Research on Exploration and Application of Wind Energy

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Abstract: At present, coal is the most important resource for utilization and development in China, but the environmental pollution caused by coal is serious. It is urgent to improve the development of clean energy. China is gradually promoting wind energy, the development and utilization of wind energy is difficult. The difficulty of storing wind energy and its instability limit the country's spread. Wind energy can only be developed better by solving the current problems. The research on the development and utilization of wind energy also becomes the key to solve the problem.

1. Introduction
Coal is the most important source of energy in China, accounting for about 75% of China's energy production and consumption. Using coal to generate electricity is expensive. Power plants use the calorific value of coal to convert heat into electricity. Domestic coal consumption is also large, accounting for about 20 percent of fuel coal. At present, the country has restrictions on the promotion of wind energy, the energy is not easy to store and the cost is too high. The instability of wind energy has not been completely solved, how to solve the current problem of wind energy is the most critical. If wind power can be better developed and applied, it will reduce energy pollution to the environment and can be renewable, as well as save costs.

2. The necessity of wind energy development

2.1. Coal as the main energy supply causes serious environmental pollution
Coal is the most used resource in China and the problem of environmental pollution is aggravated with the increase of the amount of coal used. Coal is now used more than natural gas and oil relative to other energy USES.
According to statistics, coal pollution is mainly concentrated in the following aspects: water pollution and land pollution. Coal produces a lot of smoke during its use, and every stage of its life cycle, from mining to processing to burning, affects local water supplies. Lakes, rivers, streams and drinking water supplies, for example, have been severely affected by coal mines and power plants.

2.1.1. *Water pollution.* "One-pass" coal-fired power plants Extract water directly from the source, heating it up and then pumping it back out. Blessing is usually reheated (up to 20-25 degrees Fahrenheit) than the water it receives, "Thermal pollution" in normal," which not only reduces fish's ability to reproduce, but also attributed systems pump and discharge 70 to 180 billion gallons of water a year. [2]

2.1.2. *Land pollution.* China's smog-filled cities are ringed with heavy industry, Metal Smelters, And coal-fired power plants. The air pollution and smog in Beijing and Shanghai are sometimes so bad that The airports are shut down because of poor visibility. The air quality of Beijing is 16 times Worse than New York City.[3] China and many other countries are surrounded by heavy factories, and each factory has a large amount of coal that needs to be released. The amount of coal released each day has created a serious amount of environmental pollution. The release of coal poses a serious threat to the environment, both in water and on land. It is urgent to solve the environmental problems brought by coal.

3. **Progress in wind energy’s exploitation and application.**

3.1. **National policy support**

China's push for wind power is not strong enough. As you can see from the chart below, China still lags behind the United States.[4] Wind power depends on national support. In the Renewable Energy Law promulgated by the State in 2005, the state conducts research on the science and technology and industrial development of the development and utilization of renewable energy, makes plans for the national science and technology development plan and the development of high-tech industries, and allot funds to support scientific and technological research on the development and utilization of renewable energy. This has promoted the development and utilization of renewable energy technologies, reduced the production costs of renewable energy products and improved product quality. [5]

In order to improve the abundant wind energy resources in the north, reduce the environmental pollution caused by burning fossil energy, and improve the atmospheric environment quality in the north, the state will promote the application of clean heating technology for wind power generation where conditions permit.
3.2. Wind energy’s exploitation
At present, China's wind power construction after a long time of development has formed a certain scale, and has been well promoted and applied, but there are still limitations. Wind power construction technology is also steadily improving, providing new energy for China's economic construction, which can help achieve sustainable economic development. Wind power development technology determines the progress and quality of wind power construction. China's wind energy development technology is still improving.

China has abundant wind energy resources and huge development potential. Onshore wind resources can be developed to 2.38 billion kw, offshore wind resources can be developed to about 200 million kW. By 2010, China's wind power generation reached 49.4 billion kilowatt-hours, accounting for 1.17 percent of the country's electricity generation. The national average is 2,047 hours. From January to June 2011, China's wind power generation reached 42.9 billion KWH, accounting for 1.94% of the country's large power plants. The national average is 1,252 hours. In October 2019, China's installed wind power capacity will reach 28.62 billion KWH; In November 2019, the country's installed wind power capacity was 33.42 billion KWH, and from January to November 2019, the country's installed wind power capacity was 320.4 billion KWH. Wind power generation across the country declined slightly as of November 2019.

Compared with 2010 and 2019, China's wind power generation in one month is almost equal to that in several months of 2010. That's enough to suggest that China is steadily pushing ahead with wind power, but it's sometimes in decline because of its storage and stability.[7]

3.3. Wind energy’s application
In recent years, with the increasing awareness of resource crisis, wind energy has gradually developed, and many large enterprises have also been constantly joining the ranks of wind power manufacturing industry. The continuous progress of science and technology has provided great support for wind power manufacturing industry. In this case, the wind power industry has been greatly developed. According to statistics, the development of wind energy is steadily improving.

![Figure 3. Development of energy](image)

China's wind power construction investment is also increasing. The wind power manufacturing industry is also expanding, but also facing the corresponding difficulties. China is rich in natural and industrial wind energy resources, including onshore and offshore wind resources, about 1 billion kilowatts. High altitude wind energy resources are relatively rich, up to 2 billion kilowatts. At the same time, industrial wind energy also has a good utilization prospect, which can not only contribute to the power industry, but also improve the efficiency of enterprises.

