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Energy-saving Benefits of New Energy for New Power Systems

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Abstract: New energy is a new direction of energy transformation and development in the future, and it is also a new trend in the development of future power systems. This article conducted research on new power systems based on information technology. The article first introduced the social and economic benefits brought about by the transformation of the energy structure, indicating that new power systems were the new direction of future development, and introduced the characteristics of new power systems. Finally, the combination of new power systems and digital technologies was proposed, and the development of intelligent technologies such as the Internet of Things, blockchain, and satellite applications in new power systems was introduced. The annual emission reduction and energy savings of using new energy power systems were analyzed. The data showed that the total emission reductions of sulfur dioxide and nitrogen oxide pollutants were 612 tons and 605 tons, and the emission reductions of carbon dioxide have reached 2.5 million tons. The total energy savings generated by electric power systems that mainly rely on wind and light energy were 960000 tons. It can be concluded that new energy power systems can significantly reduce carbon emissions and have produced significant results in energy conservation.

1. Introduction

In recent years, due to the global goal of implementing a “low-carbon economy”, new energy is crucial. The goal of global ecological environment protection and sustainable development is becoming increasingly important. Clean energy and low-carbon transformation are the inevitable trends of current sustainable economic development. The important source of carbon emissions is the power system, and the proportion of carbon emissions from the power industry in the energy industry exceeds 40%. Therefore, to achieve low carbon emissions, the first priority is to solve the energy problem. The construction of new power systems is a new direction for future energy structure transformation and innovation, and the development of solar and wind energy is the key to the development of new power systems. New power systems are the new direction of future power industry development, and should be combined with information technology to make new power systems oriented towards digital and intelligent development. New electric power systems have great significance for low carbon emissions.

The development of new power systems has enormous energy saving benefits for new energy sources. Recently, the building of new power systems is hot in the power industry. Badal, Faisal R described the usefulness of renewable energy for power generation around the world, and introduced the integration challenges of renewable energy and the control of microgrids [1]. Khan, Imran explored the potential of energy conservation as a strategy for managing electricity demand in least developed economies, with a particular focus on Bangladesh. However, it did take a long time to implement. These may be useful guidelines for policymakers in other developing countries that are developing national demand management strategies [2]. These studies have certain reference significance, but most of them are discussed from the theoretical level.

Digitalization and intelligence are the key technologies for the development of new power systems. The application of digital technology to new power systems has received increasing attention and research. Hosseinian discussed corresponding solutions for the application of the Internet of Things and blockchain in power systems, especially in intelligent buildings and residential electric vehicle management supply equipment [3]. Xiong, Huiyuan proposed a source to range (STR) model, and then proposed a source energy consumption rate (SECR) to evaluate vehicle energy efficiency. Finally, based on the STR model, he obtained the boundary of the same SECR for new energy vehicles and equivalent fuel vehicles. The results showed that the STR model could provide an effective tool for energy matching and energy efficiency analysis of new energy vehicles [4]. These studies have certain research value for the energy-saving benefits of new energy, but they have not been analyzed in combination with the actual situation.

The main direction of energy structure transformation is the development of new energy, and the power system gradually occupies a dominant position in the energy structure. While promoting economic development, it also brings about the issue of carbon emissions. The reduction of greenhouse gas emissions and the development of new electric power systems are key measures. The building of new electric power systems can bring new energy conservation benefits. The promotion of economy and the sustainable development of the environment are the inevitable development trends of the current electric power industry. This article combined information digitization technology to build a new type of power system, thereby generating new energy efficiency benefits, without contributing to the field of reducing carbon emissions.

2. New Energy Power System and Energy-saving Benefits

2.1 Energy-saving Benefits of New Energy

New energy refers to unconventional energy that is different from traditional energy, including solar energy, wind energy, tidal energy, biological energy, etc. Currently, the global ecological environment is severely damaged, and the popularization and application of new energy is a key measure to address environmental issues. In addition to the increasing population and the depletion of Earth’s resources, new energy is of great significance for energy conservation and emission reduction. The integration of renewable energy provides energy security, significant cost savings, and reduced greenhouse gas emissions, enabling countries to achieve emission targets [5]. The utilization of new energy can generate various benefits, including economic and social benefits, as shown in Figure 1.

