global non-government organization headquartered in Amsterdam with a presence in over 40 countries. Greenpeace works to expose global environmental problems, and force solutions for a green and peaceful future. Greenpeace's goal is to ensure the ability of the earth to nurture life in all its diversity. Greenpeace China was established in Hong Kong in 1997 and has since added office in Beijing. Greenpeace focuses on the most crucial threats to the biodiversity and environment of our country and planet; raises public awareness about environmental issues through research, lobbying and non-violent direct action; promotes constructive solutions for a healthy and sustainable future. Greenpeace does not accept donations from governments, corporations or political parties. It depends entirely on individual citizens to maintain independence.

GWEC

The Global Wind Energy Council (GWEC) is the global voice for the wind energy sector, uniting the wind industry and its representative associations. The Council was established in early 2005 to provide a credible and representative forum for the entire wind energy sector at an international level. GWEC's members represent over 1,500 companies, organizations and institutions in over 50 countries, accounting for 99% of the world's over 60 GW of installed wind power. GWEC's mission is to ensure that wind power establishes itself as one of the world's leading energy sources, providing substantial environmental and economic benefits. The main objective of GWEC is to promote the development and growth of wind energy around the world through policy development, providing strategy and business leadership, global outreach, information and education.

A Study on the Pricing Policy of Wind Power in China

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October 2006

Preface 1

Back in the 1970s, during the first global oil shocks and the birth of the modern environmental movement, the world first had to face the fact that industrialised civilisation was utterly dependent on a limited, polluting resource: fossil fuels. New renewable energy technologies first emerged which could help reduce our dependence upon (often imported) fossil fuels, providing clean, reliable energy from indigenous sources. Dreams of an energy future based on the pollution-free power of the wind, the sun and the tides first began to take shape, and governments across the world began to invest in the beginnings of such a future. However, in the early 1980s oil prices collapsed and it was back to business as usual.

Now, due to the threat of global climate change, air pollution in our cities and a new and more compelling concern about energy security, renewable energy has re-emerged as a booming industry, catalysing nearly 40 billion US dollars in largely private investment in 2005. Rather than the dreams of a few visionaries, modern renewable energy systems have hit the mainstream, playing a significant and growing role in economies across the world.

Wind power is the undisputed leader in the electricity supply sector.Clean and fuel-free, it is growing at about 28% per year, and is already well past the 60 GW mark in installed capacity; the industry attracted more than 10 billion USD in investment last year, employs more than 150,000 people and will almost certainly play an important role in our energy future.

So what is the best way for government to support and regulate the industry so that it reaches its maximum potential in the shortest amount of time? There are many ways, and there is no "right", or "one-size-fits-all" solution. Each country has to craft a system which suits its particular set of circumstances best, but the last twenty years have given us a broad palette of international experience which can be examined for keys to systems and mechanisms which work to each country's best advantage.

Excitement about the rapid growth of the wind industry in China abounds. The rapid growth in the sector over the last few years has put China among the major players in the global

industry. But it is still a young industry, and heavily reliant on an enabling pricing, regulatory and fiscal environment to thrive. This report looks at a number of the options and examines some of the mechanisms that could work well in the world's most populous country, which has emerged as a major driver of the global economy. If this study can make a small contribution to "getting it right" in China, it will have fulfilled its purpose.

Steve Sawyer
Climate & Energy Policy Advisor
Greenpeace International

Preface 2

China's economy continues to grow at a breathtaking rate, and so does its energy demand. The International Energy Agency expects the country's electricity demand to increase by 260% between 2000 and 2030, making China one of the world's biggest energy consumers.

Already, this development is putting strong pressure on the security of electricity supply in China, which is primarily based on the burning of fossil fuels. In the last few years, the country has faced severe electricity shortages. The price of coal, which generates more than 70% of China's electricity, has been rising steadily, making wind power a real alternative. Moreover, concerns about the environmental impacts - such as air pollution, acid rain and CO2 emissions - are growing.

As a result, the Chinese government is increasingly looking at renewable energy sources to help it provide the much needed electricity in an environmentally and socially acceptable way and at a competitive price. Wind energy is the market leader among those new renewable energy sources, and its large scale deployment in China is indispensable to prevent an energy crisis from happening in the world's most populated country. Moreover, wind makes economic sense: there is no price risk, no pollution, no inflation. The cost of wind power is competitive with other forms of power if the long-term increasing fuel price and the economic emissions costs to the nation are taken into account.

The Chinese government has set a target for 30,000 MW of wind capacity by 2020, but the industry believes that as much as 170,000 MW can be achieved in this timeframe. This is feasible and makes economic sense, since it will stimulate the industry, protect the economy and drive investment across the region.

China has an exceptionally good potential for the development of wind energy, but strong foreign investment is needed for this potential to be fully realised. Although the market is already growing at an impressive rate, it is still small compared to the country's size and energy needs. The current growth can only be sustained and expanded if China's renewable energy policy includes a strong market signal for wind development.

The message of this report is very clear: The nascent wind industry in China is at a crossroads. Only one road will lead to the sustainable development of this industry and bring its full benefits to the Chinese people: a well designed payment mechanism, based on a realistic feed-in tariff.

The current practice of pricing through public tendering generates great uncertainty. It reduces the investors' ability to control their risks and thus fails to attract investment in the still relatively young market. The price volatility and uncertainty caused by the current regulation harms foreign and domestic private manufacturers and developers, who are discouraged by a pricing pressure they cannot sustain. The wind industry therefore calls upon the Chinese government to review its pricing policy for wind energy, and we hope that this report can provide a sound basis for this discussion.

Arthouros Zervos
Chairman
Global Wind Energy Council (GWEC)

Executive Summary

China has recently made great strides in developing wind power. By the end of 2005, 61 wind farms had been built and 1,864 grid-connected wind turbine generators installed. The total installed capacity had reached 1,260 MW, making it the seventh largest market in the world and the second largest in Asia. Last year, the Chinese government modified its wind power development target, raising it from 20,000 MW to 30,000 MW by 2020.

The Renewable Energy Law, which came into effect on 1 January 2006, provides a legal framework for the development of renewable energy in China, including the establishment of a payment system for their electricity output. However, wind developers, investors and manufacturers, both at home and abroad, have serious doubts about the current wind pricing policy and consider that it does not pave the way for the continued rapid development of the technology. Of particular concern is that the new law continues the policy of deciding the grid-connected power price for wind power projects through a public request for tenders. This is deterring potential investors.

The concession bidding process

There have been three phases in the development of a wind power tariff system in China. In the first phase, wind power developments were funded by overseas aid funds and the price paid was less than 0.3 yuan/kWh, similar to that for coal-fired plants. In the second phase, the tariff was decided by local government, reported to central government, and varied from a relatively low price up to 1.2 yuan/kWh. In the third phase, from 2002 onwards, tariffs have been decided by competitive bidding for concession projects. These are located in regional sites selected by central government through the National Development and Reform Commission.

To date there have been four successive rounds of bidding for a number of concession wind farm projects. Each project has been over 100 MW installed capacity. In order to encourage a domestic turbine manufacturing industry, more than 50% of the equipment must be made in China. Payment for the electricity output is set at the rate of the winning bid up to 30,000

hours of operation and then falls after that to the level of the average electricity price. Contracts run for 25 years. The prospective development company which commits to the lowest grid purchase price and the highest proportion of localised production usually wins the bid.

Changes have been made to the concession process after the initial rounds. These include an increase in the proportion of domestic manufacture to 70%, the introduction of other factors in deciding the successful bid (apart from price), including technical and commercial issues, and an opportunity for manufacturers to participate directly by preparing a clear plan for domestic production.

The experience of the concession bidding process has exposed a number of weaknesses. The most important of these is that the decision to make the lowest bid the winning bid has encouraged companies, especially state-owned enterprises, to commit to an unreasonably low price in order to win the contract. In the process they have either over-estimated the wind resource and electricity generation or underestimated the cost of the wind turbines and maintenance. The result has been a project from which they will be unable to make a reasonable return. Even after the more recent adaptations to the scheme, price has continued to be the most important deciding factor. These low prices have discouraged other enterprises from participating.

It was anticipated that the 2006 Renewable Energy Law would make changes to this process. Much to the disappointment of the wind power industry, however, it did not introduce a feed-in tariff along the lines of those operating other countries but maintained the existing bidding system.

Overseas experience

In other parts of the world, especially Europe, a range of mechanisms has been introduced by governments to support wind energy and other renewable technologies. The most successful of these have been the feed-in tariff systems operating in countries like Germany and Spain. Through paying a fixed premium rate above the market price for electricity, these systems have created a stable economic environment in which both project development and domestic manufacture have been able to flourish. By 2005, 90% of the total wind installed capacity in 12 European countries (39.7 GW) had been in those implementing feed-in-tariff policies.

The experience of tendering systems similar to that operating in China, such as the Non-Fossil Fuel Obligation in the UK, has not been positive. In the first ten years of the NFFO, wind power contracts totaling 1,150 MW were successfully won. However, only 151 MW of that capacity was actually built and produced power, a success rate of just 13%.

In China, without any recognition of the costs associated with the environmental disadvantages of fossil fuels - especially coal, which accounts for the majority of electricity generation - wind power is currently more expensive. International experience shows that tariff systems and policies are very effective incentive measures for promoting wind power as a clean energy source, provided that appropriate approval processes and grid connections are also in place. As long as the tariff policy is properly used, it will promote technical advancement, market development and cost reduction.

A fresh approach to wind power pricing in China

The principles on which wind pricing policy in China should be based are:

Long-term market development: From the perspective of future energy demand, China needs hundreds or even thousands of gigawatts of wind capacity, rather than the 30 GW envisaged. Only then could wind power overtake nuclear and hydropower and alleviate our country' s heavy dependence on coal. Relatively high costs and a low electricity price, especially since 2003, are the major bottlenecks for wind power development. The solution depends on either a reduction in cost or at least an increase in the electricity price to cover the existing cost. Wind power is a new and growing industry that needs support, but the current practice of bidding is in conflict with this aim.

Broader participation: The provision of accurate wind speed assessment data and simplification of preparation procedures for wind farm development would enable a wider range of developers to get involved, not just state-owned enterprises.

Localisation of wind turbine manufacture: It is currently estimated that Chinese manufacture of wind turbine equipment will not play a significant part in the market until 2010. Only one company has so far moved towards mass production. As well as strengthening R&D and transferring technology from other countries, an attractive grid price for wind power is needed to support and promote domestic turbine manufacturers.

Competitiveness of the wind power industry: The present bidding system is likely to result in a limited number of investors and economic failures. Lessons learned in the development stages of atomic or fossil fuel power, when income generated by initial projects was enough to finance future plans, should be followed in the case of wind power. To reach this goal, the payback rate for wind power investment should not be less than that for fossil fuel power.

Preferred option

This report looks at a number of options for improving the framework for the wind power grid tariff in China. After a detailed analysis of international experience it recommends that a new tariff is based on a fixed premium above the benchmark price for local coal-fired generation. The recommendations are:

★ Transform the bidding system into a feed-in tariff system

Wind power developers should be paid the benchmark price plus a wind power premium, which it is suggested should be set at about 0.25 yuan/kWh. This would take the total income from wind power projects to a range of 0.5 - 0.6 yuan/kWh, which should provide an acceptable level for successful investment. The premium price could vary slightly according to the regions and their respective wind regimes. Calculations have been made on the likely return for projects in different parts of the country.

The premium would be paid for the average number of full load hours of wind power generation available across China, estimated at an annual 2,000, but taking into account regional variations. It would operate for a period of 15 years, after which time the price would revert to the average grid tariff.

★ Adjust the price in a timely fashion, but it should always be higher than for coal-fired power

The price paid for wind power would be reduced as domestic manufacture matures. However, in order to support the industry, a protective minimum price should be adopted. At present we suggest a level of 0.5 yuan/kWh up to the end of 2020. This will help remove the concerns of investors, developers and manufacturers.

★ Encourage self-regulation among wind power companies

Self-regulation should be established within the industry so that it can work together to create a fair environment for competition. At the same time, relevant policies should be adopted by the government to regulate the industry.

By adopting these measures, it is anticipated that the wind power market in China will develop in a healthy way and the government' s strategic goal will be reached.

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Vestas

Introduction

Around the world, 2005 saw continuing impressive progress in global wind power development. The level of annual installed capacity reached over 11, 500 MW for the first time, surpassing nuclear power and coming close to hydropower [1]. This outcome provided further evidence that large scale wind energy is becoming a genuine alternative to "conventional" power generation. Last year also witnessed a boost to China's wind power development, ending its long period of slow expansion. By the end of 2005, the cumulative installed capacity of wind power had reached over 1,200 MW, surpassing Japan and taking China to the second highest position in Asia and seventh in the world's wind power league table. In 2005, the Chinese government modified its wind power development goal, raising it from 20,000 MW to 30,000 MW [2].

The Renewable Energy Law, which came into effect on 1 January 2006, provides a legal framework for the development of renewable energies in China. The law states that the price management department of the State Council will determine the feed-in tariffs for renewable energy generation projects based on the characteristics of different types of renewable energy sources and the situation in different regions, and based on the principles of favouring the development of renewable energy as well as economic prudence. However, wind developers, investors and manufacturers, both at home and abroad, have serious doubts about the current wind pricing policy and consider that it does not pave the way for the continued rapid development

1 Eric Martinot, World Renewable Energy Development Status Report, 2006
2 Zhang Guobao, Speech made at the Beijing 2005 International Renewable Energy Conference

of wind power. Of particular concern is that the Implementing Rules of the Renewable Energy Law, issued by the National Development and Reform Commission, also state that "the grid-connected power price of wind power projects will be determined by government guided pricing, the standard of which is set by the responsible pricing department of the State Council in accordance with the price selected through a public request for tenders."

