2014 China Wind Power Review and Outlook

CREIA GWEC

2014 China Wind Power Review and Outlook

Written by

Chinese Renewable Energy Industries Association (CREIA)

Chinese Wind Energy Association (CWEA)

Global Wind Energy Council (GWEC)

Authors

Li Junfeng/Cai Fengbo/Qiao Liming/Wang Jixue/Gao Hu

Tang Wenqian/Peng Peng/Geng Dan/Li Xiuqin/Li Qionghui


Vestas

Contents

1 China Wind Power Development Overview

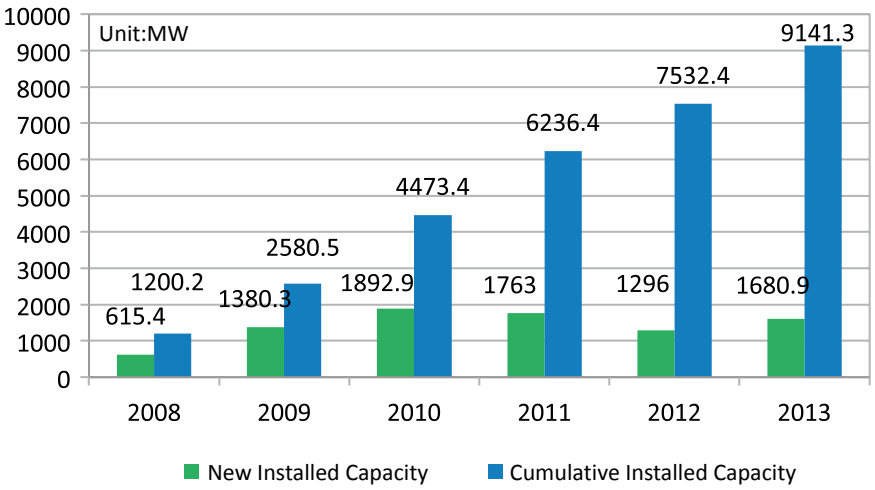
I. China Wind Power Development Overview

1.1 General Development

The Chinese wind industry installed16,089 MW in 2013, an increase of 3,130 MW over 2012, for annual market growth of 24%; the first time the annual market has grown since 2010 (see Figure 1-1). At the end of 2013, the cumulative installed capacity in China was 91,413MW, an annual market growth rate of 21%[1].

In 2013 an ultra high altitude experimental wind farm went into operation in Naqu, in theTibet Autonomous Region, the first wind farm in Tibet. There are now wind power plants in all Chinese provinces/regions. The top 4 regions with the largest cumulative installed capacity in 2013 were Inner Mongolia (20270MW), Hebei (8500MW), Gansu (7100MW) and Shandong (approx. 7000MW). Because of the construction of new transmission lines, the top province for new installations in 2013 was Xinjiang, with 3150MW.

In 2013, the National Energy Administration(NEA) issued a number of policies and measures to develop a monitoring and review system for the wind power industry and to solve the issue of wind curtailment. It also introduced an annual wind power development plan to rationalize the development of the wind power industry.

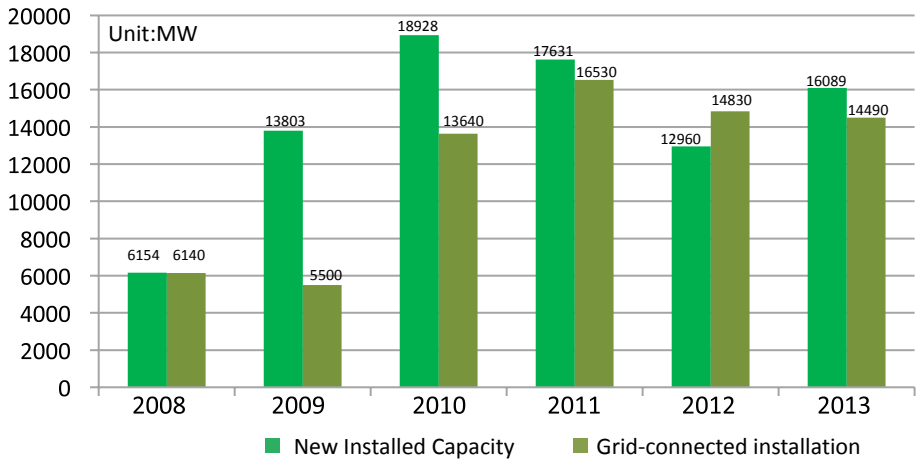


Source: CWEA

Figure 1-1: The growth of the annual and cumulative China wind power market, 2008-2013

[1] Statistics from Chinese Wind Energy Association (CWEA).

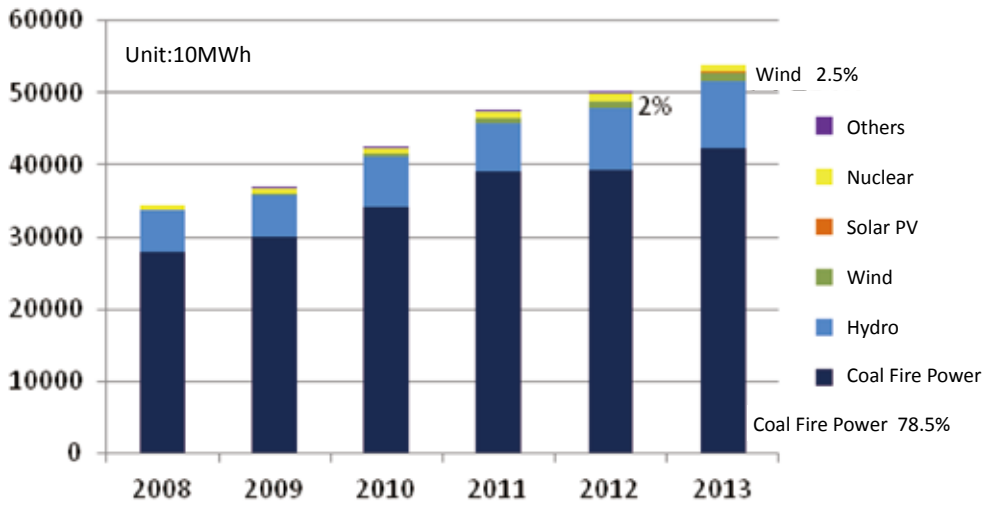
According to the data from the China Hydropower and Water Resources Planning and Design General Institute, in 2013 the newly grid-connected capacity nationwide was 14.49GW and the cumulative grid-connected capacity was 77.16GW. The figures differs from the installation figures due to the testing period of grid connection and power generation after the installation. Compared with 2009 and2 010, the gap between the official grid-connected capacity and installed capacity has decreased gradually. (see Figure 1-2).



Source: the data of new installed capacities was from CWEA and the grid-connected capacities from the China Hydropower and Water Resources Planning and Design General Institute

Figure 1-2: The new installed capacities and grid-connected capacities of China wind power, 2008-2013

In 2013, wind power generated 134.9TWh of electricity,making wind the third largest power generation source in China after thermal power and hydropower, providing 2.5% of China's electricity This is less than the EU's 8%, but an increase of 25% from 2.0% in 2012.



