The Status Quo of Renewable Energy Development and Utilization and the Prospects of Industrial Development

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Abstract: Nowadays, the development and utilization of the renewable energy is more and more favored by countries all over the world for the purpose of solving the contradiction between the energy demand and the environmental protection. The application of renewable energy (including hydraulic energy, ocean energy, wind energy, solar energy, biomass energy and hydrogen energy) in our country develops rapidly and promotes the development of related industries at present. The optimization of energy structure will be realized, and the application prospect of the renewable energy industry will be broadened under the guidance of carbon peak and requirements of carbon neutral in the future.

1. Introduction

The contradictions between the energy, economy and environment have become increasingly important now. On one hand, the traditional energy sources face problems of resource depletion, and it bring out energy crises due to the rising prices. On the other hand, it causes many environmental problems due to the greenhouse gas emissions. The traditional fossil energy sources are gradually unable to meet the current energy needs for the economic development and the requirements of the public environmental protection. In this case, the renewable energy shows an important practical significance to promote the energy conservation, emission reduction, and protecting the ecological environment. It has become the focus on responding to the fossil energy crisis and energy structure adjustment for many countries on the world.

In a general way, the renewable energy is also called green clean energy, such as the hydraulic energy, ocean energy, solar energy, wind energy, biomass energy, and hydrogen energy. Comparing with the traditional energy, most kinds of the renewable energy did not contaminate the environment due to their features of huge resource reserves or short-term regeneration, a low cost relatively and stable supply. Due to its advantages of low carbon and features of environmental protection, the renewable energy can be used in some flexible and diverse forms after being converted into electric energy. It will meet the requirements of humans fundamentally by the renewable energy and industries.

2. Development and Utilization Situation of the Renewable Energy

Parts of the renewable energy sources have been industrialized and obtained great economic, social and environmental benefits after a long-term research and utilization by human beings. According to the statistics up to the end of 2019[1], the generation of renewable energy power was 794 million kilowatts, reaching up to 39.5% of the total installed power capacity, and the renewable energy power...
generation in China was 2.04 trillion kilowatt-hours, accounting for 27.9% of the total power generation. Table 1 lists the total installed capacity and power generation of the hydropower, wind power, and solar power (photovoltaic power generation).

| Power conditions | hydroelectric power | Wind power | photovoltaic power | Other renewable energy | Total of renewable energy |
|------------------|---------------------|------------|--------------------|------------------------|---------------------------|
| Installed power capacity | | | | | |
| (Unit: billion kilowatts) | 3.56 | 2.1 | 2.04 | 0.24 | 7.94 |
| Percentage of the total | 17.7% | 10.4% | 10.1% | 1.2% | 39.50% |
| Generated energy | | | | | |
| (Unit: billion kilowatt hours) | 13000 | 6300 | 1111 | - | 20411 |
| Percentage of the total | 17.8% | 8.6% | 1.5% | - | 27.9% |

2.1. Utilization of the water energy
It is abundant for the hydropower reserves in our country, which rank first in the world and account for about 20% of the world's hydropower resources. These is an advantage that the hydropower utilization cost in our country is relatively low due to a relatively mature technology. The hydropower industry in the Southwest China has export the hydropower to the outside. Relevant data show that the total power generation capacity of hydropower resources in our country can reach 619 million kilowatts, with an average annual power generation capacity of 176 million kilowatts, with total reserves accounting for one-fifth of that of world. There is a shortage that the distribution of hydropower resources is extremely uneven. For example, the hydropower resources in the southwest and northwest regions can account for 4/5 of the whole country, but the quantities are relatively low in the economically developed areas of the eastern coastal. The hydropower reserves will be rationally developed using the existing small hydropower with simple and flexible features in our country.

2.2. Utilization of the ocean energy
The ocean energy is a kind of renewable energy which exists in the ocean. The ocean energy resources are abundant in our country, which are composed by the wave energy, tidal energy, ocean current energy, temperature-difference energy, etc., and have a high utilization value. It has a long history for the ocean energy development and utilization, rich experience and a relatively solid foundation in our country. For example, the conditions and industries are basically mature to establish a number of tidal power stations along the coast areas. The wave power stations on the seashore are also at the forefront of the world. But there is a shortage that the utilization modes of the ocean energy in our country is still relatively single with limited scales overall, which affects the overall practicability.

