

Analysis of Low Carbon Transformation Countermeasures of Thermal Power Enterprises under the Background of "Double Carbon" and High Proportion of New Energy System Access

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Abstract: *The "double carbon" target has brought profound changes to China's energy and electric power industry, and the green low-carbon transformation and digital transformation of thermal power enterprises will soon face severe challenges. Based on the interpretation, on the basis of "double carbon" goal, through combing the future energy structure change and thermal power enterprise development positioning problem, countermeasures for thermal power enterprises green transformation, and puts forward key for low carbon energy, active development of new energy, energy conservation and energy storage layout for the technical main point, to improve power system adjustment ability, negative emissions technology as supplement, Promote the high quality development of coal power three points of view, for thermal power enterprises to provide feasible ideas for low-carbon transformation.*

Keywords: Dual carbon targets, Thermal power generation enterprises, Green and low-carbon transition

1. Introduction

In September 2020, the Chinese government made a commitment to the world, putting forward the goal of reaching a carbon peak by 2030 and achieving carbon neutrality by 2060, namely the "double carbon target". In recent years, extreme climate has occurred frequently around the world. Extreme high temperature weather leads to grain loss, which threatens human food security; temperature rise leads to glacier melting and sea level rise, which affects human survival and development; excessive emission of greenhouse gases is one of the reasons for extreme climate. The Chinese government has actively responded to climate change. The "double carbon" target demonstrates the determination of the Chinese people to adhere to green and low-carbon development, which will also have a profound impact on the future economic operation, industrial structure layout, energy structure adjustment and the development of new energy industry. In China, the burning of fossil energy accounts for 80% of the total carbon emissions of the whole society, among which the power industry is the cornerstone of China's economic development and an important carbon emission sector. Electric power industry is a central part of the low carbon energy transformation, is also a "double carbon" goal realization of the key, so need to accelerate the green low carbon energy power generation,

building new energy for the main power of the structure of the power system, the formation of green low carbon, safe and efficient energy system, must take the lead to achieve carbon neutrality.

In recent years, with the substantial growth of the installed capacity of renewable energy, large state-owned enterprises and central enterprises actively arrange new energy power generation, including some thermal power enterprises. It can be seen that the installed capacity of new energy power generation involved by thermal power enterprises will show a significant growth in the future, and the role of traditional thermal power enterprises will also usher in new changes. Renewable energy generation is subject to large environmental factors, such as the volatility and randomness of wind speed and the uncertainty of solar illumination. Under the existing technology level, it will bring certain impacts to the power grid. In serious cases, it will bring impact to the power system and affect the electricity demand of residents and industrial users. At the end of 2021, wind turbines in northeast China could not output to the power grid in time due to the sudden drop in wind speed, leading to a temporary serious power supply gap. In order to prevent the collapse of the power grid system, the Northeast dispatching center timely implemented the "power cut", which brought serious impact to residents and enterprises.

In the summer of 2022 in sichuan province, with the highest temperature, precipitation, at least the highest electric load, lead to hydroelectric power output, and sichuan hydropower proportion reached 80%, sichuan electric power company start the energy supply security level of response, face a variety of realistic difficulties, has seriously affected the people's livelihood and production.

Therefore, in order to complete the construction of the new power system under the "double carbon" goal, thermal power enterprises will face severe challenges on the way to realize the green and low carbon transformation. In this paper, by analyzing the future energy structure change and thermal power enterprise development positioning problem, puts forward key for low carbon energy, active development of new energy, energy conservation and energy storage layout for the technical lead, improve power system adjustment ability, negative emissions technology as supplement, propel the development of the coal quality of three point of view, analysis of the thermal power enterprises to develop green transformation countermeasure.

