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Research on the Development and Transformation of China's Coal Industry Under the Background of Carbon Neutrality

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ABSTRACT

Realizing carbon peak by 2030 and carbon neutrality by 2060 has become a major national strategy. Coal is a long-term basic energy source in China, widely used in many fields, and has important economic and social value. However, with the increase in usage, environmental problems are becoming increasingly prominent, and coal development and utilization are also the main sources of greenhouse gas emissions in China. Coal enterprises urgently need to transform and develop, and the development of the coal industry also faces many challenges. Most coal enterprises still have a single business model of "mining and selling coal", without forming sustainable resource advantages and risk prevention capabilities. For this reason, our country has also formulated and introduced relevant policies. In this new situation, the coal industry will take the "dual carbon" work as the guide, collaborate to promote carbon reduction, pollution reduction, green expansion, and growth, accelerate low-carbon technology research and development, promote fundamental changes in coal utilization, and firmly adhere to the path of ecological priority, green, low-carbon, and high-quality development. This article will adopt the methods of literature analysis and model research to study how the government and enterprises should promote the development and transformation of China's coal industry under the background of carbon neutrality from the current situation, future development forecast, and related new energy technologies. The coal industry needs to adopt effective strategies to optimize the supply chain, improve operational efficiency, and actively explore market diversification to reduce dependence on traditional coal markets. At the same time, increasing investment in technological innovation and environmental protection, enhancing the competitiveness of coal, and seeking coordinated development with new energy will also be key directions for future development.

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KEYWORDS: *Carbon neutrality; Coal industry; Development forecast; New energy technology; Transformation measures*

1. Research Background

The proposal of the "dual carbon" target reflects China's significant consideration, responsibility, and ambition as a responsible major country for the community with a shared future for mankind and sustainable ecological development. The Central Committee of the Communist Party of China has made significant strategic decisions to achieve the eternal development of the Chinese nation and build a community with a shared future for mankind. The Ministry of Science and Technology and nine other departments jointly issued the "Implementation Plan for Science and Technology to Support Carbon Peak and Carbon Neutrality (2022-2030)". [1] The National Development and Reform Commission stated that the construction of the "1+N" policy system for carbon peak and carbon neutrality has been completed and will continue to be implemented. Liu Dechun, Director of the Environmental Resources Department of the National Development and Reform Commission, stated at the National Ecology Day event that in the next step, the National Development and Reform Commission will work with relevant departments, guided by the "dual carbon" work, to gradually shift from energy consumption dual control to carbon emission dual control, and work together to promote carbon reduction, pollution reduction, green expansion, and growth, firmly adhering to the path of ecological priority, green, low-carbon, and high-

quality development. Therefore, promoting high-quality development, improving the ecological environment, and adopting measures that combine economic and ecological benefits have irreplaceable significance for achieving the "dual carbon goals", promoting the great rejuvenation of the Chinese nation, and the long-term development of the world. [2]

"Carbon neutrality" is a term for energy conservation and emission reduction, which refers to the complete offsetting of carbon dioxide emissions in society through the mutual cooperation of various fields such as energy, industrial production, green environmental protection, and energy conservation and emission reduction, achieving" zero emissions "of carbon dioxide. In this process, there is also a stage of carbon peak, where carbon emissions enter a plateau period and then enter a stable decline phase. To put it more intuitively, it means that the carbon dioxide emissions generated by human activities offset the absorption of carbon dioxide.[3]

Li Xuliang combines the experience of other successfully transformed enterprises in China to complement each other's strengths and weaknesses. The specific strategic implementation plan includes measures such as extending the industrial chain, improving product innovation, and expanding export scale in the chemical sector. Implement measures such as improving coal automation level and establishing coal centered production bases in the coal sector. Finally, in order to ensure the smooth implementation of Lu'an Chemical Group's strategy, it is proposed to increase cooperation with relevant enterprises and institutions inside and outside the province, establish a talent training mechanism, do a good job in dual circulation, and make good use of "dual carbon" measures. [4]

The theory of green transformation and development of enterprises proposed by Yu Fawen and Lin Shan is based on the background of China entering a new era of green transformation. Ecological environment protection is the main theme of current enterprise development, and carbon peak and carbon neutrality are the main cores of future green development. Some high polluting and high emission industrial enterprises must undergo transformation and development. Yu Fawen and Lin Shan believe that the green transformation and development of enterprises stem from innovative development concepts. Following national environmental regulations, transformation and development can improve resource utilization efficiency and reduce the impact on the environment. Technological innovation is needed to support transformation and development. This article discusses the promotion strategies for transformational development, which mainly include five aspects: firstly, clarifying the conceptual goals and firmly establishing the direction of green transformation and development for enterprises; secondly, upgrading industrial structure to ensure the quality of green transformation and development of enterprises; thirdly, optimize energy structure and improve the efficiency of green transformation and development of enterprises; fourthly, innovate green technologies to enhance the ability of enterprises to undergo green transformation and development; fifthly, improve institutional mechanisms to ensure the sustainable development of green transformation in enterprises. [5]

Based on the actual equipment situation of the vast majority of coal mines, Zhang Yongqiang attempts to explore the current trend of green, safe and efficient development of coal mines from the perspective of improving safety production, environmental protection, energy conservation and emission reduction, and economic benefits through technological equipment, starting from the basic theory of improving energy efficiency of technological equipment to solve development bottlenecks. From the perspective of improving production capacity and safety mining efficiency, enhancing excavation efficiency, improving transportation efficiency, accelerating the construction of basic energy information systems, implementing unmanned fixed equipment, optimizing and stripping the mining area service industry, and improving professional technical level, targeted green development strategies are proposed to provide reference for the green and high-quality development of the coal industry. [6]