Since the introduction of these pricing mechanisms, foreign and private investors alike have slowed down their investment in wind power development, reflecting their common anxiety and doubts about the policy. To help wind developers, investors and manufacturers to understand the wind pricing policy, as well as its likely effects in China, the Chinese Renewable Energy Industry Association, Greenpeace and the Global Wind Energy Council have jointly commissioned national and international experts to examine the issues, especially the wind concession projects for which tenders must be made. Comparisons are also made with international experience. This report then makes specific recommendations for a change in wind power pricing policy.

I. Review of Wind Power Development and Pricing in China

China has made great strides in developing wind power. By the end of 2005, 61 wind farms had been built and 1,864 wind turbine generators installed. The total installed capacity had reached 1.26 GW[3], making it the seventh largest market in the world and the second largest in Asia. China has the capability to manufacture large wind turbine generators of 750 kW capacity, and a MW-size turbine is under development. The cost of manufacturing domestic wind turbines is also expected to drop, alongside mass production and technology improvements. It is estimated that wind power will be competitive with conventional energy before 2020.

There have been three phases in the development of a wind power tariff system in China:

In the early stages, the equipment was purchased through international assistance funds, so the price paid for electricity exported to the grid was low. The income could only meet the requirements of wind farm maintenance. For example, the price for the Dabancheng Wind Farm in Xinjiang was less than 0.3 yuan/kWh, almost the same as for fossil fuel power.

During the second stage, the grid price was decided by local government and reported to central government. Prices in this phase varied. The lowest price was decided by bidding, and worked out similar to that for fossil fuel power. At the Zhangbei Wind Farm, for example, invested in by China Energy Conservation Investment Company, the price was the same as for fossil fuel power. The highest price, on the other hand, could be more than 1 yuan/kWh. At the Kuoshan Wind Farm in Zhejiang province, the price was 1.2 yuan/kWh[4].

3 Shi Pengfei, Wind Power Data in China, January 2006.

4 Li Junfeng, Shi Jingli et al., A Study on the Pricing Policy and Cost Sharing Mechanisms of Renewable Energy, December 2005.

The third stage was characterised by wind farm concession projects. During this phase, a "bidding price" and an "approved price" (decided directly by the government) have both been available. Table 1 compares grid prices in a number of wind farms across China, showing considerable variation. However, the current government approved price is generally close to the grid price for wind power in other countries, showing that the price (except for some cases), before wind concessions were introduced, was generally reasonable. Apart from the pricing schemes, price differences have mainly been caused by variations in the wind resource. It is understandable that varying resources can cause price differences, although criticisms have been raised where the price difference is particularly large, but it is not understandable that different prices should be adopted in the same region. Three wind farms installed during the same period in Nan'ao, Guangdong province, for example, had three different prices - 0.74 yuan/kWh, 0.62 yuan/kWh and 0.46 yuan/kWh respectively. The difference between the highest and lowest price was 0.28 yuan/kWh.

Table 1: Grid Prices for Operating Wind Farms in China (yuan/kWh)

	Wind Farms	Grid Price (excluding tax)
Projects (average prices during the business cycle)	Inner Mongolia Zhuri	0.5918
	Inner Mongolia Huitengxile	0.5918
	Inner Mongolia Shangdu	0.5918
	Inner Mongolia Xilinhaote	0.6291
	Hebei Zhangbei	0.9840
	Xinjiang Dabancheng I	0.4000
	Xingjiang Dabancheng II	0.6600
	Liaoning Donggang	0.9154
	Dalian Hengshan, Liaoning	0.9000
	Zhejiang Cangnan	1.2000
	Hannan Dongfang	0.5600
	Guangdong Nan' ao	0.7400
	Guangdong Nan' ao Zhenneng	0.6200
	Guangdong Nan' ao Dalian	0.4600
	Fujian Dongshan Zhaishan	0.4600
	Gansu Yumen	0.7300
	Jilin Tongyu	0.9000
	Shanghai Congming	0.7730
	Inner Mongolia Dali	0.6574
Concession projects (up to 30,000 full load hours)	Jiangshu Rudong	0.4365
	Guangdong Huilai	0.5013
	Rudong II	0.5190
	Jilin Tongyu	0.5090
	Inner Mongolia Huitengxile	0.3820
	Jiangsu Dongtai	0.4877
	Jiangsu Dafeng	0.4877
	Gansu Anxi	0.4616

II. Overview of Wind Power Concession Projects

1. Historical background

In 1986, the first pilot wind farm was established in the city of Rongcheng in Shandong province. Since then, China has made great advances in increasing the number of wind farms and the amount of installed capacity. By the end of 2002, cumulative installed capacity in China (excluding Taiwan) had reached 468 MW, increasing by 18% compared with the previous year. In Europe, however, where wind power has developed fastest, the cumulative installed capacity was 23,357 GW by 2002, an increase of 33% compared with 2001. There was therefore still a big gap between China and Europe in terms of both installed capacity and the rate of increase. Even apart from this, China has encountered some problems in constructing wind farms. Some of these can be seen as part of the natural development of wind power, but others, if not properly solved, will slow down the development of the technology.

* **The size of wind farms is small.** By the end of 2002, there were only 32 wind farms in China, with an average capacity of 14.6 MW each. These small wind farms are at a disadvantage in terms of equipment purchase and engineering construction. Both engineering costs and the cost of generating electricity are therefore high.

* **Few wind turbines are domestically manufactured and their cost is high.** Most of the turbines installed in operating on-grid wind farms have been imported. There are two reasons. On the one hand, some of the investments have come as loans from international organisations or foreign governments, with no choice in the selection of turbines; only expensive imported turbines could be used. On the other hand, the domestic wind turbine manufacturing industry was less competitive in the early stages, with a small range and little practical experience. The installation cost of wind farms was therefore high and affected by the international financial market.

* **The price for wind generated electricity is unstable.** Because of the high installation

cost, wind electricity is relatively less competitive. The average cost was over 0.6 yuan/kWh (before 2003), which was almost double the cost of fossil fuel power. The cost difference had to be shared within the grid by the local utility, adding to the burden. As a result, investors could not obtain long-term and stable power purchase contracts. With the price being re-evaluated each year, the risk was further increased.

★ **Investment opportunities are limited.** Because of the high price of wind electricity and the unclear pricing policy, the profit margin for the utility is reduced. In this situation, it is easy for companies which have a direct or indirect relationship with the utility to pass the evaluation test, whereas it is hard for foreign or private investors to enter the business. This investment structure is not good for building a healthy competitive system and reducing the wind electricity price. The result is a slow-down in the development of wind power.

★ **Grid connection is difficult.** Because it is not officially decided how the grid connection cost should be shared, most wind farms have difficulties in obtaining a grid connection.

2. Features of wind power concession projects

In order to increase the scope and commercialisation of wind farms, and with reference to practices in other industries and foreign examples, the relevant government departments proposed the idea of wind farm concession projects and carried out a detailed study. In 2002, the former National Planning Commission built pilot wind farms in Jiangsu and Guangdong under the concession system. The system operates in the following way:

★ Each wind farm must be at least 100 MW. Developers who win the bidding must provide turbines with an individual capacity of not less than 600 kW.

★ The wind farm developers are decided through bidding. The developers are responsible for wind resource assessment, geographical assessment, purchase, installation and adjustment of the wind turbines and other devices. More than 50% of all the turbine equipment must be produced domestically.

★ The wind electricity price is decided in two phases. In the first phase, when the cumulative electricity generation is less than 30,000 hours, the price is that proposed by the developer in the bidding documents. In the second phase, when cumulative electricity generation has reached more than 30,000 hours and until the end of the concession period, the average

market electricity price at the time is used. The electricity generated by the wind farms must be purchased by the local utility at the price mentioned above. Any price difference should be taken into account by the provincial government.

* The provincial planning commission government is responsible for land rental, environmental protection, security of the wind farm, taxes and other related issues.

* Any prospective project takes the existing grid purchase price as the key criterion, at the same time considering the extent of local manufacture, so the developer who commits to the lowest grid purchase price and the highest localisation will win the bid.

* The National Planning Commission takes the leading role in wind farm concession projects and nominates a bidding company to issue the bidding documents, together with provincial planning commissions and other departments. The winning developer must establish a project company in the local area. The project company signs a concession agreement with the local government and an electricity purchase contract with utilities. The concession period is 25 years. By the end of the period, all the installation has to be removed, unless a new agreement has been signed.

* The construction and operation of the wind farms is subject to all national or locally relevant policies. The price bid by the developers is used as the grid payment price. If a significant loss occurs due to an alternation of national policies, the grid price will be changed to reflect the policies at that time.

* On signing the concession agreement, the project company must start construction as soon as possible to make sure that the wind farm is put into operation within three years. If not, specific explanations have to be given. If the reasons are not acceptable, the project can be stopped and the developer has to take responsibility for any resulting losses.

Table 2 makes a comparison between concession projects and ordinary wind projects under the regulatory framework of 2002. It should be pointed out, however, that the current implementing rules do not specify the size and scale of concession projects. According to the old regulations, wind projects of 50 MW or greater needed to be approved by the national government, while projects smaller than 50 MW only needed approval from the relevant energy departments at a provincial level. However, under the current regulations, it is not clear whether the grid tariff for wind projects smaller than 50 MW, which are approved at a provincial level, should also be determined through bidding. Since January 2006, a number of wind projects have been awarded to developers through bidding organised by the provincial Development and Reform Commission. These projects are approved at the provincial level. The grid tariffs of these projects vary from project to project, but most of them are higher than those of the concession projects agreed at a national level. The tariff for some projects has been higher than that of national-level concession projects by over 0.1yuan/kWh. All of these projects are yet to be approved by the National Development and Reform Commission, while the detailed implementing rules remain

unclear. All of this has made the current implementation of Chinese wind power policy even more uncertain.

Table 2: Main Differences Between Ordinary Wind Farms and Concession Projects

	Concession Projects	Ordinary Programs
Grid price	The government commits to a fixed price below a certain amount of electricity generation (30,000 hours at full operation, about 3,000 GWh for a wind farm with a capacity of 100 MW). The price difference is taken into account by the provincial government.	No fixed price. The price could be changed by the provincial utility and pricing bureau throughout the operating period of the wind farm.
Pre-preparation (wind resource assessment, site selection, land rent, environmental protection and road building)	The government takes the role of coordinator and organiser. The winning developer pays the costs.	The developer takes responsibility.
Transmission line from wind farm to grid	The utility invests and constructs.	The developer invests and constructs.
Share rate of domestic equipment	50% completely manufactured in China.	No requirements.
Government commitment and guarantee	The developer signs a concession agreement with the provincial government and an electricity purchase contract with the provincial utility.	No guarantee.
Non-direct investment fees	Expenses amount to about 20 million RMB. including 1% tendering commission fee and other expenses.	No requirements.

3. Development and improvement of the wind power concession system

Based on practice, the wind power concession system has developed and improved gradually, including the following changes:

* In order to strengthen domestic manufacturing capability, the share of domestic wind turbine equipment has increased to 70% since the second round of concession projects.

* Since some developers proposed very low bidding prices in order to win concessions during the first two rounds of bidding, comprehensive evaluation was introduced in the third round. Price was not the only indicator that affected the ranking, and other factors, such as overall capability, technical planning, grid price and economic benefit were taken into consideration, with weighted scores. In the third round of bidding, the grid price was weighted at 40% and in the fourth round at 25%.

* Another big difference in the fourth round of concession bidding is that wind turbine manufacturers could participate in the bid directly, either as developers or suppliers. The condition is that the manufacturers have to propose a plan and show how the equipment will be domestically manufactured.

4. The bidding procedure for wind power concession projects

Concession bidding is organised by the National Development and Reform Commission (NDRC). The NDRC reviews the projects submitted by the local government, decides the project areas and issues the notifications.

The NDRC nominates China International Bidding Co., Ltd and China Hydro Engineering and Consultation Group Co., Ltd to organise and prepare the bid. The two companies draft bidding documents based on the bidding rules and issue the bidding invitation via important national newspapers and the internet every April.

After issuing the bidding documents, the companies issue clarifications based on updates and requests from bidders. These clarification documents become complimentary to the original bidding documents. According to the bidding requirements, provincial Development and Reform Commissions (DRCs) and bidding companies co-organise field visits for the bidders, as well as a bidding meeting. Field visit reports and meeting summaries are sent to all the bidders and kept together with the bidding documents. The bidding is publicly opened in Beijing on an agreed date.

5. Summary of wind power concession projects

The first concession projects were Rudong Wind Farm in Jiangsu (100 MW) and Shibeishan Wind Farm in Huilai, Guangdong (100 MW), and bidding opened in Beijing on September 1, 2003.

Table 3 shows each bidder's name and the bidding price (including VAT), which applies to the first 30,000 hours in full operation or the equivalent.

Table 3: Opening Bids for Rudong Wind Farm, Jiangsu

Bidders	Price including tax at 33% (yuan/kWh)	Price including tax at 15% (yuan/kWh)	Level of domestic manufacture (%)
Huarun Group Co., Ltd	0.7191	0.6469	53.86
Huaneng New Energy Environment Protection Co., Ltd	0.6070	0.5850	68.30
Nawala Co., Ltd, Spain	0.715	0.682	65.34
Yinghua Co, Ltd, Germany	0.6087	0.5978	51.50
Longyuan Power Group Co., Ltd	0.6890 (0.6190 after discount)	0.6716	>50
Huarui Co., Ltd	0.4365	0.3979	68.4

Table 4: Opening Bids for Shibeishan Wind Farm, Huilai, Guangdong

Bidders	Price including VAT at 33% (yuan/kWh)	Price including VAT at 15% (yuan/kWh)	Level of domestic manufacture (%)
Huarun Group Co., Ltd	0.6753	0.6043	53.60
Yinghua Co., Ltd, Germany	0.5414	0.5306	51.50
Guangdong Yuedian Group Co., Ltd	0.5013	0.4763	>60
Guohua Group Co., Ltd	0.7179	0.6796	68.40
Beijing International Investment Energy Conservation Co., Ltd	0.5595 (0.5053 after discount)	0.5129 (0.4721 after discount)	68.30

Notes: Figures includes income tax at two different rates as well as VAT. The price announced when the bidding opens is the final price.

