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Comparative Analysis of the Development of Wind Power and Photovoltaic Power Generation

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ABSTRACT

Wind power and photovoltaic power generation occupies an important position in the development of new energy. Wind power and photovoltaic power generation have made great contributions to the protection of the environment and the conservation of non-renewable resources such as coal and oil. The proportion of national wind power and photovoltaic power generation in the total electricity consumption of the whole society is continuously increasing. National policies also strongly support the development of wind power and photovoltaic power generation. This paper compares the application of two clean energy power generation methods and gives a perspective description on their development.

Keywords: Wind Power Generation; Photovoltaic Power Generation; Sustainable Development

1. INTRODUCTION

Energy is an important issue of concern to all countries, and everyone should be responsible for carbon dioxide emissions [1]. China has a large population and the problem of insufficient energy supply appeared in the middle of the twentieth century. At that time, the country's technological development was immature and new energy sources could not be used on a large scale. Thermal power generation has always been the main method. According to statistics in 2020, thermal power generation accounts for more than 70%, and the fossil fuels consumed by thermal power generation have caused serious pollution to the atmosphere. It was not until 2010 that China's wind power and photovoltaic power generation developed at a high speed. With the expansion of scale, there is also a certain correlation between wind power and photovoltaic power generation [2]. The use of these clean energy sources has made outstanding contributions to environmental protection. China has always advocated the path of sustainable development, which will also improve people's lives.

2. RELATED WORK

Since 2016, the global installed capacity of wind power has grown rapidly. Figure 1 shows the cumulative installed capacity of global wind power from 2016 to 2021. The installed capacity in 2016 was 487GW, and the annual compound average growth rate reached 9.56%. It is expected to be in 2021, the global installed capacity of wind power will reach 756GW by the year. Today, China has become the country with the largest installed wind power capacity in the world. Figure 2 shows the cumulative installed capacity of global photovoltaic power generation from 2016 to 2021. The rapid development of photovoltaic power in China has achieved a process from following to leading. The sun releases about 80KW of energy to the ground every year. It can be quantified that the energy of sunlight hitting the earth per second is equivalent to the heat released by burning 5 million tons of coal. Burning one ton of coal produces an average of 2.7 tons of carbon dioxide, which can produce 3000 Kilowatt hours of electricity. Therefore, good use of wind and solar energy saves a lot of non-renewable resources and reduces a lot of pollution for mankind.

The scale of wind power and photovoltaic power generation is getting bigger and bigger, so the grid dispatching operation is also of great significance [3]. For wind power and photovoltaic power generation, a variety of methods have been used at home and abroad to conduct research. In the literature on the evaluation of power generation adequacy and capacity credibility of large-scale wind farms [4], the power generation reliability evaluation model and wake effect model of

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wind farms are established, and the capacity credibility evaluation of wind farms is carried out. In the literature on the evaluation of the confidence capacity of grid-connected photovoltaic power plants [5], a method for calculating the reliability of power system generation based on sequential Monte Carlo simulation is proposed. For the effective use of resources, it is also necessary to study the correlation between wind power and photovoltaic power generation. China's terrain is diverse, and the use of wind and solar energy is unevenly distributed. The two energy sources are also related to a certain degree at different time periods. Therefore, when using two new energy sources, it is necessary to consider the integration of the two. Resources need to be used rationally according to geographical and time characteristics. In order to analyze the correlation between wind power and photovoltaic power generation, a pair of Copula-based multi-dimensional wind power correlation analysis and modeling [6] proposed a high-dimensional correlation model of wind power based on Pair Copula, and the corresponding Sampling method.

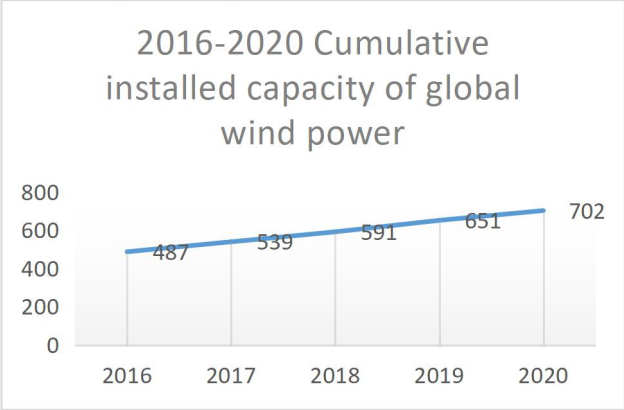

Fig.1. Cumulative installed capacity of global wind power

By 2020, the utilization rate of wind power in China will increase to 97%, and the utilization rate of photovoltaic power will also reach 98%. Supported by government policy, China's wind power and photovoltaic power generation accounted for 11% of the total electricity consumption in China in 2021, and will continue to increase. It is expected to reach about 16.5% in 2025. In order to implement "carbon neutrality" and "carbon peaking", China will strive to achieve the task of achieving a total installed capacity of wind and solar power generation above 1.2 billion kilowatts in 2030. The data in Figure 1 and Figure 2 are from http://www.askci.com.