Shuaiyong, Zhao Bin, and others have summarized the technical advantages of ultra supercritical power generation, circulating fluidized bed combustion, carbon sink and carbon capture, utilization, and storage (CCUS) in clean coal power generation technology based on the current status of coal-fired power generation technology in China. They analyzed the flexibility technology of coal-fired power plants that adapts to the "dual carbon" goal and various biomass fuel co firing technologies based on coal-fired power units. They also explored the feasibility of coupled supercritical CO2 Brayton cycle or solar thermal power generation technology based on coal-fired power units and looked forward to three development stages of high-efficiency clean coal-fired power generation. He believes that the active peak shaving transformation and CO2 treatment technology of coal-fired power generation are

important development directions for clean and low-carbon coal-fired power generation in the future. The coupling of coal-fired power generation systems with new energy can simultaneously achieve energy cascade utilization, reduce coal consumption and CO2 emissions, promote the consumption of new energy, and help upgrade the coal-fired power generation industry. These technological studies also have profound implications and inspirations for us. [7]

In recent years, the development of green economy has also infused economic ideas into engineering construction. Therefore, construction enterprises have regarded green development as an indispensable part of their core competitiveness, and research has begun to construct a green core competitiveness index system to quantify this issue. The literature on enterprise transformation and development, which focuses on coal as the research object, should be analyzed around the green development model. In order to ensure long-term development prospects, the coal industry needs to take sustainable development as the foundation and green development models as necessary guarantees. Specific measures can be taken by integrating production processes, combining technological innovation and transformation, resource allocation, and management system optimization, etc., so that coal enterprises can not only maintain operational efficiency during production and operation, but also ensure social and environmental benefits. The energy production sector needs to undergo a green transformation. In order to achieve the new goal 7 and realize the development vision, it is necessary to optimize strategic priorities and strive for energy conservation and consumption reduction. If the coal industry can maintain green and low-carbon development, it cannot only aim at profit and promote economic benefits, but also focus on large-scale development, integrate resources from all aspects, and achieve sustainable development. [8]

Based on previous research, this article first summarizes the current situation of China's coal industry through descriptive statistical methods. On this basis, the grey prediction model is used to predict our coal supply and consumption. Based on the results of statistical research, this article will further explore the transformation direction of China's coal industry on the basis of analyzing new energy technologies related to "dual carbon".

2. Introduction to Data and Methods

2.1. Data sources

This article collected data on the total coal consumption of some industries, the coal consumption in Beijing, the coal import quantity, and the total amount of primary energy, all of which were sourced from the National Bureau of Statistics.

2.2. Research method

2.2.1. Literature analysis method

Literature analysis method refers to the process of searching and summarizing data on the research content and theoretical viewpoints before conducting a study, and finally introducing relevant important viewpoints. The advantage of literature analysis method is that it can organize relevant materials and information of the research problem, analyze the key factors required for the research, and is an important foundation for the research work. The literature review in this article is a compilation and summary of a large amount of literature, including related concepts such as carbon information and carbon neutrality, providing theoretical support for subsequent research. [9]

2.2.2. Model research method

This article adopts the grey prediction model for analysis. Grey theory holds that although the behavioral phenomena of a system are vague and the data is complex, they are still orderly and have overall functions. The generation of grey numbers is to find patterns from chaos. Meanwhile, grey theory establishes a generative data model, not a raw data model. Therefore, grey prediction models use a small amount of incomplete information to establish a 1-color differential prediction model, which provides fuzzy descriptions of the development laws of things. Although the appearance shown in gray is random, it is still ordered and bounded, so the resulting data set has potential patterns.

G represents grey, M represents model

The defined $x^{(1)}$grey derivative is:

$$d(k) = x^{(0)}(k) = x^{(1)}(k) - x^{(1)}(k-1) \quad (1)$$

$x^{(1)}$Generate a sequence of adjacent values $z^{(1)}(k)$for the sequence, i.e.:

$$z^{(1)}(k) = \alpha x^{(1)}(k) + (1-\alpha)x^{(1)} \quad (2)$$

The grey differential equation for GM (1,1) is defined as:

$$d(k) + \alpha z^{(1)}(k) = b\text{或}x^{(0)}(k) + \alpha z^{(1)}(k) = b \quad (3)$$

Among them, it is $x^{(0)}(k)$called the gray derivative, the αdevelopment coefficient, the $z^{(1)}(k)$whitening background value, and b is the amount of gray used.

Substitute the time into:

$$\begin{cases} x^{(0)}(2) + \alpha z^{(1)}(2) = b \\ x^{(0)}(3) + \alpha z^{(1)}(3) = b \\ \cdots \\ x^{(0)}(n) + \alpha z^{(1)}(n) = b \end{cases} \quad (4)$$

Introduce matrix vector notation:

$$u = \begin{bmatrix} a \\ b \end{bmatrix} \quad Y = \begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ \cdots \\ x^{(0)}(n) \end{bmatrix} \quad B = \begin{bmatrix} -z^{(1)}(2) & 1 \\ -z^{(1)}(3) & 1 \\ \cdots & \cdots \\ -z^{(1)}(n) & 1 \end{bmatrix} \qquad (6)$$

The GM (1,1) model can be expressed as Y=Bu.

The estimated value obtained by the least squares method is:

$$u = \begin{bmatrix} a \\ b \end{bmatrix} = (B^T B)^{-1} B^T Y \qquad (7)$$

Based on this, we choose to use the grey prediction model for prediction.

3. The current situation of China's coal industry

According to data from the National Bureau of Statistics, the overall production of raw coal in China has shown an upward trend from 2001 to 2021. In 2016, China's raw coal production dropped to its lowest point in nearly a decade, reaching 3.41 billion tons, mainly due to the structural transformation and upgrading of the coal industry. Since the supply side capacity reduction of the coal industry in 2016, a large number of ineffective and backward production capacity has been withdrawn. The coal supply side reform continues, especially under the guidance of the dual carbon target, the control of coal supply side production is particularly strict. In 2021, the country began to vigorously promote the integration of coal mining enterprises, and the coal flow market has also tended to converge. This will gradually increase the market entry barriers for coal circulation enterprises, forming a competitive pattern of strong alliances and constant strength in the coal industry. In 2022, the supply and demand sides of China's coal market are showing a trend of "reduction". From the supply side, with the implementation of policies and measures to reduce coal production capacity and coal mine production at the beginning of the year, the output has decreased by more than 10% since April, and the national coal supply and demand situation has gradually shifted from severe oversupply to supply-demand balance. In 2022, the raw coal production of coal enterprises above designated size in China was 3.364 billion tons, a decrease of 9.4% compared to the previous year.

