

# China's Energy Structure Problems and Optimization Suggestions from the Perspective of Low-carbon Economy

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**Abstract:** Energy consumption, technological level, and sustainable industrial system are crucial for developing a low-carbon economy. China's excessive reliance on coal has led to low energy utilization efficiency, which has become an important factor affecting the optimization of China's energy structure and further constraining the sustainable development of the economy. In this regard, this article attempts to explore the issues of China's energy structure from the perspective of a low-carbon economy, and proposes strategies for optimizing China's energy structure from the perspective of a low-carbon economy. In the context of developing a low-carbon economy, starting from China's specific national conditions, the government should play a guiding role, optimize China's energy structure step by step, and promote the development of new energy projects. Based on China's actual technological situation, technological upgrading and industrial structure transformation, we will focus on developing low-carbon related industries and strategic emerging industries. Only by continuously innovating and applying new energy can we achieve the transformation of energy application structure in the production and living fields, gradually shifting from high pollution and high emissions to low pollution and low emissions.

**Keywords:** Low carbon economy, China's energy structure issues, Optimization.

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## 1. Introduction

The development of human economy and society is always accompanied by the development and utilization of various energy sources. However, with the increase of the global population and the continuous growth of the economic scale of various countries, the production and consumption mode at the expense of environmental resources has brought great negative effects to human society. The global fossil fuel is gradually exhausted, the climate is gradually warming, and the environment continues to deteriorate. The low-carbon economic development model characterized by low energy consumption, low pollution and low emissions has not only become the consensus of global economic development, but also the inevitable choice for China to achieve sustainable economic development [1]. The so-called low-carbon economy aims at reducing greenhouse gas emissions and building an economic development system based on low energy consumption and low pollution, including low-carbon energy system, low-carbon technology and low-carbon industrial system. It can be seen that the industrial system of energy consumption, technical level and sustainable development is very important for the development of low-carbon economy [2]. Since the reform and opening up, due to the large population but lack of resources, China's energy supply and demand pattern has always been dominated by coal. However, on the one hand, excessive dependence on coal leads to a single structure of energy supply and demand in China, which reduces the utilization rate of resources, on the other hand, it will also cause ecological and environmental problems, which greatly restricts the sustainable development of China's economy [3]. The optimization of China's industrial structure must be based on the development of low-carbon economy, and to achieve low-carbon economy, it is necessary to adjust and optimize the industrial structure. Industrial development has a certain law of development. As far as the present situation of industrial development in China

is concerned, resources and environment are increasingly restrictive to industrial development. Whether energy can be effectively allocated and used has been the main constraint for the sustainable and healthy development of China's economy. Therefore, under the background of developing low-carbon economy, starting from China's specific national conditions, the government should play a guiding role, optimize China's energy structure step by step, and promote the development of new energy projects [4]. To realize the path of "development+governance" in the adjustment and upgrading, we should take sustainable development as the requirement and low-carbon economy as the guidance, ease the contradiction between China's economic development and resources and environment, realize the optimization of industrial structure under the constraint of low-carbon economic development, and finally realize the dual development goals of low-carbon economy and industrial structure optimization [5].

## 2. Problems in China's Energy Structure

### 2.1. Coal based energy structure

The actual situation of industrial development in China has not taken into account the optimization of industrial structure, neglecting the pressure on resources and environment during development, and neglecting the sustainable development of the industry. China's excessive reliance on coal has led to low energy utilization efficiency, which has become an important factor affecting the optimization of China's energy structure and further constraining the sustainable development of China's economy [6]. According to statistics, the total energy utilization efficiency in China is about 48%, which is more than 15 percentage points lower than the international average. The energy waste caused by low energy utilization efficiency is a major issue that affects the sustainable development of China's economy. In the context of the energy crisis, only by

developing new technologies to utilize new energy can China achieve sustainable energy utilization and sustainable economic development[7]. In the trend of developing a low-carbon economy in the world, we actively seek ways to optimize China's energy structure, gradually replacing coal with new, renewable, and clean energy sources such as nuclear energy, wind energy, and solar energy, and achieving a diversified energy structure.

## **2.2. Significant energy constraints**

Although China has abundant energy resources, it is relatively insufficient. The per capita recoverable energy reserves are far lower than the world average. As China enters the middle stage of industrialization and the per capita income level increases, the demand for clean and high-quality energy will grow rapidly in the next 20 to 40 years. Correspondingly, there is a shortage of high-quality energy supply and a primary energy production structure dominated by coal. The sustained and rapid growth of China's economic development level, coupled with the rapidly increasing demand for energy consumption, has led to a widening gap between energy supply and demand, leading to an increasingly prominent contradiction between energy supply and demand, which in turn has affected the speed of economic development[8]. The high import dependence of crude oil involves issues such as supply and demand patterns, posing significant energy security risks to China. At the same time, a large amount of coal combustion has caused serious air pollution, reducing pollution emissions and protecting the ecological environment are urgent.