Source: collected from the data of the China Electricity Council and the National Statistics Bureau websites[2]

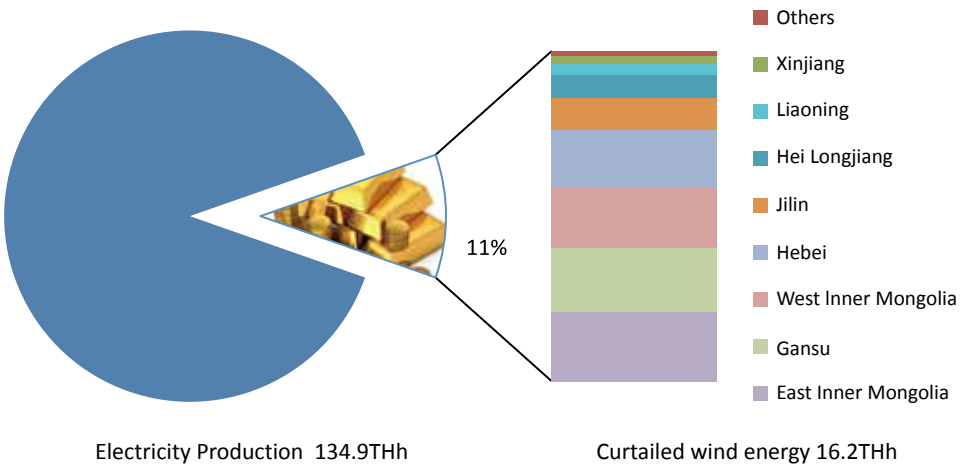
Figure 1-3: The trend of China's energy generation markets, 2008-2013

The region with the largest on-grid energy production in 2013 was Inner Mongolia, followed by Hebei, Gansu and Liaoning, all exceeding 10TWh. Among them, the Western Inner Mongolia Power Grid produced 21.6TWh of electricity. It was the top region with the highest wind power on-grid energypenetration ratio nationwide. The on-grid electricity produced by the wind power of production of the Eastern Inner Mongolia Power Grid reached 14TWh, Hebei 14.1TWh, Gansu 11.9TWh and Liaoning 10TWh.

In comparison with the loss of 20TWh in 2012, the total nationwide energy loss from wind curtailment in 2013 was 16.2TWh. Losses due to curtailment:

- Eastern Inner Mongolia Power Grid 3400GWh;
- Western Inner Mongolia 2990GWh;
- Jilin 1572GWh;
- Liaoning 528GWh;
- Gansu 3100GWh;
- Hebei 2800GWh;
- Heilongjiang 1151GWh;
- Xinjiang 431GWh.

From Figure 1-4 of the curtailed wind energy and distribution, one can find that the regions in China with richest wind power resources are the one with most serious wind curtailment issue.

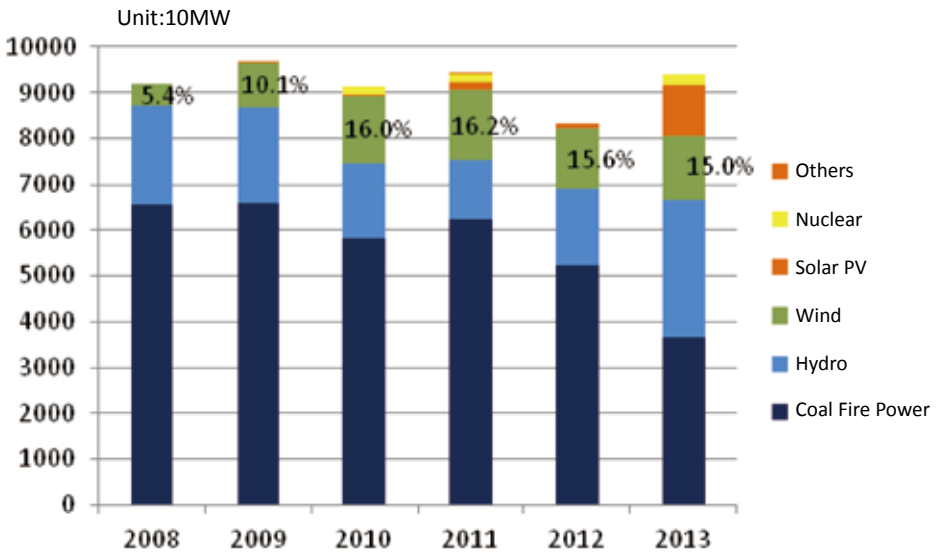


Source: collected from the published data of the National Energy Bureau website

Figure 1-4: China's curtailed wind energy and distribution

Because of the curtailment, the construction of large wind power bases has slowed down, whereas areas with lower wind speed resources, closer to load centers, have become development hot spots. Many Original Equipment Manufacturers (OEMs) have developed "low speed" and "high-altitude" wind power turbines, bringing better economic development potential to regions with wind speeds under 6m/s. Most low windspeed sites are located in the south central and southwestern parts of China; but new wind farms were also built in the mountainous areas.

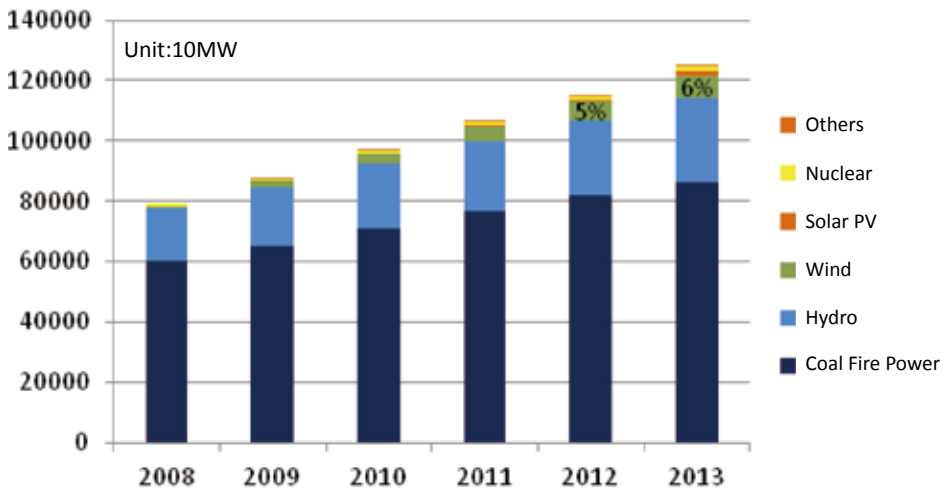
Since 2010, China's annual installations have been 15-16% of new generation capacity. The new wind power capacity in 2013 was 15% of total new-build, but solar surged to 12% and Hydro to 32%, while thermal plants dropped to 29%. For the first time in 2013 the majority of new power installations in China were renewable.



Source: collected from the data of the China Electricity Council website [3]

Figure 1-5: The Structure of China's new installed electric capacity, 2008-2013

As seen in Figure 1-6, the cumulative installed capacity of wind power accounted for 6% of the national installed electric capacity by the end of 2013, up from 5%in 2012; in third place behind thermal power (70%) and hydropower (22%).



Source: collected from the data of the China Electricity Council website

Figure 1-6: The energy structure of China's cumulative installed electric capacity, 2008-2013

[3] Translator's Note: the captions mean: other; nuclear; solar; wind; hydroelectric; and thermal.

With a market of of 15GW per year, China will exceed the established plan of 100GW by 2015 and easily meet the target of 200GW by 2020. Given the available wind power resources, reliance on coal, the grim air pollution problem and the need to reduce emissions, China needs to step up its efforts in transforming its energy structure, reviewing and increasing the targets for wind power and renewable energy development. Wind power is at the moment relatively cheaper and technically more mature than other renewables with the most development potential. China has rich wind power resources and the capabilities to build wind power equipment to meet market needs. In order to remain the world's largest wind power market, China needs to improve wind power's grid integration, speed up the construction of large offshore and onshore wind power sites, and maximize the role of wind power in terms of clean energy supply, smog control and emissions reduction.

1.2 The Development Potential of China Wind Power

With the support of the state administration, the Wind and Solar Energy Resources Center of the China Meteorological Administration launched the "National Wind Power Resources Exploration and Review" project in 2008. For areas with average wind power density of ≥300W per square meter, and factoring in geographic constraints, China's onshore potential is estimated to be 2000 GW at 50m height, 2.6 TW at 70m, and 3.4 at 100m. . ("National Wind Power Resources Exploration and Review". Wind Power: 2011, Issue 8, 26-30. Wind and Solar Energy Resources Center of the China Meteorological Administration.) It also assessed areas with average wind speeds of ≥ 200W per square meter, and found an additional 3600 GW of potential.

