

## A Brief Analysis on Wind Power Generation

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**Abstract.** The wind power generation serves as a kind of green source, which has several advantages such as improving the structure of energy and economy environmental protection, etc. Moreover, it is a trend of the development of energy power in the future. The issues related to the development of wind power generation are analyzed, and the feasibility of wind power generation in China is discussed in this thesis.

### The Necessity of Wind Power Generation in China

**The Energy Crisis We are Facing in Our Country.** With the growing consumption of conventional energy and the serious problems of environmental pollution, countries all over the world invest a large amount of manpower and money in application of renewable resources. As one of the most important alternative energy sources, wind power not only technically mature, wind power is being large-scale development and utilization<sup>[1]</sup>. The rapid growth of national economy in our country, especially the high-speed growth of energy-intensive industries, drive the overall rising demand for energy, especially for the rapid growth of the power needs, which has caused tension of electricity supply and demand in our country. In addition, From the structure of our country electric power industry as you can see, the coal is occupied 70%, water 23%, oil 6%, nuclear power accounted for 1%[1]. In order to coordinate the layout of the power generation and power consumption of contradictions, we should awake ordinary people's consciousness about energy security, speed up construction of thermal power, promote energy conservation, rein repeat development of industry, at the same time, we should vigorously develop and utilize the new energy and renewable energy, develop alternative fuels and technology, wind energy as a renewable energy, has received wide attention around the world.

**Environmental Pressures Faced by Our Country.** China is one of few countries using coal as main energy. The data released by the National Development and Reform Commission Energy Bureaus shows that China's total energy output is 170000 tons of standard coal. The burning of coal leads to decrease in air quality linearly. Among 471 cities in China, 262 cities' air quality can't up to national secondary standard. The acid rain caused by coal burning phenomenon is very serious. The frequency of acid rain in central China accounts for 80%. At the same time, emissions releasing from the burning fossil fuels not only led to greenhouse effect which is responsible for the change of global climate, but also increased frequency of flood and drought. As a result, many experts agree that development of renewable energy, mostly wind power, will be a strategic choice.

**Our Government Attaches Great Importance to the Development and Utilization of Wind Power.** With the enactment of Renewable Energy Law and Regulations about Renewable Energy Generation, these laws established the basic legal system of China's renewable energy development and formed a general policy and regulatory framework of promoting renewable energy development and utilization. With the strength of policy, the next few years, the development of wind power market in China will enter a accelerating stage, wind power demand will grow at a rate of more than 30%.

### Wind Power Generation Technology

**Principle of Wind Power.** Wind turbines typically consists of wind turbines, generator (including drive device), to the modulator (tail), tower, speed and energy storage devices such as building

security agency. Wind turbines is set wind device, whose role is to transform the air flow kinetic energy is transformed into the rotor rotating mechanical energy. Usually it consists of 2 ~ 3 blades. Wind generator works by converting wind energy into mechanical work of power machinery. Basic working principle is the rotor rotate under the action of wind, the wind's kinetic energy into mechanical energy of the wind wheel shaft, the wind wheel shaft drive the generator to produce electricity. The wind energy conversion device called a wind turbine.

**The Development of Wind Power Generation Technology.** Wind power technology is by no means easy. A typhoon power unit is in fact a variety of high-tech application of complex (lightweight materials, the aerodynamic design, computer control, etc.). The development of wind power technology is closely related to the development of aerodynamics, aerospace. And wind power technology must have high strength fatigue resistance performance. Although wind power technology is complex, wind power technology has made great progress with sustained hard work.. In the past 20 years, wind power has increased 100 times, which made substantial drop in wind power costs. Now wind power technology is still in rapid progress, the main development trend in performance[2]:

1) Wind turbine capacity continues to increase, megawatt units with hundred kilowatts units have better economic benefits than smaller units. Wind turbine blade growth have greater ability to capture the wind. With the ascendance height, 50 meters in height to capture wind energy 20% more than 30 meters high.

2) Wind turbine control technology using variable speed wind turbines (wind turbine blade with the wind speed change to change its rotation speed), when the average wind speed reach 6.7/seconds,

Which can capture more than 15% of wind energy of the constant speed wind turbine?

3) Offshore wind power generation technology progress, compared with the same capacity, land than sea cost increased by 60%, but the generating capacity is increased by more than 50%, and every 10 km towards the sea wind power increases by about 30%. Further more offshore wind farm can reduce turbulence unit fatigue load, prolong the service life.