The second concession projects were Rudong Wind Farm Phase II, Jiangsu (100 MW), Huitengxile Wind Farm, Inner Mongolia (100 MW) and Tuanjie Wind Farm in Tongyu, Jilin (100 MW). Bidding opened on September 1, 2004. Tables 5-7 show each bidder's name and the bidding price.

Table 5: Opening Bids for Huitengxile Wind Farm, Inner Mongolia

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
China Huadian Group Co., Ltd	0.3938	72
Inner Mongolian Longyuan Wind Energy Development Co., Ltd	0.4260	77.1
Beijing International Power New Energy Co., Ltd and Beijing International Power Development	0.3820	97.8
Huaneng New Energy Environment Protection Industry Stock Co., Ltd and China Huaneng Group (Hongkong) Co., Ltd	0.4244	73.5

Table 6: Opening Bids for Tuanjie Wind Farm in Tongyu, Jilin

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Longyuan Power Group Co., Ltd; Jilin Jineng Power Group Co., Ltd; and Xiongya (Weierjing) Co., Ltd	0.5090	72.12
Huaneng New Energy Environment Protection Industry Stock Co., Ltd and China Huaneng Group (Hongkong) Co., Ltd	0.5096	73.5

Table 7: Opening Bids for Rudong Wind Farm Phase II, Jiangsu

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Longyuan Power Group Co., Ltd and Xiongya (Weierjing) Co., Ltd	0.5190	77.1
Huarui Investment Group Co., Ltd and Euro-sino Lianneng Wind Power Investment Co., Ltd	0.5660	72

The third concession projects were Dongtai Wind Farm, Jiangsu (200 MW), An ' xi Wind Farm, Gansu (100 MW) and Mowangcun Wind Farm, Shandong (150 MW). Bidding opened on August 16, 2005.

Tables 8-10 show each bidder ' s name and bidding price.

Table 8: Opening Bids for Dongtai Wind Farm, Jiangsu

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Huadian International	0.4600	84.4
China Power Investment	0.4998	95.96
Longyuan, Nantong Tianshenggang Power and Xiongya (Weierjing)	0.5460	77.4
Guohua Energy and Shenhua	0.5280	Dazhong 84.4, Gold Wind 96.24
Wuhan Kaidi	0.5060	84.4
Jiangsu Jinling, Haqi Turbine, Jiangsu Fukasi Environment Protection	0.5050	> 95
Three-dam Development Co., Ltd, Huarui, Euro-sino Power	0.5223	81.7

Table 9: Opening Bids for An' xi Wind Farm, Gansu

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Hydropower Development for Upstream of Huanghe River Co., Ltd	0.4616	95.582
Longyuan, Gansu Power Construction Investment	0.5080	70
Kaidi, Wuhan	0.5560	750kW 95.3, 1.2MW 96.24
Huating Power Co., Ltd	0.5200	84.4

Table 10: Opening Bids for Jimo Wangcun Wind Farm, Shandong

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Huadian International	0.7261	Not known

The fourth concession projects were Ximeng Huitengliang wind farm in Inner Mongolia (300 MW), Bayin in Baotou, Inner Mongolia (200 MW) and Danjin Hefeng in Zhangbei, Hebei (200 MW). Bidding opened on August 16, 2006.

Tables 11-13 show each bidder' s name and bidding price.

Table 11: Ximeng Huitengliang Wind Farm

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
China Huadian Corporation	0.5299	80
Longyuan and HERO ASIA BVI CO. LTD.	0.4498	79.4
China Datang Corporation	0.5000	76
China Guangdong Nuclear Energy Development Corporation and China Guangdong Nuclear International Co. Ltd,.	0.4058	70

Table 11: (continued) Ximeng Huitengliang Wind Farm

Huaneng Renewable Energy (holding) Co. Ltd..	0.5651	70.8
Shanxi Luneng Hequ Power Co. Ltd,.	0.5096	76
Guohua Energy Investment Co. Ltd,. and Shenhua International (Hongkong) Co. Ltd,.	0.4523	1.5MW 94.46, 750kW 96.5
North United Power Co. Ltd,.	0.4200	79

Table 12: Baotou Bayin Wind Farm

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
China Huadian Corporation	0.5010	79
China Datang Corporation	0.5550	78.3
China Energy Conservation investment Corporation and Hongkong Construction Co. Ltd,.	0.4566	77.5
Longyuan Power Group Co., Ltd and Hero Asia BVI Co. Ltd.	0.4656	94.46
Beijing International Power Cooperation and Beijing Energy Investment Group Co.Ltd	0.4799	>70
China Guangdong Nuclear Energy Development Corporation and China Guangdong Nuclear International Co. Ltd,.	0.5221	78.4
Huaneng Renewable Energy (holding) Co. Ltd..	0.5525	80
Shanxi Luneng Hequ Power Co. Ltd,	0.5100	76.05
Guohua Energy Investment Co. Ltd,. And Shenhua International (Hongkong) Co. Ltd,.	0.5036	81
North United Power Co. Ltd,.	0.5000	76

Table 13: Zhangbei Danjing Wind Farm

Bidders	Price up to 30,000 hours including VAT (yuan/kWh)	Level of domestic manufacture (%)
Guohua Energy Investment Co. Ltd,. and Shenhua International (Hongkong) Co. Ltd,.	0.5018	78
Shanxi Zhangze Power Co. Ltd,.	0.5198	80.2
China Energy Conservation investment Corporation and Hongkong Construction Co. Ltd,.	0.5006	78.5
Longyuan and Hebei Construction and Investment Co. Ltd,.	0.5518	80
Shandong Luneng Development Group Co. Ltd,.	0.5173	96.22
China Guangdong Nuclear Energy Development Corporation and China Guangdong Nuclear International Co. Ltd,.	0.5058	78.4
Huaneng Renewable Energy (holding) Co. Ltd,.	0.6010	81
Huadian Power International Corporation Limited	0.5269	80

In the fourth concession round, 17 developers took part in the tender. All of them are state owned enterprises, five of which have joined forces with enterprises registered abroad, allowing them to take advantage of preferential policies as foreign investors. Since the bidding assessment methods have been adjusted, with the focus more on localisation and less on the power price level, the experiences gained from the first three concession rounds have been shown to have an effect. The bidders' power price has therefore been more reasonable. The price range bid for the Huitengliang 300 MW wind farm in Inner Mongolia is 0.4058~0.5651 yuan/kWh, with an average of 0.4788 yuan/kWh. At the Bayin 200 MW

wind farm in Inner Mongolia it is 0.5006 to 0.6010 yuan/kWh, with an average of 0.5281 yuan/kWh. These prices reflected the overall conditions for construction; most of the economic benefit has reached the basic internal rate of return of the industry.

Since the tender required a link between developers and the manufacturers who would supply the turbines. there were 12 bidders. Among these there was one foreign business. three joint ventures, one private enterprise, two share holding companies and five state owned companies. There were 19 types of wind generator, with rotor diameters ranging from 49 to 83m, their rated power from 750 kW to 2000 kW, and with 6 of them having proprietary intellectual property rights. Meanwhile, a 1 MW sized machine has started mass production in China, a prototype 1.5 MW machine is at the testing/design stage, and a 2 MW turbine has yet to emerge. The manufacturers who attended the bidding have all signed agreements with parts suppliers and have work plans aimed at reaching the 70% localisation requirement.

6. Organisation and procedure for evaluating bids

1) Organisation of the evaluation

The director of the evaluation committee comes from the Division of Renewable Energy and Rural Electrification within the NDRC. The members are from provincial DRCs, state utilities, provincial power companies, bidding agencies and technical experts.

Within the evaluation committee there is a Business Group and a Technical Group.

The Business Group is responsible for: ① primary evaluation, ② evaluation of the concession agreement with notes, ③ supporting the Technical Group in finishing the evaluation, ④ ranking and clarification and ⑤ collecting relevant documents and finishing the report.

The Technical Group is responsible for: ① delivering detailed evaluation of the bidding documents (technical plan, financial plan, financing proposal and experience), ② evaluation of the electricity purchase contract with notes and ③ completing the ranking, clarifying and evaluation report with the Business Group.

2) The evaluation procedure

a) Primary evaluation—— The Business and Technical Groups decide whether the proposals respond to the bidding requirements and whether there are mistakes or reservations. The Business Group will finish the primary evaluation report on the noted concession agreement and submit it to the evaluation committee. The Technical Group will evaluate the technical plan and noted electricity purchase contract and submit them to the evaluation committee.

b) Detailed evaluation —— The Technical Group evaluates the technical plan, financial plan, financing proposal, experience etc. to decide whether they meet the requirements. It will finish the evaluation on the noted concession agreement and electricity purchase contract and determine the list of candidates.

c) Ranking of candidates ——The evaluation committee ranks the candidates based on the detailed evaluation report. The companies ranked second and third are recommended as candidates for negotiation.

d) Clarification - In order to evaluate and compare the proposals, the bidders might be requested to give written clarification on unclear statements in their proposals. However, requests, proposals, permission or acceptance of a change related to the price or other

important contents are not acceptable. All clarification requests must be issued and collected in writing. They need signatures from both parties and can form part of the eventual contract with legal power.

e) Negotiation - The evaluation committee negotiates with the candidates on the bidding documents and suggestions or modifications according to the bidding requirements. The negotiation begins with the candidate who has the highest ranking and continues until the committee is satisfied. Negotiation involves both price terms as well as any other non-price items.

After negotiation, the committee decides the winning bidder and reports the results, with the evaluation report, to the NDRC.

3) Evaluation results

In the first concession round the winner for the Rudong Wind Farm, Jiangsu was Huarui (bidding price 0.4365 yuan/kWh), and for the Shibeishan Wind Farm, Huilai, Guangdong was Guangdong Yuedian Group Co., Ltd., (bidding price 0.5013 yuan/kWh).

In the second round, for Huitengxile Wind Farm, Inner Mongolia, Beijing International Power New Energy Co., Ltd. and its partners won the bid. But because the areas near the proposed site also have good wind resources, the NDRC decided that a wind farm of the same scale could be built under the same conditions and bidding price if other bidders agreed. China Huadian Group Co., Ltd. agreed to build another 100 MW wind farm after negotiations. For Tuanjie Wind Farm in Tongyu, Jilin, Longyuan Power Group Co., Ltd. and Huaneng New Energy Environment Protection Industry Stock Co., Ltd. won the bid together. The bidding price was 0.5090 yuan/kWh. Because the exploitable capacity was 400 MW, both companies agreed to build a 200 MW wind farm each after negotiations. For Rudong Wind Farm Phase II in Jiangsu, Longyuan Group Co., Ltd. and its partners won the bid. The price was 0.5190 yuan/kWh. The total installed capacity was adjusted to 150 MW after a field check.

In the third round, for Dongtai Wind Farm in Jiangsu, Guohua Energy Investment Co., Ltd. won the bid. The price was 0.5190 yuan/kWh. After negotiations, China Power Investment Group Co., Ltd. agreed to build a 200 MW wind farm in Dafengxian under the same conditions. For An'xi Wind Farm in Gansu, Hydropower for Development of Up-stream of Huanghe River Co., Ltd. won the bid. The price was 0.4816 yuan/kWh. For Mowangcun

Wind Farm in Shandong, Huadian International Stock Co., Ltd. won the bid. Since the potential for installation was affected by cropland, the final installed capacity and bidding price were adjusted to 100 MW and 0.60 yuan/kWh respectively on approval by the NDRC.

In the fourth round, Longyuan Cooperation and Hero Asia BVI Co. Ltd. together won the bid for Bayin Wind farm in Inner Mongolia, with a bid price of 0.4656 yuan/kWh. China Energy Conservation Investment Corporation and Hong Kong Construction Co. Ltd together won the bid for Danjing wind farm in Hebei Province, with a price of 0.5006 yuan/kWh. Two bidders won the concession for Huitengliang Wind Farm in Inner Mongolia - China Guangdong Nuclear Energy Development Corporation/China Guangdong Nuclear International Co. Ltd and North United Power Co. Ltd. Each will develop 300 MW wind farms. The bid price was 0.4056 yuan/kWh.

