



Market Potential and Technology Transfer——Experience and Expectations from a Chinese Perspective

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Content



- ***Development Status of China Wind Power***
- Chinese wind turbine technology
- Incentive Policies of China Wind Power
- Market development of China wind power
- Conclusions

China's Wind Power Development Status



- The grid-connected wind capacity in 2008 is 6,246 MW and that was 3,304 MW in 2007. The growth rate of newly installed capacity is 89% in 2008.
- By the end of 2008, there are more than 11.6 thousand units installed with the capacity 12,153 MW. Comparing to the cumulative installed capacity of 5,906 MW in 2007, the growth rate of total installation capacity is 106% in 2008.
- They are distributed in 24 provinces (or autonomous regions), compared to the previous year, 3 provinces (or city) are added into the list, which are Chongqing, Jiangxi and Yunnan. Provinces with wind installation capacity of more than one million kW , are Inner Mongolia, Liaoning , Hebei and Jilin.
- In 2008 the wind power capacity assess to grid is estimated about 14 billion kWh.

2008 Installed capacity by province



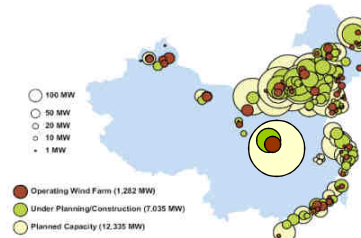
	2007 total (10 MW)	2008 New installation (10 MW)	2008 total (10 MW)
Inner Mongolia	156	217	374
Liaoning	52	73	125
Hebei	49	62	112
Jilin	61	46	107
Heilongjiang	40	43	84
Jiangsu	29	35	65
Gansu	34	30	64
Xinjiang	30	28	58
Shandong	35	22	57
Ningxia	36	3.8	39
Others	68	64	132
Total	591	625	1215

Rapid development of wind farms



By the end of 2008 :

- More than **239** wind farms in the whole country
- More than **24** provinces (autonomous regions) have a wind farm or a wind turbine at least
- **12** provinces (regions)' wind power installation capacity are more than 200MW; **4** provinces more than 1000MW.



China's Wind Farms Distribution

Breakthrough for the Developers on Wind Farm Development



In 2008, Long Yuan Power Group made a breakthrough of new wind power installation capacity of 1200MW. The total wind power installed capacity reached 2630MW, accounting for 21.2% of national installed capacity.

Source: Long Yuan

Breakthrough for the Developers on Wind Farm Development



In 2008, China Datang Corporation's new wind power installed capacity made a breakthrough of 100MW. The total wind power capacity has reached 2026.7MW, accounting for 16.3% of the whole country's total cumulative installed capacity.

Photo source : WebSite of Datang Corporation

Progress in Donghai Bridge Offshore Wind Power Project



The infrastructure construction started in September 2008, the entire project is expected to be completed by the end of 2009.

The tender for Shanghai Donghai Bridge's 100 MW offshore wind power demonstration project was completed in June of 2007. The total investment is about 3.0 billion RMB, and it is planned to install 34 units of 3MW turbine produced by Sinovel.

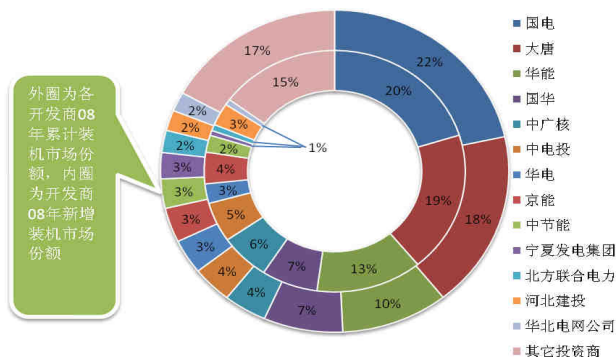
The launch of infrastructure construction of 10 million kW wind power in Jiuquan, Gansu Province



- Second phase of 5250MW equipment bidding ended in April of this year;
- Wind turbine manufacturers which won the bid are: Sinovel, DEC, Goldwind, MingYang, Xiangtan Electric(XEMC) Manufacturing Co. Ltd., Windey, United Power.

