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INTERNATIONAL SUPPORT FOR DOMESTIC CLIMATE POLICIES

North-South Cooperation and Private-Public Partnership: A Case Study of China's Wind Power Industry

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Abstract

China has become a leading country in the world in terms of wind power technology deployment and manufacturing capacity, and has a great market for future wind turbine deployment in the context of mitigating CO_2 emissions. The paper gives of an overview of China's wind power industry development. From the story of China's wind power development, lessons on innovative North-South co-operation mechanisms and private-public partnership can be learnt. This is vital to create an enabling environment for wind technology research, development, transfer and diffusion. The paper also demonstrates the great potential of wind power in mitigating GHG emissions in China and highlights the necessities and opportunities for international co-operation to translate the potential into reality.

Keywords: Wind Technology, North-South Cooperation, Private-Public Partnership, China

1. The Current Status of China's Wind Power Market

China's wind energy resource is pretty rich. The development potential of land wind resources is as much as 253 GW at 10-meter height, with an annual electricity generation of more than 50 billion kWh. The rate of growth of wind turbine installations in China is impressive (Figure 1), and this growth could continue indefinitely. The accumulative installed capacity of wind turbines went from 550 MW in 2003, to 760 MW in 2004, to 5900MW in 2007. The increased installed capacity of wind power in 2007 reached 3,304MW. Further 2007 was the first time that the market share of Chinese manufacturers surpassed that of foreign companies (Table 1 and Table 2). Seven domestic manufactures share approximately 55% of the increased installed capacity of 2007, while the four foreign companies 42%. Two domestic manufacturers, Goldwind and Sinovel, share 45% of the market while two foreign manufacturers, Gamesa and Vestas, 28%. In terms of accumulative installed capacity, however, the market share of foreign companies was still larger than that of Chinese companies by 2007 (Table 3 and Table 4).

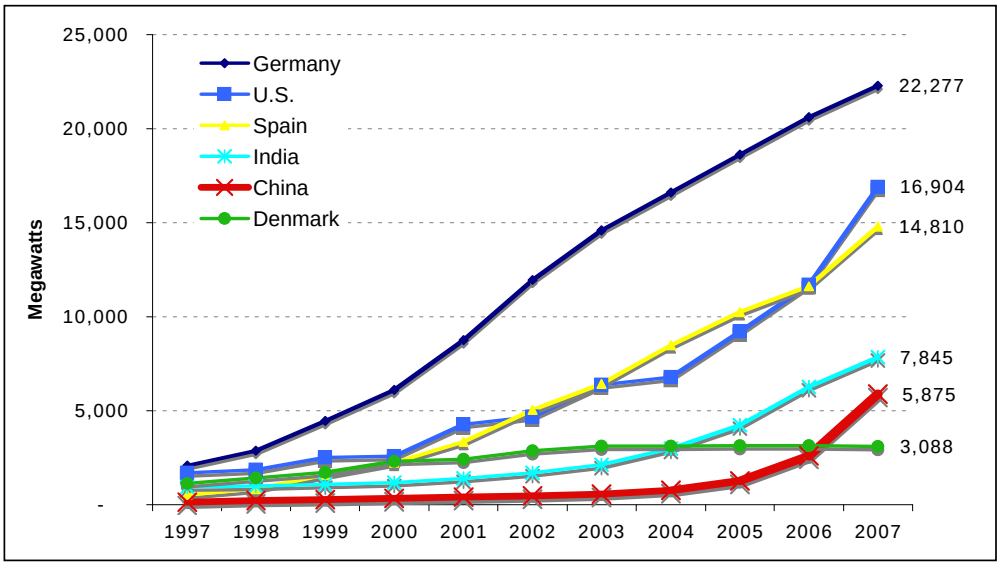

Figure 1. Leading Countries: Installed Wind Power Capacity: 1997-2007. (Source: BTM, 2007; Windpower Monthly, 2008).

China's wind technology level has fallen behind Europe, as the core technology and know-how are still in the hands of foreign companies. China's key R&D priorities for wind are large-capacity turbines, variable speed technologies, variable screw distance, and off-shore turbines and wind farm designs. Production costs have been decreasing, in line with international costs, over the past decade, and these cost declines need to continue among Chinese manufacturers.