From the demand side, as China's carbon peak and carbon neutrality goals continue to advance, the installed capacity of photovoltaic and wind power will increase, replacing a considerable portion of coal demand. According to the statistical chart of China's demand for coal in the production sector, from 2016 to 2021, only the total consumption of industrial coal has slightly increased, while the total consumption of coal in the other primary and tertiary industries has decreased to a certain extent. From 2003 to 2021, the coal consumption in Beijing has shown a continuous downward trend, from a peak production of nearly 30 million tons to nearly zero annual production. Over the past 20 years, coal production has sharply declined.

According to the statistical chart of China's demand for coal in the production sector, from 2016 to present, only the total consumption of industrial coal has slightly increased, while the total consumption of coal in the other primary and tertiary industries has decreased to a certain extent. Since 2003, the coal consumption in Beijing has shown a continuous downward trend, from a peak annual output of nearly 30 million tons to nearly zero annual output. Over the past 20 years, coal production has sharply declined. In the context of declining coal production, China's coal imports have also slightly increased, and the import growth rate has been rising year after year. Faced with tight coal supply and significant price increases, coal production enterprises are making every effort to increase production and supply, accelerate the release of high-quality production capacity, and effectively ensure the safety and warmth of the people during the winter and the smooth operation of the economy.

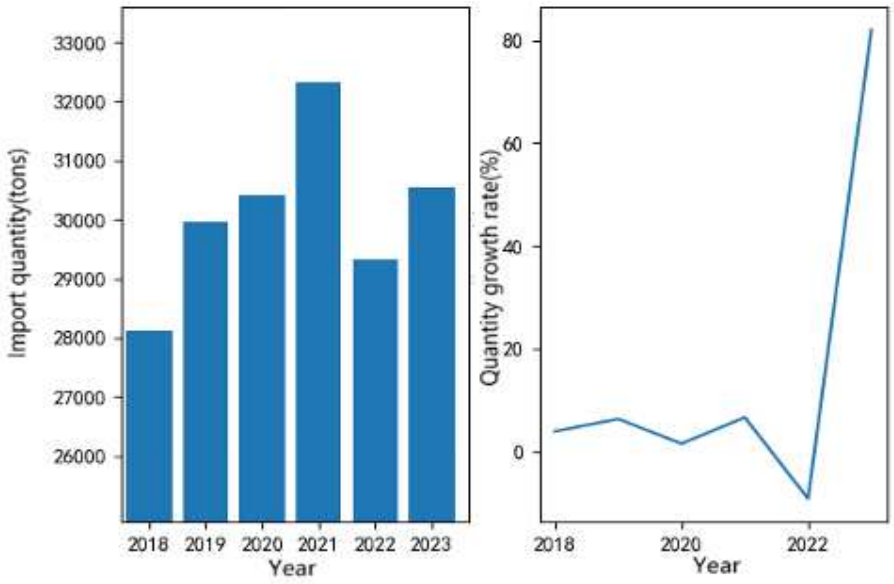

Figure 1 Statistical Chart of Import Volume and Growth of Coal and Lignite in China

According to the statistical chart of the import volume and growth of coal and lignite in China, from 2018 to August 2023, the import volume of coal and lignite in China showed a fluctuating upward trend. The import growth rate was relatively stable from 2018 to 2022, and showed a rapid upward trend from 2022 to 2023, rising linearly from -9.2% to 82%. The increase in winter heating demand may lead to a short-term increase in coal imports. In 2023, due to the super cold wave weather caused by La Nina phenomenon, the demand for electricity for private heating will increase sharply, leading to an increase in coal imports. The increase in import volume leads to a decrease in coal prices, causing inflated coal prices to fall back, which helps alleviate the overall upward pressure on prices and promotes sustained and healthy development of the domestic economy. [10]