Name	Capacity of the Contract (MW)
Sinovel (HuaRui)	2005.5
DEC (Dong Qi)	1474.5
Goldwind	775.5
Ming Yang	301.5
XEMC (Xiang Dian)	300
Windey	250.5
United Power	150

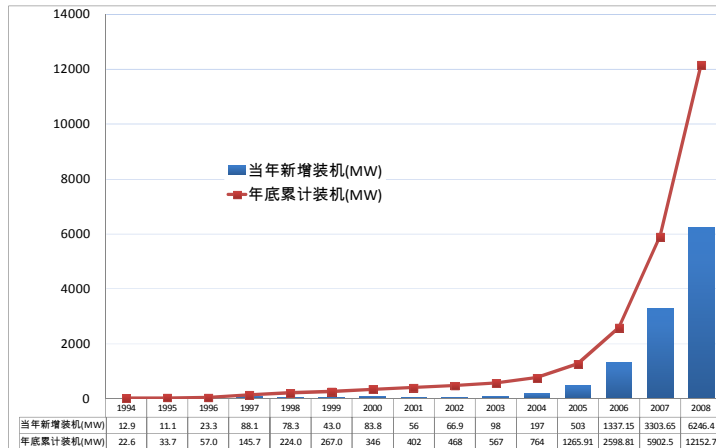
Developers' installation capacity keep high



Breakthrough in China's Wind Power Installed Capacity



- In 2008 China's total installed capacity has reached more than **12GW**, and the target of "Eleventh Five-Year plan of renewable development" that to reach **10GW** in **2010** is fulfilled ahead of schedule.



China joined the Club of Wind Power Leaders



- In 2008, China exceeded India and became **the world's top four wind power country that has the installed capacity of more than 10 million kilowatts**. The newly installed capacity accounted for 23% of the world's, **ranking the second**.

国家	装机容量 (MW)	百分比 (%)
美国	25170	20.8
德国	20900	19.0
西班牙	8754	13.9
中国	12210	10
印度	9645	8
意大利	3736	3.1
法国	3404	2.8
英国	3241	2.7
丹麦	3180	2.6
葡萄牙	2862	2.4
其他	16686	13.8

国家	装机容量 (MW)	百分比 (%)
美国	8353	31
中国	6309	23
印度	1800	7
德国	1665	6
西班牙	1609	6
意大利	1010	4
法国	950	4
英国	836	3
葡萄牙	712	3
加拿大	523	2
其他	3293	12

Data source : GWEC (It's different from the domestic statistical data, but difference doesn't affect the ranking)

Development Status of Turbine and Wind Farm Investors



- The **total capacities** produced by both domestic companies and joint ventures reached 62% of the wind turbine market share, for the first time exceeded foreign companies.
- Among **the newly added capacities** of 2008, domestic companies and joint ventures' productions reached 76% of wind turbine market share, exceeding foreign companies.
- Major domestic wind farm developers are the central and local state-owned power generation companies and energy firms investment enterprises, private and foreign enterprises less. The newly added capacity of Central Power Generation Group and Energy Group enterprises reached 76%.

Proportion of Developers' New Installations in 2008



Power Utility			61%
	Longyuan	22%	
	Datang	17%	
	Huaneng	15%	
	China Power Investment	5%	
	Huadian	2%	
Energy Enterprise			15%
	China Nuclear, Guangdong	8%	
	Guohua	6%	
	CECIC	2%	
Others			
	Hebei Construction&Investment	3%	

Major Equipment Manufacturers' Added Installed Capacity and Proportion in 2008



Manufacturer	Capacity (kW)	The Proportion of Domestic Manufacturers	The Proportion of Added Total Installed Capacity
Sinovel	1402500	29.71%	22.45%
Goldwind	1131750	23.98%	18.12%
DEC	1053000	22.31%	16.86%
Windey	233250	4.94%	3.73%
Sewind	178750	3.79%	2.86%
Mingyang	174000	3.69%	2.79%
CASC ACCIONA	150000	3.18%	2.40%
XEMC	120000	2.54%	1.92%
Xinyu	73500	1.56%	1.18%
Beizhong	60000	1.27%	0.96%
Others	143680	3.04%	2.30%
Total	4720430	100.00%	75.57%