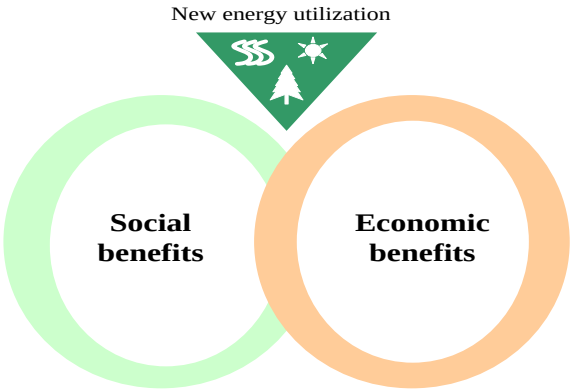

Figure 1: Benefits from new energy utilization

1) Economic benefit analysis: With the development of society and the growth of global population, human activities and the consumption of earth resources exceed the carrying capacity of the earth, and human production activities have caused tremendous pressure on the ecological environment, hindering the sustainability of economic development. With the outbreak of the international financial crisis, the governance of energy resources and global climate change has become increasingly difficult. In this context, it can be analyzed that it is not a long-term solution to rely on traditional non renewable energy to achieve sustainable economic development. The development of new energy industries, the promotion of energy structure transformation, and the upgrading of the economic and industrial structure are urgent needs of the current international situation and environmental protection. Only by developing energy-saving and environmentally friendly new energy industries can the Earth's resource and environmental problems be alleviated to promote energy conservation and emission reduction, accelerate the transformation of economic development patterns, and achieve sustainable economic development. The development of the new energy industry can not only reduce the cost of energy consumption, but also reduce the pressure on environmental management. Therefore, new energy vehicles have great development prospects in the future.

2) Social benefit analysis: The popularization and application of new energy have greatly reduced the emissions of pollutants such as carbon dioxide, and reduced the damage to the ecological environment. Affected by the low carbon economy, countries around the world have vigorously promoted new energy buses, electric vehicles, and shared bicycles, which have been widely recognized by residents and rapidly popularized, greatly improving the energy structure and consumption structure, reducing air pollution, and improving the environmental quality of residents' lives. It can be analyzed that the promotion of new energy products has significant effects on promoting the construction of ecological cities. The national subsidy policy for new energy vehicles has greatly benefited both residents and enterprises. Carbon emissions have been reduced, and production costs for enterprises have also been significantly reduced, promoting harmonious and healthy development of society.

2.2 New Power Systems

New power systems refer to power systems that use new energy as the main energy source. Power systems account for the largest proportion of total carbon emissions, and the carbon dioxide and other gases generated by power systems each year cause significant damage to the ecological environment. Rising energy costs, current grid losses, risks posed by nuclear power generation, and global environmental changes are driving the transformation of traditional power generation methods [6]. Therefore, the promotion of the transformation of the power system to a clean,

low-carbon, digital intelligent energy system is a new trend in the current development of the power industry. Uncertain transmission delays, sampling periods, uncertainties in power system parameters, load fluctuations, and intermittent generation of renewable energy significantly affect the frequency of power systems [7]. The new power system has the following characteristics, as shown in Figure 2.

1) Clean and low-carbon: New electric power systems are an energy structure dominated by new energy, so the development direction of new electric power systems is cleaner and low-carbon. The energy consumption system focuses on clean and low-carbon, reducing carbon emissions, and achieving significant energy-saving benefits.

2) Strong flexibility: The new type of power system integrates scientific and technological achievements, enhances the ability to regulate power generation and load in the power system and the ability to allocate power grid resources. It has the ability to control and resist disturbances, achieving flexible conversion of multiple energy sources, and can better adapt to the development needs of the system.

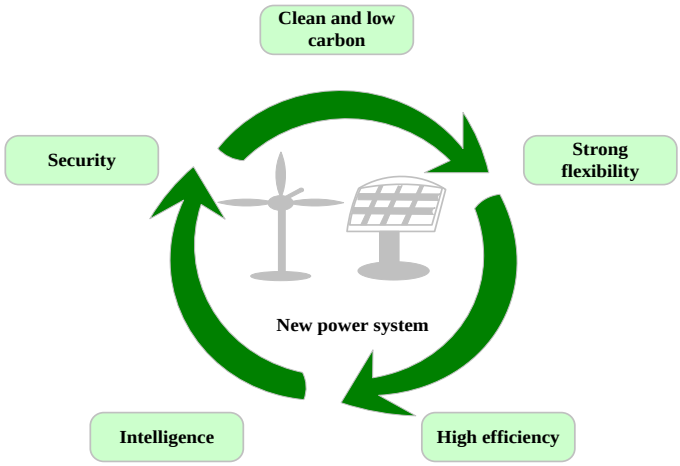

Figure 2: Characteristics of the new power system

3) Security: The new power system has active support capabilities, combined with a security defense system, and its structure is also enhanced. The system has flexibility and self-healing capabilities.