In line with government policy supporting wind power development in China's low wind speed areas, many OEMs have recently developed special low wind speed turbines. For example, the GW115/2000 ultra-low wind speed direct-driven permanent-magnet turbine developed by Goldwind has enabled the development values of ultra-low wind speed sites with average wind speeds of 5.2 m/s, or~200W per square meter. This and similar new machines significantly augments China's wind power potential.

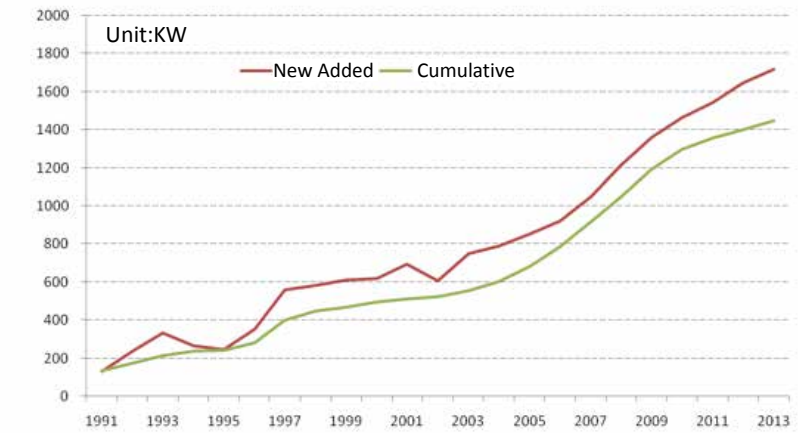
1.3 The Wind Power Equipment Manufacturing Industry: General Information

There were 29 wind power OEMs which sold or installed at least one machine in the market in 2013, the same number as in 2012, with a total manufacturing capacity of more than 20 GW/year.

Regarding the R&D of new products, the launch of several ultra-low wind speed turbines was a prominent achievement during 2013. In September 2013, for example, United Power's 1.5MW ultra-low wind speed turbine with a rotor diameter of 97 meters was connected to the grid. At the beginning of 2014, Envision Energy built a

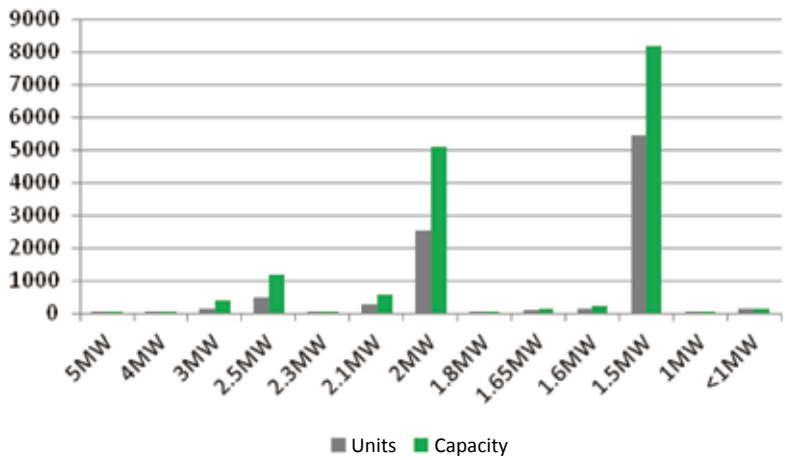
1.8MW turbine with a rotor diameter of 106 meters, which was based on a 1.5MW turbine with a rotor diameter of 93 meters. These new turbines will facilitate the development of China's low wind speed areas, which contain at least half of the country's potential

There was no major progress in the development of multiple MW wind power turbines in 2013. However, the average power rating of newly installed turbines continued to grow, reaching 1720KW in 2013, an increase of 74KW the previous year's 1646KW (see Figure 1-7). The size of the machine installed in most number in 2013 was the 1.5MW turbine, with 5466 new installations, accounting for 51%. There were 3692 new machines exceeding 1.5MW, 31.6% of which were 2MW turbines; and 13.8% were multiple MW turbines exceeding 2MW (including 2.1MW, 2.3MW, 3MW, 4MW, and 5MW). 2.1MW and 2.5MW turbines were the main machines (213 and 469 installed respectively) in this category, and 79 installations of 2.3MW turbines, 136 of 3MW turbines, and 1 each of 4MW and 5MW turbines. See Figure 1-8



Source: CWEA [4]

Figure 1-7 The average power of China's new installed and cumulative capacities



Source: CWEA [5]

Figure 1-8 The single-machine power distribution of China's new installed wind power capacities

[4] Translator's Note: the captions mean, left, "new average power" and ,right, "cumulative average power".
[5] Translator's Note: the captions mean, left, "number of turbines" and ,right, "capacity".

Both direct-drive and gearbox transmissions have been successfully developed in China. In 2013, eight OEMs had supplied a total of 3052 direct-drive wind power turbines without gearboxes, including Goldwind, XEMC Wind Power, Geoho Energy, Yinhe Wind Power and a few others. A total of 23 OEMs provided 6304 wind power turbines with gearboxes (certain firms manufactured both turbines), including Mingyang Wind Power, United Power, Envision Energy, Shanghai Electric Group, Sinovel, Haizhuang, Dongfang Turbine, Windey, Vestas, Gamesa and many others.

In 2013, China's top 15 enterprises in terms of new installed capacity accounted for around 90% of the national market. The largest OEM was Goldwind, which installed 3750.25MW, 23.31% of the total market share. The runner up was United Power, with 1487.5MW accounting for 9.25%. The third was Mingyang Wind Power, with 1286MW (7.99% market share), and Envision Energy rose quickly from seventh to fourth place this year with 1128.1MW, up from 2012's 544MW. See Table 1-1.

Table 1-1 The market rank of China's newly installed wind power capacity

NO.	Enterprise	Installed Capacity（MW）	Market share
1	Goldwind	3750.25	23.31%
2	United Power	1487.5	9.25%
3	Mingyang Wind Power	1286	7.99%
4	Envision Energy	1128.1	7.01%
5	XEMC Wind Power	1052	6.54%
6	Shanghai Electric Group	1014	6.30%
7	Sinovel Wind Power	896	5.57%
8	Chongqing Haizhuang	786.7	4.89%
9	Dongfang Electric	573.5	3.56%
10	Zhejiang Windey	538.75	3.35%
11	Vestas	507.7	3.16%
12	China Creative Wind Energy	474	2.95%
13	CSR	343.45	2.13%
14	Zhejiang Huayi	314.1	1.95%
15	Taiyuan Heavy Industry	293	1.82%
	Others	1643.65	10.22%
	Total	16088.7	100%

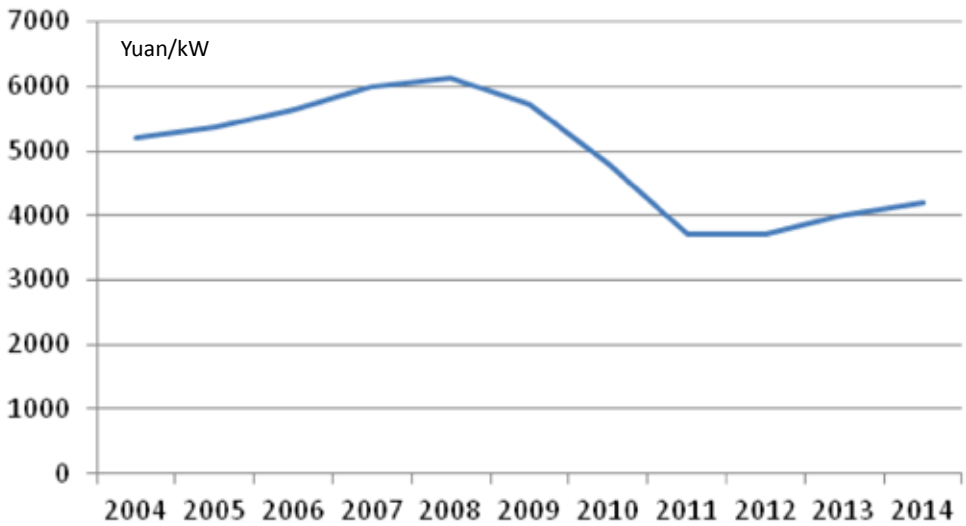
Source: CWEA

After 2010, China's wind power market slowed down and many OEM's output was reduced. However, many maintained steady growth amid adversity, including Envision Energy, XEMC Wind Power, Shanghai Electric Group, Chongqing Haizhuang, and Zhejiang Windey. Goldwind's annual sales had fallen since 2010, but set a new record in 2013.