2.3. Utilization of the solar energy
The solar energy is a superior renewable energy. The solar energy received from the earth for ten days is equal to the total energy reserve of all the fossil fuels in the world. The utilization modes of the solar energy are flexible and diverse, mainly including aspects of the solar power generation, solar water heaters and solar buildings. The China has become the world's largest consumers for the solar photovoltaic power generation and thermal energy at present, and the extension coverage of the solar heating buildings is also expanding.

It has obtained good social and economic benefits from the solar energy. The total solar power generation reached to 116.67 billion kilowatt-hours in 2017, which accounts for 7.2% of all the renewable energy power generation, with an annual growth rate of 78.47%. The installed capacity of solar power generation was 250 million kilowatts up to the end of 2020. The installed solar power generation capacity in the Inner Mongolia exceeded 11 million kilowatt-hours, which ranked forefront in our country.
2.4. Utilization of the wind energy

The wind energy resources have advantages of abundant reserves, wide geographical distribution, clean and pollution-free. According to estimated data from the National Meteorological Administration, the density of wind energy in our country is 100 W/m, and the total reserves of wind energy resources are about 160 GW. There are about 300 million kilowatts of available wind energy in the mainland of our country, and about 700 million kilowatts in the coastal areas according to the estimated data. It has realized the transmission of surplus wind power resources to the North, South, and Central China areas which consume large amounts of electricity, which benefits from the west-to-east power transmission, ultra-high-voltage power transmission and other technical projects in the "Three North Areas" of our country. There is a continuously expanding scale of the wind power application from the initial household electricity consumption to the current situation of various infrastructure applications at present, such as railways, roads and communications. The wind power generation has become one of the major three power generation energy sources alongside the thermal power and hydropower, and the utilization and development of the wind power is gradually becoming mature.

The new grid-connected wind power capacity exceeded 10 million kilowatts in our country just from January to August in 2020. The installed wind power capacity in our country was 280 million kilowatts up to the end of 2020, ranking first in the world. The installed wind power capacity just in the Inner Mongolia has exceeded 37 million kilowatts, ranking first in our country.

2.5. Utilization of the biomass energy

The biomass energy is mainly derived from tree branches, crop stalks, livestock manure, etc. with features of uniform distribution, large resource capacity, renewable, clean and environmentally friendly. It is an important approach to alleviate the greenhouse effects, maintain ecological balance, and solve the contradiction between environmental pollution. It draws attention by more and more people due to their ability to replace the fossil fuels. Biomass energy, according to its utilization forms, mainly includes energy plants, fuel ethanol, biodiesel, biomass power generation and heating, etc. The biomass energy biogas is developing towards the commercialization and industrialization.

The energy plants can be divided into 3 categories according to their specific chemical components [2]. The first is the hydrocarbons and olefin plants that contain more similar substances which can be extracted from the petrochemical products [3]. There are advantages of low cost of production and high rate of utilization, but the disadvantage is that the hydrocarbon energy plants in our country are relatively scarce, so they are not suitable for a large-scale promotion. The second is oil-rich plants, whose fruits, seeds, and milk in flora conduit can be used as the raw materials to produce biodiesel. The third is the energy plants, which contain high-sugar, high-starch and other carbohydrates. The ethanol fuel can be finally obtained with a wide variety of types and distribution.

2.6. Utilization of the hydrogen energy

As a clean, safe, efficient and renewable energy carrier, the hydrogen has advantages of high utilization rate, high combustion calorific value, high energy density, wide existence, storage and transmission, etc. It is one of the most economical and effective alternative energy sources for humans to get rid of the "three major energy sources" [4]. The development and utilization of hydrogen energy has become an important part of the energy system in the developed countries. The hydrogen energy planning has been elevated as a height of their national energy strategy in the United States, Japan, Germany and other developed countries. The utilization of the hydrogen energy will focus on two aspects: hydrogen vehicles in the transportation field and hydrogen energy-friendly houses in the construction field. A large-scale utilization of the hydrogen energy will benefit our country to enter a hydrogen energy society of self-sufficient energy in a long run.

The industrialized hydrogen production technology and industry is matured now. Producing hydrogen using the renewable energy (biomass, microbial biomass and solar energy) can reduce the energy waste, and it is the most potential and promising process in the future hydrogen production.
industry \cite{5}. However, a shortage is that there is a low conversion rate and the industry has not yet been put into practice.

3. The renewable energy and industrial layout
The comprehensive development and utilization of the renewable energy resources can ensure the security of national energy resources and energy supplies, which plays a more important role in the energy structure. The renewable energy industry is an economic aggregation of the production and service activities related to the technical research and the utilization of the renewable energy technologies. It is a key factor for the economic transformation, upgrading and sustainable development in a local area or even a whole country to promote the renewable energy industry and increase investment steadily.