4) Intelligence: The new type of power system integrates intelligent technology, using technologies such as the Internet and big data to intelligently control the system, changing the traditional way of power configuration into a highly perceptive, two-way interactive power system.

5) High efficiency: The new type of power system can adapt to the access of various new technologies and equipment, and can be flexibly converted, greatly improving the overall efficiency of the system.

2.3 Application of Digital Technology in Power Systems

With the popularization of big data technology, digital technology has brought revolutionary changes to the power industry, and intelligent technologies such as the Internet and cloud computing have a profound impact in various fields. The combination of digital technology and power technology has led to a high degree of intelligence in various fields of power systems. The penetration of digital technology has led to a high degree of integration between the power system and economic society, which has great significance for the innovation of the power system. Currently, the application of digital technology in the power system can be divided into the following categories, as shown in Figure 3.

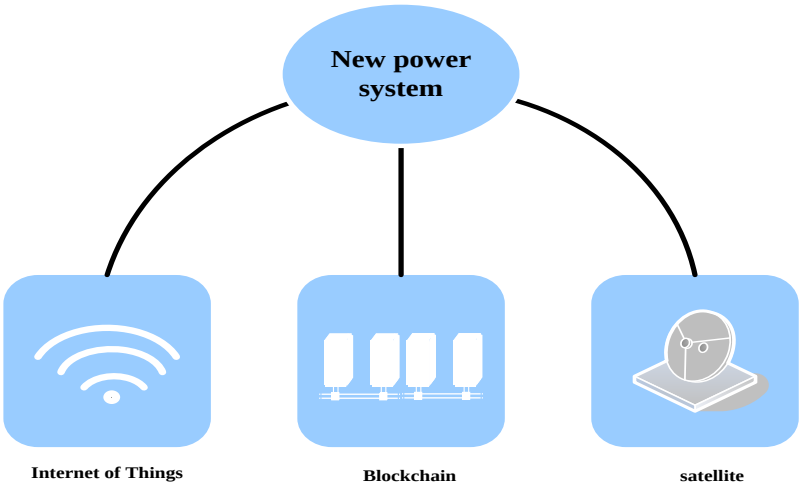

Figure 3: Application of digital technology in new power systems

1) Internet of Things: The Internet of Things technology enables automatic control technology, which allows information transmission, analysis, and computation without human interaction, and enables communication between devices. The Internet of Things technology can be applied to monitoring and transmission systems in new power systems to improve system automation and control technology.

2) Blockchain: Blockchain technology can provide a decentralized distributed database system for new power systems, which can facilitate transactions between users and enterprises through consensus mechanisms without providing third-party guarantees. This can not only reduce the production and transaction costs of the new power system industry, but also improve transaction efficiency.

3) Satellite application: The role of satellite systems in power systems can achieve communication between substations and dispatching centers, as well as between mobile devices, and can also locate power systems. High resolution satellite images are used for circuit monitoring, providing technical support for new power systems, achieving high flexibility and intelligence.

Digital new power systems are the new direction of future development. Power and energy systems are undergoing transformation to provide clean distributed energy for sustainable global economic growth. Digital technology provides capabilities such as real-time monitoring, situational awareness, and intelligence, control, and network security, transforming existing power and energy systems into intelligent network supported power and energy systems, making them more efficient, safe, reliable, resilient, and sustainable [8]. The energy-saving benefits of the new power system are tested and analyzed below.

3. Simulation Experiment on Benefits of New Power System

New power systems use wind, solar, and bioenergy to generate electricity. Both solar and wind energy are renewable energy sources. These power generation methods can generate certain energy saving benefits. The formula for energy saving is as follows:

$$E = P \times \bar{C} \tag{1}$$

In Formula (1), E represents the energy savings of wind or solar power generation in a year. P represents the online power consumption in this year. $\bar{C}$ represents the average coal consumption for power supply of the total coal power in this year. The use of wind and solar power to generate electricity does not emit pollutants and greenhouse gases [9]. Therefore, the emission reduction

amount of this type of energy can be calculated. Emission reduction refers to the quality of all pollutants and greenhouse gases generated when converting reduced power generation to coal power generation. Therefore, the emission reductions from wind and solar power generation can be calculated using the following formula:

$$Er = P \times \rho_c \quad (2)$$

In Formula (2), Er represents the annual emission reduction, and ρ_c represents the emission intensity of coal electric pollutants. The emission intensity can be obtained from public ITU (International Telecommunications Union) data of a country or region. For example, the following is the emission intensity of various pollutants in a country from 2018 to 2020, as shown in Table 1.