Accumulated Installed Capacity of Wind Turbine Manufacturers And The Proportion in 2008



Manufacturer	Capacity (kW)	The proportion of total domestic manufacturers	The proportion of the total installed capacity
Goldwind	2629050	35.02%	21.63%
Sinovel	2157000	28.74%	17.75%
DEC	1290000	17.19%	10.61%
Windey	330250	4.40%	2.72%
CASC ACCIONA	250500	3.34%	2.06%
Sewind	201250	2.68%	1.66%
Mingyang	175500	2.34%	1.44%
XEMC	128000	1.71%	1.05%
Xinyu	82500	1.10%	0.68%
北重	60000	0.80%	0.49%
Others	202170	2.69%	1.66%
Total	7506220	100.00%	61.76%

The Full Name of Domestic And Joint Venture Manufacturers




Short Name	Full Name
Beizhong	Beijing Beizhong Gas turbine Co., Ltd.
DEC	DEC Steam Turbine Company
CASC ACCIONA	Nantong CASC Wanyuan ACCIONA Wind Turbine Manufacture CO.,LTD
Sinovel	Sinovel Wind Power Technology Co., Ltd.
Goldwind	Goldwind Technology Co., Ltd.
Mingyang	Guangdong Mingyang Wind Power Co.,Ltd.
Sewind	Sewind Wind Co.,Ltd.
XEMC	Hara XEMC Windpower Co., Ltd.
Xinyu	Jiangsu Xinyu Wind Power Co.,Ltd.
Windey	Zhejiang Windey Engineering Co., Ltd.

Foreign Manufacturers' Added Installed Capacity In 2008




Manufacturer	Capacity (kW)	The proportion of foreign-owned manufacturers	The proportion of the total added installed capacity
Vestas	599700	39.30%	9.60%
Gamesa	508300	33.31%	8.14%
GE	145500	9.53%	2.33%
Nordex	144000	9.44%	2.31%
Suzlon	128500	8.42%	2.06%
Total	1526000	100.00%	24.43%