Manufacturer	Capacity (kW)	Percentage of Domestic manufacturers	Percentage of total increased capacity
Goldwind	829950	44.93%	25.12%
Sinovel	679500	36.79%	20.57%
DEC	222000	12.02%	6.72%
Windey	65250	3.53%	1.98%
Sewind	22500	1.22%	0.68%
New Unite	9000	0.49%	0.27%
XEMC	8000	0.43%	0.24%
Others	10850	0.59%	0.33%
Total	1847050	100%	55.91%

Table 1. Market share of increased installed capacity in 2007 of Chinese manufacturers.

Manufacturer	Capacity (kW)	Percentage of foreign manufacturers)	Percentage of total increased capacity
Gamesa	560150	39.91%	16.96%
Vestas	368700	26.27%	11.16%
GE	213000	15.18%	6.45%
Suzlon	206250	14.69%	6.24%
Nordex	55500	3.95%	1.68%
Total	1403600	100%	42.49%

Table 2. Market share of increased installed capacity in 2007 of foreign manufacturers.

Manufacturer	Capacity (kW)	Percentage of Chinese manufacturers	Percentage of total capacity
Goldwind	1497300	56.55%	25.35%
Sinovel	754500	28.50%	12.77%
DEC	237000	8.95%	4.01%
Windey	97000	3.66%	1.64%
Sewind	22500	0.85%	0.38%
New Unite	9000	0.34%	0.15%
XEMC	8000	0.30%	0.14%
CSIC	3700	0.14%	0.06%
Huachuang	3000	0.11%	0.05%
Wandian	2400	0.09%	0.04%
Huide	2000	0.08%	0.03%
Others	11210	0.43%	0.21%
Total	2647610	100.00%	44.83%

Table 3. Market share of accumulative installed capacity by 2007 of Chinese manufacturers.

Manufacturer	Capacity (kW)	Percentage of foreign manufacturers	Percentage of total accumulative capacity
Gamesa	1044200	32.17%	17.68%
Vestas	855500	26.36%	14.48%
GE	492000	15.16%	8.33%
Suzlon	218750	6.74%	3.70%
Nordex	184750	5.69%	3.13%
Others	325370	13.88%	5.51%
Total	3120570	100.00%	52.83%

Table 4. Market share of accumulative installed capacity by 2007 of foreign manufacturers.

2. Domestic Policies for Wind Power

2.1 Renewable Energy Law

China's *Renewable Energy Law* was passed by the Congress on February 28, 2005, and took effect on January 1, 2006. The law recognizes the strategic role of renewable energies in optimizing China's energy supply mix, mitigating environmental pollution, improving energy supply security, and promoting rural social development. It also relates renewable energy development and utilization directly to China's energy system transition. More importantly the law largely shapes an integrated renewable energy policy framework by providing a set of directives encouraging renewable energies; including, national renewable energy targets, a feed-in tariff, a special fiscal fund, tax relief, and public R&D support as

well as education and training. Wind turbines have been listed as a priority renewable energy technology by the law. Among others, the major policies and/or institutions covered by the law included various directives on:

- Setting indicative renewable energy targets;
- Renewable energy planning;
- Functions and responsibilities of the relevant government agencies in renewable energy management;
- Removal of barriers of renewable energy products to entry energy market;
- Grid connection of renewable power generation project;
- Feed-in tariff of renewable power generation;
- Taxation measures;
- Special fiscal fund of renewable energy development; and
- Renewable energy technology research and development, standards and certification.

2.2 Market-based Policy Instruments

The normal value added tax (VAT) rate is 17% in China. To increase the competitiveness of wind power, the Central Government allows wind farm developers to enjoy 50% VAT relief. Furthermore, if for some reason accessories and renewable energy equipment can not be produced in China, duty free or low customs tax rates are applied to the imports of key parts of wind equipments. Some local governments also provide favorable tax policies within their authorities. For example, in Xinjiang and Inner Mongolia, renewable energy enjoys tax-free incentives or tax deduction policies. In addition to tax measures the Chinese Government has also implemented a policy of 0.2% electricity surcharge to subsidize renewable power including wind power.

In January 2006, a policy document *Interim Measure of Renewable Energy Tariff and Cost Sharing Management*, released by the National Development and Reform Commission (NDRC), stipulated that a subsidy of 0.25 Chinese RMB/kWh is provided for biomass power generation. The policy document also states that wind tariffs are decided through public bidding for projects with a total installed capacity over 50MW; while for solar geothermal and ocean energy power generation, the price should be approved by government in advance through special processes. For the difference between the average grid tariff and renewable energy tariff, the cost will be shared nationwide.