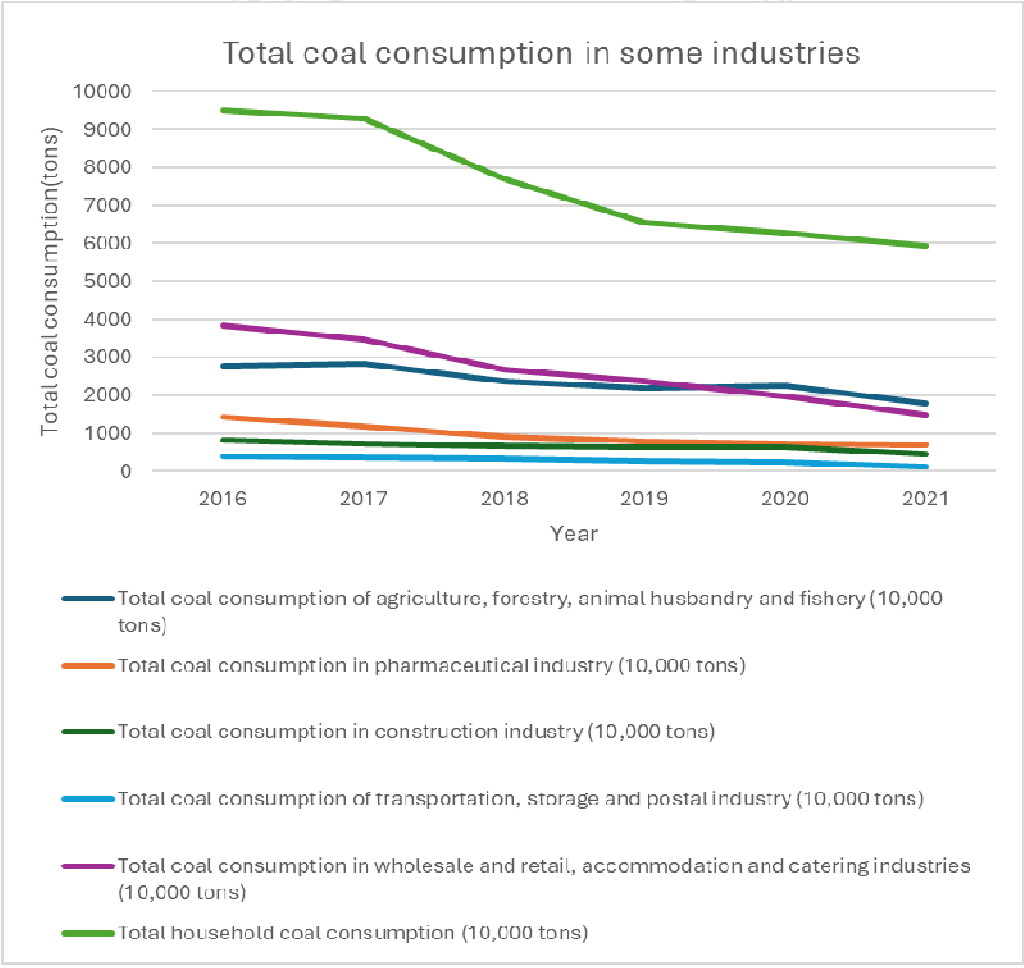

Figure 2: Total Coal Consumption of Some Industries from 2016 to 2021

According to the statistical chart of total coal consumption in some industries, the total consumption of industrial coal is showing a slow upward trend, while other industries are showing a slow downward trend, and the overall situation is relatively stable. The total consumption of industrial coal is far greater than that of other industries. The reasons for this situation may be influenced by factors such as energy structure adjustment, technological progress, changes in international energy prices, and international cooperation and commitments. With the transformation and upgrading of the Chinese economy, the energy consumption structure is also undergoing changes. The government is promoting the green and low-carbon transformation of energy consumption, reducing dependence on coal, and increasing the use of clean energy. For example, according to data from the National Bureau of Statistics, the proportion of carbon consumption in the total national energy consumption in 2023 was 55.3%, a decrease of 0.7 percentage points from the previous year. Technological progress has made alternatives to coal more economical and feasible. The cost of renewable energy technologies such as wind and solar energy continues to decrease, making these energy sources more competitive than coal in some cases. In addition, the development of clean and efficient utilization technologies for coal has also reduced direct consumption of coal. China's commitment to reducing greenhouse gas emissions on the international stage has also driven domestic policies and actions to reduce coal consumption and shift towards clean energy. When international coal prices are high, domestic companies may be more inclined to use alternative energy sources or improve energy efficiency to reduce costs. The slowdown in China's economic growth has also affected coal consumption. The slowdown in industrial production growth, especially in high energy consuming industries, has led to a decrease in coal demand. In the industrial production process, especially in high energy consuming industries such as steel, building materials, and chemicals, there is a strong demand for energy. Coal, as a relatively inexpensive and high energy density energy source, has become the main energy choice for these industries. Moreover, industrial production scales are generally large, requiring a large amount of energy support during the production process, especially for continuous production processes, which require high stability and reliability of energy supply. Coal, as a relatively stable energy supply, can meet the needs of such large-scale production. Many industrial production technologies and equipment are highly dependent on coal, and the transition to using other energy sources requires significant investment in technological and equipment upgrades, which also makes it difficult to significantly reduce industrial coal consumption in the short term. From an economic cost perspective, coal has a price advantage compared to other energy sources such as natural gas, electricity, etc. Especially when energy prices fluctuate, coal prices remain relatively stable, making industrial enterprises more inclined to use coal.