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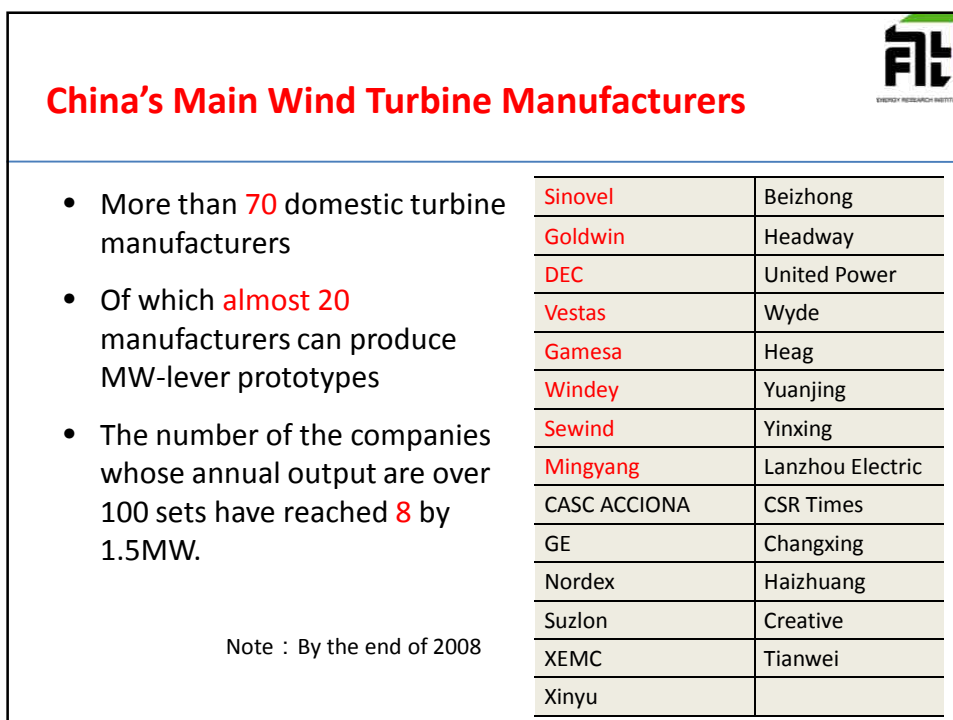
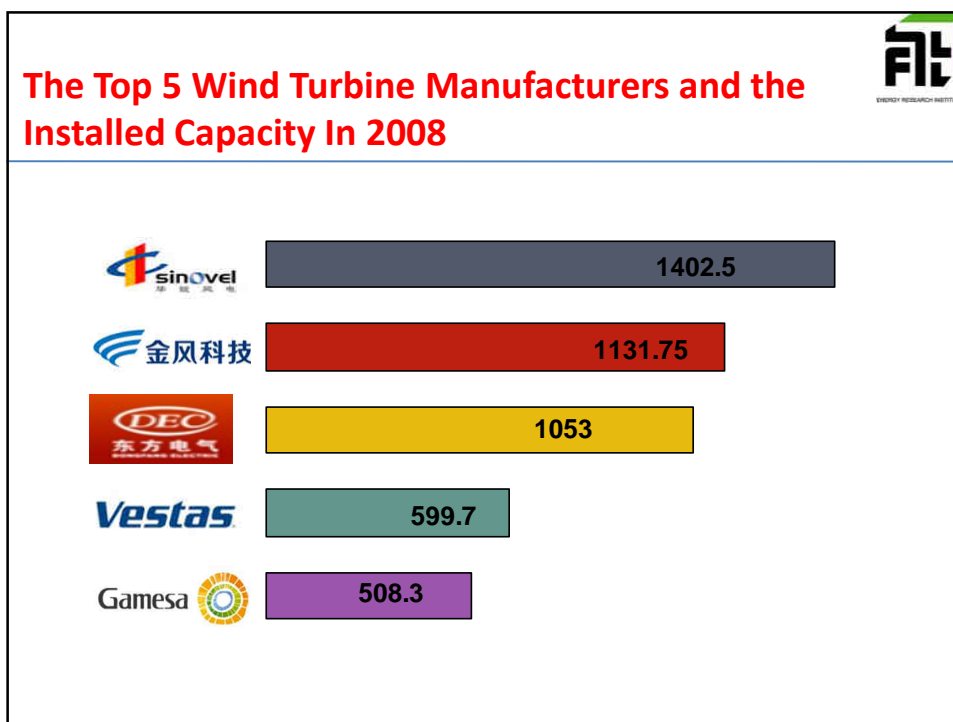
Accumulated Installed Capacity of Foreign Manufacturers And The Proportion in 2008

Manufacturer	Capacity (kW)	The proportion of foreign-owned manufacturers	Cumulative proportion of the total installed capacity
Gamesa	1552500	33.41%	12.77%
Vestas	1455200	31.32%	11.97%
GE	637500	13.72%	5.25%
Suzlon	347250	7.47%	2.86%
Nordex	328750	7.08%	2.71%
Others	325370	7.00%	2.68%
Total	4646570	100.00%	38.23%


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China's Rapid Growth of Wind Turbine Manufacturing Industry

- Domestic enterprises have basically mastered the manufacturing technology of megawatt-level wind turbine, and can produce the main parts by themselves.
- In 2008, the outputs of Sinovel, Goldwind, and DEC were separately more than 1 million kW, and Windey, Sewind, Mingyang and Xiangtan Electric respectively more than 100,000 kW. More than 20 wind turbine manufacturer's products were launched to the market, then the market competition formed.
- A variety of prototypes of 2 MW-level to 3 MW-level have been developed, and some were produced in small batch, which need to run in the field assessment, exposure problems, then be improved.