Table 14: Feasibility Research Data for Wind Concession Projects in 2006

Project	Bayin	Danjinghe	Huitengliang
Capacity to be installed (MW)	200	200	300
Wind Resource			
Met tower height (m)	67.3	67	67.5
Annual average wind speed (m/s)	7.80	7.75	8.32
Annual average wind density (W/m²)	417	395	517
Power Production Prediction			
Annual expected power production (1,000 kWh)	64,341	66,678	117,8240
Annual expected power production (kWh/ m2 rotor swept area)	1,170	1,220	1,501
Annual expected full load hours (h)	3,206	3,387	3,872
Annual power production sold to grid (1,000 kWh)	47,628	47,469	82,974
Annual full load hours sold to grid (h)	2,383	2,369	2,726
Grid losses (deduction factor)	0.74	0.73	0.71
Wind Turbine Price			
Price per kW including tower (yuan/kW)	6,295	6,307	6,386
Wind turbine proportion of total investment(%)	72.4	71.1	70.8
Project Financial Criteria			
Total investment (million yuan)	1,738.58	1,786.68	27,50.48
Investment per kWh (yuan/kW)	8,674	8,918	9,168
First session grid price including tax in feasibility study (yuan/kWh)	0.5143	0.5361	0.4803
Second session grid price including tax in feasibility study (Yuan/kWh)	0.3999	0.4202	0.3604
Internal return on total investment in feasibility study (%)	8.05	8.3	8.2
Internal return on capital in feasibility study (%)	10.25	10.7	11.3
Average Price over 20 years According to Feasibility Study Data			
20 years average grid price including tax (yuan/kWh)	0.4729	0.4942	0.4285

Table 14: (continued) Feasibility Research Data for Wind Concession Projects in 2006

First session grid price including tax in feasibility study (yuan/kWh)	0.5143	0.5361	0.4803
Agreed bid price (yuan/kWh)	0.4656	0.5006	0.4200
Lowest bid price (yuan/kWh)	0.4566	0.5006	0.4058
Highest bid price (yuan/kWh)	0.5550	0.6010	0.5651
Project	Bayin	Danjinghe	Huitengliang

Note 1: The highest and lowest figure in every item were not included in the average calculation
Note 2: First session grid price refers to the power produced within the 30,000 full load hours, with the remainder in the second session.

Table 15: Research Data from Concession Project Feasibility Studies in 2006, Using Domestic Enterprises Average and Foreign Enterprise Research Data

Project	Baying	Danjinghe	Huitengliang	Huitengliang (Foreign)
Installed capacity (MW)	200	200	300	300
Wind Resource				
Met tower height (m)	67.3	67	67.5	65
Annual average wind speed (m/s)	7.80	7.75	8.32	8.40
Annual average wind density (W/m^2)	417	395	517	579
Power Production Prediction				
Annual power connected to grid (million kWh)	476.28	474.69	829.74	868.00
Annual full load hours connected to grid	2,383	2,369	2,726	2,893
Wind Turbine Price				
Price per kW including tower (yuan/kW)	6,295	6307	6,386	9,300
Wind turbine proportion of total investment (%)	72.4	71.1	70.8	75
Project Financial Criteria				
Total investment (million yuan)	1,738.58	1,786.68	2,750.48	3,701.52
Investment per kWh (yuan/kW)	8,674	8,918	9,168	12,338

Table 15: (continued) Research Data from Concession Project Feasibility Studies in 2006, Using Domestic Enterprises Average and Foreign Enterprise Research Data

First session grid price including tax in feasibility study (yuan/kWh)	0.5143	0.5361	0.4803	0.7151
Second session grid price including tax in feasibility study (yuan/kWh)	0.3999	0.4202	0.3604	0.3684
Internal return on total investment in feasibility study (%)	8.05	8.3	8.2	8.51
Internal return on capital in feasibility study (%)	10.25	10.7	11.3	10.0
Average Price for 20 years According to the Feasibility Study Data				
20 years average grid price including tax (yuan/kWh)	0.4729	0.4942	0.4285	
First session grid price including tax in feasibility study (yuan/kWh)	0.5143	0.5361	0.4803	0.7151
Agreed bid price (yuan/kWh)	0.4656	0.5006	0.4200	0.4200
Lowest bid price (yuan/kWh)	0.4566	0.5006	0.4058	0.4058
Highest bid price (yuan/kWh)	0.5550	0.5006	0.5651	0.5651
Project	Baying	Danjinghe	Huitengliang	Huitengliang (Foreign)

Note 1: The highest and lowest figure in every item were not included in the average calculation
Note 2: First session grid price refers to the power produced within the 30,000 full load hours, with the remainder in the second session.

7. Lessons learned

The wind farm concession project has great significance in terms of the expansion of wind power in China and has important positive aspects.

Three rounds of wind concession projects from 2003 to 2005 are important steps in the context of Chinese power sector reform, which is resulting in the separation of power generating companies from the utilities. This reform process exempts wind power from market competition by offering it a fixed price and a long-term contract. The utilities invest

in the construction of transmission lines and transformers from wind farms to the grid. Investors are in turn encouraged to participate in the wind concession projects in order to reduce the price. The former monopoly in wind power by the power department has been broken, helping to draw in various investors at home and abroad and encourage competition. Requirements for the extent of localisation in turbine manufacture have been set.

Compare this with the situation before the introduction of concession projects, where there was no fixed price for wind power and the local governments and utilities were not supportive of wind farm development. Against that background, concession projects organised by the central government have played a significant role in promoting larger project sizes and realising economies of scale.

A number of problems have emerged during the process, however. In the first and second rounds, because the former National Planning Commission promised that the bidders proposing the lowest bidding price would be the winners, the winning price was in fact far below a reasonable level. In 2003, for instance. Huarui proposed 0.436 yuan/kWh for the Rudong Wind Farm whilst the price range of the other five bidders was between 0.607 and 0.715 yuan/kWh. The bidding price for Huilai Wind Farm by Yuedian was 0.5013 yuan/kWh, whilst the price range of the other four bidders was between 0.505 and 0.718 yuan/kWh. Bidding prices for Rudong Wind Farm Phase II and Tongyu Wind Farm in 2004 were also only just above 0.5 yuan/kWh. The bidding price for Huitengxile Wind farm by Beijing International Power New Energy Co., Ltd. was even as low as 0.382 yuan/kWh, with the winner apparently mainly concerned to enter a promising industry. Even though profit was not guaranteed, they were still willing to go ahead. The example of Rudong Wind Farm further underlines the point. In 2003, the bidding price by Huarui was 0.3979 yuan/kWh, whereas in 2004, the same company bid 0.56 yuan/kWh. The wind resource and other conditions were almost the same, but the price had increased by 0.16 yuan/kWh (40%) in just one year.

Even though the third and fourth rounds have taken non-price criteria into consideration, in almost all instances the lowest price project appears to have won the bids. This suggests that despite the fact that other factors are considered, price is typically the determining factor.

In order to reduce the bidding price, bidders have either over-estimated the wind resource and electricity generation, set a higher price at the second phase or underestimated the cost

of the wind turbines and maintenance. Some of the bidders have established joint ventures with companies registered abroad, a method by which they can avoid VAT and reduce income tax. This is being used as a means of unfair competition, and will mean loss of tax for the country.

The requirement that only the bidder who offered the lowest price could win the bid has in fact led to a situation where the winning price was so low that private and foreign investors did not want to invest. Almost all of the bidders in the fourth round of bidding were state-owned companies. These companies all have promises of strong financial support from their parent companies and will finance wind power projects from their fossil fuel power income. Another motivation for state-owned power companies to bid at low prices might be the current discussion about a quota obligation system, which, once applied, would require the large power companies to produce a certain percentage of electricity from renewable energy sources.

Whatever the reasoning, the low price has slowed down not only the development of wind farms but research and manufacturing of domestic turbines and the production of components. The result has been conflict with the goal of supporting a new industry.

Besides the low bidding price, there have been other problems with the concession process, including:

1. Pre-preparation has been insufficient. At Huilai Wind Farm, for example, there was only one set of wind measurement data, and the location of the wind measurement mast was not marked on the bidding proposal. As a result, the wind measurement was unrealistic, reflecting a failure by the government to check sufficiently. At Rudong Wind Farm Phase I, the location of the wind farm and land management office were in conflict with what was written in the bidding documents. At Tongyu Wind Farm, the winning bidder Hua` neng New Energy Company found that the actual installation site was not the same as that described in the bidding documents. Instead they found out that the reserved land was covered with forests and crops. There was also no feasibility study on the estimated generation and whether the capacity could reach 200 MW. In 2005 the Jimo Wind Farm in Shandong was listed as one wind concession project. In practice, there was insufficient wind measurement or land data, and the technical feasibility study required by the NDRC was also missing. During implementation, the winning developers found that many problems could have been solved if proper preparations had been made.

2. The phase II price is the so-called "average market price at that time," which has been estimated by bidders. The purpose of phase II is to make sure that the price is fixed during the period of the loan, normally 15 years. Once the period of electricity generation has exceeded 30,000 hours, the operating cost is greatly reduced due to the payback of the loan. At that time, the company can operate well even when the average market power price is adopted. However, in practice, some bidders reduced their phase I bidding price by increasing their phase II price. The difference is in a range from 0.3038 yuan/kWh to 0.5425 yuan/kWh. If the winning price is low, however, the operation of the company during the loan period will be strongly affected, making it difficult to repay the investment.

3. The proportion of domestic wind turbine manufacture is merely a number used in the proposal. When the bidders are successful, some will re-select their suppliers. This has nothing to do with their bidding proposal. Since there are no concrete regulations on how to punish the developers if they do not pass the evaluation on the completed project, it is difficult to take any action. In the fourth round bids, it was therefore required that the developers should work together with equipment suppliers to submit a domestic manufacturing plan according to the proposed turbine types.

III. International Experience ofWind Tariffs

Pricing policy has been an effective measure for promoting renewable energy power generation, especially the international wind power market and industry. Without taking into account the environmental costs of conventional power, the cost of wind power generation is still higher than that of existing fuel sources. Many countries have therefore adopted pricing policies to encourage its development. By the end of 2005, different types of renewable energy pricing systems and policies had been set up and implemented in 44 countries around the world, with identifiable results.

Depending on the different wind resources, economic standards and capacities, the formats and price standards of wind power policies also vary. In respect to the format, there are three main categories:

(1) Fixed tariff system: Two specific forms of such a system are the fixed feed-in tariff and fixed premium systems. Under these power utilities are obliged to enable renewable energy plants to connect to the grid, and they must purchase any electricity generated at fixed minimum prices. These prices are generally set higher than the regular market price, and payments are usually guaranteed over a specified period of time. The additional costs of these schemes are paid by suppliers and are passed through to the power consumers.

(2) Tendering: under this mechanism, the government organises public bidding for a particular or set of wind farms, and determines the developer based on price and non-price criteria. The concession projects are then built on a contract basis at the price resulting from the tender. The additional costs generated by the purchase of wind power are passed on to the end consumer.

(3) RE Certificate: This tariff system includes two specific forms, which are the fixed quota system and the green electricity system. The former is usually priced through certificate sales in the market; the latter is based on the guaranteed commitment of end-users of power consumption, and no certificate trade is generally conducted.

1. Fixed tariff system

Basic definition

Fixed tariff means that the market price for renewable energy (RE) electricity is regulated directly by the government. Currently, there are 41 countries and provinces that have set up the fixed tariff system, including 11 developing countries and provinces. Europe is the main region as 19 European countries have implemented fixed tariff policies. A few American states used to have similar policies. In China, the Guangdong provincial government also used to employ a fixed tariff for wind power projects. Countries or provinces generally decide to support wind power because the technology is ready and the economic prospects are promising.

The fixed tariff policy usually prescribes the following guidelines:

(1) Clear price standards and calculating measures according to wind resources and technical standards;
(2) An operational period;
(3) Declining prices over time in order to encourage technical progress and market development.

The main point of a fixed tariff system is that the government can roughly fix the investment level in wind power through adjustment of the price standard and operating period so as to control the speed of wind power development.

Case study

Germany is the most prominent country to have implemented the fixed tariff system and policy, which was launched in 1990. In 2000, legislation was passed to calculate tariff standards for RE electricity in categories based on the different technologies and with consideration for their technical development level and available resources. In addition, the price is revised every two years according to the RE cost difference and market development status. In 2004, the RE tariff standard was revised, establishing that the wind tariff could not be lower than 5.5 Euro cents/kWh and the implementing period would be 20 years. In addition, depending on the wind resources in a particular area, for the first five years of project operation (or in some cases even longer) an extra tariff of 3.2 Euro cents/

kWh could be obtained. With regard to new wind projects built in 2005 and afterwards, a 2% annual decrease will be applied to the basic tariff of 5.5 Euro cents/kWh so as to promote the technical progress of wind technology and lower its cost.

The effect of implementing a fixed tariff in Germany is clear. In 2005, the installed capacity of wind power reached 18,430 MW, or 30% of the world total, maintaining Germany' s status as the leading wind power country in the world.

Merit and flaw analysis

The advantages of a fixed tariff are as follows:

(1) It is simple, effective and low cost. As the tariff standard and implementing period is quite clear, it is easy to implement and supervise both for power generation enterprises and grid companies.

(2) It reduces regulatory and market risk for the investor. With a clear definition of the tariff and implementing period, the investment return is basically stable, which reduces the investment risks for developers and the loan risks for financial enterprises.It therefore promotes investment and market development. The successful experiences in Germany and Denmark prove this point.

(3) A stable investment environment promotes the development of manufacturing. In Germany, for example, where the development of wind power was later than that in Denmark, the country eventually became a major manufacturer of wind turbines.

(4) Greater diversity is achieved in project size, type, ownership and location. With a stable wind price policy and clear wind tariff level, the actual form of wind projects is decided by the market. In Germany, for example, the wind industry is much diversified. Companies of any size, big or small, or even individuals, can invest in wind power; developers decide the scale of projects according to the wind resource conditions and their own economic situation. The result in Germany is projects of different sizes ranging from several megawatts to several hundreds of megawatts, as well as different kinds of turbines and technologies. For a burgeoning industry like wind power, diversification is good for both technology advancement and market development.

2. Fixed premium system

Basic definition

The main principle of a fixed premium system is that a proportion of the price is based on the wholesale price of conventional power and the RE price therefore fluctuates along with changes in the conventional power market. Such a tariff system has been mainly implemented in Spain.