In China, the main manufacturers of wind turbine blades are Sinoma Science & Technology, Zhongfu Lianzhong, AvicHuiteng, LM Windpower, ShidaiXincai, Luoyang Sunrui, CQGI, DTC, Sino-Wind Energy, and Shanghai FRP Research Institute. In addition, many OEMs produce their own blades including Mingyang, Dongfang Electric, United Power and Vestas. Sinoma Science & was the 2013 leader, supplying over 3 GW worth of blades; followed closely by Zhongfu Lianzhong.

In addition to the traditional gearbox manufacturers such as NGC, CQ-Gearbox, Dalian Heavy Industry, Hangzhou Advance Gearbox and foreign firms Bosch Rexroth and Winergy, recent market entrants for gearboxes include Chongqing Wangjiang, Tianjin Teek Transmission, and Ningbo Donly. There was no shortage of other components such as generators, bearings, and converters.

With the heating up of the market in 2013, OEMs received larger orders, and prices also rebounded. At present, the most popular 1.5MW turbines (tower excluded) are sold at around 4000 yuan or a bit higher per KW.



Source: CWEA

Figure 1-10 The market price trend of domestic 1.5MW wind power turbines (tower excluded)

Although the rise in turbine prices was good news for the turbine manufacturers, overdue payments and low profit margins and the resulting cash-flow difficulties were still the biggest limitations of the manufacturing industry in 2013. Delays in payment of the wind power fixed price premium since 2010 to operators has meant delays in payments to manufacturers, which has meant delays in payment to component suppliers, cascading up and down the entire supply chain. This has been the greatest impediment to the progress of the industry since 2010. Although the government has taken some steps to improve this, it is still a problem for the supply chain.

1.4. Development by Provinces, Autonomous Regions and Municipalities

1.4.1 Installed Capacity

A significant change in China's wind power development in 2013 was that the developments in the Northwest, Central South and North China were accelerated. Northwest and Central South boasted the fastest growth rates; the newly installed capacity in Northwest reached 5435.2MW, an increase of 76.7%. The main reason for the big growth was that Xinjiang's capacity grew dramatically, ranking No.1 in terms of new installed capacity by province in 2013.

In comparison, the growth in the Northeast and the Southwest slowed down. The newly installed capacity in the Northeast was 1645.2MW, a decrease of 22.4%. And in the Southwest region, the major reason for the decline was the drop in installations in Yunnan province, a result of policy adjustments which meant that installations in 2013 were only 520MW, an almost 50% decrease from the previous year.

In 2013, the top five provinces for newly installed wind power capacity were: Xinjiang (3146MW), Inner Mongolia (1647MW), Shanxi (1309MW), Shandong (1290MW) and Ningxia (885MW). The top five's installed capacity totaled 8275.7MW, accounting for 51.4% of the national total. Xinjiang boasted the fastest growth rate of 271%, mainly because the completion of new transmission lines, which enabled rapid development of wind power.

In 2013, there were 4 provinces with annual newly installed capacity of over 1GW – Xinjiang, Inner Mongolia, Shanxi and Shandong.

In terms of cumulative installed capacity, the top five provinces were: Inner Mongolia (20270MW), Hebei (8500MW), Gansu (7096MW), Shandong (6981MW) and Liaoning (6758MW). Only one province's cumulative capacity exceeded 20GW. Five provinces' cumulative installed capacities were greater than 5GW but less than 10GW: Hebei, Gansu, Shandong, Liaoning and Xinjiang.

Table 1-5 Statistics of Newly-installed Capacities and Cumulative Installed Capacities of All Provinces in China in 2013

Unit: MW

NO.		Newly-installed Capacity	Cumulative Installed Capacity
1	Inner Mongolia	1646.5	20270.31
2	Hebei	521.1	8499.9
3	Gansu	617	7095.95
4	Shandong	1289.55	6980.5
5	Liaoning	639.7	6758.01
6	Xinjiang	3146	6452.06
7	Heilongjiang	623	4887.35
8	Ningxia	884.7	4450.4
9	Jilin	382.5	4379.86
10	Shanxi	1308.95	4216.05
11	Jiangsu	543.6	2915.65
12	Yunnan	520	2484
13	Guangdong	527.6	2218.88
14	Fujian	265.5	1556.2
15	Shaanxi	583	1292.5
16	Guizhou	683	1190.1
17	Hunan	522	771.25
18	Hubei	453.6	647.5
19	Henan	154.6	647.15
20	Zhejiang	128.6	610.27
21	Anhui	97.5	591.5
22	Qinghai	204.5	386
23	Shanghai	18	369.95
24	Guangxi	157	360.5
25	Jiangxi	38	325.5
26	Tianjin	27	305
27	Hainan	0	304.7
28	Sichuan	77.5	157
29	Beijing	1.5	156.5
30	Chongqing	19.7	124.05
31	Tibet	7.5	7.5
32	Hong Kong	0	0.8
Total		16088.7	91412.89

Source: Chinese Wind Energy Association

1.4.2 Grid connectivity and grid connected capacity

According to the statistics of China Hydropower and Water Resources Planning and Design General Institute, the cumulative grid connected capacity (referring to the installed capacity that passed the test phase and tariff paid was 77.16GW.The grid connected capacity of Inner Mongolia was 18.33GW, ranked first in the nation, followed by Hebei and Gansu with capacities of 7750MW and 7030MW respectively. The grid connected capacities of the North, Northeast and Northwest regions accounted for 83.6% of the national total.

Table 1-6 Statistics of Cumulative Wind Power Installed Capacity of All Provinces in 2013

Unit: MW

NO.	Provinces (Autonomous Regions and Municipalities)	Cumulative Grid Connectivity Capacity
1	Inner Mongolia	18330
2	Hebei	7750
3	Gansu	7021
4	Liaoning	5650
5	Xinjiang	5051
6	Shandong	5011
7	Heilongjiang	3860
8	Jilin	3770
9	Shanxi	3470
10	Ningxia	3011
11	Jiangsu	2560
12	Yunnan	2140
13	Guangdong	1810
14	Fujian	1471
15	Guizhou	1020
16	Shaanxi	990
17	Hubei	630
18	Zhejiang	500
19	Anhui	490
20	Henan	400
21	Hunan	355
22	Shanghai	326
23	Hainan	302
24	Jiangxi	298
25	Tianjin	228
26	Qinghai	158
27	Beijing	15
28	Guangxi	128
29	Sichuan	109
30	Chongqing	96
31	Tibet	7.5
Total		77157

Source: National Renewable Energy Center

In 2013, the electricity production of wind power in nine provinces (autonomous regions) exceeded 5TWh: Inner Mongolia, Hebei, Gansu, Liaoning, Shandong, Xinjiang, Heilongjiang, Ningxia and Jilin, among which the annual electricity production of Xinjiang, Heilongjiang, Ningxia and Jilin topped 5 GWh for the first time. Inner Mongolia maintained its top ranking in production of electricity from wind power, with production of 35.6TWh, accounting for around 26% of the national total, of which 21.6TWh was generated in Western Inner Mongolia, and 14TWh in Eastern Inner Mongolia.

1.5 Construction of Large-scale Wind Bases

As of the end of 2013, the cumulative capacity of large-scale wind power bases with full government approval that were coordinated and facilitated across the nation reached 19GW.