2. "Double carbon" target and energy structure reform

2.1 "Dual Carbon" targets and their implications

In academic circles, there is no standard definition of "carbon peaking and carbon neutrality". It is generally believed that if the annual carbon dioxide emissions of a region or organization reach the peak in a certain period of time, they will maintain fluctuations within a certain range and then enter the evolution process of steady decline, which is called carbon peaking. Carbon neutral means to achieve a dynamic balance between carbon emissions and carbon sequestration of carbon emissions is the main industrial form of fossil fuels (coal, natural gas, oil, etc.) combustion, carbon absorption is mainly refers to the natural environment digestion or by technical means of curing and store carbon dioxide environment free, is generally believed that the forest carbon sinks form is better than that of carbon capture (CCS). The power industry is the main source of carbon emissions, which is estimated to account for more than one third of the total carbon emissions. Low-carbon electricity is also the most basic condition for achieving carbon neutrality. Therefore, to realize the core of the "double carbon" goal is to build in the form of renewable energy power generation supplemented, thermal power and nuclear power, energy storage and negative carbon core technology for a new type of power system, strengthen energy saving, low carbon, clean production technology popularization, relevant government departments with certain policy measures and the market mechanism, social citizens form the consciousness of energy conservation, green, environmental protection, Finally realize the optimization of energy structure and technical progress. Under the ambitious goal of "2060 carbon neutrality", the low-carbon development path is gradually clear and clear, and the green and low-carbon transformation of thermal power enterprises is clear.

2.2 Reform of energy supply structure

In the past decade, China's renewable energy development has made rapid progress. By the middle of 2022, the installed capacity of wind power, photovoltaic power, biomass power and other new energy has exceeded 700 million kW, accounting for 28% of the country's installed power generation capacity. In addition, China has the world's largest hydropower stations, including the Three Gorges Hydropower Station, Baihetan Hydropower Station, Wudong Hydropower Station, etc. Currently, the installed capacity of conventional hydropower generation is 360 million kW, including 40 million kW of pumped storage hydropower station. Renewable energy accounted for 43% of the total installed capacity. In the first half of 2022, China's new energy generation reached 1.06 trillion KWH, accounting for 31.5 percent of the country's total electricity consumption. In the future, new energy generation will also usher in rapid development, and traditional thermal power enterprises mainly in the form of coal power will certainly face greater challenges. On the other hand, with the prominent emergence of new energy grid-connected problems, the power grid system also needs to adjust the previous operation mode, which will bring greater challenges to the reform of energy structure.

China is still the largest developing country in the world, and there is still a lot of room for growth in electricity demand in the future. In 2020, China's electricity consumption was 7.5 trillion KWH, and it is estimated that it will reach 11 trillion KWH in 2030 and 15 trillion KWH in 2060. The power structure will also be cleaner, and the proportion of non-fossil energy installed will gradually increase, gradually evolving into the main form of energy generation. In 2020, the proportion of non-fossil energy installed will be 36%. It is estimated that the total installed power system will reach 4 billion kW in 2030, of which the proportion of non-fossil energy will be 51%. In 2060, the total installed capacity will reach 7.1 billion kW, and non-fossil energy will account for about 90 percent of the total.

3. Challenges in the transformation of thermal power enterprises

With the gradual implementation of the "double carbon" goal, traditional thermal power enterprises are bound to bear some operational pressure. Global coal prices and oil prices have increased a lot with geopolitical fluctuations, and some thermal power units will face the situation of losing money once started. At present, China is still a developing country, which needs to industrialize and recycle its economy. Coal power generation and fossil fuel emissions account for the majority of carbon dioxide emissions. The volatility of new energy generation is still one of the problems troubling the stability of the power grid system. For a period of time in the future, thermal power units are still the main force of energy supply. In the near future, thermal power unit will undertake a grid system is the main peak power balance and emergency safeguard function, the escort for the stable operation of power system, with the development of new energy industry and energy storage technology further mature, the regulation of power system capacity will gradually increase, the retirement of coal and

alternative will also continue to increase, Finally, only part of the thermal power units are reserved to ensure the safety of the power grid system. How to solve the thermal power development is the foundation of our country can achieve low carbon transformation, which involves the transformation of large capacity units, industry waste workers professional, enterprise assets, and other problems, scientific planning, crew coordination good thermal power with the pace of the development of new energy, keep some efficient unit with a high quality, energy saving, large capacity, and provide flexible adjustment ability to power grid, Ensure the safe and stable operation of the power system.

In recent years our country new thermal power unit are mainly composed of large capacity, is difficult to be eliminated, our country has the world's most active level of GW supercritical unit, so think in terms of cost, at present most of the thermal power unit did not reach retirement point in time, for that part of the unit's retirement and carbon reduction task situation is more complex, need to coordinate, arrange.

Along with the further enhancement of automation equipment, enterprise human resources management system is the motive force of sustainable development, decided to thermal power enterprise with thermal power and coal industry upstream and downstream industry chain has thousands of workers, the future as the further realization of the goal "double carbon", the future development of these employees will also be faced with some problems. In addition, the aging population is one of the challenges facing China, which will also have an important impact on the upgrading of industrial structure. The working environment of coal and thermal power plants is relatively poor and dangerous, and the labor cost of enterprises will further increase. Some energy enterprises frequently have a large employee gap.