Case study

In 1998, a fixed premium system for renewable energy power was established in Spain and remained in effect until 2004. In 1998 a royal law was passed which regulated that the extra RE tariff could be adjusted annually according to the RE power generation cost. However, the basic principle of annual tariff adjustment was that a certain profit should be obtained by the RE power developers, and at the same time it should be guaranteed that the RE grid tariff should remain within 80-90% of the electricity sale price. The extent of tariff adjustment was decided at the end of each year, with each RE power generation company being required to submit a report on its current costs to the government agency in charge of electricity price adjustment. The government agency would then calculate the specific amount of the two tariffs for the following year based on the reports and other research material and information. The wind tariff in Spain therefore fluctuated between 80% and 90% of the sale price of conventional electricity, but the specific price would be determined through negotiations between power generation enterprises and power transmission enterprises.

The fixed premium system has successfully promoted the development of wind power in Spain. In the mid 1990s, the wind turbine industry had only started at a small application level, but it now ranks as a world leader both in industry and application (in terms of industry, it ranks third behind Denmark and Germany, and in terms of electricity production, it ranks second behind Germany). The average rate of increase in capacity has been more than 60% over ten years By the end of 2005, the cumulative installed capacity in Spain had reached 10,027 MW, accounting for 15% of the world' s total installed wind capacity and 13% of the total generating capacity in Spain. The market sale of the three largest wind turbine manufacturers accounted for 20% of the world total in 2005, giving Spain the second largest wind turbine manufacturing industry in the world[5].

5 GWEC, Global Wind 2005 Report, 2006

However, there were some problems during the implementation process of the fixed premium policy. Firstly, the tariff adjustment process was quite complicated and there was no common and effective way of calculating and controlling the power generation costs provided by RE developers, which made the tariff adjustment an opportunity for bargaining by RE power developers and suppliers through the adjustment agency. The RE grid tariff had therefore in practice become a negotiated price in Spain. Secondly, it was hard to formulate a long-term steady tariff. In the case of wind power, for example, the pace of development slowed down from 2002 to 2003. The main reason was that the average national electricity price decreased in 2003, while the RE grid tariff still had to follow the regulation of 80-90% of sale price. This reduced the enthusiasm of wind power developers.

Based on these experiences of the fixed premium system, Spain therefore made some modifications to its RE tariff system in 2004 in order to solve the existing problems and encourage positive competition among RE enterprises in the power market. The modification decided was for the RE tariff to have two options - a fixed tariff or a free market sale combined with a market participation incentives. Generating companies could choose one option each year, but the choice could only be made once a year and then take effect for the whole year. To be specific, the two options introduced were:

(1) Fixed tariff: the wind price is 90% of the average electricity tariff.

(2) Fixed premium: the wind price equals the price set by the market plus a premium of 50% of the average electricity tariff.

For both options, the system introduced in 2004 set specific timetables for the duration of the different tariffs and premiums, thus providing stability and confidence for investors. A review system of the amounts was also introduced for every four years.

The Spanish government determines the average electricity tariff according to the electricity sale conditions in the power market. It is publicised at the end of the previous year and lasts for the whole following year (even if the tariff is changed in that year). Based on the market status of 2005, the average electricity tariff taking effect in 2006 is 7.6588 Euro cents/kWh.

Merit and flaw analysis

Viewed as mechanisms, there are similarities between the fixed premium and fixed price systems. In both, the RE price is stable over a given period and the producers can decide whether or not to invest in the construction and operation of a power project according to the investment return rate. As a result, both systems help to encourage the investment and construction of RE.

In the new mechanism which Spain started to implement from 2005, there are two parallel systems. In one, the wind farm owners choose the option of selling the power at a fixed price, which provides a basic tariff guarantee. The other is a market system in which wind farm owners choose to compete and take the risk of making a higher profit. The policy is therefore both effective and has obtained good results.

Compared to the fixed price system, the implementation process of the fixed premium system is more complicated, as wind power is also participating in general power market competition. But if there is already an existing competitive power market, no extra work needs to be done.

3. Tendering tariff system

Basic definition

The basic definition of a tendering tariff is that the government is responsible for organising public tendering for one specific or several wind power projects and decides the developer after considering bidding prices and other factors. Within such a system, the bidding price is usually the main factor for evaluation. The successful bidder therefore gets a fixed price for the project, although this will vary from project to project.

There are several examples of the tendering tariff system, such as the non-fossil fuel obligation (NFFO) mechanism implemented in the UK from 1990 to 1998, the concession tendering in Quebec, Canada from 2003 and wind power concession tendering mechanism implemented in China since 2003. The British and Chinese programmes follow two different formats. Under the NFFO tendering purchase system applied by the UK in the 1990s, the principle was that the government only laid down the overall development objectives and the purchasing scope and amount while the bidders chose the investment projects. Concession projects in Quebec follow the same pattern. Under the process

adopted by China, concession tendering is conducted for a specific project. The successful bidder signs a concession operation agreement and an electricity purchase and sale agreement. The sharing of the differential price policy among consumers is applied. The project is allocated to the most appropriate investor through tendering and bidding.

The NFFO tendering purchase system continued in operation through five rounds over a period of nearly ten years. But although a certain amount of wind power was installed in the UK, a large number of projects were never built and market growth was hampered. When the NFFO implementing period concluded in 2001, the installed capacity of wind power had reached a mere 427 MW.

Merit and flaw analysis

The advantage of the competitive tendering system is that it helps to decrease the wind power tariff as well as the additional unit cost for wind power.

There are also disadvantages caused by competition, however. The main flaw is that the bidding price can fall so low that the contracts cannot be fully implemented. Many investors have not been able to finish the project construction as stipulated in the contract. In the first ten years of the UK's NFFO, wind power contracts totaling 1,150 MW were successfully won. However, only 151 MW of that total capacity was actually built and produced power, achieving a success rate of just 13%[5]. The main reason was that the lowest bidding price won the bid for the project. Some unqualified developers also won projects and were then unable to develop them due to financial and technical problems. The NFFO model did not penalise developers if they failed to install the capacity for which they had secured a power purchase contract.

Another disadvantage of the tendering system is that it increases project preparation costs, which in turn increases the proportion it takes of the total investment (compared to conventional power projects, the scale and the total investment of wind power projects is smaller). Apart from that, as only one bidder can win a project, the enthusiasm of other investors decreases greatly after several rounds of tendering. Lastly, as the development of wind power in the UK was much slower than expected and the price was too low, the wind turbine manufacturing industry did not develop either. Compared to other European countries, this was a clear negative effect.

4. Fixed quota system / Renewable Portfolio Standard (RPS)

Basic definition

A fixed quota system usually involves the issuing of green certificates for RE power generation through an obliged quota (an energy enterprise is required to produce or sell a regulated proportion of RE electricity compared to its production or selling of conventional power) and a trading system (the government verifies and issues green certificates to enterprises that produce RE power, and the green certificates can be traded between energy enterprises, with the price determined by the market). Thus the RE electricity price is the sum of the average grid tariff and the price of the green certificate.

5 IEA, Renewable Energy, Market and Policy Trends in IEA Countries, 2004

An important precondition for implementing such a pricing policy is a power market (including all factors such as power generation, transmission, distribution and power consumption) with sufficient competition and fully commercialised. Otherwise, the sale of the certificates would not be valued.

Currently, 32 countries, states and provinces have had set up fixed quota systems, including Australia, the UK, Italy, Japan, some Canadian provinces, Indian states and most of the states in the USA.

Merit and flaw analysis

Under the fixed quota system, different RE power technologies receive the same certificate price. But the certificate price varies along with RE market supply and demand, and the overall price changes with the power market. Wind power is the RE technology that is closest to being commercialised and the cost is comparatively low. So it is in a favourable position and could develop quickly.

In addition, setting prices through the market in theory reduces the unit cost of RE power generation, which is good from the point of view of the overall economy.

The following are some problems that have clearly emerged from the market price system:

(1) A penalty system is usually introduced for those enterprises which do not fulfill their obligation by promoting wind power and other RE development. Generally, the government will stipulate the penalty amount imposed on those companies that fail to accomplish the appointed quota. But if the penalty amount is not high enough, there will be enterprises that prefer to pay the penalty instead of fulfilling their commitment. The result is that the system does not effectively stimulate the development of RE, including wind power.

(2) The penalty amount usually becomes the upper limit of an RE power transaction. For example, the penalty amount in the UK is 3 pence/kWh, which is equal to 4.5 Euro cents/kWh. Added to the varying grid tariff of conventional power, this made the total RE tariff payment 7-8 Euro cents/kWh in 2004.

(3) The quota proportion becomes the upper limit of RE development. Under such circumstances, setting up a proper level for the quota is especially important in order to avoid making it an obstacle to wind power development.

(4) The quota system influences project financing and increases the risk for financing organisations. Under this type of price formulation system, the RE product price will not be finally determined before a transaction has taken place. This has an impact on project financing, especially for small and medium enterprises, while benefiting large groups and enterprises, causing unfair competition.

5. Green electricity price system

The mechanism of a green power pricing system is that the government determines the RE price, energy consumers purchase it voluntarily and the purchase certificate is generally not traded for benefit. An example of this is the Netherlands, where 30% of consumers bought some green electricity in 2004. The voluntary purchase price for green power was then 8-9 Euro cent/kWh. The RE power producing enterprises therefore receive a favourable price, but the system is based on the acceptance of green energy by both consumers as well as enterprises. Only in countries and areas with high public awareness of the environment can this type of price mechanism be effective. There is a pilot project for green electricity sales currently operating in Shanghai.

6. International wind power prices

Wind power technology is the most commercialised among the different RE technologies. Many countries have therefore placed an emphasis on wind power in their RE development policies. The central part of this policy is a high tariff. Currently, there are 44 countries that stipulate and implement price policies regarding different RE power technologies, and wind power is always included. Though there are different formats for different tariff systems, and tariff standards are not the same, the difference is not the only important factor for wind power enterprises. The main reason is that wind power cost is closely connected with the available wind resource. To take an example, suppose there are two wind projects of a similar scale but their wind resources are different (one produces 3,000 hours while the other produces 1,500 hours). The cost of power generation from the former is half of the latter, making it potentially equal to that of conventional fuel, while the latter could be 2 to 4 times the price. Once the government has stipulated an appropriate tariff policy, therefore, the overall development scale for RE power project construction will still be determined by the producer and investor.

In Australia and the US, for instance, there is sufficient land area and many locations with a good wind resource can be found. As already mentioned, for wind farms in the US, annual production time is around 2,800 hours and in Australia it is above 3,500 hours. The tariff that the government stipulates based on the market price system is usually low, between 6-8 US cents/kWh. Therefore wind projects will not be developed in areas with a wind resource similar to those in other less windy countries. But in Germany, Italy and the UK, the wind resource can be lower (in some wind farms in Germany, operating hours are around 1,800, and in Spain about 2,200), so the tariff is between 8-12 Euro cents/kWh, which is comparatively high. As a result, producers and investors have the enthusiasm to develop wind projects in areas with a relatively poor wind resource. This emphasises the importance of stipulating an economically appropriate price.

Table 16 presents the wind prices in the top ten countries in terms of installed capacity. It shows that the price standard is generally between 6-12 Euro cents, higher than the grid tariff for conventional energy except in Denmark, the US and India. (In India, wind power cost is reduced through tax-free, rapid depreciation and direct investment subsidies.) This shows that most countries have subsidy policies for wind power but with differing types and formats.

7. Comparison of implementation effects of different tariff systems and their feasibility in China

International experience shows that tariff systems and policies are very effective incentive measures, provided that appropriate approval processes and grid connections are also in place. As long as the tariff policy is properly used, it will promote technical advancement, market development and cost reduction. It is fair to say that the above-mentioned tariff systems all have their own characteristics, preconditions for application, advantages and disadvantages. But for implementation, the fixed feed-in tariff and the fixed premium policies have the greatest and most powerful effects on wind market development, while the fixed quota system is less effective. Table 17 lists the development status and the adopted tariff policy in some European countries. It shows that:

★ By 2005, 90% of the total wind installed capacity in the listed countries (39.7 GW) was in those implementing feed-in-tariff policies.

* In 2005, of the 5,960 MW newly installed wind power capacity in the listed countries, over 80% was in those implementing feed-in tariff policies.

As for China' s wind energy market, the fixed tariff system is the most appropriate to be adopted as it is easy to implement and operate and reduces long-term regulatory and market risks. It will also ensure that wind energy is implemented in regions where the resources are best. The tendering tariff system, as implemented in China now, has brought many problems, especially the issue of a low contract implementation rate and its negative impact on industry development. Quota and market price systems, on the other hand, need a completely commercialised power market as a precondition for their introduction. In addition, only when wind power and other tradable RE power resources have reached a large enough scale can the operational cost of the certificate and trading system be reduced to an economically proper proportion of the total cost, thus making the quota system feasible from an economic point of view. Finally, the necessary condition for a green power system is that a society has developed to a certain standard and the citizens has a high degree of environment awareness. This is currently not the case in China.