Table 1: Emission intensity of pollutants from 2018 to 2020

Pollutant	Sulfur dioxide	Carbon dioxide	Nitrogen oxide
2018(Emission intensity)	0.3	841	0.19
2019(Emission intensity)	0.3	912	0.21
2020(Emission intensity)	0.4	901	0.17

The application of new power systems can bring good energy conservation and emission reduction benefits. After using new power systems and developing new energy industries in a country, pollutant emissions have been significantly improved. The emission reduction of a country this year is calculated, as shown in Figure 4.

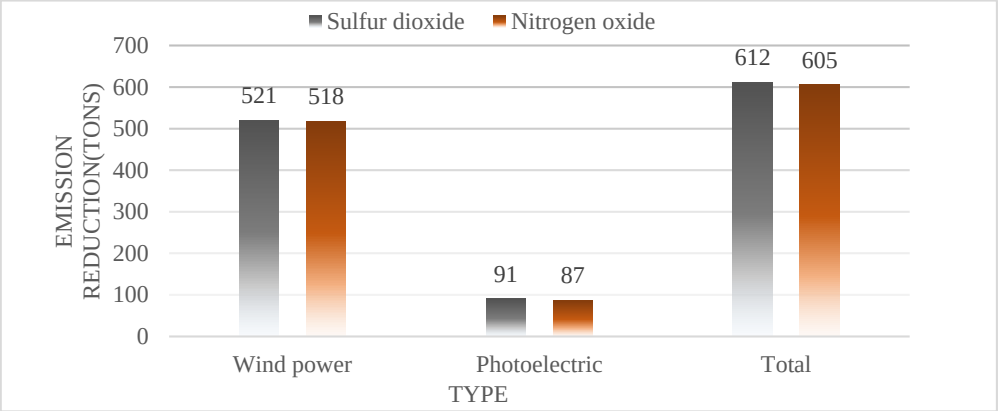

Figure 4a: Annual emission reductions of sulfur dioxide and nitrogen oxides

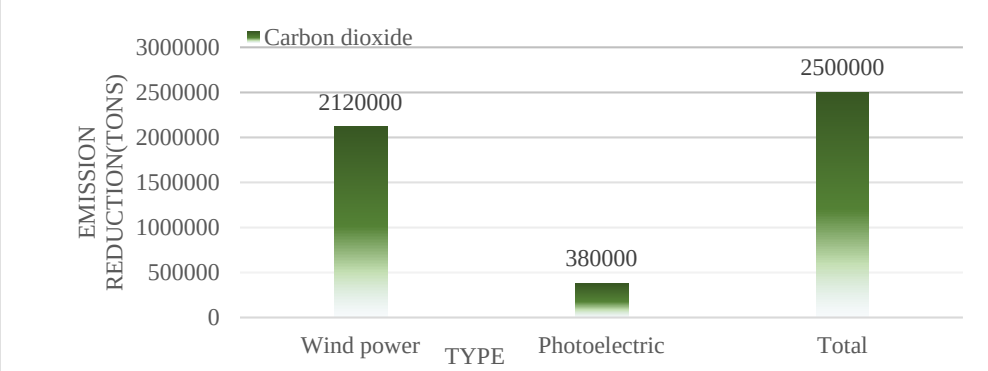

Figure 4b: Annual CO2 emission reduction

Figure 4: Annual emission reductions of various pollutants

Figure 4 shows the annual emission reductions of pollutants in the country after the implementation of the new energy power system, including the emission reductions under wind power and photovoltaic power, and the total. From Figure 4a, the data shows that the emission reduction amount of sulfur dioxide in the wind power system is 521 tons, and the emission reduction amount in the photoelectric system is 91 tons. The emission reduction amount in the nitrogen oxide wind power system is 518 tons, and the emission reduction amount in the photoelectric system is 87 tons. The total emission reductions for the two pollutants are 612 tons and 605 tons. Figure 4b shows the emission reductions of carbon dioxide. From the data, it can be seen that the emission reductions of carbon dioxide are far greater than those of the first two pollutants, and the annual emission reductions of carbon dioxide are thousands of times greater than those of sulfur dioxide and nitrogen oxides. It can be seen that the new electric power system has a significant effect on carbon dioxide emission control. The data shows that the carbon dioxide emission reduction amount under the wind power system is 2.12 million tons, and the emission reduction amount under the photoelectric system is 380000 tons, a total of 2.5 million tons. It can be concluded that the new energy power system has played a significant role in reducing pollutants, especially carbon dioxide emissions. The following is a summary of the energy savings of the country under the new energy power system throughout the year [10-11].