Figure 1-7 Cumulative installation by Wind bases

NO.	Province	Wind Base	Installed Capacity (GW)
1	Gansu	Jiuquan Wind Base	6.8
2	Hebei	Zhang Jiakou	3
3	Hebei	Chengde	1
4	Inner Mongolia	Kailu, Tongliao	1
5	Inner Mongolia	Urat Zhongqi, Bayannur City	2.1
6	Inner Mongolia	Damao Qi, Baotou City	1.6
7	Xin Jiang	Hami	2
8	Gansu	Hongshagang, Town, Minqin County	1
Total			18.5

Among these bases, the Phase I Project in Jiuquan (3.8GW) and Phase I Project in Zhangjiakou (1.35GW) have been fully completed;

Damao Qi Base (1.4GW), Phase II of Jiuquan Base (3GW), Phase II of Zhangjiakou Base (100MW), Phase I of Chengde Base (400MW), Kailu Base in Tongliao City (600MW), Wind Power Base in Urat Zhongqi, Bayannur City (1.8GW), Hami City (1.4GW) and the base in Hongshagang Town, Minqin County, Gansu Province (1GW) are still under construction.

1.6 Wind Farm Developers

According to the Chinese Wind Energy Association, more wind power enterprises entered the business of developing wind power in 2013. The number of wind power developers reached 90, an increase of more than 20 from the 2012 figure.

These power companies can be classified into the following types: central government administered enterprises; local state-owned enterprises; as and as private and foreign-funded enterprises.

Among them, there are 21 central government administered enterprises. These developers are mainly state-owned large-scale power and energy companies, notably the so called Big Five Utilities: Datang, Huaneng Corporation, Guodian, Huadian, China Power Investment (CPI) There are 33 local state-owned enterprises, mainly local energy, power and investment companies, such as China Suntien Green Energy, XEMC, Jingneng, Fujian Energy, Ningxia Power, Fujian Investment, Datong Coal Mine, Guangxi Water Resources & Electric Power Group and Guangdong Hydrapower Group. There are 39 private and foreign-funded enterprises, including Tianrun, China Wind Power, Daqing Ruihao, Huayuan Electric Power, Kaidi Power, Xinmaoxinfeng, Shengtian, Dongrun Wind Power, etc.

In 2013, China Guodian Corporation maintained its leading position with new installed capacity of 1751.1MW, of which 1055.1MW was implemented by Longyuan Power, accounting for 10.9% of the new installed power capacity nationwide. CPI (1712.2MW) and CGNPG (1536.65MW) were ranked the second and the third, respectively. The Top 10 Chinese wind farm developers accounted for 69% of the new installed capacity nationwide. Tianrun, a private wind power developer and a subsidiary of GoldWind, ranked the sixth among the top ten. Other developers on the list were state-owned central enterprises (Huarun/China Resources Corporation,CRC was listed in Hong Kong, but it was still a state-owned central enterprises in nature).

Table 1-7 Top 10 Wind Power Developers in terms of New installed Capacity in 2013

Unit: MW

NO.	Investment Enterprises	Newly-installed in 2013	Proportion of Installed Capacity (%)
1	Guodian Corporation	1751.1	10.88
2	China Power Investment	1712.2	10.64
3	China Guangdong Nuclear Power Corporation	1536.65	9.55
4	Huaneng	1329.5	8.26
5	Huadian	1163.95	7.23
6	Tianrun	879	5.46
7	Datang Group	820.5	5.10
8	Guohua	753	4.68
9	Three Gorges Corporation	626	3.98
10	Huarun/CRC	554.3	3.45
11	Others	4962.5	30.84
Total		16088.7	100

Source: Chinese Wind Energy Association

In terms of cumulative installed capacity, China Guodian Corporation, the mother company of Longyuan (11.84GW), ranked No.1 with 17.51GW installed, of which 68% is from Longyuan, accounting for 19.2% of the national total. Next were Huaneng and Datang, with 10686MW and 10569MW installedrespectively. The shares of the top three developers accounts for 40% of total installations. The only private investment enterprise in the top10, Tianrun's cumulative capacity reached 2.6GW, accounting for 2.85% of the market.

Table 1-8 Top 10 Wind Power Developers in terms of Cumulative Installed Capacity in 2013

Unit: MW

NO.	Investment Enterprises	Cumulative Capacity in 2013	Proportion of Installed Capacity (%)
1	Guodian Corporation	17508	19.15
2	Huaneng	10686	11.69
3	Datang Group	10569	11.56
4	Huadian	5865	6.42
5	China Power Investment	5268	5.76
6	China Gguangdong Nuclear Power Corporation	5001	5.47
7	Guohua	4897	5.36
8	China Resources	3079	3.37
9	Tianrun	2608	2.85
10	Three Gorges Corporation	1928	2.11
11	Others	24003	26.26
	Total	16088.7	100

Source: Chinese Wind Energy Association

1.7 Offshore Wind Power

In 2013, only 39MW of offshore wind power was installed in China, a 69% decrease from 2012. The cumulative installed offshore capacity reached 428.6MW, ranked the fifth in the world.

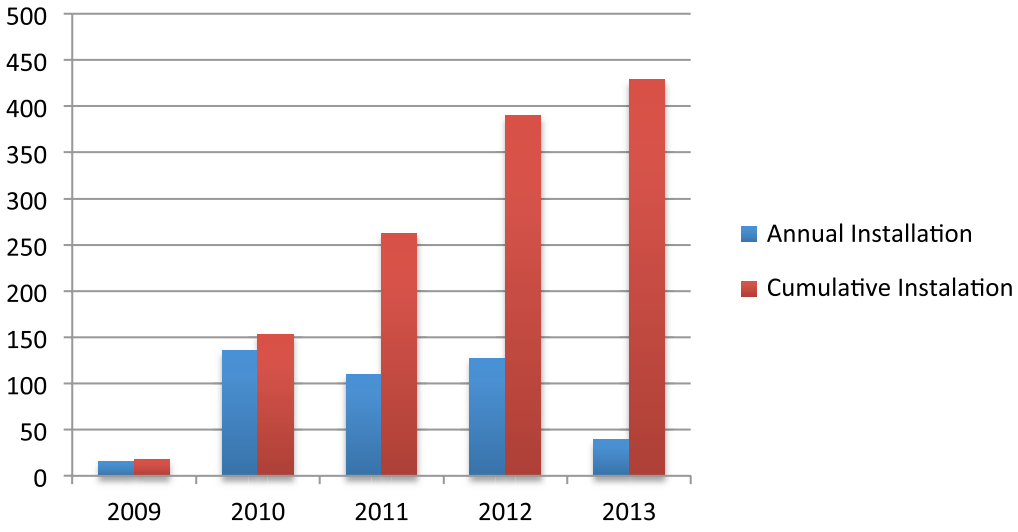
The newly launched 39MW offshore wind power projects in 2013 were all inter-tidal projects. As of 2013, the cumulative capacity of inter-tidal projects reached 300.5MW, while near-shore projects totaled 128.1MW.

Table 1-10 Newly-launched Offshore Wind Power Project in 2013

Project Name	Developer	Turbine Manufacturer	Province	Number of Turbines	Installed Capacity (MW)
GuodianLongyuan 5MW Prototype Project	Longyuan	Dongfang Turbine	Jiangsu	1	5
Jiangsu Xiangshui Inter — tidal T5 Project	Three Gorges Corporation	Dongfang Turbine	Jiangsu	1	3
Rudong Inter — tidal Trial Wind Farm	Longyuan	Envision Energy	Jiangsu	1	4
LongyuanBinhai (Tianjin) 33MW Project	Longyuan	United Power	Tianjin	18	27
Total				21	39

Source: Chinese Wind Energy Association

	2009	2010	2011	2012	2013
Annual Installation	16	135.5	109.58	127	39
Cumulative Instalation	17.5	153	262.58	389.58	428.58



Source: Chinese Wind Energy Association

Figure 1-11 Offshore Wind Power Installation in China during 2009-2013

The main suppliers of offshore wind turbines in China include: Sinovel, Goldwind and Siemens/Shanghai Electric. The turbines supplied by Sinovel and Siemens are mainly used for near-sea projects, while the products of other suppliers are mainly used for inter-tidal projects.

