Analysis on the Global Energy Interconnection to Change the World

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Abstract. Clean energy can be transported and utilized on a large scale through the global energy interconnection. The development of the global energy status and the imbalance of resource allocation are analyzed, and the necessity of building the global energy interconnection is illustrated. Combined with the development of UHV technology and strong smart grid, the feasibility of building a global energy interconnection is discussed. By building the three stage of the global energy interconnection, we gradually implement the "two alternatives" to fundamentally solve the constraints of global energy resources shortage and environmental pollution, so as to achieve the sustainable development of global energy. Finally, it explains the wonderful life that the global energy interconnection brings to people.

Introduction

The exploitation and utilization of energy is promoting the rapid development of social economy. With the invention of steam engine, the coal has been mining and using widely, which has promoted the development of the first industrial revolution of the society. Then fossil fuels, such as oil and natural gas, have also been developed and utilized. But it also brings problems such as resource tension, environmental pollution, climate change and so on, which seriously threaten the survival and development of human [1-3]. In recent years, experts and scholars all over the world have studied the clean energy such as wind energy, hydropower and solar energy to replace fossil energy. However, clean energy has its limitations, and it has intermittent and fluctuating uncontrollable factors with geographical differences and weather changes. And at present, these clean energy sources are only transported and used in small areas, and it is only a cup of water for a large amount of energy demand now. However, the development of UHV technology and the establishment of strong smart grid can commendably solve the issues of large capacity, long distance transmission, intermittence and volatility of clean energy. Based on the exploration and practice of global energy shortage, Chairman Jinping delivered an important speech entitled "Jointly Seeking Sustainable Development as a Win-win Cooperation Partner" at the UN Development Summit. He proposed to explore and build a global energy interconnection, to promote the clean and green way to meet global electricity demand [4-6].

The Necessity of Building a Global Energy Interconnection

Global Energy Development Status

A long period of time in the global energy development process is the direct use of natural energy such as wind power, hydraulic power and firewood. Among them, the firewood is the dominant position in the energy consumption structure. In the mid nineteenth century, the emergence of steam engines led to the development of the industrial revolution, and coal was extensively mined and utilized. By the end of nineteenth century, coal replaces firewood, which plays a dominant role in the energy utilization. Since then, the world energy has entered the era of coal. In the 1960s, electricity has been developed rapidly, and oil has become the main energy source of energy consumption in the world, and the world's energy has entered the petroleum era. In 70s, there was an oil crisis, which led to a decrease in oil consumption and a gradual increase in the proportion of
natural gas. However, the proportion of oil in the world's energy consumption structure remains large. In the 21st century, clean energy such as hydropower, wind power and solar energy has been gradually developed and utilized. The changes in the structure of the world energy consumption are shown in Fig. 1.

![Figure 1. Changes in the structure of the world energy consumption.](image)

The Disequilibrium of Global Energy Allocation

The distribution of global fossil energy and clean energy is extremely uneven. The distribution of coal resources in Europe and Eurasia, Asia, North America and other regions has reached 95%. The distribution of oil resources in the Middle East, North America and central and South America accounts for about 80% of the world's oil. Meanwhile over 70% of the natural gas resources are distributed in Europe and Eurasia and the Middle East. Although these fossil fuels are unevenly distributed, they can be transported to anywhere in the world by means of transportation. Clean energy is very abundant, but they are distributed in some special fixed areas. Most of the hydropower resources are distributed in Asia, South America and North America. Wind energy resources are mainly distributed in the Arctic and its vicinity, near the ocean. Most of the solar energy is distributed around the equator, and there are also some solar energy resources in some deserts, Gobi and other climate regions [7].

With the continuous growth of the global population and the rapid development of the economy, the global energy consumption has increased dramatically. At present, the world's energy supply is dominated by fossil energy. However, the fossil energy storage is limited, and the gas generated by burning fossil energy has destroyed the ecological environment, such as water pollution, air pollution, and greenhouse effect. Clean energy such as hydropower, wind energy and solar energy is rich. And accelerating their development and utilization can effectively solve such problems as energy shortage, environmental pollution and unbalanced distribution of energy resources. Only by accelerating the construction of the global energy interconnection can clean energy be developed on a large scale and long distance transmission.

The Development of UHV Technology and Strong Smart Grid Have Created Conditions for the Global Energy Interconnection

UHV Technology

The Arctic and equator are abundant in wind and solar resources due to their special geographical location. Therefore, we can develop and construct an extremely large scale wind and solar power generation bases at “one polar and one equatorial” (Arctic and equatorial). These energy bases are far from the load center, and it is necessary to transport energy on a large scale and long distance. UHV technology has the characteristics of long distance, large capacity, low loss energy transportation and small footprint [8-11]. Our country’s regulations stipulate that the AC voltages of 1000kV and above and DC voltages of ±800kV and above are UHV. With the same transmission distance, when the voltage level is doubled, the line power loss theoretically will be a quarter of the original. Meanwhile, the power capacity of UHV transmission is large. In the case of the same line
power loss and the transmission conductor material and conductor cross-sectional area remaining unchanged, when the voltage level is doubled, the theoretical transmission distance will be four times. When the voltage level is increased, the conductor cross section is usually increased, which makes the distance of the power transmission much farther. Therefore, the development of UHV technology can be an efficient solution to the problem of the global energy long distance transmission.