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Well-known Turbine Manufacture Enterprises

Foreign Companies




Joint Ventures




Domestic Companies






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A series of new types of wind turbines



September 18, 2007, Jiangsu
Xinyu, 1.5MW



September 19, 2007, XEMC 2MW
wind turbine in Datang wind farm

A series of new types of wind turbines



October 21, 2007, China Creative Wind Energy, Shenyang (CRE) 1.5MW installed in Inner Mongolia



November 22, 2007, Chongqing Haizhuang 2MW Wind Turbine

A series of new types of wind turbines



November 2007, CSR Times 1.65MW Wind Turbine successfully integrated into grid



December 20, 2007, REpower North 2MW Wind Turbine was installed successfully

A series of new types of wind turbines



Source: the Enterprise

January 2008, Zhejiang,
HeWind 780kW wind turbine
installed successfully in Luxi
Island

HeWind 1.5MW wind turbine
successfully off the assembly
line

A series of new types of wind turbines



Source: the Enterprise

In January 2008, Baoding Tianwei's first 1.5MW wind turbine prototype off
the assembly line, was installed successfully in September 2008

A series of new types of wind turbines



Source: the enterprise

January 2008, Nantong Kai Lian 2MW wind turbine at the completion of lifting, Qidong

A series of new types of wind turbines



Source: the Enterprise

March 2008, the National Electric Power completed the first 1.5MW wind turbine installation, and is now in small batch production

A series of new types of wind turbines



Source: Shenyang Industry University Website

March 30, 2008, Lanzhou Electric's first prototype 1MW wind turbine is installed in Gausu Jieyuan wind farm

A series of new types of wind turbines

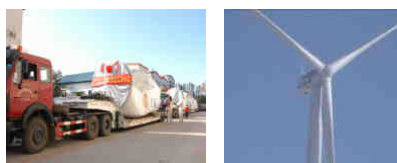


Source: the enterprise

August 2008, Wuhan Guoce's first 1MW dual-blade wind turbine was successfully off the assembly line, and has small batch production these days



A series of new types of wind turbines



Source: the enterprise

September 1, 2008, Beizhong 2MW wind turbine,
connected into grid in November 2008



A series of new types of wind turbines



Source: the enterprise

October 11, 2008, China Steel Group, Xi'an Heavy Machinery 1.5MW Direct Drive Wind
Turbine completed lifting, November 2nd two prototype started generate electricity



A series of new types of wind turbines



Source: Shenyang Industry University Website

October 15, 2008, Daqing REHAU's first prototype 1.5MW wind turbine was successfully installed in Longjiang wind farm



A series of new types of wind turbines



Source: the enterprise

October 15, 2008, Zhongke Tiandao 1.5MW wind turbine, installed in December 20

A series of new types of wind turbines



Source: the enterprise

November 10, 2008, Sanyi electric's first 1.5MW wind turbine was installed in Huadian Coulomb wind farm in Inner Mongolia

A series of new types of wind turbines



Source: the enterprise

December 27, 2008, Jiang Xi Maide 1.5MW direct-drive wind turbine

A series of new types of wind turbines



Source: the enterprise

By the end of 2008, Shenyang Yuanda's first 1.5MW wind turbine successfully connected into grid

Export of wind turbine is increase gradually



- By the end of 2007, Baoding Huide has exported 10 units to the U.S.A;
- January 2008, Zhejiang Huayi exported 3 units of 780kW wind turbine to Chile;
- July 2008, Jiangsu Xinyu exported one 1.5MW wind turbine to Thailand;
- December 2008, GoldWind exported 6 units of 750kW wind turbine to Cuba;
- By the end of 2008, Sewind exported 1.25MW wind turbine to Thailand and the UK.

The development of manufacturing led to the rapid increasing of the total amount of component manufacturers



- More than 50 domestic blade manufacturers
- More than 15 gear box manufacturers
- More than 15 bearing manufacturers
- Nearly 20 generator manufacturers
- More than 10 converter manufacturers

Progress of testing and certification



- Certification has been recognized in the whole wind energy industry;
- China is building the domestic testing and certification capacity.