Table 1-12 Offshore Wind Power Installation by Wind Turbine Manufacturers in China

Manufacturer	Installed Capacity (MW)	Proportion of Installed Capacity (%)
Sinovel Wind Power	170	39.7
Goldwind	109.5	25.5
Siemens	49.98	11.7
United Power	39	9.1
Chongqing Haizhuang	14	3.3
Shanghai Electric Group	13.6	3.2
Dongfang Turbine	8	1.9
XEMC Wind Power	7.5	1.7
Envision Energy	7	1.6
Mingyang Wind Power	6	1.4
Sany Electric	4	0.9

Source: Chinese Wind Energy Association

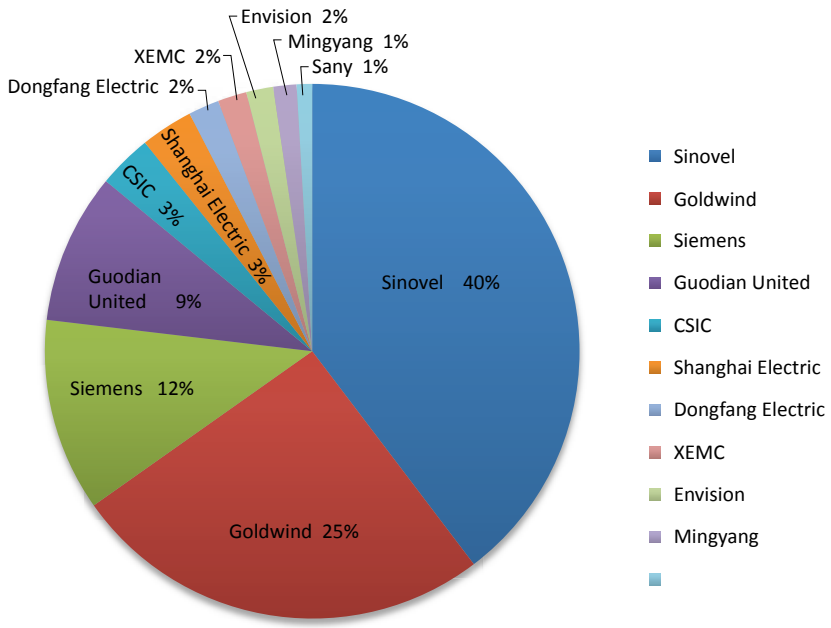


Figure 1-12 Offshore Wind Power Installation by Wind Turbine Manufactures in China

As of the end of 2013, a total of 17 projects with a total size of 4098MW had obtained project approval from the state or provincial authorities, of which Jiangsu, Hebei and Fujian were the top three with capacities of 1450MW, 800MW and 750MW, respectively. In addition, pre-feasibility reports for offshore wind power projects with the total capacity of around 11GW are being prepared.

During 2013, many projects were approved, and many were at different stages of construction. Among the first four concession bidding projects of offshore wind power, the 200MW project in Dafeng, 200MW project in Dongtai, and the 300MW project in Binhai, Jiangsu Province, have obtained the approval from departments of Jiangsu Province. In addition, Phase II of Shanghai Donghai Bridge Offshore Project, Jiangsu Xiangshui Near-sea Wind Farm 200MW Demonstration Project, CGN Rudong Offshore Wind Farm Project, Huaneng Dafeng 300MW Offshore Wind Power Demonstration Project and Zone 2 Engineering Project of Guodian Zhoushan Putuo No.6 Offshore Wind Farm have also obtained approval from national or provincial competent departments.

1.8 Exports and Overseas Investment

According to CWEA, seven OEMs exported 341 wind turbines with a capacity of 692.35MW in 2013, an increase of 60.8% of capacity over 2012.

The total of cumulative exports reached 1392.5MW, to 27 countries. Figure 1-14 shows the cumulative capacity and the destinations of wind turbine exports from China by the end of 2013.

USA was the destination with the largest volume, with a total of 335.75MW, followed by Australia and Ethiopia, totaling185MW and 135MW, respectively. In terms of regional distribution, 375.6MW was exported to Europe, accounting for 27% of the total; 335.75MW to USA, accounting for 24%; 234.5MW to Africa, accounting for 17%; 185MW was exported to Oceania (Australia), accounting for 13%; and the exports to Asia and Latin America were both less than 10%.

As shown in Table 1-15, as of the end of 2013, a total of 17 Chinese companies engaged in export of wind turbines, and the cumulative export capacity reached 1392.5MW. Goldwind boasted the largest export capacity among Chinese wind turbine manufacturers, accounting for 45% with the export capacity of 630MW. Sinovel and Sany followed Electric, accounting for 25% and 11%, respectively. The export capacity of other companies was relatively small, and their market shares were less than 5%.

Table 1-13 Exports of Wind Turbines in 2013

Manufacturer	Destination	Number of Shipped Units	Set Capacity (MW)
Goldwind	Australia	73	165.5
	Pakistan	33	49.5
	Panama	22	55
	Bolivia	2	3
	Romania	20	50
	Turkey	7	5.25
	Chile	22	33
	Subtotal	179	361.25
Sinovel Wind Power	South Africa	18	54
	Sweden	10	30
	Turkey	12	18
	Italy	13	39
Sany Heavy Energy	Subtotal	53	141
	Ethiopia	56	84
	USA	4	8
	Subtotal	60	92
Shandong Swiss Electric	Cyprus	10	20
	Thailand	3	9
	Iran	20	40
	Subtotal	33	69
Guangdong Mingyang	India	7	10.5
	Subtotal	7	10.5
Envision Energy	Chile	5	10.5
	Denmark	1	3.6
	Subtotal	6	14.1
Dongfang Electric	Finland	3	4.5
	Subtotal	3	4.5
Total		341	692.35

Table 1-14 Cumulative Statistics of Destination Countries of China's Wind Turbine Export

NO.	Destinationw	Number of Units	Capacity (MW)
1	USA	186	335.75
2	Australia	86	185
3	Ethiopia	90	135
4	Italy	35	91.5
5	Turkey	55	77.25
6	Panama	22	55
7	South Africa	18	54
8	Bulgaria	34	51.5
9	Romania	20	50
10	Pakistan	33	49.5
11	Chile	32	48.84
12	Iran	23	45.5
13	Sweden	12	36
14	Spain	12	36
15	Brazil	23	34.5
16	India	17	25.5
17	Thailand	10	22
18	Cyprus	10	20
19	Ecuador	11	16.5
20	Cuba	6	4.5
21	Finland	3	4.5
22	UK	3	3.75
23	Denmark	1	3.6
24	Bolivia	2	3
25	Kazakhstan	2	1.56
26	Belarus	1	1.5
27	Uzbekistan	1	0.75

Source: Chinese Wind Energy Association

Table1-15 Exports of Wind Turbine Manufacturers in China by the end of 2013

Manufacturer	Export Capacity (MW)	Proportion (%)
Goldwind	630	45.24
Sinovel	345	24.78
Sany Electric	154	11.06
Shandong Swiss Electric	69	4.96
Mingyang	61.5	4.42
China Creative Wind Energy	61.2	4.39
Envision	14.1	1.01
AVIC Huide	10	0.72
United Power	9	0.65
Huayi Wind Energy	8.4	0.6
Shanghai Electric Group	6.25	0.45
XEMC Wind Power	6	0.43
New United Heavy Industry	6	0.43
Dongfang Electric	4.5	0.32
Chongqing Haizhuang	4	0.29
Ruixiang Wind Energy	2.05	0.15
Zhejiang Windey	1.5	0.11

2 Key Issues for the Wind Power Industry

2. Key Issues for the Wind Power Industry

China's rapid economic development has amazed the world over the past three decades. However, as pointed out by many China observers, with out the rule of law, the country's economy cannot maintain the strength it has had since the 1980's. The wind industry is a perfect case to reflect what this means.