Table16: Wind Tariffs in the Top Ten Countries by Installed Wind Capacity

Country	Wind installed capacity (MW)[7]		Price	Note
	New capacity in 2005	Total by end of 2005	(Euro cents/ kWh)	
Germany	1,808	18,428	5.50+3.20	• The implementing period of 5.5 Euro cents/kWh is 20 years • In the first five years of project operation, wind power can gain an extra price of 3.2 Euro cent/kWh • If the electricity generated by a wind farm is 150% lower than the amount generated by a reference location, for each 0.75% it is lower than the reference, the period of obtaining the extra 3.2 Euro cent/kWh s extended two months • For wind projects built in 2005 and afterwards, the price decreases 2% each year from the baseline of 5.5 Euro cents/kWh in 2004 • The lowest price for an offshore wind farm is 6.19 Euro cents/kWh
Spain	1,764	10,027	6.89	• The price of the fixed tariff in 2006 • If using the fixed premium system to participate in the power market, the overall price is around 7 Euro cents/kWh • The application period is the lifespan of the wind ferm
US	2,431	9,149	About 6 US cents	• Plus 1.9 US cents/kWh tax deduction
India	1,430	4,430		• About 1.2 times the conventional power tariff

7 GWEC, Global Wind 2005 Report, 2006

Table16: (continued) Wind Tariffs in the Top Ten Countries by Installed Wind Capacity

Denmark	22	3,122	About 4 Euro cents	• Electricity tariff for the North Europe power market plus 0.1 Danish krone (about 1.3 Euro cents/kWh) • A favourable tariff is given to electricity generated by "repowered" wind projects. For the first 12,000 full load operational hours, the subsidy is 0.17 Danish krone (about 2.3 Euro cents/kWh)
Italy	452	1,717	11.7	• Green certificate market • The price is 6.7 Euro cent/kWh plus a market price of 5 Euro cents/kWh
United Kingdom	446	1,353	7-8	• The government requires that RE power should reach 3% of a company's supply, otherwise a penalty of 4.5 Euro cents/kWh will be applied • The wind price is the competitive grid tariff plus the certificate price of 4.5 Euro cents/kWh
China	498	1,260	4-9	• Approved tariff and tendering tariff • The application period is generally 30,000 hours
Netherlands	154	1,219	6.8-9	• Wind tariff and green power price is generally 8-9 Euro cents/kWh • Fixed price of on-land wind farm is 6.8 Euro cents/kWh • Fixed price of offshore wind farm is 4.9 Euro cents/kWh, applicable for 18,000 hours in the first 10 years
Japan	142	1,078	10.5	• The price in 2002-2003 • The RE quota imposed on power sale enterprises is 1.35%
Portugal	500	1,022	7-8.2	• The tariff is 8.2 Euro cents/kWh for the first 2,000 hours each year, and 7 Euro cents/kWh for the following 2,000 hours

Table16:(continued) Wind Tariffs in the Top Ten Countries by Installed Wind Capacity

France	367	757	8.38	• The application period is 15 years • The tariff is 8.38 Euro cents/kWh for the first five years • For the following 10 years, if the annual operational time of the wind farm is lower than 2,000 hours, the tariff is 8.38 Euro cents/kWh; if the annual operational time is 2,000-3,600 hours, the tariff is 5.41 Euro cents/kWh • The above tariff is applicable in the case that the total national installed capacity is not over 1,500 MW. If the total amount surpasses that amount, both of the prices will be reduced by 10% • From 2002, the baseline price of a newly built project has been 8.38 Euro cents/kWh, with a 3.3% annual decrease.
Sweden	58	500	10-11	• When the green certificate system was implemented in 2003, the certificate price was 0.6 Swedish krone/kWh (6.5 Euro cents/kWh) • If the quota fails to be achieved, the penalty prices for 2003 and 2004 were 1.75 Swedish krone/kWh (1.93 Euro cents/kWh) and 2.4 Swedish krone/kWh (2.65 Euro cents/kWh) respectively • For wind turbines starting operation in 2003, a subsidy to the tariff will be applied for 5 years. The subsidy is 0.15, 0.12, 0.09, 0.06 and 0.03 Swedish krone/kWh from 2003 to 2007 respectively • Wind power enjoys a tax rebate of 0.181 Swedish krone/kWh from 2000 to 2009 (2 Euro cents/kWh)
Austria	218	819	7.80	• Operational from 2003 • The previous price was 10.9 Euro cents/kWh

Table16:(continued) Wind Tariffs in the Top Ten Countries by Installed Wind Capacity

Greece	100	573	6.16-7.31	• The tariff varies in different areas. For on-shore wind farms, 90% of final sale price can be obtained, which was 6.16 Euro cents/kWh in 2001. For stand alone wind farms, 7.31 Euro cents/kWh could be obtained. • A 40% subsidy is applied to the capital
Belgium	71	167	9	• For on-shore wind farms the lowest tariff is 9 Euro cents/kWh, for off-shore wind farms the lowest tariff is 5 Euro cents/kWh

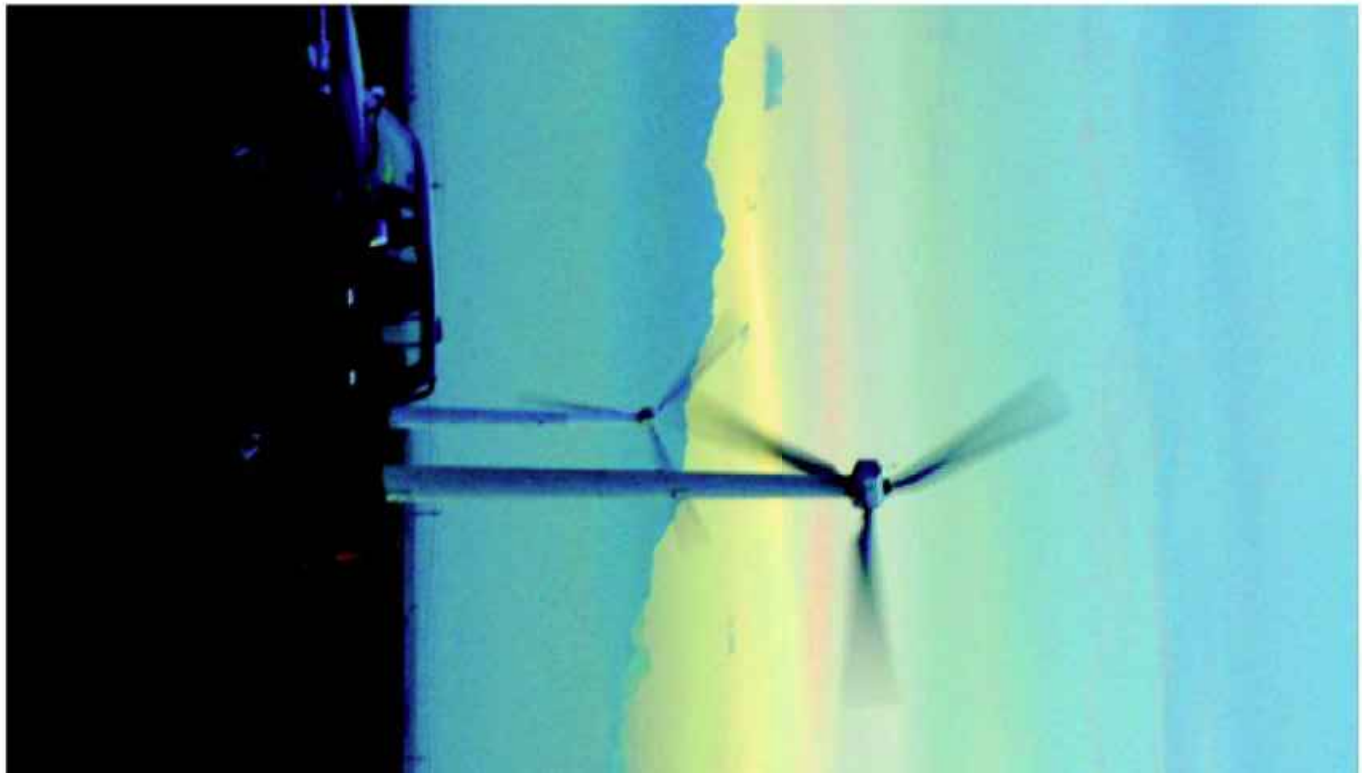

Table 17: Installed Capacity and wind policies in some EU countries

Country	Wind installed capacity (MW)		Feed-in-tariff		Tendering price	RE Certificate	
	New capacity in 2005	Total by end of 2005	Fixed price	Fixed premium		Market price	Market price
Germany	1,808	18,428	✓(since 1990)				✓ (since 1996)
Spain	1,764	10,027	✓ (from 1994-1998, since 2005)	✓(since 1998)			
Denmark	22	3,122	✓ (since 1996)				
Italy	452	1,717				✓ (since 1999)	
UK	446	1,353			✓(1990-2001)	✓ (since 2002)	
Netherlands	154	1,219	✓ (since 2003)			✓ (1990-2000)	✓ (since 1997)
Portugal	500	1,022	✓ (since 2001)				
France	367	757	✓ (since 2001)				
Sweden	58	500	✓ (since 2003)			✓ (since 2003)	
Austria	218	819	✓ (since 2001)				
Greece	100	573	✓ (since 1999)				
Belgium	71	167				✓ (since 2002)	
Total	5,960	39,704					

Table 18: Wind development status and policies in the top ten countriesby installed wind capacity

Country	Wind installed capacity (MW)		Feed-in-tariff		Tendering price	RE Certificate	
	New capacity in 2005	Total by the end of 2005	Fixed price	fixed premium		Market price	Green power price
Germany	1,808	18,428	✓ (since 1990)				✓ (since 1996)
Spain	1,764	10,027	✓ (since 2005)	✓ (since 1998)			
US	2,431	9,149		✓ (since 1978)		✓ (20 states, since 2002)	
India	1,430	4,430	✓ (1978– 1988)	✓ (since 1992)		✓ (6 states, since 2004)	
Denmark	22	3,122	✓ (since 1996)				
Italy	452	1,717				✓ (since 1999)	
UK	446	1,353			✓ (1990-2001)	✓ (since 2002)	
China	498	1,260			✓ (since 2003)		
Netherlands	154	1,219	✓ (since 2003)			✓ (1990-2000)	✓ (since 1997)
Japan	142	1,078				✓(since 2002)	
Total	9,147	51,783					

IV. Calculation of Wind Power Grid Tariff in China

As already mentioned, there are variations in wind power tariffs among different countries, mainly due to their different wind resources. Prices range from 6 US cents to 12 Euro cents/kWh. The average annual operating time for wind turbines is around 1,800 hours in Germany, 2,200 hours in Spain, 2,800 hours in the US, 3,500 hours in Australia and 2,000 hours in China, which sits between Germany and Spain but is much lower than Australia and the US.

1. Tariff calculation design and options

There is a great difference in the wind resource in different locations in China. Even in the same general area, wind speeds are not always the same. Taking that into account, there are four options for determining an appropriate wind power grid tariff.

Option 1

Divide China into areas based on wind resources. For example, Inner Mongolia, Xinjiang, Gansu and Ningxia can be listed as areas with rich wind resources, coastal areas can be listed as areas with good wind resources and other areas listed as areas with weaker wind resources. Based on the resource investigation results, China can be divided into a number of areas according to resources and geographical situation, such as the northern, coastal and inland areas. Regional fixed wind tariffs could be set according to the typical wind resource in that region. Table 19 lists the expected tariff for a wind farm with a capital cost of 9,000 yuan/kW.

Table19: Calculation for Option 1 Wind Tariff and Project Investment Return Rate

Region	Northern areas	Coastal areas	Inland areas
Typical operating hours at full load	2,700	2,200	1,900
Tariff reference (yuan/kWh)	0.48	0.58	0.68
Project IRR (%)	10.91	10.24	10.77

To set the feed-in-tariff for a particular region, we can refer to the tendering tariffs for wind concession projects in the same region so as to add a certain increase to that figure. However, we can only do that if the bidding prices have been reasonable. Regions can also be further divided according to different resource conditions and then differing tariffs introduced.

The advantage of such an arrangement is that it allows for the difference in wind resources and economic potential. The disadvantage is that it will be hard to solve disputes over wind resource differences, no matter in how much detail the region is sub-divided. In areas of rich wind resources like Xinjiang and Inner Mongolia, for example, there are significant variations in different areas. Another example is that coastal areas generally have better wind resources than inland areas, but in some inland parts the resource can be even better than at the coast.

Option 2

Following the German model, a reference price is proposed based on the annual average wind speed. For example, suppose the annual average wind speed in China is 6 metres/second and the annual production is 2,100 hours. Under the same financial conditions and basic costs, the reference price is calculated as 0.62 yuan/kWh. If the average wind speed at a particular site is higher or lower than the average, the grid tariff would decrease or increase from the standard price. The disadvantage of this option is that the annual wind speed data needs to be recorded in detail and the enterprises need to be highly self-disciplined.

Option 3

Regardless of resource conditions, within a certain amount of total electricity generated (up to 30,000 or 50,000 hours, for example) a higher incentive tariff is applied. Beyond that amount the average grid tariff in the power market or a fixed contracted price is paid. The

incentive tariff can differ in areas with varying wind resources in order to balance out the benefit. To take an example, suppose the capital cost of a wind farm is 9,000 yuan/kW and its operating period is 2,000 hours. Also suppose that the price beyond 30,000 hours is 0.45 yuan/kWh, and that up to 30,000 hours the price does not fall lower than 0.65 yuan/kWh. This would make the investment return rate on capital 9.51%. For those wind farms with less than 2,000 operational hours, the price for up to 30,000 hours could be adjusted accordingly.

Option 4

A fixed level of full load hours - 2,000 for example - is set as the differential point. For 15 years after project commissioning a subsidy is paid for these fixed full load hours on top of the local coal-fired power benchmark price, but no subsidy is applied beyond that. After the project has been in operation for 15 years, the price becomes the same as the average grid tariff. The advantage of this option is that not only is the wind resource difference considered but it reflects to some extent regional differences in economic potential. On the one hand it promotes development and utilisation in areas which satisfy the basic wind resource development conditions, on the other hand it should encourage the technical advancement of enterprises to increase wind power's operating hours as much as possible and utilise wind resources more efficiently.