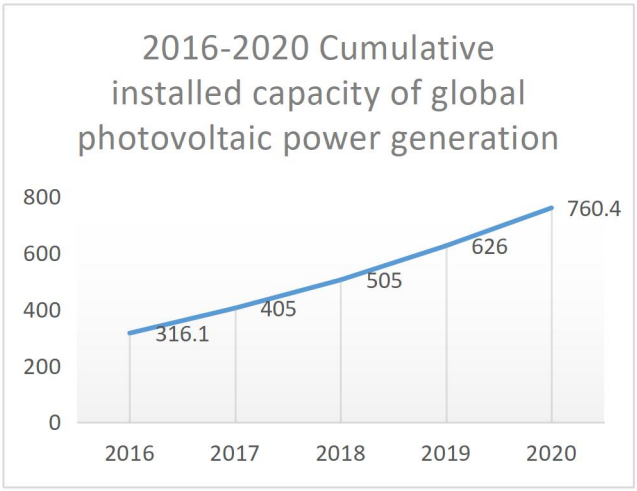

Fig.2. Cumulative installed capacity of global photovoltaic power generation

3. CORRELATION ANALYSIS OF WIND POWER AND PHOTOVOLTAIC POWER GENERATION

In order to rationally use wind and solar energy, it is necessary to analyze the correlation between wind power and photovoltaic power generation, and also to predict the use of electricity. One of the reasons for the prediction is to plan the use of electricity in the future to achieve the purpose of saving resources. In order to facilitate the study of energy utilization, it is necessary to analyze the use of electricity.

3.1 Power usage analysis

On the whole, electricity usage varies throughout the year. In summer, there is more electricity, and 6 pm is the peak electricity consumption period. Most users use electricity for cooling, and electricity consumption is relatively stable in spring, autumn and winter. The electricity consumption on working days and non-working days is also different. The load difference between working days and non-working days is the smallest at night and the largest during peak hours [7].

Analyzing the electricity situation in China, China is still dominated by thermal power generation. Figure 3 shows the electricity consumption in 330 months, and according to the existing data, the machine learning method is used to calculate the electricity usage in the next 20 months. A prediction was made. According to China's electricity usage data, electricity consumption is increasing year by year. Figure 4 shows the detailed forecast for the next 20 months. The overall forecast is above 6000KWh. It can also be analyzed that China has been developing at a high speed and consumes energy. At the same time, it has created huge benefits, but in order to protect the environment, China attaches great

importance to the use of clean energy, so it is speeding up the construction of wind power and photovoltaic power generation. China's wind energy is rich and evenly distributed. There are large-scale wind farms from the coast to the inland, and the offshore wind power is continuously developed to make rational use of wind energy resources. In terms of the spatial distribution of photovoltaic companies, Chinese photovoltaic companies are mainly distributed in the Yangtze River Delta and surrounding areas, as well as in some cities in the Pearl River Delta and inland Hebei and Henan [8]. The state continues to invest capital and technology to develop new energy sources.

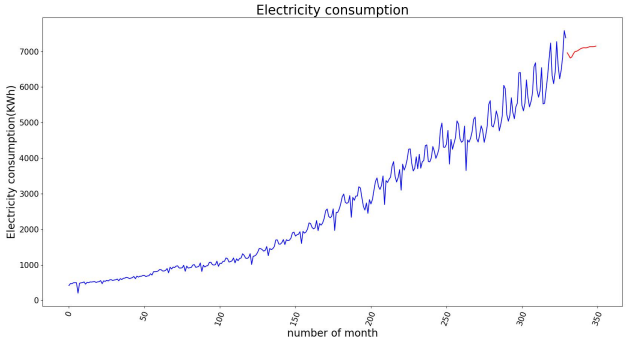

Fig.3. China's power generation

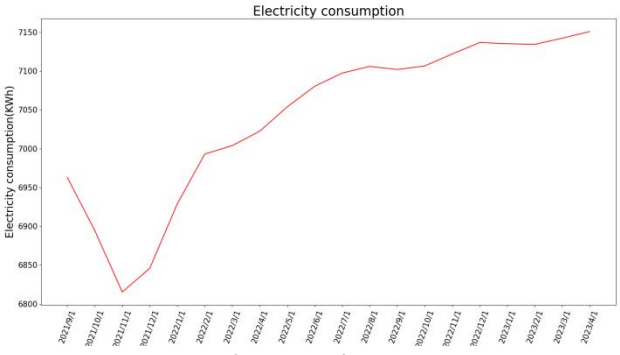

Fig.4. 20-month forecast of power generation

3.2 Wind power and photovoltaic power generation

Wind power has developed earlier than photovoltaic power generation and has a larger scale. It uses machine learning methods to make predictions. Figure 5 shows the 128-month wind power generation, showing an overall upward trend. Figure 6 shows the forecast of wind power generation in the next 20 months. Figure 7 shows the photovoltaic power generation in 54 months, which also shows an upward trend. Figure 8 shows the forecast of photovoltaic power generation in the next 20 months. Both power generation methods have tortuous rises, which are related to the instability of the weather.