**Strong Smart Grid**

The strong smart grid has bi-directional flow of power flows and digital information flows, with a strong flexibility and adaptability [12-13]. It optimizes system operation and resource utilization in real time by means of two-way communication, advanced sensors, power electronic devices, automation equipment and distributed computing, and enables all kinds of centralized and distributed clean energy to access to the grid stably and reliably. Clean energy such as hydropower, wind energy and solar energy, etc., which is affected by the weather factors, is generally uncontrollable, such as intermittent and volatility [14]. When integrated into the grid, these irregular and uncontrollable fluctuations will directly affect the safe and stable operation of the power grid. The development of smart grid is to connect both the traditional power supply base and the clean energy power supply base to the grid, and it adopts the way of hierarchical zoning and decentralized and uses UHV technology to build global energy interconnection, which can achieve complementary clean energy and traditional energy sources, and ensure stable and reliable operation of the power grid. Through the rational dispatching and control method of strong smart grid, the power grid can operate safely and steadily, and various energy resources can be effectively configured according to the demand of the power load, which improve the utilization rate of energy [15].

The global energy interconnection is a strong smart grid based on the UHV power grid as the backbone network and the global interconnection. And it is the basic platform for large-scale development, deployment and utilization of clean energy on the global scale. The essence is "UHV power grid + smart grid + clean energy". The UHV power grid is the key, the smart grid is the foundation, and clean energy is the focus. Therefore, the combination of UHV technology and smart grid can not only meet the large-capacity and long-distance transmission of power, but also enable the simultaneous access of clean energy and traditional energy to the grid to achieve safe and stable operation of power grid, which create favorable conditions for building the global energy interconnection and promoting the optimization configuration of global energy.

**Global Energy Interconnection Promotes Sustainable Development of the World**

At present, the global energy development is facing major challenges such as resources shortage, environmental pollution, and climate change, et al. The best way to solve the above problems is to accelerate the construction of the global energy interconnection, and to implement the "two alternatives", that is, clean substitution and electric energy substitution. In the development and utilization of energy, clean energy, such as water energy, wind energy and solar energy, is implemented to replace fossil energy. In this way, it can fundamentally solve the constraints of global energy resources shortage and environmental pollution, and promote the transformation of energy structure from fossil energy as the principal to clean energy, so as to promote the sustainable development of world energy. In the energy consumption we imply electric energy substitution, and use electric energy to replace the direct consumption of fossil energy such as coal and oil, to increase the proportion of electric energy in terminal consumption.

The overall construction of the global energy interconnection can be divided into three stages. The first stage is the domestic interconnection. From now until 2020, we will accelerate the development of clean energy and the domestic power grid interconnection, and significantly increase the power grid configuration capacity, intelligent level and the proportion of clean energy in each country. The second stage is the Intra continental interconnection. From 2020 to 2030, the development of large-scale energy bases in the continent and cross-border interconnection of power
grids will be promoted to achieve optimal deployment of large-scale, large-range, and high-efficiency clean energy in the continent. The third stage is intercontinental interconnection. From 2030 to 2050, we will speed up the energy base development in “one polar and one equatorial” (the wind energy base in Arctic, and the solar energy base in equatorial) together, and basically build the global energy interconnection, to achieve the goal that the clean energy is dominant in global, comprehensively solve the problem of world energy security, environmental pollution and greenhouse gas emissions.

After the global energy interconnection is basically established, the proportion of global clean energy will reach over 80% in energy consumption. It will fundamentally solve the problems of energy and poverty in the related countries and regions in Asia, Africa, and Latin America [16]. Furthermore, the significant using of clean energy will reduce the global carbon dioxide emissions and effectively controlled the global temperature rise. The completion of the global energy interconnection can reduce the dependence on fossil energy, accelerate the rapid development and utilization of clean energy, and promote the sustainable development of world energy.

Global Energy Interconnection Opens a Good New Life

The construction of the global energy interconnection allows everyone to enjoy the convenience and pleasure of a good new life. In the field of production technology, the scientific information technology will be perfectly integrated with clean energy to realize the utilization of energy resources with artificial intelligence. The manufacturing industries, such as vehicles, machinery and factories, will fully realize intelligent automation control. In daily life, all traffic such as cars, trains, high speed rail, and aircraft will be unprecedentedly convenient and unimpeded. Air conditioners, refrigerators, washing machines, TV, microwave oven and other household appliances can be integrated through the terminal electronic products such as smart phones to achieve intelligent control. People can remotely control the air conditioner and rice cooker in advance by intelligent terminal before going home so that the indoor temperature is appropriate and the rice is cooked when people comes home. With the rapid development of home economics, people can book their own doctors, and communicate with doctors and inquire about their condition in video at any time. The doctor also can go to the patients’ home to serve them according to the patient's requirements. Distance education is more intelligent, and students can choose the appropriate teaching methods according to their own preferences. Teachers can teach students according to their learning situation and the progress of knowledge. The development of e-commerce will realize the three-dimensional mode. People can use three-dimensional model to view their favorite merchandises, and use the camera to intelligently select fashion clothes, shoes and accessories after exhaustive scanning, so as to comprehensively improve the level of life intelligence. The global energy interconnection makes the social life system more intelligent. Everyone will enjoy a sustainable energy supply and live together in a beautiful and harmonious global village.

Summary

Global clean energy, such as wind energy, hydropower and solar energy, is virtually inexhaustible. The construction of the global energy interconnection can give full play to its characteristics of large-capacity, long-distance and intelligent energy allocation, and realize the production, transportation and distribution of clean energy, so as to improve the utilization of clean energy. Pushed by the global energy interconnection, new energy, new materials, new technologies, new equipment and other technology industries will be prosperous and vibrant, and green low-carbon energy will become a new fashion. The full completion of the global energy interconnection will open the new statutes for the world’s sustainable development.

References