4. Analysis of counter measures for transformation and development of thermal power enterprises

4.1 Take low-carbon energy as the key to actively layout and develop new energy

In 2022, China's installed capacity of renewable energy has reached 1.06 billion kW, ranking first in the world. In the future, new energy power generation will gradually become the main form of energy power generation, and it is estimated that it will account for more than 90% of the total installed capacity in 2060, among which wind power and solar power will account for about 75% of the country's total power generation. At present, China's new energy development projects mainly concentrate. Offshore wind power and distributed photovoltaic power station will become a new investment direction in the future, which needs to be based on safety, demand-oriented, and rational planning and utilization in stages. China's wind resources are rich and light, wind power and photovoltaic power can be developed to 3.5 billion kW, 5 billion kW, the new energy development industry chain is relatively complete, among which there are also some overall business development advantages have entered the front ranks of the

world, which can provide solid protection for large-scale development and sustainable development.

Wind power, with the rapid development of new energy industry in recent years, land centralized project has gradually become saturated, offshore wind power will become the main focus recently, economically developed coastal region, social power consumption demand is huge, can be achieved on the given, avoid the northwest large-scale abandon the abandoned light problems. It will steadily push forward decentralized wind power projects and "tall tower" wind power projects in Northwest, central east and North China. With the saturation of wind resources development in the east and northwest, offshore wind power will move to the far sea. It is estimated that the installed capacity of offshore wind power will reach 500 million kW in 2060. Photovoltaic power generation, light resources in China is relatively abundant, sunshine time long places are mainly distributed in the northwest region, the main construction of concentrating solar power base, in order to facilitate the construction of thermal power plant, distributed photovoltaic projects by using in situ, with the development of energy storage technology, users can also be part of the electric energy for storage, for household electric vehicle charging, It is expected to install 2.6 billion kW of photovoltaic power generation projects in 2060. In terms of hydropower, the construction of hydropower stations involves many issues such as ecology, people's livelihood and economy. It is necessary to develop and protect the ecological environment in an overall way, steadily promote the construction of hydropower bases in southwest China, strengthen the comprehensive development and utilization of ecology, power generation and economy in hydropower basins, and promote the construction of strategic hub projects.

Due to its volatility and difficulty in being fully utilized, new energy generation needs to be diversified and utilized by combining energy storage technology and thermal power unit regulation. It is difficult to achieve safe and stable supply goals by simply relying on the power system.

Therefore, cross-system development is an important way of comprehensive utilization.

Green electricity should be actively used to make hydrogen, gas, heat and other power diversification conversion and cross-energy system utilization, combined with CO₂ captured by thermal CCUS to produce methanol, methane and other industrial raw materials, and comprehensively expand the scale of carbon cycle economy.

4.2 Take energy conservation and energy storage as the technical guidance to improve the regulation capacity of the power system

Under the new power system dominated by new energy, thermal power units will mainly play the role of peak and frequency regulation and system regulation, and assist new energy to strive for carbon neutrality. It is necessary to strictly control the new planning of thermal power units and coordinate the development of coal and coal power according to the principle of "optimizing the existing units and eliminating backward production capacity". Our wind resources and light

resources superlative regions are in Northwest and North China, thermal power units need to cooperate with renewable energy generation, play to the advantage of ultra-high voltage transmission projects. The government has taken relevant measures to guide the carbon trading market, coordinate regional demand for winter heating and power generation, and effectively promote the efficient development of coal-fired cogeneration.

While solving the carbon emission problem of thermal power units, it is also necessary to consider the carbon emission caused by municipal waste incineration. By mixing and burning coal with municipal waste and other substances, the efficiency of biomass energy generation can be improved, and the high efficiency of large-capacity coal-fired units can be used to reduce carbon dioxide emissions. The volatility and instability of new energy power generation will have an impact on the power grid system. The construction of pumped storage power stations can be orderly promoted to enhance the regulation ability of the power grid system to the new energy generation and give full play to its role of "energy storage".