Nowadays, there is a general trend for the economic development of the world to develop a low-carbon economy and strengthen the environmental protection. The "14th Five-Year Plan" is an important and critical period for China's energy of low-carbon transition and green development. On the December of 2020, the China proposed that it will achieve a carbon peak by the year of 2030, that is, China’s carbon dioxide emissions of the GDP per unit will drop by more than 65% comparing to the year of 2005. The proportion of non-fossil energy (mainly renewable energy) in the primary energy consumption will reach to about 25%, and the forest stock volume will increase by 6 billion cubic meters comparing with the year of 2005, and the total installed capacity of wind power and solar power will reach more than 1.2 billion kilowatts. However, the fossil energy still dominated the current energy consumption structure in our country. Compared with the Europe and the United States, the total carbon emissions in our country are still relatively high.

The renewable energy industry not only has no ecological and environmental problems, but also can keep the sustainable economic development. Therefore, it needs to reduce the carbon emissions significantly in the future and achieve the social development goals of carbon peaking and carbon neutrality for our country. It is an urgent thing to plan the layout of the renewable energy industry and develop the renewable energy industry rapidly.

4. Thoughts on the development prospects of the renewable energy industry
It is developing towards large-scale and basic development with a very broad prospect for the renewable energy industry. Take the wind power industry as an example, the China has adopted a series of policies to encourage the development of wind power industry clusters, and it has achieved relatively satisfactory results in recent years. It is an important work to support these areas with abundant wind energy resources to accelerate their wind power development, regulate the production standards of wind power equipment, and promulgate wind power grid connection privileges, which greatly promotes the utilization of wind power. The development and utilization of wind power indirectly promotes the wind-driven generator, wind power plant, and wind pumps, wind power generation groups and other related industries.

The renewable energy power generation often characterized by randomness, volatility and intermittent. The large-scale grid connection brings a new challenge for grid planning. In the future, the construction of a new power system will speed up which adapts to the development of a high proportion of renewable energy. It offers assistance in guiding the grid planning work using the scientific, efficient, and reliable grid planning decisions and the cloud computing. These measures will realize the power supply of renewable energy grid-connected operation with a high proportion.

The relevant departments of our country stated that we will vigorously adjust the energy structure and actively promote the replacement of the low-carbon energy from high-carbon energy and the renewable energy from the fossil energy on January 19, 2021. In the future, the development of renewable energy will be accelerated, the proportion of renewable energy installed capacity will be further increased, and the proportion of energy production and supply will be increased.

Firstly, we will further improve the overall technical levels of the wind power. In this stage, we are focusing on the development and utilization of the wind energy on the land to build a large-scale wind
power base in the Northwest China. In the future, we will take the unique geographical advantages on the coast to appropriately develop the offshore wind energy in the eastern coastal areas. Secondly, we will accelerate the progress of hydropower development in the important areas and steadily increase the level of hydropower transmission in the southwest. Thirdly, we will promote the development of photovoltaic power generation based on the solar energy, and promote the construction of leading bases for the distributed photovoltaic, centralized photovoltaic power generation and the "photovoltaic +" in an orderly manner. Fourthly, we will speed up the research on the layout of the hydrogen energy industry, the planning works, guidance and the top-level design. We will introduce the hydrogen energy projects in areas with relatively mature conditions and good supporting industries to enhance the competitiveness of hydrogen energy in the energy, transportation and construction domain. the problems of human's energy demand may be fundamentally solved by development of the hydrogen energy industry.

5. Conclusion
The development for renewable energy-related industries has been put on the agenda of the energy structure adjustment and industrial planning duo to the resource crisis of conventional energy sources such as coal and petroleum. Facing the strong energy demand in the future, the utilization and development approaches of the renewable energy will be more and more broad, and the utilization degree will increase continually with the increasingly mature renewable energy development and utilization technology.

In the future economic development progress of the world, improving the renewable energy power generation technology and establishing a long-term management mechanism of grid-connected renewable power will be very useful to cease the proportion of the renewable energy in energy supply, and reduce the carbon emissions. It can further promote the energy industry developing to a green and sustainable direction for the environmental protection, and it will undergo some profound changes for the energy structure in the world.

Fund projects: The special project of geological mineral resources and environment investigation "geological survey standardization and standard formulation and revision (2019-2021)" was funded (No.: DD20190470)

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