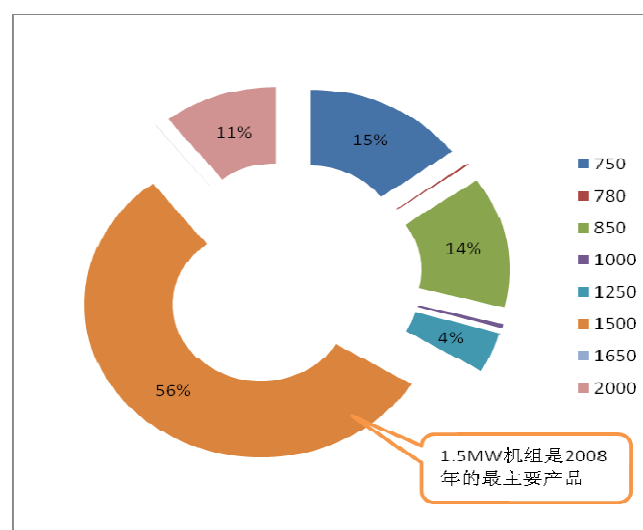
A few domestic manufacture and component enterprises has got the product certification.

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Composition of wind turbines in China, 2008



Situation of China's wind turbine technology development



- Independent R & D capacity is weak, especially lack of independent design tools with intellectual property and the optimal design technology
- Lack of sufficient testing and certification capacity, especially lack of public technical service platform for wind turbine
- Quality control techniques of some key components of wind turbine is still relatively backward
- Wind turbine standards and certification system has not been fully established
- Domestic wind turbine manufacturing enterprises are mainly copying foreign products, which are not always applicable with domestic conditions and lead to a high failure rate

Domestic MW wind turbine development approach



- Joint venture
- Purchase License
- Joint R&D
- Independent R&D
- Foreign direct investment

Domestic wind turbine development approach



Joint Venture	Purchase License	Joint R&D	Independent R&D	Foreign direct investment
CASC ACCIONA	Sinovel	Baoding Tianwei	China Creative Wind Energy	Vestas
Hafeiwinwind	Windey	Windey	Hadian	Gamesa
Wuhan Guoce's	Goldwind	Goldwind	Goldwind	Suzlon
XEMC	North Gas Turbine	Zhongshan Mingyang	Sinovel	GE
REpower North		Chongqing Haizhuang	Nantong Kailian	
Yichuan Ende				
中外合资模式	购买许可证模式	联合开发模式	自主开发模式	外商独资模式
航天万源安迅能	华锐	保定天威	沈阳工大/华创	Vestas
哈飞威达	浙江运达	浙江运达	哈电	Gamesa
武汉国测诺德	金风科技	金风科技	金风科技	Suzlon
湘电风能	东方汽轮机	中山明阳	华锐	GE
瑞能北方		重庆海装	南通楷链	
恩德银川				

Specialized manufacturing industry in China



Turbine	Goldwind Windey	Dalian Zhonggong DEC Gas Turbine	Shanghai Electric Zhongshan Mingyang	Chongqing Haizhuang Shenyang CWE
Gear Box	Chongchi Nangaochi	Hangzhou Qianjin Xi'an Hanghong	
Blade	Baoding Huiteng	Shanghai FRP Research Institute	Tianjin LM	
Generators	Shanghai Generators Yongji Generators	CSR Times XEMC	Lanzhou Generators Shenyang Generators	
Yaw system	Luoyang Axis Group	Wafangdian Axis Group	Xuzhou Huizhuan Axis Group	
Electronic Control System	Institute of Electrical Engineering,CAS	Goldwind	Windey	
Infrascture	Ningxia Xuqi Shanxi Yanhe Machinery	Xi'an Zhenbang	

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Incentive policies in China



Type	Name	Contents
Act.	Renewable Energy Law, January 1 st , 2006	Legislation on resource investigation, development planning, industry guidance, technical support, promotion and application of price management and cost-sharing, economic incentives and monitoring measures, responsible parties and other aspects related to wind energy development.
Planning	Energy development, 11th – five year plan, April.2007	Clarify the national energy strategy, energy development goals, development layout, the direction of reform, priority areas of energy-saving environment protection. Emphasizes the importance of wind power and identify some key technology innovation areas.
	Medium to long term Renewable energy development plan ,Sept. 2007	Generate policies: renewable energy account for 10% in 2010 and 15% in 2020 of primary energy consumption. accounted for 15%, to develop 10 GW-class wind farm, and 10 GW wind power farms; put "financial support and preferential tax policy" as a principle.
	Renewable energy development, 11th five year plan, Mar. 2008	Clarify development tasks, guiding ideology, development goals, overall layout, priority areas, and incentive policies for the "Eleventh Five-Year" period