In March 2022, China's BYD announced that it would stop producing fuel cars to help green and low-carbon travel. As a pollutant, exhaust emissions from fuel vehicles are also one of the main sources of air pollution and increased carbon emissions. The vigorous development of electric vehicles can effectively solve this problem. Therefore, it is necessary to accelerate the technological research and development of battery energy storage materials to improve the safety of electric vehicles. In addition, electric energy storage technology can also effectively solve the problem of the consumption of renewable energy and the excess electric energy produced by distributed photovoltaic power stations. When it is not possible to transmit power to the power grid, part of the electric energy can be stored for peak and frequency regulation in the power grid system.

4.3 Promote high-quality development of coal-fired power with negative emission technology as a supplement

Only through forest carbon sink can not completely absorb the total social carbon emissions, so some additional technologies are needed to capture part of the free carbon in nature, collect it and convert it into other industrial products through certain means. Tianjin institute of industrial biotechnology, Chinese Academy of Sciences in 2022 yan-he ma team, for the first time in the lab from carbon dioxide to the synthesis of starch molecules, traditional starch synthesis are required to participate in, the photosynthesis of plants and their unnatural through the use of carbon sequestration technologies can not only realize absorb carbon, and can solve part of the food problem. The Beijing 2022 Winter Olympics implemented a new carbon-dioxide ice-making technology that can ensure the temperature and quality of the ice surface. This technology can mitigate the greenhouse effect without damaging the ozone layer, and the manufacturing process is energy efficient and environmentally friendly.

Carbon capture and storage (CCUS) technology is a powerful way to achieve the 2060 carbon neutral goal, especially for the current power sector, by avoiding large amounts of emissions

while reducing existing stock emissions. In the future, it is inevitable to retain a certain proportion of thermal power units for peak and frequency modulation, so it is necessary to consider the collection and capture of this part of carbon emissions for further utilization. Biomass power generation part of the waste incineration units will also emit a large amount of carbon dioxide, if this part of the carbon emissions are not sequestered, will not be able to offset the future emissions of hundreds of millions of tons through forest carbon sink.

In conclusion, CCUS technology is the key to achieving "carbon neutrality" in the future, and it is estimated that the technology could save 1.1 billion to 2.7 billion tons of CO₂. Carbon dioxide collection methods include absorption method, cryogenic freezing method, etc., which is conducive to capture for thermal power units or biomass incineration units. Carbon sequestration and utilization technology mainly includes two aspects, one is a geologic sequestration and curing, the collected CO₂ sequestration to underground, strengthening mining fossil fuels such as oil, natural gas, also can be placed at the bottom of the sea, the sea water can not only be dissolved carbon dioxide, at the same time, the surface of floating algae can also be transformed into oxygen and organic materials, In August 2021, China's first offshore carbon dioxide sequestration demonstration project was officially launched in the Pearl River Mouth Basin, which collected carbon dioxide in the process of oilfield development, and then sequestered into the deep sea floor of 800 meters to achieve zero carbon dioxide emissions. The other is the synthesis of valuable chemicals, such as carbonated drinks, synthetic starch, carbon dioxide ice technology, etc. However, this technology still has some challenges, both from the perspective of technology and cost, because carbon remediation, storage and utilization are still in the stage of basic research, there is still a certain distance from commercial use, and the cost is high. Most of the current projects are scientific and technological demonstration projects, which need the support of the state and scientific research projects.

5. Conclusion

Electricity is the main artery of economic development in our country, and we need to give overall consideration in the process of achieving "double carbon" goals. We should not only consider economy and green, but also pay attention to safety and responsibility, by continuously increasing the proportion of non-fossil energy power, and constantly optimize our energy structure, and gradually form the main force of carbon emission reduction. Therefore, to achieve the "double carbon" goal, Chinese power enterprises need to continuously enhance the output of new energy generation forms. Thermal power generation and new energy generation combined with energy storage constantly optimize the security of the power grid system, and increase the planting of green vegetation and the further use of CCS technology.

"2030 carbon peak, 2060 carbon neutral" ambitious goals need to be coordinated the power of the whole society, for reduction, the government departments to coordinate, participation, various industries, the power industry because fossil fuel burning carbon way set, new energy and new energy storage

form of combination, offshore wind platform hydrogen production technology, the new method of low carbon transformation path, Scientifically plan the development of new energy, gradually retire some coal power units, balance and coordinate the internal and external environment, and finally form a new power system with new energy generation as the main form, thermal power and nuclear power as the auxiliary, energy storage and negative carbon as the technical core.

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