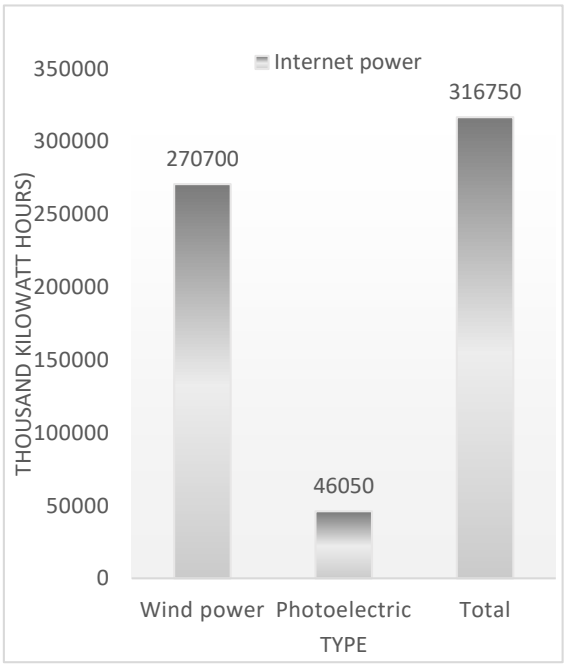

Figure 5a: Annual on-grid power consumption of the new power system

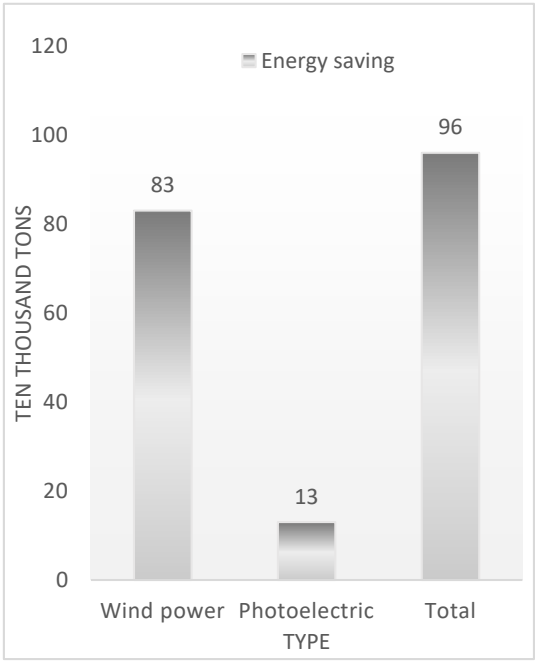

Figure 5b: Calculation of annual energy savings for new power systems

Figure 5: Calculation of annual energy savings of the new electric power system

Figure 5 shows the calculation of energy savings generated by the implementation of the new energy power system in a certain year in the country. Figure 5a shows the online electricity consumption for a year, and Figure 5b shows the energy savings calculated based on Figure 5a. According to the data, the annual online power consumption of wind power based power systems is 2707 million kilowatts, while that of light power based power systems is 460.5 million kilowatts, totaling 316750. It can be seen that the current new electric power system mainly relies on wind power generation. From Figure 5b, in a wind power system, the energy saving amount is 830000 tons, while in a light power system, the energy saving amount is 130000 tons, with a total energy saving of 96. Therefore, it can be concluded that power systems based on wind and light energy can generate significant energy-saving benefits [12-13].

4. Conclusions

The new energy industry has occupied a leading force in the future economic industrial structure. Therefore, new power systems are the new direction of development in the future power industry. The development of new electric power systems and the response to low-carbon economic goals provide impetus for sustainable economic and environmental development. This paper studied the energy-saving benefits of new energy based on new power systems. The article first introduced the economic and social benefits brought by the use of new energy, and then introduced the concept of new power systems, indicating that new power systems were the new direction of future development [14-15]. Moreover, the characteristics of new power systems based on new energy were introduced, and it was proposed to develop new power systems combining digital technology to construct more intelligent new power systems. Finally, the usage of the new power system was analyzed from two aspects: emission reduction and energy saving. The data showed that the implementation of the new power system industry in the country has generated good energy saving benefits, reduced carbon emissions, and greatly saved energy consumption.

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