The following chapter will elaborate four major issues facing China's wind industry. Putting the adjustment of the wind FIT aside, the other three issues: delay in the reimbursment of the FIT; difficulties with end of warranty; and grid curtailment; are all a result of either bad law enforcement or lack of law or regulation. These problems are currently being solved one by one, but the lack of an effective enabling environment is the main issue faced by the industry today.

In addition, there are some cross-cutting issues where the authors of this report would like to offer some advice to the government to improve the situation:

1. When applying the Law on Tenders and Bids, caution should be applied, especially on the issue of winning bids at the lowest price. An open and transparent industrial monitoring system should be developed. Turbine performance data should be released on a compulsory basis. Equipment with good quality and a proven track record should be prioritized in the bidding process.

2. The relevant departments should strengthen the monitoring of contract enforcement and prevent the delayed payment by manufacturers, which happens in both cases of end of warranty disputes, and in the delay in FIT premium payments, where downstream manufacturers delay payment of the upstream manufacturers. They should also urge manufacturers to compete reasonably while ensuring their profitability. Any unreasonable low price competition should be identified and resolved using the relevant clauses of the Law of the People's Republic of China for Countering Unfair Competition.

3. Industry technology and quality standards should be established, which should become the minimum market access standard and ensure the healthy development of the domestic wind power equipment quality and performance.

4. An industrial monitoring, review and information disclosure system is needed, with historical data on wind power equipment availablity, full load hours,

and major incidents. The information should be released to the public as an incentive to encourage manufacturers to improve the competitiveness of their products based on quality and reliability.

2.1 Adjustment of the Wind FIT

The current FIT was introduced with effect from 1st August 2009. There are four different levels of tariff associated with different resource levels: 0.51RMB/kWhl, 0.54RMB/kWh, 0.58RMB/kWh and 0.61RMB/kWh. [6]

With the continuous decline of the onshore wind turbine price, the pressure for lowering the FIT for onshore wind power is growing. In addition, the current FIT was introduced in 2009, and was supposed to be reviewed after five years, which is due in 2014. The consensus of the review of the FIT has always been to lower the tariff. However, the industry is against this as the industry's margin of profit is very low, as discussed below.

First of all, although equipment prices have declined, the extra profits from equipment cost reduction have been offset by increased construction costs. Most of the better wind areas have already been exploited. Though the tariffs for lesser wind areas are higher, the costs associated with lower wind speed sites are much higher, especially when it comes to land use costs. In recent years, wind power development has begun to enter the southern regions with lower wind speeds. Most of the wind power projects in the southern regions are located in mountainous areas, where there are major technical and construction difficulties. The land acquisition fees, which is a fee the developer must pay for renting the land from the government, are 30-45 RMB higher per square meter than the northern regions; which, together with additional land use compensation to the local government in some cases, can increase project costs by

[6] The four categories and the provinces associated with these categories. Category I: Inner Mongolia except Chifeng city, Tongliao city, Hing'an , Hulun Buir City; XinJiang: Urumqi, Ili Kazak Autonomous Prefecture, Changji Hui Autonomous Prefecture, Karamay and Shihezi city;
Category II: He Bei Province: Zhang Jiakou city and Chengde City; Inner Mongolia: Chifeng city, Tongliao city, Hing'an , Hulun Buir City; Gan Su Province: Zhang Ye city, Jia Yuguan city and Jiu Quan city.
Category III: Ji Lin Province: Bai Cheng city and Song Yuan City: Hei Longjian Province Jixi city, Shuang Yashan city, Qi Taihe city, Suihuacity, Yichun city, Da Xinganling region; Gansu province except Zhang Ye City, Jia Yuguan city and Jiu Quan city; Xin Jiang except Urumqi, Ili Kazak Autonomous Prefecture, Changji Hui Autonomous Prefecture, Karamay and Shihezi city; Ninxia Autonomous region.
Category IV: Areas out side the coverage of category I, category II and category III.

millions of RMB. Secondly, financing costs were also rising. The interest rates for wind projects were usually 10% lower than the benchmark interest rate introduced by the central bank, but now are returned to the benchmark rate.

Last but not least, the issue of wind curtailment remains unresolved. In 2013, according to the data released the National Energy Administration, the total capacity of wind curtailment was around 16200GWh. The percentage of curtailment in some wind farms was as high as 50%, while the national average was above 10%. The curtailment cannot be solved overnight and will continued to be an issue for the industry for years to come. However, the current FIT did not take into account the factor of curtailment when it was introduced back in 2009.

Currently there is a draft proposal circulated by the National Development and Reform commission, proposing a 7-8% decrease of tariff at better wind site and 3% at lower wind areas. The new tariffs, according to the draft proposal, will kick in by end of June 2015. If this is the case, then it will be a huge blow to the industry, which just has struggled out of the downturn since 2012, and the thin profit margin gained by the developers now will be further squeezed to almost nothing.. But the draft is still in a consultation phase: hopefully the final decision will be less drastic, and it is something definitely worth watching. There will almost certainlybe a surge of projects installed before the new FIT kicks in, and a bust in the months afterwards, i.e., in the second half of 2015.

2.2 FIT Premium Reimbursement Delay and Its Impacts on the Supply Chain

In China, when wind project developers deliver electricity to the grid, they are then paid only the benchmark coal fire tariff; and the premium between the FIT and the coal tariff is later reimbursed by the central government from the Renewable Energy Fund. Reimbursement is usually appropriate by the end of the year, which is up to 11 month delay in some cases. However, the delays since 2010 have been even greater, when the reimbursements were not given by the end of the year for electricity sold to the grid in the second half of 2010. It happened again in 2011, and in 2012. In the beginning of 2013, the government started a new system, where the premium is paid every three months. Since the historical backlog has not yet been completely solved, the situation has created a negative cash flow which permeates the whole supply chain.

The delayed payment consists of about 22-39% of the income from the electricity. It created huge cash flow problems for developers, and was then passed onto the turbine OEMs and the component manufacturers. It also created a weird and unique phenomenon of huge "accounts receivable" in companies' account books. The situation has spread through upstream and downstream manufacturing enterprises and constitute a heavy burden on the entire industry.

2.3. Turbine manufacturers unable to get out of warranty period

"Out of warranty" means a lot for Chinese manufacturers, as the developers retain a huge proportion of the project payments as so-called "deduction for warranty", which is usually 10% or more of the total contract value. This is a common strategy employed by the developers because of quality concerns about the equipment, which is also applied in other industries in China. However, in the wind industry, the developers extend the usual 2 year warranty period to 5 years, and even 8 years in some cases; and the wind OEMs in the 2007-2010 period were so eager to seal a deal, they jumped at whatever was proposed by the developers. This has continued as a common industry practice even today..

According to the Chinese Wind Energy Association, by the end of 2013, 74% of the 62,000 units of grid connected wind turbines should be out of warranty. However, there are still 34,000 units not able to be out of warranty, and the 'warranty deductions', totaling 20 billion RMB, will be further retained. In some cases, whether or not the turbine can exit the warranty period and the manufacture can receive full payment for the turbine is arbitrarily determined by the developers.

Very large quantities of these deductions have not been recovered, which in effect transfers the risks and costs of wind farm operation from the wind farm owners to turbine manufacturers, resulting in huge financial pressure for the latter.

However, the issue has two main aspects: On the one hand, because of stiff competition, the developers are in a stronger position to impose terms favorable to them, such as the extended warranty period of 5 years, and 10%, or more, of warranty deduction. The manufacturers are in a weak position to argue for themselves, because of the fierce competition. On the other hand, turbine quality was a key issue in the early days from 2007-2010, with developers taking large risks by using some of the turbines with no track record.

The situation is now gradually being solved by the introduction of the third party assessment of the "out of warranty period" test. However, the practice of arbitrarily introducing a long warranty period and warranty deduction is certainly not a welcome industry practice.