### **Wind Power Generation Technology Mature Gradually**

The first wind machine in the world used to generate electricity was built in 1891 in Denmark. Nevertheless, due to technical and economic reasons, wind power has not been regarded as energy in the grid until oil crisis in 1973, as one of the reasons, such as, forced the United States, Western Europe and other countries to seek energies substituting for fossil fuel, invest a lot of money, develop the modern wind turbine with new technology. With the development of wind power market, some domestic enterprises created joint venture enterprises with foreign enterprises in the form of skill trade combination. While constructing wind farm, we have been developing large wind power generators by digesting imported technology so as to speed up the localization of large-scale wind turbine. By the end of 2005, wind turbines, except Taiwan province, account for 1864. The installation capacity reaches 1.266 million kilowatts. There are 62 wind farms all over the country. Compared with cumulative installed capacity 764000 kW in the 2004, growth rate of installation is 65.6% [3].

### **The Cost of Wind Power**

**Wind Energy Resources.** According to the Chinese Academy of meteorological Sciences estimated that China's wind resources are very rich. The actual land available for development of wind energy resources totals 253 million kilowatts. The areas suitable for developing large scale wind power include Northwest, Northeast and North China, as well as coastal regions [4]. In addition, the offshore wind power is also very rich in China. According to the preliminary estimate, the offshore wind power is about three times of land wind energy resources. The total amount of resources which can be developed and utilized is 750 million kilowatts. According to preliminary

estimates, wind power reserves 10 m is 32.26 million megawatt. Among them, 2.53 million megawatts can be developed. Offshore (no more than 10 m) area, wind power 10 meters above sea level is about 7.5 million mw.

**The Cost of Wind Power Planning.** The main factors limiting wind large-scale commercial. Development-wind power costs. In the past 20 years, there has been a sharp decline. The wind power resource is different, the scale of wind farms and different using different technology, wind power generation costs are also different. The cost distribution is shown in Fig. 1.

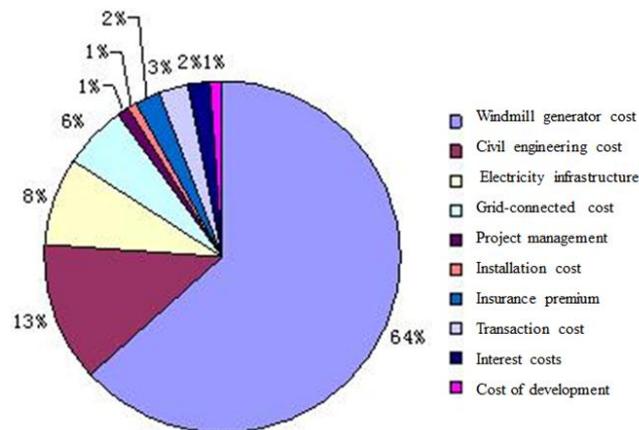


Figure 1. Wind power cost analysis diagram

With the improvement of wind power technology, the wind turbine will be more and more cheap and efficient. Increases the size of wind turbine capacity of infrastructure investment costs will be reduced, and the same capacity units need to be more a few purpose, it also saves the costs. With the loss of the cost of financing and experienced developers, project development costs also get lower accordingly. Wind turbine reliability improvement is to reduce the average cost of operating maintenance. According to the national renewable energy laboratory NREL's statistics, from 1980 to 2005, wind power costs fell by more than 90%, the wind power cost (including the parts shown above) become the renewable energy technologies in one of the fastest cost reduced power generation technology.

**The Main Impact of Wind Power Cost.** Wind power cost is affected by many factors, including the wind resources of the construction of the wind plant, the performance of the wind turbine used by the wind plant, the initial investment situation and the daily management of the wind plant etc. The influence of wind speed of costs is by influencing the power to influence the cost. The relationship between the output power of the wind turbine and the wind speed:  $W = 1/2\rho AV^3 C_p$  (W- The output of power of windmill; A- The rotor swept area; V- wind speed;  $C_p$ - The power coefficient of wind turbines). Wind turbine output by the type that wind velocity, the greater the power, the greater the namely the higher capacity, based on cost calculation formula of the higher capacity, the smaller unit KWH cost. Therefore the greater the wind speed, wind power cost is lower. Wind speed meter only between wind speed and removal of wind speed, table 1 describes the wind power density grade table

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Wind Power density grade	10m height		30m height		50m height	
	wind power density <sup>2</sup> w/m	Referenc Evalue m/s	wind power density <sup>2</sup> w/m	Referec Evalue m/s	wind power density <sup>2</sup> w/m	Referec Evalue m/s
1	<100	4.4	<160	5.1	<200	5.6
2	100-150	5.1	160-240	5.9	200-300	6.4
3	150-200	5.6	240-320	6.5	300-400	7.0
4	200-250	6.0	320-400	7.0	400-500	7.5

Therefore, China is now in the development of offshore wind power technology, which can reduce the costs, but also to extend the service life of the equipment.