Incentive policies in China

Type	Name	Contents
Industrial policy	"Promoting wind power industry opinions"2006	Clarify main targets, goals and principles of the wind energy development during 11 th five year plan. Generate implementation plan for resource investigation/testing and certification, grid planning, wind farm management and capacity building etc.
	"Regulations for Renewable energy for power generation " 7 th , Feb. 2006	Clarify the roles of central and provincial government, principles for project certification, management authority, on-grid price, price sharing and the responsibility of grid companies and power companies
	"Grid Code of State Grid" (temporal) 2006	Provide a grid code for wind power grid integration
	"Grid Code of State Grid for integration design" (temporal) 2006	Provide a series of rules for the design of grid connection



Incentive policies in China

Type	Name	Contents
Industrial policy	Regulation on price sharing, Jan. 2006	Clarify certain principles on price sharing
	"Renewable energy tariff to deploy additional revenue Interim Measures"Jan.11. 2007	Clarify the price-making policy and regulation measures
	"Regulations for Grid companies purchase renewable energy electricity" Sept. 2007.	Emphases on the principles that grid companies should fully purchase the electricity generated from renewal energy
	Regulations for the renewable energy fund 2007	Generate rules and principles for the utilization of the fund

Incentive policies in China



Type	Name	Contents
Industrial policy	Regulation for wind farm environmental protection Dec. 2007	Clarify certain rules for environment protections and land use for wind farm.
	"Interim Measures of the fund for Wind power equipment" Aug. 2008	Clarify rules for final support rate for the 1.5 MW and above domestic wind turbine manufactures and certain components
	Regulations on Wind farm construction from NDRC》 2005	Emphases on the 70% domestic equipment rate of wind farm and the on grid price generation mechanism

Incentive policies in China



Type	Name	Contents
Industrial	"Regulations on adjustment of the import tax policy for big generating units, key components and raw materials, " in April 2008	Implementation of import VAT rebate policy for key component and raw materials for large scale wind turbine since January 1, 2008 and in the meanwhile stop the duty free policy for wind turbines less than 2.5 megawatt.
	Regulations for on-grid power price for wind energy, NDRC , Jul. 20. 2009	Identify four wind energy resource zones with different price benchmark range from 0.51 yuan, 0.54 yuan, 0.58 yuan and 0.61 yuan.. Offshore wind power electricity price will be determined on a case base. Extra cost will be shared among the grid as domestic tariff



Incentive policies in China

Type	Name	Contents
Industrial policy	Renewable energy and new energy international cooperation plan, Sept. 22, 2007	A specific fund is set up to support international cooperation on wind and other renewable energy and new energy technologies.
	"Guideline for National Defense Science and Technology Industry's investment on Wind Power Equipment manufacture ". Sept. 2007	Encourage defense industry to participate the wind equipment manufacture industry.



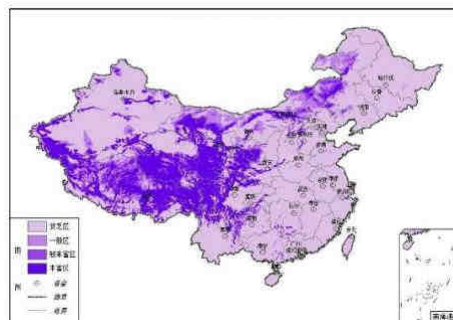
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Rich in National Wind Energy Resource Reserves, Less in development at 3%



- National land on the 50m high technology development of wind energy resources about **600-1000GW** ;
- National 20km offshore area, 50m height of the wind energy resources technology can be developed about **100-200GW**.



中国风能资源区划图 (50m)

Development Route of Wind Power Industry



- Based on the guide of government and the priority of market pull to stress on research and solve the national three major problems which are resource issues, grid issues and the independent innovation intellectual property rights of wind power technology. The solution to the three issues shall be greatly contribute to the steady industrial development and providing stability foundation for industrial upgrading before 2010.
- To establish a comprehensive wind power system for the purpose of achieving the established targets for wind energy before 2020.
- The wind power industry chain has been basically established, while it needs continuing to expand the domestic market share, and become more competitive in the international market during 2020-2030.
- Wind power will occupy a large competitive advantage and the wind power will also enter into mature development's track stably after 2030.