2.4 Wind Power Grid Integration and curtailment

The issue of grid curtailment and integration is a prominent issue for China's wind industry. First, the much of wind development to date in China is in large wind farms far away from load centers. The installed capacity in Western and Eastern Inner Mongolia, Gansu and Northern Hebei accounts for 50% of the national total. However, the electricity consumption in these regions accounts for only 10% of the national total. The electricity cannot be consumed locally and transmission is needed

to send the wind electricity to the load centers in the east.

Secondly, the scale of wind power development has been faster than development of the grid. For example, during the 2010-2015 period, electricity consumption in the Northeast has grown by 5-6% per year, and the average annual increase of integrated wind power was 25.3% - the growth rate of wind power online is much higher than that of local electricity demand. The insufficient capability of outbound transmission is the fundamental reason for the surplus. Although the issue of wind curtailment was improved with the efforts from all relevant sectors in 2013, the ratios of wind curtailment in Jilin, Gansu, Eastern Inner Mongolia, Hebei, Heilongjiang and Western Inner Mongolia were still above 10%, and the ratios in Gansu and Jilin were as high as 20%.

Thirdly, in the "Three North" regions where wind resources are abundant, the power structure is simple, and flexible power sources are limited. Gas powered stations and pumped storage accounts for less than 2% of the total electricity mix. The peak regulation capability is very limited, especially in winter when the heating units (usually combined with coal-fired power stations) are being fully utilized.

Unless transmission lines are built at an exceptional rate to connect the "Three North" areas with the east and south, there is little room for further construction of large-scale wind farms in the area. Small market size, limited peak resources and lack of flexible energy structure are hindering the utilizing existing wind power resources, never mind further expansion. However, wind power installed capacity is only around 6% of the total national electricity mix, and wind power penetration is less than 3%. In the Central East regions, the market potential for consuming wind power has not been fully exploited. The main issue lies in the weak links between the regional grids, and the capacity for cross-regional trading is insufficient. The currently situation of wind power consumed and balanced locally without efficient and effective

transmission, results in a severe waste of wind power resources.

Overall Grid integration and transmission situation of Wind Power in 2013

In 2013, the overall grid integration and consumption of wind power improved somewhat. With the exception of Zhangjiakou city, Hebei province, the curtailment rates were dropping in most other areas where wind farms are developed, including Inner Mongolia, Jilin, and Jiuquan in Gansu. The national average full load hours of wind power increased to 2046 hours, an increase of 143 hours from 2012. The average wind curtailment rate was 11%, a year-on-year drop of 6%. The cumulative curtailed wind power in national wide was 16,231GWh, a drop of 4600GWh compared to the same period last year.

According to China Electricity Council, the Cumulative generation of wind power in 2013 reached 134.9TWh (CEC data), an increase of 34%, accounting for 2.5% of the social power consumption. The top five provinces (autonomous regions) of wind power generation were: Western Inner Mongolia, Eastern Inner Mongolia, Northern Hebei, Gansu and Liaoning.

On November 9, 2013, the daily maximum wind power capacity of the State Grid reached 31,350MW, and the daily generation capacity on November 10 hit 620GWh, increased by 29.2% and 35.4% respectively, both breaking historical records. In Western Inner Mongolia, Eastern Inner Mongolia, Gansu and Jilin, the maximum proportions of the daily generation capacities of wind power in electricity consumption, and the maximum ratios of momentary output in loads continued to rise over 2012.

In 2013, the annual generation capacities of wind power in electricity consumption in Eastern Inner Mongolia, Western Inner Mongolia, Gansu and Jilin reached 31%, 12%, 11% and 9%, respectively.

Table 3-2 Comparison of Wind Power Operation Indicators in Key Regions in 2013

Region/Country	Ratio of Annual Wind Power Production to Electricity Consumption		Maximum Ratio of Daily Wind Power Production to Electricity Consumption		Maximum Ratio of Momentary Output of Wind Power to Load	
	2013	2012	2013	2012	2013	2012
Western Inner Mongolia	12%	11%	28%	28%	36%	35%
Eastern Inner Mongolia,	31%	28%	94%	88%	111%	84%
Jilin	9%	7%	32%	32%	40%	34%
Gansu	11%	9%	33%	33%	39%	34%
Denmark	33.2%	28%	92%	89%	136%	126%
Spain	21%	19%	46%	46%	66%	64%

There are several reasons behind the improvement. Firstly, the year of 2013 was a good wind year. The wind force in 2013 was stronger than in 2012, especially during the summer and autumn. In 2013, the wind resources were 11% higher than that of 2012, while cumulative wind power production increased 27% compared to the previous.

Secondly, the power load increased quickly in 2013 while the wind development slowed down since 2011, where it gives the grid more space to adjust. The power load of in provinces under State Grid in 2013 rose substantially, a year-on-year growth of 13%, higher than the load increases of 12%, 9% and 8% in 2010, 2011 and 2012 respectively.

Thirdly, the prioritized dispatch of wind power was reinforced to maximize the consumption of wind power. At the end of 2012, the State Grid published the "Prioritized Scheduling of Wind Power" and developed a management system for the entire process of wind power scheduling and operation. In 2013, the thermal utilization hours in northeastern region were 4097 hours, a year-on-year drop of 285 hours. Pumped-storage plants were fully utilized. In 2013, the Pushihe pumped-storage plants had over 1000 start-ups and shut-downs, with a pumped power potential of around 1800GWh at off-peak moments. In the northeastern region, the jointly prioritized scheduling of hydropower and wind power was carried out, with a wind power increase of 500GWh in Hexi region. In addition, the transmission lines in East Inner Mongolia and Jiuquan, Gansu were equipped with auto-controls, so as to fully utilize the existing transmission capacity. The transmission capacity of wind power increased 4GW.

Last but not least, a series of newly constructed transmission lines and increasing trading activities between the grids improved the situation:

- The Gaoling-Tianma third trans-regional transmission line was put into operation, raising the trans-regional transmission capability to 3GW.
- The trans-regional trade of wind power between

Northeast and North China was carried out in 2013, with a total trade volume of 4000GWh, accounting for 11% of the annual wind power production in the northeastern region. It significantly improved the transmission and consumption capabilities of the wind power in northeastern area.

- The second 750kV transmission line of the Xinjiang-Northwestern grid connection project was put into operation, increasing the transmission capacity of Jiuquan, Gansu, from 2600MW to 4200MW. In 2013, the transferred power in Gansu increased 5% compared to same period last year, and the power transferred to Qinghai had a year-on-year increase of 41%, which fully utilized the Qinghai hydropower station to balance the wind power production. In 2013, the wind power generated in Gansu increased 27% compared with same period last year, with a year-on-year increase of 145 hours of utilization hours.

On the grid integration side, State Grid is closely tracking the progress of wind power projects and adjusting their priorities on the construction of transmission lines. By the end of 2013, State Grid had invested 71.6 billion Yuan in constructing wind power substation of 24.77 million kVA and operating a 34000km long wind power transmission for wind integration.

CREIA

Chinese Renewable Energy Industries Asscoication
Address: No. A2106 Wuhua Plaza, A4 Che Gong Zhuang Street, Xi Cheng District, Beijing, 10044, P.R. China
Tel：+86 68002617/18
Fax：+86 10 68002674
Website：www.creia.net
E-mail：creia@creia.net

Chinese Wind Energy Association (CWEA)
Address: No. 11 Yiheng Plaza, 28 Bei San Huan East Road, Chao Yang District, Beijing, 10013, P.R. China
Tel：+86 10 5979 6665
Fax：+86 10 6422 8215
Website：www.cwea.org.cn
E-mail：cwea@cwea.org.cn

GWEC

Global Wind Energy Council
Address: Rue d'Arlon 80, Brussels, Belgium, 1040
Tel：+32 2 213 1897
Fax：+32 2 213 1890
Website：www.gwec.net
E-mail：info@gwec.net