The difficulty with this option lies in how to determine the basic hours of wind power operation and the subsidy levels. Currently, the average of full load hours of operating wind farms in China is lower than 2,000 because of the available wind resources at the sites, equipment performance and utilisation efficiency. With 2,000 hours as the basic amount, however, most enterprises could make the system work, with an effort. Only a few enterprises in areas with bad wind resources or with management problems could not. Such a regulation should therefore encourage and stimulate investment.

Comparison and selection of calculation options

In practice, the outcomes of Options 2, 3 and 4 are virtually the same. Option 4 is easy to calculate and the average base price is introduced at the initial stage of any project, reminding developers and equipment manufacturers that wind power is definitely moving towards market competition. To ensure economic benefits, the underlying aim is to reduce cost, improve equipment performance, develop projects with good resources and increase the amount of electricity produced. Therefore option 4 is recommended.

2. Tariff standard and investment return rate calculation

The operating parameters for the proposed tariff would be:

* The subsidy price of wind power is 0.25 yuan/kWh applied for 15 years from the commissioning date of the project. This government subsidy can be cancelled after 15 years of operation.

* The wind standard tariff will be implemented until the annual full load reaches 2,000 hours or above for land-based wind power and 2,500 hours for offshore projects. Any output exceeding this will be paid according to the standard tariff paid for coal-fired power in the province in 2005.

* From 2010, the government tariff will decrease 2% annually for newly built projects.

In 2005, the standard tariff for coal-fired power generation was roughly between 0.235 and 0.439 yuan/kW, while the grid tariff standard for wind power in different areas, calculated according to the operational period, was roughly between 0.40 to 0.60 yuan/kWh. The difference between the two prices is about 0.15 to 0.20 yuan/kWh. On the basis of 2,000 hours as the baseline full load period, the subsidy should therefore be at least 0.25 yuan/

kWh to compensate for the difference. This means that in Inner Mongolia and Xinjiang, for example, the grid tariff for wind power up to 2,000 full load hours would be about 0.50 yuan/kWh, and beyond 2,000 hours about 0.25 yuan/kWh. Assuming 3,000 hours as the annual full load period, the rate would be about 0.417 yuan/kWh, with the average tariff standard about 0.167 yuan/kWh. At the same time, the calculated wind grid tariff standard based on this system is close to the tendering price of wind concession projects. Based on the above methodology, combined with an economic analysis module, the investment return rate for wind projects can be calculated for areas with different wind resources. This can be seen in Tables 21 and 22. Table 20 lists the basic parameters and conditions used in the module.

Table20: Reference Parameters for Economic Analysis of Wind Power Projects.

Project construction period	One year
Operational period	20 years
Initial investment cost	9,000 yuan/kW
Staff	12 people
Average salary	20,000 yuan/person
Annual maintenance costs	1.5% in the first 10 years, 2% in the second 10 years6.12%
Capital proportion	20%
Annual loan rate	6.12%
Loan repayment period	15 years
Cash flow	1.5 million yuan
VAT rate	8.5%
Interest rate	33%
Depreciation rate	8%

Table 21: Investment Return Rate of Wind Power Projects (Internal Rate of Return)

Province	Stan-dard tariff for desulphu rised coal (yuan/ kWh)	Wind tariff: For the first 2,000 hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh; after 2,000 hours it is the same as the standard price for desulphurised coal.								Wind tariff: Disregarding the operational hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh				
		Annual full load hours of electricity production								Average wind price yuan/kWh	Annual full load hours of electricity production			
		1,700		2,000		2,200		2,500			1,700	2,000	2,200	2,500
		Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)		Total investment return rate (%)	Total investment return rate (%)	Total investment return rate (%)	Total investment return rate (%)
Shanghai	0.411	0.661	6.11	0.661	8.31	0.638	9.12	0.611	10.28	0.661	6.11	8.31	9.59	11.41
Jiangsu	0.386	0.636	5.59	0.636	7.80	0.613	8.58	0.586	9.69	0.636	5.59	7.80	9.07	10.85
Zhejiang	0.416	0.666	6.22	0.666	8.41	0.643	9.22	0.616	10.39	0.666	6.22	8.41	9.70	11.52
Anhui	0.369	0.619	5.24	0.619	7.44	0.596	8.21	0.569	9.29	0.619	5.24	7.44	8.71	10.46
Fujian	0.379	0.629	8.45	0.629	7.65	0.606	8.43	0.579	9.53	0.629	8.45	7.65	8.92	10.69
Beijing	0.345	0.595	4.73	0.595	6.90	0.572	7.66	0.545	8.71	0.595	4.73	6.90	8.18	9.91
Tianjin	0.345	0.595	4.73	0.595	6.90	0.572	7.66	0.545	8.71	0.595	4.73	6.90	8.18	9.91
Jibei	0.345	0.595	4.73	0.595	6.90	0.572	7.66	0.545	8.71	0.595	4.73	6.90	8.18	9.91
Jinan	0.339	0.589	4.60	0.589	6.76	0.566	7.52	0.539	8.57	0.589	4.60	6.76	8.05	9.77
Shandong	0.344	0.594	4.70	0.594	6.88	0.571	7.64	0.544	8.69	0.594	4.70	6.88	8.16	9.88
Shanxi	0.259	0.509	2.65	0.509	4.81	0.486	5.45	0.459	6.40	0.509	2.65	4.81	6.07	7.81
Inner Mongolia	0.257	0.507	2.59	0.507	4.76	0.484	5.40	0.457	6.34	0.507	2.59	4.76	6.01	7.75
Guangxi	0.354	0.604	4.92	0.604	7.11	0.581	7.87	0.554	8.93	0.604	4.92	7.11	8.38	10.12
Hainan	0.377	0.627	5.40	0.627	7.61	0.604	8.39	0.577	9.48	0.627	5.40	7.61	8.88	10.64
Yunnan	0.255	0.505	2.53	0.505	4.71	0.482	5.34	0.455	6.28	0.505	2.53	4.71	5.96	7.70
Guizhou	0.267	0.517	2.88	0.517	5.01	0.494	5.67	0.467	6.64	0.517	2.88	5.01	6.28	8.02

Table 21: (continued) Investment Return Rate of Wind Power Projects (Internal Rate of Return)

Province	Standard tariff for desulphurised coal (yuan/kWh)	Wind tariff: For the first 2,000 hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh; after 2,000 hours it is the same as the standard price for desulphurised coal.								Wind tariff: Disregarding the operational hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh				
		Annual full load hours of electricity production									Annual full load hours of electricity production			
		1,700		2,000		2,200		2,500		Average wind price yuan/kWh	1,700	2,000	2,200	2,500
		Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)	Average wind price yuan/kWh	Total investment return rate (%)		Total investment return rate (%)	Total investment return rate (%)	Total investment return rate (%)	Total investment return rate (%)
Guangdong	0.439	0.689	0.689	8.86	8.86	0.666	9.70	0.639	10.92	0.689	6.69	8.86	10.17	12.03
Hubei	0.366	0.616	0.616	7.37	7.37	0.593	8.15	0.566	9.22	0.616	5.17	7.37	8.64	10.39
Hunan	0.384	0.634	0.634	7.76	7.76	0.611	8.54	0.584	9.65	0.634	5.55	7.76	9.03	10.80
Jiangxi	0.372	0.622	0.622	7.50	7.50	0.599	8.28	0.572	9.36	0.622	5.30	7.50	8.77	10.53
Henan	0.336	0.586	0.586	6.69	6.69	0.563	7.45	0.536	8.49	0.586	4.53	6.69	7.98	9.69
Sichuan	0.333	0.583	0.583	6.62	6.62	0.560	7.38	0.533	8.42	0.583	4.47	6.62	7.91	9.62
Chongqing	0.327	0.577	0.577	6.48	6.48	0.554	7.23	0.527	8.27	0.577	4.34	6.48	7.77	9.48
Liaoning	0.347	0.597	0.597	6.95	6.95	0.574	7.71	0.547	8.76	0.597	4.77	6.95	8.23	9.95
Jilin	0.339	0.589	0.589	6.76	6.76	0.566	7.52	0.539	8.57	0.589	4.60	6.76	8.05	9.77
Heilongjiang	0.337	0.587	0.587	6.72	6.72	0.564	7.48	0.537	8.52	0.587	4.55	6.72	8.00	9.72
Eastern Inner Mongolia	0.330	0.580	0.580	6.55	6.55	0.557	7.31	0.530	8.34	0.580	4.41	6.55	7.84	9.55
Shaanxi	0.282	0.532	0.532	5.38	5.38	0.509	6.08	0.482	7.07	0.532	3.32	5.38	6.68	8.39
Ningxia	0.248	0.498	0.498	4.53	4.53	0.475	5.15	0.448	6.07	0.498	2.32	4.53	5.77	7.51
Gansu	0.242	0.492	0.492	4.38	4.38	0.469	4.99	0.442	5.89	0.492	2.14	4.38	5.61	7.35
Qinghai	0.245	0.495	0.495	4.46	4.46	0.472	5.07	0.445	5.98	0.495	2.23	4.46	5.69	7.43
Xinjiang	0.235	0.485	0.485	4.46	4.46	0.462	4.80	0.435	5.67	0.485	1.93	4.20	5.42	7.16

Table 22: Wind Project Investment Return Rate Using Private Capital (the private fund takes 20% of the total investment)

Province	Standard tariff for desulphurised coal (yuan/kWh)	Wind tariff: For the first 2,000 hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh; after 2,000 hours it is the same as the standard price for desulphurised coal. When the annual the full load hours electricity producing is calculated								Wind tariff: Disregarding the operational hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh				
		1,700		2,000		2,200		2,500		Average wind price yuan/kWh	Annual full load hours of electricity production			
		Average wind price yuan/kWh	Return rate of self-fund (%)	Average wind price yuan/kWh	Return rate of self-fund (%)	Average wind price yuan/kWh	Return rate of self-fund (%)	Average wind price yuan/kWh	Return rate of self-fund (%)		1,700 Return rate of self-fund (%)	2,000 Return rate of self-fund (%)	2,200 Return rate of self-fund (%)	2,500 Return rate of self-fund (%)
Shanghai	0.411	0.661	5.33	11.05	11.05	0.638	13.31	0.611	16.74	0.661	5.33	11.05	14.69	20.31
Jiangsu	0.386	0.636	4.13	9.64	9.64	0.613	11.80	0.586	14.99	0.636	4.13	9.64	13.17	18.51
Zhejiang	0.416	0.666	5.58	11.33	11.33	0.643	13.61	0.616	17.09	0.666	5.58	11.33	15.00	20.67
Anhui	0.369	0.619	3.33	8.66	8.66	0.596	10.77	0.569	13.81	0.619	3.33	8.66	12.15	17.31
Fujian	0.379	0.629	3.80	9.24	9.24	0.606	11.38	0.579	14.51	0.629	3.80	9.24	12.75	18.02
Beijing	0.345	0.595	2.26	7.27	7.27	0.572	9.27	0.545	12.17	0.595	2.26	7.27	10.69	15.62
Tianjin	0.345	0.595	2.26	7.27	7.27	0.572	9.27	0.545	12.17	0.595	2.26	7.27	10.69	15.62
Jibei	0.345	0.595	2.26	7.27	7.27	0.572	9.27	0.545	12.17	0.595	2.26	7.27	10.69	15.62
Jinan	0.339	0.589	2.00	6.92	6.92	0.566	8.89	0.539	11.75	0.589	2.00	6.92	10.31	15.20
Shandong	0.344	0.594	2.22	7.21	7.21	0.571	9.21	0.544	12.10	0.594	2.22	7.21	10.62	15.55
Shanxi	0.259	0.509	0	2.43	2.43	0.486	3.81	0.459	6.02	0.509	0	2.43	5.22	9.65
Inner Mongolia	0.257	0.507	0	2.32	2.32	0.484	3.69	0.457	5.88	0.507	0	2.32	5.09	9.51
Guangxi	0.354	0.604	2.66	7.79	7.79	0.581	9.83	0.554	12.78	0.604	2.66	7.79	11.24	16.25
Hainan	0.377	0.627	3.70	9.12	9.12	0.604	11.26	0.577	14.37	0.627	3.70	9.12	12.63	17.87
Yunnan	0.255	0.505	0	2.22	2.22	0.482	3.57	0.455	5.73	0.505	0	2.22	4.96	9.37
Guizhou	0.267	0.517	0	2.85	2.85	0.494	4.30	0.467	6.61	0.517	0	2.85	5.73	10.22

Table 22: (continued) Wind Project Investment Return Rate Using Private Capital (the private fund takes 20% of the total investment)