For example, China has increased investment in wind power construction, and the wind power manufacturing industry has also been greatly developed, which can provide corresponding construction equipment and technical support for wind power construction. China already has the
capacity to mass-produce 2 and 1.5 megawatts of wind turbines, and will continue to produce 3 and 5 megawatts or more.[9]

4. Existing Issues

4.1. Storage
Wind power generation is not as easy to store as coal. Wind power is an expensive resource everywhere, so storage is hard to justify. Ensuring full value from storage research is a promising area of research. A study of the future of the Irish system with the results of high (BBB30 energy) levels of wind energy production costs shows that compared with conventional power plants, the main benefits of wind storage are reduction of wind abandon and management of uncertainty. Pumped storage is unlikely to justify itself in the Irish system at current storage costs. [10]

4.2. Difficulty in utilization
Wind energy is expensive, and it has seasons and time cycles, so it can be unstable. There are seasonal and time period of wind. Wind itself is an unstable factor, so its production is also unstable. At present, the most common wind energy conversion control system USES MPPT method, but this method largely needs the wind speed information provided by the anemometer to make a judgment. The high cost of doing this, not to mention the instability of the wind, in many cases, the anemometer does not provide accurate data.

4.3. Noises
With the rapid development of wind power, wind noise is a major drawback. The working principle of wind turbines is to drive the gears mechanically by rotating turbine blades, thus generating electricity. But when the gears bite into each other, they vibrate so much that they make a lot of noise. The infrasonic waves produced by this kind of situation are harmful to human beings. Of course, the impact of noise on wildlife is not to be underestimated, and many sea creatures die because of infrasound damage. Take sonar as an example. Many businesses that develop the ocean don't know what to do because of the creatures in the ocean, so they decide to kill them with sonar.

5. Solution

5.1. Wind energy store
Wind power is itself a renewable resource. According to statistics, using batteries to store energy is a good way of renewable resources, and has been recognized by more people. This is also known as chemical energy storage. The battery in the battery pack is the key to charging your phone when it runs out of power. At present, this method is relatively safe and low cost. Can be long-term development, suitable for research.

Lithium-ion batteries store a lot of energy on their own, so they can store enough to generate wind energy. Lithium batteries have superior "usable" capacity, unlike lead-acid batteries, which are thought to often actually use 90 percent or more of the rated capacity of lithium batteries, sometimes more. Consider a 100 mah battery -- if it's a lead-acid battery, you'd better use 30 to 50 amps, but if it's a lithium battery, you can use 90 amps or even 100 amps (100% DoD).[11]

Stanford has also responded to battery storage: scientists are working on using batteries to store excess renewable energy. But achieving low-cost batteries with large storage capacity that can be recharged during the day and discharged thousands of times at night has been the biggest challenge so far. "Green scale storage takes 20 to 30 years," Cui said. "If you cycle every day for 30 years, you need about 10,000 batteries to cycle for 30 years. No battery lasts that long. This is the greatest difficulty we are facing. Second, costs still need to be very low."[12] Of course, this approach has advantages and disadvantages. In order to make better use of batteries for wind energy storage, efforts should be made in terms of battery life, cycle affordability and cost.
5.2. Instability
The instability of wind energy has also become a major problem in the development and utilization of wind energy. According to research, most wind power is currently generated by the variable Speed Wind Energy Conversion System (WECSs), which can produce maximum power by controlling the speed of the shaft. The effective maximum power tracking (MPPT) control algorithm is an important part of the modern variable speed WECS control system. The performance of some traditional MPPT methods depends largely on the wind speed information provided by the anemometer. However, this has increased WECS's capital, installation and operating costs. In addition, for high performance MPPT controls, the measured wind speed may not be accurate. [13]

Different wind turbine, generator configurations, and converter topologies are presented. Its stability and power quality are also studied. An WECS based on squirrel cage induction generator (SCIG) is considered in the simulation study. One control scheme is based on vector control theory. An indirect magnetic field orientation control (IFOC) scheme based on proportional integral is proposed. A simple maximum power point tracking strategy is used to determine the optimal speed under variable wind speed. The method is mainly to increase the speed changing device, through which stability can be achieved. As mentioned above, for the high performance MPPT control, the measured wind speed may be inaccurate, but after installing the variable speed device, the wind speed can be quickly tracked and its stability can be determined, and the wind speed will not cost more.

5.3. Noise reduction
Wind power relies on blades that are tangent to the wind, but this produces noise that cannot be removed. The only way to do this is to reduce the amount of noise you make, or to reduce the volume. Wind power produces a sound similar to that of a fan. A lot of methods cannot do without sound insulation cotton to wind power generation, however sound-proof can be taken into consideration. The Windows of wind turbines can use muffler louvers to reduce noise transmission; In order to make the special structure of the muffler to reduce noise, it is necessary to install the muffler not only in the air outlet of the fan, but also in the fan. However, the structures of wind turbines and fans are not exactly the same, and similar principles can be used in the research method. If complete control is needed, further work is needed.

6. Conclusion
Coal will bring more pollution to the environment, and wind energy as a clean energy source can reduce pollution. For further development and utilization of wind energy and wind power generation, problems such as storage, wind energy instability and noise must be solved. For storage problems, it is a relatively convenient method to switch to battery energy storage. The instability of wind energy has a lot to do with customs. There are many uncertainties in the generation of wind. People cannot control the wind speed, but it can be used. The speed change device is solved. Infrasound waves generated by wind power can endanger health and the survival of animals, and reducing noise is the key to solving the problem. The silencer is a good method, but the method is not perfect. The use of a wind generator depends on the structure of the generator itself. It is hoped that wind energy can solve the existing problems and make wind power generation a convenient and functional technology.

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