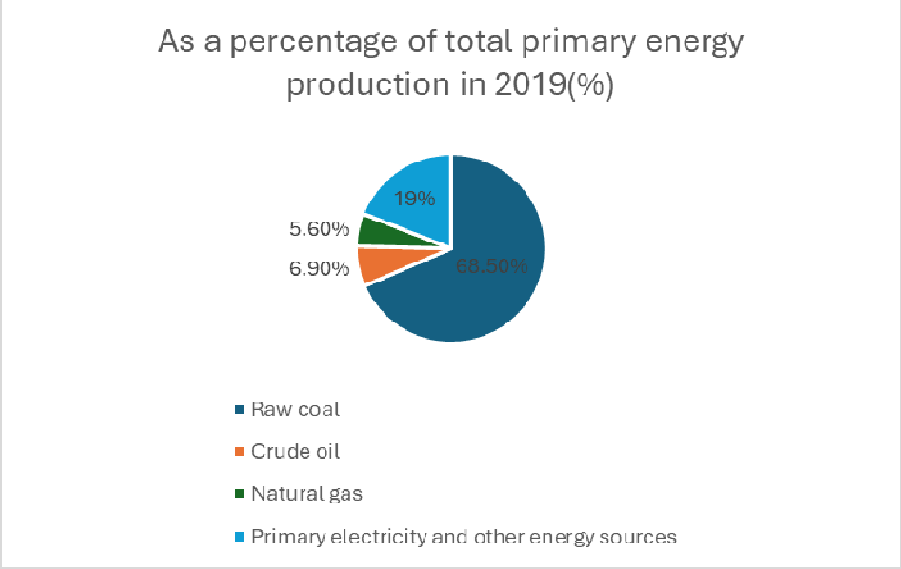

Figure 3 Proportion of Primary Energy Production in 2019

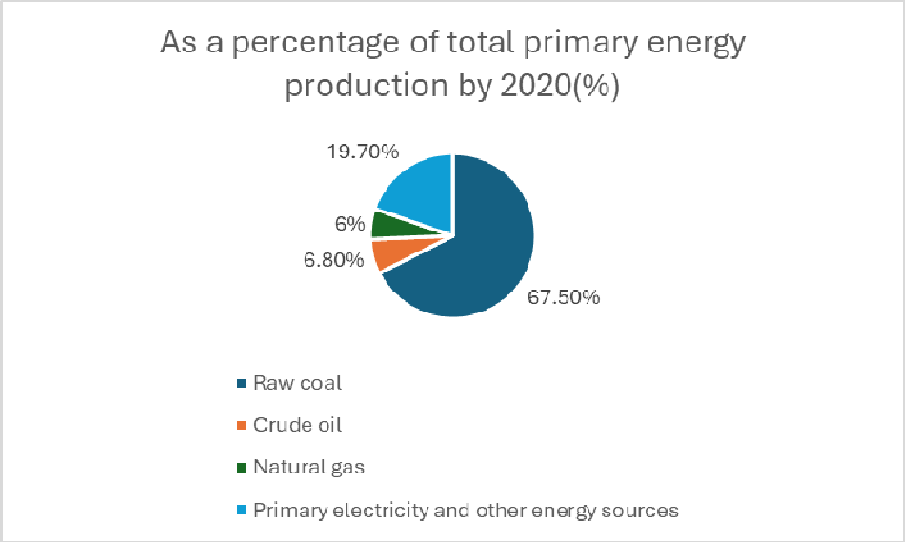

Figure 4 Proportion of Primary Energy Production in 2020

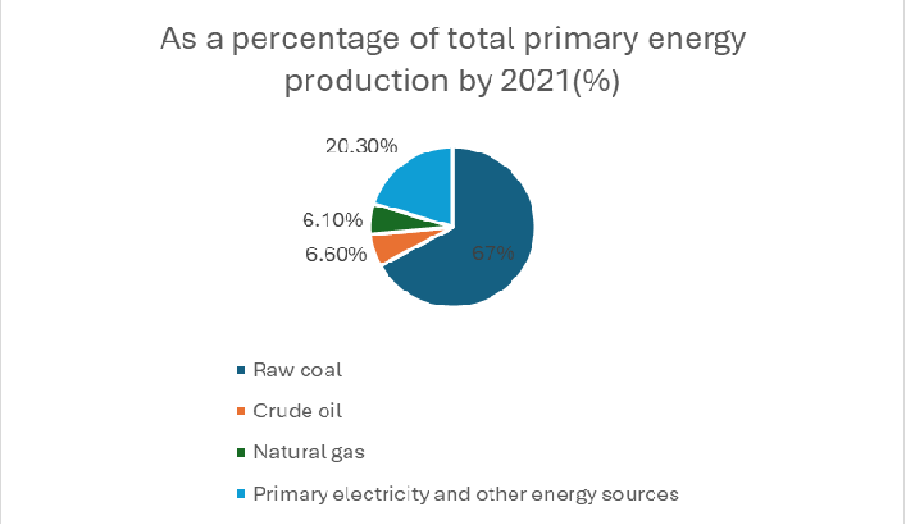

Figure 5 Proportion of Primary Energy Production in 2021

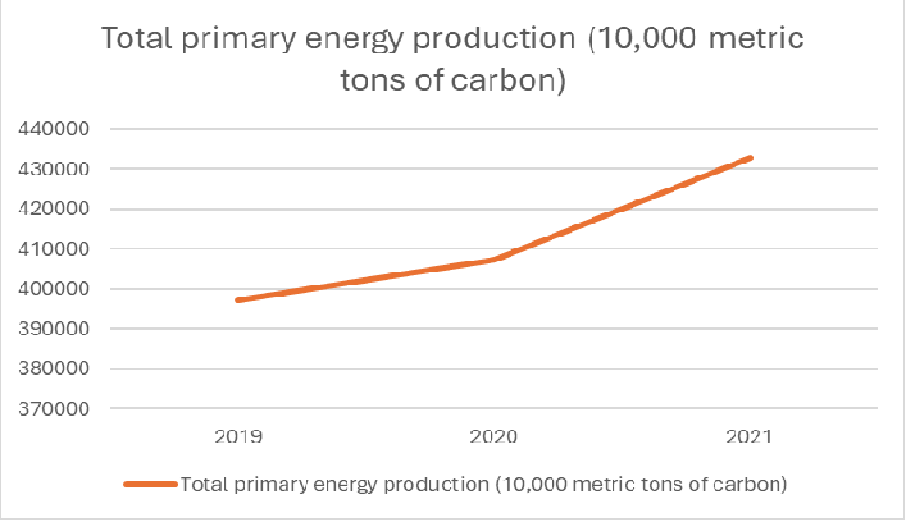

Figure 6: Total Primary Energy Production from 2019 to 2021

According to existing data records, in the past three years from 2019 to 2021, the proportion of raw coal was as high as about 68%, while the proportion of primary electricity and other energy, crude oil, and natural gas decreased in order, with little difference in the proportion of crude oil and natural gas. The three-year proportion structure remains basically stable and unchanged. The total production of primary energy has shown an upward trend from 2019 to 2021, with a three-year growth of nearly 300 million tons.

Overall, under the background of carbon neutrality, the advantages of the coal industry in terms of industrial scale, energy structure proportion, and economic viability will gradually diminish. The coal market, coal-fired power utilization, and enterprise survival environment will face major challenges. However, there are also opportunities for the development of the coal industry. A 10-year period has been reserved before the carbon peak, and there will be a game development time between coal and non fossil energy after the carbon peak. In the future, the coal industry still has time to promote the development of related innovative technologies and the application of carbon sinks to win greater opportunities for the transformation of the coal industry.

4. The Future Development Strategy of China's Coal Industry

In 2022, the coal industry faces both challenges and opportunities. On the one hand, the promotion of environmental protection agenda will increase the constraints on the coal industry, which may lead to the risk of phasing out some old and high energy consuming coal mines. On the other hand, with the continuous innovation of coal technology and equipment, cleaner and more efficient coal mining and utilization methods will receive more attention, which will bring new development opportunities to the coal industry.

Based on the basic requirements of the problem, first process the basic information, and then use the processed data as the basis, with the help of EXCEL tool, use the grey system GM (1,1) model to predict the coal consumption demand in China from 2013 to 2022, and predict the trend of coal consumption and demand in China in the next 10 years under the background of carbon neutrality.