Province	Standard tariff for desulphurised coal (yuan/kWh)	Wind tariff: For the first 2,000 hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh; after 2,000 hours it is the same as the standard price for desulphurised coal. When the annual the full load hours electricity producing is calculated								Wind tariff: Disregarding the operational hours, the price is the standard price for desulphurised coal plus 0.25 yuan/kWh				
		1,700		2,000		2,200		2,500		Average wind price yuan/kWh	Annual full load hours of electricity production			
		Average wind price	Return rate of self-fund	Average wind price	Return rate of self-fund	Average wind price	Return rate of self-fund	Average wind price	Return rate of self-fund		1,700 Return rate of self-fund	2,000 Return rate of self-fund	2,200 Return rate of self-fund	2,500 Return rate of self-fund
		yuan/kWh	(%)	yuan/kWh	(%)	yuan/kWh	(%)	yuan/kWh	(%)		(%)	(%)	(%)	(%)
Guangdong	0.439	0.689	6.72	0.689	12.59	0.666	15.02	0.639	18.73	0.689	6.72	12.59	16.41	22.35
Hubei	0.366	0.616	3.20	0.616	8.49	0.593	10.58	0.566	13.61	0.616	3.20	8.49	11.97	17.09
Hunan	0.384	0.634	4.03	0.634	9.52	0.611	11.68	0.584	14.85	0.634	4.03	9.52	13.05	18.37
Jiangxi	0.372	0.622	3.47	0.622	8.84	0.599	10.95	0.572	14.02	0.622	3.47	8.84	12.33	17.52
Henan	0.336	0.586	1.87	0.586	6.74	0.563	8.70	0.536	11.55	0.586	1.87	6.74	10.13	914.99
Sichuan	0.333	0.583	1.74	0.583	6.57	0.560	8.51	0.533	11.34	0.583	1.74	6.57	9.94	14.78
Chongqing	0.327	0.577	1.49	0.577	6.21	0.554	8.13	0.527	10.92	0.577	1.49	6.21	9.56	14.37
Liaoning	0.347	0.597	2.35	0.597	7.39	0.574	9.39	0.547	12.30	0.597	2.35	7.39	10.81	15.76
Jilin	0.339	0.589	2.00	0.589	6.92	0.566	8.89	0.539	11.75	0.589	2.00	6.92	10.31	15.20
Heilongjiang	0.337	0.587	1.91	0.587	6.80	0.564	8.76	0.537	11.62	0.587	1.91	6.80	10.19	15.06
Eastern Inner Mongolia	0.330	0.580	1.62	0.580	6.39	0.557	8.32	0.530	11.13	0.580	1.62	6.39	9.75	14.58
Shaanxi	0.282	0.532	0	0.532	3.65	0.509	5.24	0.482	7.71	0.532	0	3.65	6.70	11.27
Ningxia	0.248	0.498	0	0.498	1.87	0.475	3.16	0.448	5.22	0.498	0	1.87	4.53	8.86
Gansu	0.242	0.492	0	0.492	1.57	0.469	2.81	0.442	4.79	0.492	0	1.57	4.16	8.43
Qinghai	0.245	0.495	0	0.495	1.72	0.472	2.98	0.445	5.01	0.495	0	1.72	4.34	8.65
Xinjiang	0.235	0.485	0	0.485	1.72	0.462	2.40	0.435	4.30	0.485	0	1.22	3.73	7.92

The above calculations, using the recommended price system, tell us something about the likely market choices open to power generators. Those developers who choose areas rich in wind resources, such as Xinjiang or Inner Mongolia, will find that the benchmark price is low, and will have to find projects with annual full load hours of over 2,700. On the other hand they could get the same return from projects with annual full load hours of about 1,700 in the eastern part of the country, where the benchmark price is high.

Based on these calculations, the recommendation for the grid price is as follows: the average operating hours of existing wind farms indicates that China has 2,000 applicable hours of wind resources, which can be taken as the reference for deciding the average grid price; 0.6 yuan/kWh is adopted in areas with 2,000-2,200 hours of wind per year and 0.5 yuan/kWh in areas with more than 2,200 hours of wind per year. In areas where the annual wind hour total is below 2,000, however, the price is decided by evaluation or bid. These prices are close to international standards, and the payback rate is the same as or higher than that for fossil fuel power. This is consistent with the principles of China's Renewable Energy Law.

V. Recommendations on Wind Power Pricing Systems and Support in China

The wind price policy in China should be subject to the following principles:

* Towards a long-term development strategy for wind power

From the perspective of future energy demand, what China needs is hundreds or even thousands of gigawatts of wind capacity, rather than merely 5 to 30 GW. Only in this way can wind power replace nuclear and hydropower, become the second biggest power resource and alleviate our country's heavy dependence on coal. Relatively high costs and a low electricity price, especially since 2003, are the major bottlenecks for wind power development. The solution depends on either a reduction in cost or at least an increase in the electricity price to cover the existing cost.

Many complex factors such as technology improvement, industrial development and market supply and demand affect the cost, so it is not easy to reduce it in a short period of time. It is therefore very important to set a reasonably profitable price for wind power for a certain period in order to encourage its steady and healthy development. Wind power is a new and growing industry that needs support, but the current practice of bidding is in conflict with this aim. Any product or industry has its growing period. A new industry can develop steadily and become well established and reliable if it is properly nurtured, but it can also fail if the wrong policies are implemented. The British Non-fossil Fuel Obligation (NFFO) is an example of the latter, yet it has still been repeated frequently elsewhere, indicating that the lessons have not been learned. On the other hand, effective policies have been adopted in Germany, Spain and Denmark, enabling the wind power industry in these countries to develop a firm foundation, grow steadily and become firmly established.

China has entered an important stage in developing its wind power potential. Whether it will succeed or fail depends on how the policies are adjusted. Great investment has already been made in the industry. That said, if there is no systematic, positive and strong policy support, the industry will encounter serious failure, great losses and long-term effects.

* Participation of all stakeholders

Since the bidding system has led to uncertainties in both the electricity price and the development of the industry, wind power developers are in a dilemma in terms of wind resource assessment. It is risky to assess the wind resource in a particular area because the investment cannot be refunded if you lose the bidding; however, it is difficult to offer a reasonable bidding price if you don't assess the wind resource. In fact, the government department in charge of bidding is responsible for providing accurate wind measurement data. This is is not being done properly, however. It takes a considerable amount of time to obtain accurate wind data. Wind resource assessment is the basis for economic evaluation and a feasibility study and it is one of the most important bases for selecting the site.

A detailed nationwide wind resource assessment has not yet been conducted. Although the China Science and Technology Research Institute of Meteorology is currently conducting a wind resource assessment, this will only be useful for macro-level strategy. It is not sufficient for selecting individual sites and evaluating wind farms. The responsible department should therefore strengthen its evaluation of the wind resource in the current bidding system, avoiding a repeat of the situation where wind data used for economic evaluation and feasibility studies has been in conflict with what has been estimated later by the developers, leading to a large impact on their profit. It is essential to set up a wind resource assessment system to ensure greater accuracy.

Another big problem to emerge is the high indirect costs associated with wind power development. For a 100 MW wind farm, the cost of pre-preparation can run into millions or tens of millions of yuan, along with a bid dealing cost of 1%. The developers have to pay about 20 million yuan before the project is even started, which is too much for small and medium size developers. The result is that development of wind power is likely to be a game that only large enterprises can afford to play. This is not good for attracting the interest of all stakeholders.

* Promote the localisation of wind turbine manufacturing

Since 2004, the wind turbine manufacturing industry has changed greatly. Some large manufacturing groups, including Oriental Turbine Group, Shanghai Electrification Group, Harbin Electronic Group and Dalian Heavy Equipment Manufacture Group, have started to invest in wind turbine manufacturing. In addition, international technology has been trans-

ferred to develop the industry. However, a manufacturing base has still not been fully realised. It is currently estimated that it will not play an important role until 2010.

In terms of manufacturing output, only Xinjiang Golden Wind Co., Ltd. has reached a certain scale and created a stable customer base. The company is now on its way to mass production. Many other companies are still at an early stage, without fixed products or a stable customer base. They are not yet capable of manufacturing wind turbines on a large enough scale. There is also still a big gap between domestic and international technology. We need to strengthen R&D as well as acquaint ourselves with transferred technology in order to bridge the gap and increase the competitive capacity of domestic turbines. An attractive grid price for wind power is needed in order to support and promote domestic turbine manufacturers.

★ Promote diversity and competition

When analysing the procedures and outcomes of the past concession bids, we have noted that the bidding prices do not reflect the true price of wind power. For example, some companies have taken advantage of so-called joint ventures in order to enjoy the VAT discount on the purchase of locally-made equipment and other tax benefits, which are mainly tax incentives introduced by the national government aiming at attracting more foreign investment. Some companies have even listed the potential income from the trading of greenhouse gas reduction certificates (CERs), which is not available to majority overseas businesses, as company revenues. All of these have contributed to lowering the prices, on the one hand resulting in an illusory low price for wind power and sending misleading information about a reasonable pricing system to the policy makers, on the other hand creating unfair competition between developers and making it especially difficult for small-to-medium size companies or foreign investors.

This means that if we decide to take the bidding prices as a reference in order to set a feed-in-tariff, we will need to disregard these special factors, which could lead to as much as a 0.1 yuan/kWh (excluding the income from CERs) decrease in wind power price or 0.15 yuan/kWh (including the income from CERs). Only in this way can an environment for fair competition be created and a diversified body of investors attracted.

★ Competitiveness of the wind power industry

The wind power industry is still growing in China and there are many obstacles to overcome,

such as an unclear resource, unfair regulations,, inconsistent, unsystematic and unfeasible incentives as well as insufficient manufacturing capacity. Among these obstacles, the inconsistent incentives, of which the central focus is pricing policy, play the most crucial role. Since bidding was used for the first time in 2003, the grid price for wind electricity has drawn a great deal of attention in the renewable energy sector, but a low price is harmful to the development of the industry. This situation did not change even by the third round of bidding in 2005. In 2006, the NDRC issued new regulations under the Renewable Energy Law concerning "pricing and cost sharing" for renewable energy. Much to the disappointment of the wind power industry, however, these did not introduce a feed-in tariff but maintained the excsting bidding system.

As described earlier, the former National Planning Commission originally decided that the bidder who proposes the lowest grid price for wind power will win the bid. In 2003, six companies bid for the 100 MW Rudong Wind Farm. The bidding prices of five of the bidders ranged from 0.6070 to 0.7191 yuan/kWh. However the sixth bidder proposed 0.3979 yuan/kWh (estimate based on a 15% tax rate for the joint venture). As a result this company won

the bid. However, they overestimated the wind resource and underestimated the equipment cost, loan rate and maintenance costs, and the price they proposed was not sufficient to cover their costs. In 2005, even after "the lowest bidder wins" rule was removed, the price was still weighted at a percentage of 40%, higher than the other indicators.

So far, eleven concession projects have proceeded as a result of the four rounds of bidding. Ten bidding notices have been issued to thirteen companies (Longyuan and Huaneng won the bid of the Tongyu Wind Farm together). The total installed capacity of these projects is 2.35 GW, representing the majority of proposed new capacity in China. But the bidding prices for these projects are in the range of 0.382 yuan/kWh to 0.519 yuan/kWh. If the cost of building a wind farm is between 0.373 yuan/kWh and 0.461 yuan/kWh, then a reasonable grid price should be in the range of 0.566 yuan/kWh to 0.703 yuan/kWh (VAT included). These bidding prices are therefore about 0.20 yuan/kWh below a reasonable price. The evidence suggests that the equipment and financing costs of these projects have grown compared with earlier estimates, although they are not yet completed.

Although these projects may well be successful technically, they are likely to face economic failure. If big economic losses occur, the wind farm industry will be affected seriously in the long-term.

The latest rules introduced under the 2006 Renewable Energy Law state that the payment for wind electricity will not only be subject to a price introduced by the government, i.e. the price decided by a winning bid, but that price will also apply to any other wind farms proposed in the same area. As a result, unreasonable prices resulting from the bidding affect even those projects which have not participated. This kind of pricing arrangement will not attract investment. Lessons learned in the development stages of atomic or fossil fuel power, when income generated by initial projects was enough to finance future plans, should be followed in the case of wind power. To reach this goal, the payback rate for wind power investment should not be less than that for fossil fuel power.

The suggestions for achieving this are:

1) Transform the bidding system into a feed-in tariff system

The four bidding rounds have established the basis for a shift from a bidding price to a fixed price. Under this system, China would be divided into three resource categories. A fixed price would then be decided for areas rich in wind resources (2,500 hours or more annually),

areas with exploitable wind resources (2,000-2,500 hours annually) and areas with fair wind resources (2,000 hours or below annually). The fixed price in the consultation version of the No.7 Notice can be adopted - "an additional 0.25 yuan above the local price for coal-fired electricity generated at a desulphurised power station."

2) Maintain an attractive price level

The following method can be used to decide the fixed price for different areas. Taking the bidding prices for the various projects in Jiangsu, Guangdong and Jilin provinces, the new price for coastal areas can be decided by averaging all the prices, excluding the lowest and highest. That makes the average price about 0.6 yuan/kWh. The same method can be used to determine the price in areas with rich wind resources, by averaging the bidding prices in Inner Mongolia, Hebei and Xinjiang. The result would be a price of about 0.5 yuan/kWh. A maximum price can be set for other areas, for example it should be no more than 0.65 yuan/kWh.

3) Adjust the price in a timely fashion, but it should always be higher than for coal-fired power

Wind power technology is developing very fast. It is expected that the wind power cost will drop with a reduction in manufacturing costs. The grid price can therefore be reduced alongside the development of domestically manufactured wind turbines. However, in order to support the wind power industry, a protective minimum price should be adopted. At present we would consider a level of 0.5 yuan/kWh up to the end of 2020. This will help remove the concerns of investors, developers and manufacturers.

4) Encourage self-regulation among wind power companies, working together to create a fair competitive environment

According to the Renewable Energy Law, the price of renewable energy should be set based on the principles of favouring the development of renewable energy as well as economic good sense. It also states that the government encourages enterprises with a range of ownerships to participate in the development and utilisation of renewable energy, and protects the legal rights of developers in accordance with the law. These regulations have created a good policy environment for different investors to take part in wind power development. On the other hand, companies should make full use of such a policy environment and set up self-regulation for the industry so that it can work together to create

a fair environment for competition. At the same time, relevant policies should be adopted by the government to regulate the industry and encourage self-regulation. For those wind companies which have arbitrarily bid a low price and have a poor performance (induced losses for three continuous years), the government should organise a compulsory auction and re-confirm the tariff after the auction.

By adopting these measures, it is anticipated that the wind power market will develop in a healthy way and the government's strategic goal will be reached.

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