### 3.3.2 The influence of fan performance

The characteristic of the wind turbines affects the output of itself, and then affect the cost of wind power. When the wind speed is greater than the starting wind speed  $V_{in}$ , wind turbines to generate electricity. When the wind speed is greater than the rated wind speed  $V_r$ , wind turbines can reach the highest power. When the wind speed is greater than the down wind speed where  $V_0$ , fan, you must stop and not to produce electricity. Typical power of the wind turbines curve analysis diagram is shown in Fig. 2.

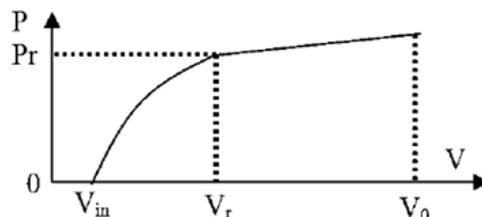


Figure 2. The typical output curve analysis diagram of wind turbine

The Fig. 2 shows that enables the wind power generation of wind speed range between  $V_{in}$  -  $V_0$ , Each kind of wind turbines because of its technical performance, itself has its specific rated wind speed and wind speed using scope effectively, which also affects the cost of wind power. So, in the technical transformation can minimize the rated wind speed of  $V_r$ , so it can make the wind turbine can achieve the highest output range of wind speed increased, at the same time also can reduce the  $V_{in}$  or  $V_0$  that can power generation increased range of wind speed, The power generation is increased, so that the cost of wind power is reduced.

## Wind Power Potential Market

**Wind Power's own Advantage.** It is almost green energy with no pollution, except for have growth box near the "teeth" and "flash" fan blade impact air noise (less than 55 dB 300 metres), compared with coal-fired thermal power, also send 1 KWH electricity, wind power carbon dioxide 0.75 kg, 0.0045 kg, nitrogen dioxide sulfur dioxide of 0.006 kg, 0.0052 kg of smoke particles[5] When the wind power almost no consumption of mineral resources and water resources (except for lubricating oils), Compared with coal-fired thermal power, with 1 KWh electricity can save 0.39 kg of the standard coal and 3 kg of water. Wind power is the most commercial scale on the technology and economic development condition of the new energy, at the same time, with the improvement of

degree of localization of wind power generator, wind power cost can drop dramatically, and thermal power and nuclear power cost reduction space is very limited or almost none. Under the situation of the current power supply and demand contradiction in China, the development of wind power can be optimized to adjust power structure, is extremely rich vitality. Because is wind maximum period from autumn to spring, the wind can full power, which coincided with hydropower, wind can supplement the shortage of hydropower in the power grid. The large proportion of hydropower or runoff hydropower station of power grid, the more wind power and hydropower complementary, the role of the balance of power.

**The Market Demand.** "Wind cake" is so huge. Wind power industry for its characteristics of the technology and capital intensive, technology research and development, production and marketing of all don't need the money of a large number of inputs, the process of production, marketing and can make a contribution to the local GDP and corporate profits. According to the former state economic and trade commission of wind power development goals, in 2020 to reach 30 gw of installed capacity, means that the next ten years, China's wind power to keep the average annual growth of 30%, annual average 1.9 million kilowatts of new power. To achieve this goal, it is necessary to improve the domestic wind power equipment manufacturing capacity, speed up the process of wind power equipment localization. Form with synchronous production capacity of wind farm construction, meet the needs of the domestic market, at the same time can also be exported.

## Conclusion

With the development of electric power system, energy shortage and the pressure of environmental pollution, wind power is most likely to become one of the world's attentions. In view of pressures from current energy shortage and environmental pollution, this article analyzes the technology and the cost of wind power generation and studies the feasibility of the development of wind powering in our country. Analysis results show that wind power generation can not only reduce costs by making full use of energy, but also can alleviate environmental pollution. In broad sense, wind power generation provides a broad prospect for energy development in state grid.

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