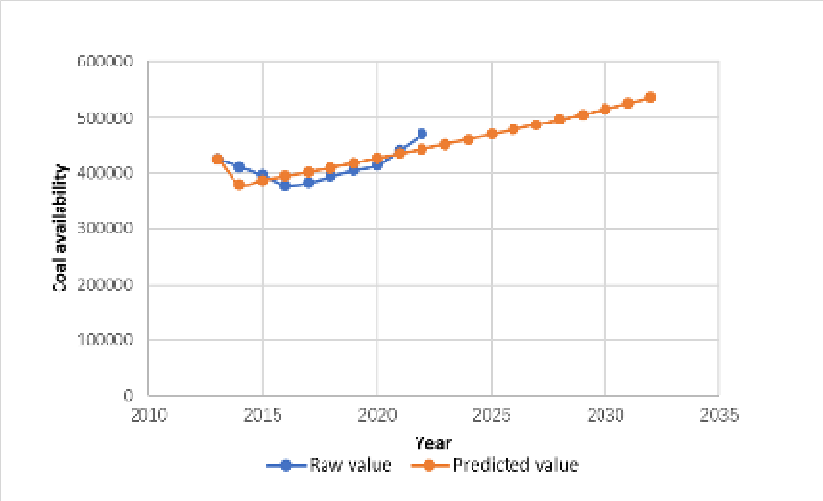

Figure 7 Prediction of Coal Supply

As can be seen from the graph, the predicted trend of coal supply from 2013 to 2022 is not significantly different from the actual data, and the coal supply will show an upward trend in the next 10 years, indicating that China's coal production and supply capacity continues to strengthen, effectively ensuring stable coal power supply and price stability during the peak winter season, and enabling the market to operate smoothly and orderly.

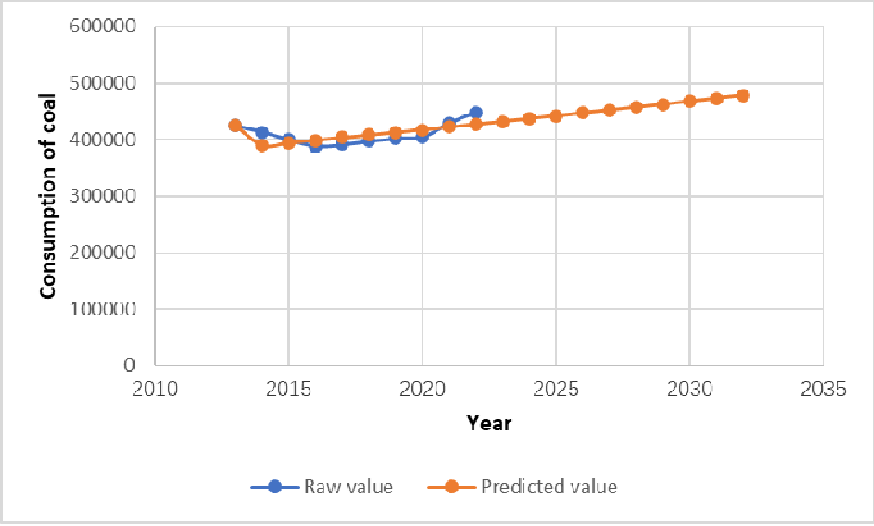

Figure 8 Prediction of Coal Consumption

As can be seen from the graph, the predicted trend of coal consumption from 2013 to 2022 is not significantly different from the actual data, and coal consumption will show an upward trend in the next 10 years, indicating that coal occupies a dominant position in China's energy consumption, accounting for more than 50%, and coal prices are relatively low. During the economic recovery period, international natural gas prices will rise, and the demand for electricity consumption will increase. As a relatively cheap energy source, coal consumption will also increase accordingly. However, the production conditions of the coal industry may deteriorate due to consumption growth, and coal mining and consumption will have serious impacts on the environment, including resource consumption, pollution, ecological damage, etc. Therefore, the transformation of the coal industry and the development and utilization of new energy are gradually being valued.

It is predicted that from 2023 to 2060, there will be a revolutionary evolution in the supply pattern of fossil and non fossil fuels. Carbon based energy will experience a significant reduction in annual carbon emissions, resulting in 80% carbon dioxide emissions and 80% consumption of carbon containing fossil fuels. By 2060, non carbon new energy will account for over 80% and carbon dioxide emissions will be reduced by over 80%. [11]

Overall, in 2023, the quality of the national coal supply system will improve and the supply guarantee capacity will be enhanced. The coverage of medium and long-term coal contracts will expand, and the supervision of medium and long-term contract performance will continue to strengthen. The overall market expectation is stable and positive, and the coal transportation guarantee capacity will continue to improve. It is expected that the supply and demand of the coal market will maintain a basic balance.

5. New energy technologies related to "dual carbon"

With the proposal of carbon peak and carbon neutrality in China, and the continuous growth of global energy demand, the supply of traditional energy resources is gradually becoming tight. The extraction and use of fossil fuels such as oil and coal have also caused serious pollution and damage to the environment. The development of new energy technologies plays a crucial role in protecting the environment.

5.1. Research on New Energy Technologies Abroad

5.1.1. Carbon dioxide capture, utilization, and storage technology

The capture, utilization, and storage of carbon dioxide refers to the process of separating carbon dioxide from factory emissions and reusing it through technology to reduce carbon dioxide emissions. Carbon dioxide, as an excellent oil displacement medium, is an important resource in the open utilization of oil reservoirs. Combining carbon dioxide oil displacement with this technology can achieve the reduction of carbon dioxide emissions, which has excellent benefits in both social and economic aspects. It has now gained universal recognition from the international community. The report from the Global Carbon Capture and Storage Research Institute shows that carbon dioxide capture, oil displacement, and storage technologies are the main ways to reduce carbon emissions, and have a significant impact on reducing global emissions of oxidized carbon. At present, there are 28 global carbon reduction projects with an annual capture capacity of 3816 × 104 tons, of which 22 are carbon dioxide capture, oil displacement, and storage projects with an annual capture capacity of 2926 × 104 tons, accounting for 76.68%. [12]

5.1.2. Developing dry quenching technology for waste heat recovery

The hot coke produced in the coke oven is quenched with inert gas, and the heat is used to generate steam and generate electricity. Compared with wet quenching, it saves 40% energy. Developing a new generation of coking technology (Scope 21): Scope 21 is a national development project aimed at enhancing resource and energy response capabilities. This project includes many innovative technological developments such as shortening coking time and improving coke quality. The technology developed using Project 1 will expand the utilization of low-grade coal and significantly reduce carbon dioxide emissions.