2.3 Mandatory Targets and Market Shares

The Chinese Government issued and released the *Middle and Long-term Renewable Energy Development Plan* in September 1997. The Plan has set specific targets for China's renewable energy development:

(1) *Improve the proportion of renewable energy in the energy structure. By 2010, renewable energy will provide for 10% of total energy consumption, and by 2020, the ratio will be 15%.*
(2) *Take advantage of local resources to develop renewable energy in order to solve the shortage of fuel for home use in the rural area and electricity supply in remote areas without access to electricity. Try to supply electricity to the whole population in 10 years through utilization of renewable resources and basically solve the shortage of fuel for home use in rural areas.*
(3) *Promote development of renewable energy technology and industry. By 2010, a capacity of manufacturing main renewable energy equipment locally will be gained through introduction and understanding of foreign technology combined with innovation. Beyond 2020, capacity will be further improved in technology research and development as well as innovation and thus self-manufacturing main equipment with domestic intellectual property.*

Wind power has been identified as a priority renewable energy technology. According to the Plan, the installed capacity of wind power should reach 30GW. Furthermore, a mandatory market share policy has been introduced by the Plan. The share of renewable power excluding hydro in the main electricity grids should reach 1% and 3% by 2010 and 2020 respectively. For those electricity investors owning an installed capacity of more 5GW, they are requested to have more than 3% and 8% of renewables excluding hydro in their electricity capacity by 2010 and 2020 respectively. The *Renewable Energy Plan during the 11th Five-Year-Plan Period* released by the National Development and Reform Commission requests that the installed capacity of wind power should be more than 10GW.

2.4 Technology Research and Development

The Chinese government has made substantial efforts to support wind technology R&D. The National Basic Research Program (973 Program), the National High-tech R&D Program (863 Program), as well as the National Key Technology R&D Program, are the three key programs (TKPs) of China. Wind energy technology research and development has been an important element of these programs. Other programs and projects have also largely supported the demonstration and industrialization of wind energy technologies, such as Bi-Emphasis Projects, National Debt Investments for Wind Power, and international cooperation projects. Some experiences have been gained in terms of wind resource survey and evaluation, wind farm operation and management, and wind power turbine design and manufacture. At the same time, some human resources have been built up with capability to pursue technology R&D and project management. However, the development of wind

power as a whole in China was at the lower level. There are very wide gaps between China and the EU. So far the core technologies of wind turbines are still held by foreign companies.

3. North-South Cooperation and Private-Public Partnership: A case study of a Chinese wind turbine manufacturer - Goldwind

Technology transfer has played an important role in China's wind power development. Goldwind is the largest wind turbine manufacture in China, and currently holds more than 25% of China's wind power market. The company originated from a research institution in Xinjiang in 1986. With grant support from the Danish Government, the research institution was restructured into a wind power company in 1988. In 1989 the company introduced 13 150kW-sized wind turbines from BONUS, a Danish company, to build the largest wind farm in Asia. In 1996, using a loan from the German Government, the company became the first company to install and operate 600 kW-sized wind turbines in China. In 1997, the company made an agreement with Jacob, a German company, on licensing Goldwind to manufacture 600 kW sized wind turbines in China, and at the same time the technology transfer deal was supported by the National Key Technology and Research Program for localizing the technology. In 1999, the 600kW wind power generator set was successfully developed and localized. In 2001, the company introduced the 750 kW wind turbine technology by licensing from REpower, a Germany company. In the same year, the company received support from the 863 Program to carry out research and development of a MW stall-regulated wind power generator set and its key components. In 2002, after the establishment and commissioning of the heavy-rating modern wind power generator set assembly base, the company made itself ready for an annual manufacturing capacity of 200 sets of 600kW-1MW wind power generators. In 2005, the company's first 1.2MW wind power generator set was put into operation in the wind farm of Dawanching. At the same time, the company was listed as the technical support company for the localization of the 750kW heavy-rating wind power generator technology. In 2006, Goldwind had captured 33% of China's market share, ranking top domestically and 10th in the world. In 2007, the company's first batch of five 1.5MW wind power generator sets were put into operation in Dawanching Wind Farm, and the company was listed at the Shenzhen Stock Exchange.