Compared with thermal power generation, wind power generation and photovoltaic power generation have a shorter time, so the amount of data is not large enough, and the predicted value obtained through training data will have a certain deviation. However, according to the analysis of national policies, the development of this new energy It will not stand still, but will only occupy more of the share of thermal power generation. China has put forward the goals of "carbon peak" and "carbon neutral", and will achieve "carbon peak" in 2030 and "carbon peak" in 2060. Carbon neutrality" reduces environmental pollution. In the process of achieving these two goals, it was proposed to use photovoltaic, wind power and other technologies to achieve clean power generation.

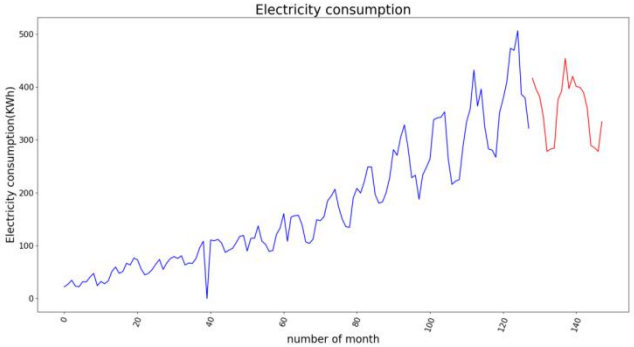

Fig.5. China's wind power generation

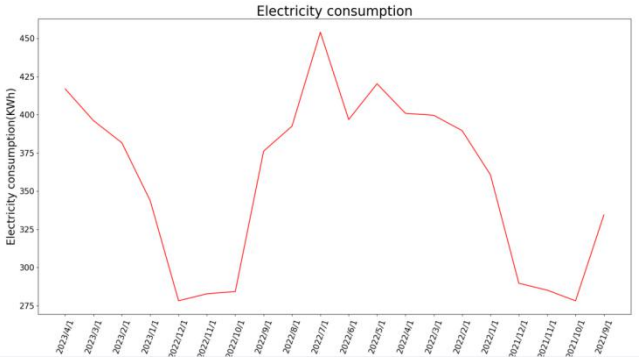

Fig.6. 20-month forecast of wind power generation

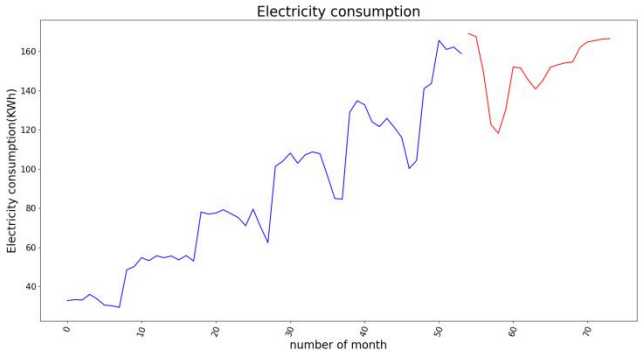

Fig.7. China's photovoltaic power generation

4. CONCLUSION

This paper uses machine learning methods to analyze China's power generation growth over the years, as well as the development of wind power and photovoltaic power generation. New energy is developing steadily. The use of non-renewable resources will be effectively controlled and the environment will be greatly improved. China is moving on the road of sustainable development, and people's quality of life will be further improved. The data in Figure 1 and Figure 2 are from www.askci.com, The data required in Figure 3 to Figure 8 are all from http://www.stats.gov.cn/.

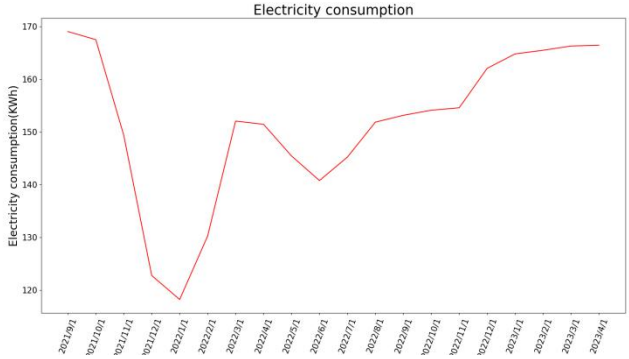

Fig.8. 20-month forecast of photovoltaic power generation

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