5.2. Research on Domestic New Energy Technologies

5.2.1. Microbial electrochemical system

Microbial electrochemical system is an electrochemical reaction device that utilizes microorganisms for cathodic reduction and anodic oxidation, and has become a research hotspot in environmental microbiology in recent years. Microbial electrochemical systems are used for carbon dioxide reduction, which can achieve the recycling of carbon dioxide, reduce carbon dioxide emissions, and have important implications for the

environment, energy, and resources. Microorganisms can reduce carbon dioxide to compounds with higher added value. Studies have shown that microorganisms can directly reduce carbon dioxide to synthesize chemicals such as methane and acetic acid through electrodes or by producing hydrogen gas. Acetobacter can catalyze the reduction of carbon dioxide to synthesize multi carbon organic compounds more rapidly. In nature, acetogenic bacteria can use hydrogen gas as an electron donor to reduce carbon dioxide and synthesize acetic acid through the Wood Ljungdahl pathway. [13]

5.2.2. Photovoltaic power generation - crystalline silicon solar cells

After more than 20 years of development, the photovoltaic industry has become one of the few strategic emerging industries in China with international competitive advantages, and an important engine for promoting China's energy revolution. At present, China's photovoltaic industry has achieved a layout of the entire industry chain of silicon materials, silicon wafers, solar cells, components, and power generation systems, ranking first in the world in terms of manufacturing scale, industrialization technology level, and industrial system construction. With the support of policies, China's photovoltaic industry has made rapid progress, surpassing developed countries in terms of production capacity and making significant contributions to reducing the cost of photovoltaic power generation per kilowatt hour worldwide. However, there are still bottlenecks such as insufficient original innovation and dependence on foreign technologies. In the early stages of promoting these efficient battery technologies, the corresponding manufacturing and testing core equipment relied on imports. With the development of China's photovoltaic industry, the market demand for independent technology is becoming increasingly strong; On the basis of digestion and absorption, some leading enterprises are increasing their R&D investment and promoting technological upgrades.

5.2.3. High voltage lithium nickel manganese oxide cathode material and battery technology

The new generation of power batteries is becoming the focus of global competition. The lithium-ion battery materials team of Songshan Lake Materials Laboratory (hereinafter referred to as the "Lithium Battery Team") focuses on breaking through the industrialization of high-voltage lithium nickel manganese oxide materials and battery application technology, and has taken the lead in achieving long cycle life of high-voltage lithium nickel manganese oxide full batteries internationally.

Overcoming the challenges in material science and laying out core patented technologies for lithium nickel manganese oxide batteries. Since 2019, the lithium battery team has synthesized surface stable lithium nickel manganese oxide cathode materials through innovative surface modification methods. Combined with the development of high-voltage resistant electrolytes, modification of cathode auxiliary materials, and optimization of binders, the cycling performance of high-voltage lithium nickel manganese oxide batteries under high temperature and high pressure has been greatly improved The lithium battery team focuses on the protection of core intellectual property rights, with material technology related to nickel manganese oxide lithium batteries as the core, and has carried out a relatively complete patent layout. Currently, more than 50 patents have been authorized and applied for, forming a relatively complete core patent technology system for nickel manganese oxide lithium batteries. The "Third Generation Lithium ion Power Battery" project of the lithium battery team has advanced to the top 350 startups in the 2021 Guangdong Hong Kong Macao Greater Bay Area High Value Patent Cultivation Layout Competition.

6. Transformation measures for China's coal industry

Under the influence of the "dual carbon" target, the demand for coal is bound to decline, and the coal industry will also face new adjustments. According to the inherent situation of China's coal resources, traditional old coal production bases will gradually shift to the north and west, and old coal bases will gradually exit the market. Therefore, coal enterprises should shift from single coal production to multiple energy product suppliers. This shows that the transformation pressure faced by enterprises related to old coal production bases is increasing. The restructuring and integration of enterprises between multiple provinces and autonomous regions will become a reasonable path for future development. Therefore, the coal industry should actively conduct relevant research, and relevant governments at all levels should also take corresponding measures to ensure the orderly exit of coal production enterprises and the achievement of goals. [14]

To achieve the goals of carbon peak and carbon neutrality, it is necessary to accelerate the transformation and upgrading of the coal industry. Based on the research results of this article, the following specific measures are proposed.

6.1. Government

From the perspective of the relationship between development and emission reduction, we need to be based on the reality that China is still a developing country, with significant room for economic and social development, and the economy still needs to maintain a medium to high growth rate. Energy is the key to the "dual carbon" issue, and it plays a crucial foundational supporting role in China's economic and social development. The essence of implementing the "dual carbon" goal is low-carbon development, the core of low-carbon development, and low-carbon is the way. From a holistic and local perspective, the main factor currently constraining people's needs for a better life is the problem of unbalanced and insufficient development. The problem of uneven development lies in the uneven development of various regions, industries, and enterprises. The development level gap between the eastern, central, and western regions of China is relatively large, so the "4 carbon" target should not be achieved in unison, but should be tailored to local conditions. This requires the government to provide a stable policy environment and increase support for new energy. On the one hand, encourage and support localities, key industries, and key enterprises with conditions to take the lead in reaching peak; On the other hand, while ensuring the achievement of the overall "dual carbon" target, it is allowed for some regions with relatively backward development and some industries with significant growth potential and difficulty in reducing emissions to reach peak or neutralize late, that is, to respect the law, adhere to seeking truth from facts, and do a good job in balancing and coordinating between regions, industries, and enterprises.