The Development Ensuring Measures of Wind Power Industry



- Policy and regulation is a fundamental guarantee to promote healthy and steady development of wind power generation. Thus, development and implementation the regulations and rules will contribute to the "Renewable Energy Laws" implementation.
- It is a critical period of wind power industry development before 2010, as well as the basic research work and the cultivation of the wind power industry development both needs to have capital investment.
- To establish complete management and coordination system overseeing the national wind power development. Such system may coordinate "National Wind Technology Center", "National Wind Energy Resource Assessment Center "and" National Wind Power Testing and Certification Center "and other national institutions. All these resources and efforts shall be allocated for key technology R&D and national-level key project implementation.

The Development Route of Wind Power Technology



- Wind Energy Resources Survey and Evaluation (2006-2010)
- MW-level wind turbine design (2006-2015)
- MW Wind Turbine Manufacturing Technology (2006-2015)
- MW Wind Turbine Detection Technology and Authentication Technology (2006-2015)
- Offshore wind power technology (2006-2020)
- Wind power grid integration technology (2006-2015)
- Non-grid wind power and large-scale electrical storage technology (2006-2020)
- The reliability of wind turbine at adverse weather conditions (2006-2020)

Wind Power Market Outlook in China



- An national renewable energy development plan for the first time defined the mandatory market share target published in 2007,
 - Assumptions :
 - The total installed capacity of 900 million national electricity kW, power consumption 4.5 trillion kWh at 2010.
 - The total installed capacity of 1.5 billion domestic electricity kW, power consumption 7.5 trillion kWh at 2020 .
 - Grid within the coverage area of non-hydro renewable energy sources of electricity :
 - 2010 - 1%, 40 billion kWh (wind power installed capacity 20 million kW)
 - 2020 – 3%, 210 billion kWh (wind power installed capacity 100 million kW)
 - In fact the total amount of biomass and solar power are smaller, mainly in wind power capacity can be achieved.

Wind Power Market Outlook in China



- Wind power should be in the rapidly growing power industry and accounted for a certain proportion in order to play a role in adjusting the energy structure.
 - Suppose in 2020 the total installed capacity is 1.5 billion kW, power consumption is 7.5 trillion kWh.
 - Among 3% of the non-hydro renewable energy power, 100 million kW shall be from wind power
 - Wind power installed capacity accounted for approximately 6% in the total power industry
 - Wind power accounted for approximately 2.8% in the power industry
- To establish 10GW-level wind park

10 GW Wind Park planning



- To establish seven 10 GW wind parkl in six Provinces by 2020:
 - The total installed capacity reached 126.3 million kW
 - Wind power grid integration is about 281 billion kW

Market: 2020



- 120GW – 150GW
 - If there is no problem on grid connection

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Conclusions



- Market is enough large in China: 150GW in 2020
 - Resources, policy and wind farm
- No real successful story for technology transfer
 - Most small technology company, but still no batch bulk productions
 - It is impossible for big manufactures
- Policy is two-edged for technology transfer
 - No policy, no wind
 - Wind electricity price is high
 - Wind electricity need transport in long distance
 - Policy more benefit for domestic enterprises because of policy finance source
 - Foreign technology transfer is difficult
 - Foreign company also want to make big money, but it is difficult to compete with domestic enterprises because of policy
 - It will be lose more benefits for foreign big company transfer technology?

Conclusions



- Market for foreign technology transfer in China
 - More opportunities for foreign technology designing companies
 - More business opportunities for foreign component enterprises
 - But it should be changed from independent to join-venture and domestic (transfer)
 - More mature technology, more ease transfer and more benefit if transfer to domestic enterprise
 - Big turbine manufactures?
 - How calculate your benefits

Technology Transfer in China



- Domestic: 58 enterprises
 - Licenses: 11
 - Technology transfer: 14 (7 domestic)
 - Join-development: 9
 - Independent development: 28
- Join-venture: 7
 - Batch bulk: 2
- Foreign independent: 9

Capital Market Share Change on Wind Power Development in China