4. Opportunities for Future International Cooperation

To identify the contribution of wind power in China's sustainable energy system transformation we develop a **CO_2 Emission Constraint Scenario**: A scenario for achieving the target of zero CO_2 emissions growth after 2025 through the aggressive development of alternative low-carbon energy, along with assumed improvements in market efficiency through policies and measures, and a clearing of any relevant market barriers. The Tsinghua Message Model depicts the power generation technology composition of this scenario (Figure 2). According to the outputs of the modeling work, under this scenario China's wind power installation will reach 30GW in 2020, 285GW in 2030, and 395GW in 2050,

respectively, showing that China will have considerable wind power market opportunities for investors in future. However, substantial efforts should be made to achieve the wind installations under the CO_2 control scenario, including necessary international cooperation initiatives, for example:

(1) **Capacity building for wind turbine design**. So far Chinese wind turbine manufactures have not the capacity to design state of the art wind turbines. In order to further reduce the cost and improve the operational performance of wind turbines, wind turbine design systems and related databases need to be transferred into China.

(2) **Transfer of technologies for manufacturing some key parts of wind turbines**. Chinese wind turbine manufactures do not have adequate capacity to manufacture key parts of wind turbines, such as bearing and control systems. If these technologies are successfully transferred to China, the economics and operational performance of wind turbines can be improved significantly.

(3) **Transfer of off-shore wind turbine technology.** So far, China does not have the capacity for manufacturing, installing and operating off-shore wind turbines. To increase the contribution of wind energy in China's energy supply, China has to utilize her abundant off-shore wind resource. To make off-shore wind power competitive with coal-fired power in China, the country must localize the manufacturing of off-shore wind turbines.

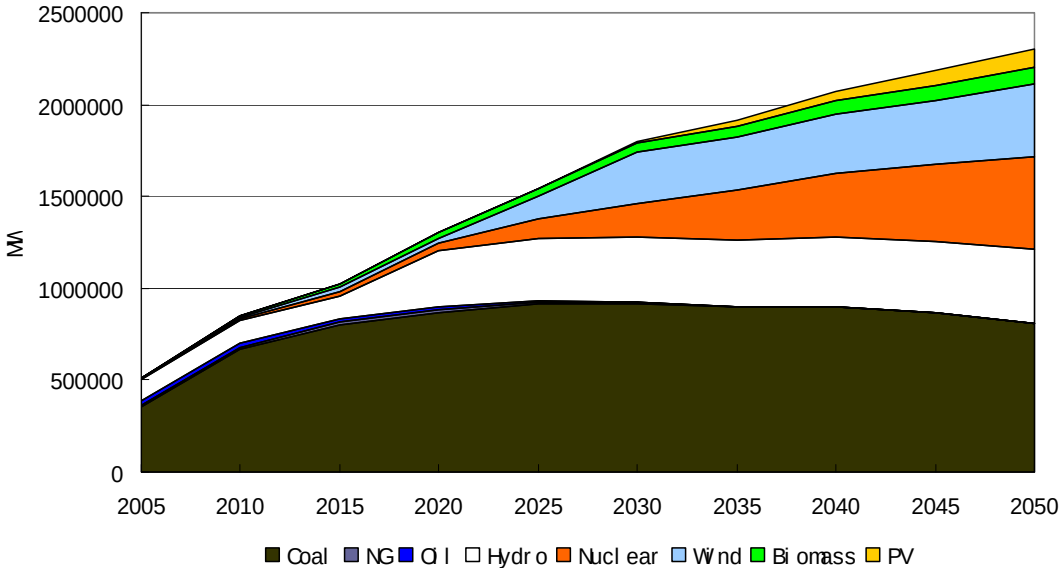

Figure 2. Power Generation Technologies under CO_2 Control Scenario.

A number of barriers must be overcome to successfully achieve win-win cooperation. Such barriers include high license costs, intellectual property rights, and a lack of trust between Chinese and EU companies. In this context there is a necessity to come up with domestic policies in both China and related EU countries as well as through international schemes.

5. Concluding Remarks

China has become a leading country in the world in terms of wind power technology deployment and manufacturing capacity, and the country also has a great market for future wind turbine deployment in the context of mitigating CO_2 emissions. From the case study of China's wind industry development, the following points can be drawn out:

1) Technology transfer can play an important role in the development and deployment of wind technologies. Almost all the wind turbine technologies used in China now originate from developed countries.
2) The business interests of the companies involved in the technology transfer process should be well protected, which is the foundation for any successful cooperation.
3) There is a need for a portfolio of policy instruments in developing countries to induce demand for wind power and enhance the technology innovation and manufacturing capacity.
4) Finance from developed countries can catalyze the process of international transfer for wind technologies;
5) Combined North-South cooperation and private-public partnership are vital to create an enabling environment for wind technology research, development, transfer and diffusion.

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