In promoting the application of new energy technologies, the government should simplify and accelerate the approval process for new energy projects, provide green channels for new energy projects, reduce unnecessary administrative barriers, improve approval efficiency, optimize the process of connecting new energy projects to the grid, achieve full online processing, provide financial and financial support, strengthen international cooperation, and enhance the international competitiveness and influence of China's new energy industry. The Chinese government has always maintained a high level of attention to the development of the new energy industry and formulated a series of policy support measures. The government's policies on deducting income tax and research and development expenses for new energy enterprises, as well as investing in research and development funds for new energy technologies, have provided strong policy support for the development of the new energy industry. The Chinese government strongly encourages procurement support at all levels of government. The Chinese government also actively encourages governments at all levels to purchase and use new energy products, promoting the promotion and application of new energy products.

6.2. Enterprise

From the perspective of short-term and long-term relationships, the issue of "dual carbon" should be viewed dynamically. On the one hand, in the short term, we are facing the stage of carbon peak, which means that with future development, carbon emissions still have a certain moderate growth. The focus of enterprise work should be on controlling increment and optimizing stock. The long-term challenge is carbon neutrality, gradually decoupling growth from emissions, and the focus of enterprise work will shift towards both growth and increment. On the other hand, the "dual carbon" work should also be continuously deepened and adjusted over time. It should also be noted that technological progress plays a deep role in the "dual carbon" work, such as the speed of cost reduction of new energy and energy storage such as wind power and photovoltaics, technological innovation in optimizing and upgrading the power system, technological progress in upgrading the process flow of major emission sectors such as steel and building materials, and artificial negative carbon and carbon dioxide utilization technologies such as carbon capture, storage and utilization (CCUS). Their progress and effectiveness are also related to the path and means of "dual carbon" work. Therefore, enterprises should keep up with the times and view the issue of "dual carbon".

In terms of new energy technology, enterprises should increase research and development investment, focus on core and key technologies in the field of new energy, such as clean and efficient utilization of coal technology, carbon capture and storage (CCS) technology, etc., and strengthen cooperation with scientific research institutions and universities to promote the integration of industry, academia and research. We can utilize our own financial advantages and land resources to develop new energy projects such as wind power and photovoltaics, especially in coal mining areas and surrounding areas. We can build a clean energy base that integrates wind, solar, electricity, heat, and gas from the ground and underground. Actively exploring clean conversion technologies for coal, such as coal to oil, coal to gas, coal (methanol) to olefins, as well as the development of coal based new materials, to increase the added value of coal. Enterprises need to train and introduce

professional talents in the field of new energy to support the development and management of new energy projects.

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Reference

[1] Ministry of Science and Technology; National Development and Reform Commission; Ministry of Industry and Information Technology; Ministry of Ecology and Environment; Ministry of Housing and Urban Rural Development; Ministry of Transport; Chinese Academy of Sciences; Engineering Institute; National Energy Administration Notice from the Ministry of Science and Technology and Nine Other Departments on Issuing the Implementation Plan for Science and Technology Support for Carbon Peak and Carbon Neutrality (2022-2030)

[2] Zhao Wenxuan. Research on the impact of tiered carbon taxon emission reduction efficiency in coal and oil industry [D]. Shandong University of Finance and Economics, 2023

[3] Liu Hang. Analysis of Development Strategies for the Coal Industry under the Background of Carbon Neutrality [J], 2021, Issue 9, 41, 43

[4] Xuliang Li. Research on Transformation and Development Strategy of Lu'an Chemical Group under Carbon Peaking and Carbon Neutrality Background [D], 2022.6

[5] Yufa, Wen Linshan. Promotion Strategies of Green Transformation and Development of Enterprises under the "Dual Carbon" Goal [J], 2022, 336 (2) 144-155.

[6] ZHANG Yongqiang. Research on the countermeasures for green and high-quality development of coal mines based on the "dual carbon" goal[J], 2022.9, Vol. 38, No. 17

[7] SHUAI Yong, ZHAO Bin, JIANG Dongfang, HE Suoying, LYU Junfu, YUE Guangxi. Status and prospect of coal-fired high efficiency and clean power generation technology in China [A], 2022.1, Volume 51, Issue 1

[8] Liu Junyi Research on Core Competence of China Coal Xinji GroupCo., LTD under the background of carbon neutrality [D]. Shihezi University, May 2023

[9] Zhang Ya Research on Carbon Information Disclosure of H Coal Company under the Background of Carbon Neutrality [D]. Hunan University of Technology, March 19, 2023

[10] Source: China Statistical Yearbook 2022 Edition [Z]

[11] Zou Caineng, Wu Songtao, Yang Zhi, Pan songqi, Wang Guofeng, Jiang Xiaohua, Guan Modi, Yu Cong, Yu Zhichao, Shen Yue. 《Progress, challenge and significance of building a carbon industry system in the context of carbon neutrality strategy》 [D]. Research Institute of Petroleum Exploration and Development, PetroChina, China Petroleum Shenzhen New Energy Research Institute Co., Ltd., National Energy Tight Oil and Gas Research and Development Center, China Petroleum Qinghai Oilfield Company, China University of Petroleum, March 2023

[12] Song Xinmin, Wang Feng, Ma Desheng, Gao Ming, Zhang Yunhai. 《Progress and prospect of carbon dioxide capture, utilization and storage in CNPC oilfields》 [D]. PetroChina Research Institute of Petroleum Exploration, tate Key Laboratory of Enhanced Oil and Gas Recovery, PetroChina Jilin Oilfield 2023.2

[13] Zhang Pengcheng, Wang Li, Li Yangyang, Chen Xiaojin, Hu Ning. 《Simultaneous production of formate and acetate from carbon dioxide with microbial electrochemical systems》 [D]. Wuhan University of Science and Technology, 2018.9

[14] Wangchen. 《Research on the development path of China's coal industry under the background of carbon neutrality》 [C]. Information Institute of Ministry of Emergency Management, 2021.5