## **2.3. The energy infrastructure construction system is not sound**

At present, China is in an important transitional period of urbanization development, and there is still a high demand for some high carbon products, such as the power industry and cement industry, which have largely driven the rapid development of China's economy[9]. However, the energy infrastructure construction system plays a crucial role in optimizing the energy structure, developing a low-carbon economy, driving the development of related industries, and promoting the development of the national economy[10]. At present, China lacks the construction of regional transmission channels and strategic reserve facilities. These energy infrastructure construction systems are not perfect, which restricts the development pace of energy structure optimization. In the practice of economic and social development, the low-carbon economic development model should be implemented in the optimization of industrial structure. In the development of low-carbon economic model, further adjustment and optimization of industrial structure are also necessary, which has important practical significance for China's economic and social development. Therefore, while maintaining the development of basic industries, China needs to increase the utilization of energy resources, reduce the carbon emission intensity of the industry, and achieve the optimization of China's industrial structure.

# **3. Strategies for Optimizing China's Energy Structure from The Perspective of Low-carbon Economy**

## **3.1. Guiding industry direction**

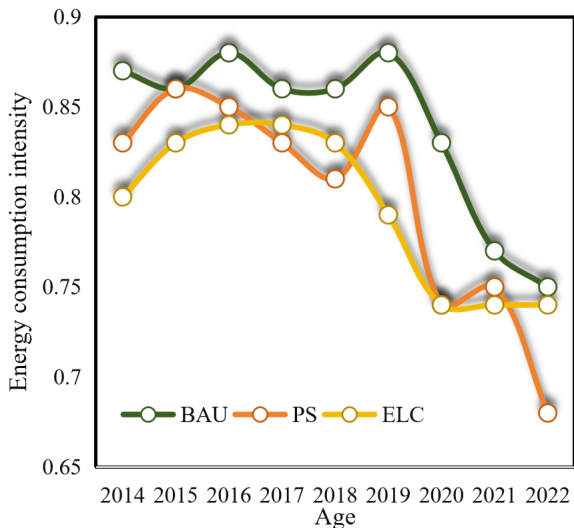
Make use of the comparative advantages of industrial

economy, adjust and optimize the industrial structure, promote the transformation of economic development mode, build an ecological, economical and intensive industrial development model, improve the comprehensive competitiveness of the industry and cultivate the sustainable development of the industry. Establish a reasonable energy consumption fee model, vigorously promote energy conservation and emission reduction, improve energy utilization efficiency, and guide social consumption demand by adopting some means and make it reasonable. Restrict the transition and expansion of energy consumption, strengthen the construction of energy-saving system, and implement energy conservation and emission reduction to the greatest extent, so as to improve the utilization rate of energy. Give full play to the leading role of the government, make reasonable guidance with financial support, intensify energy technology innovation, establish a long-term mechanism for energy technology innovation, steadily promote the development of energy science and technology, and unite enterprises, universities and scientific research units to give full play to the agglomeration effect of Industry-University-Research, so as to provide technical support for establishing a new efficient, clean and low-carbon energy industrial system in China. Change the carbon sink conversion rate of China's primary industry, strengthen the technological innovation rate of China's secondary industry, increase the output share of China's tertiary industry, expand China's industrial development space, comprehensively implement the development of low-carbon economy, promote the development of low-carbon technology and low-carbon industries, and realize the development of China's low-carbon industries.

## **3.2. Promote low-carbon technologies**

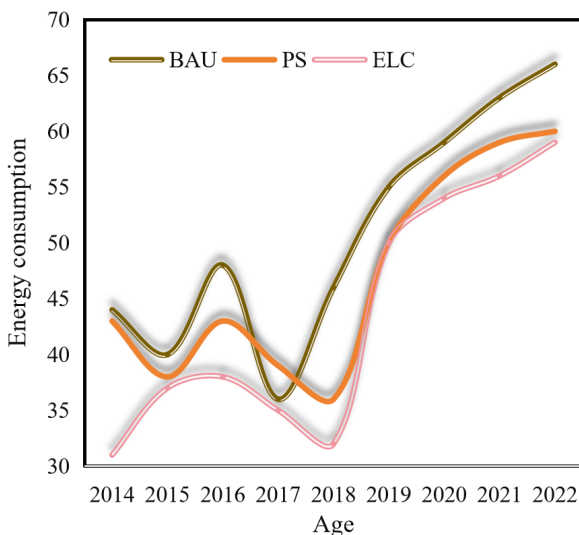
Accelerate the development of new energy and new materials, enhance the proportion of China's new energy industry, and realize China's low-carbon energy industry. Strengthen investment policies to support industrial energy structure, promote the transformation of energy structure, reduce the proportion of coal energy in industrial structure, comprehensively utilize renewable energy in various ways, and increase the proportion of renewable energy utilization. According to China's national conditions, the coal-based energy consumption pattern will not change fundamentally in the long term, so developing clean coal technology and clean utilization of coal is the best choice for China to realize energy conservation and emission reduction and reduce or control the total energy consumption. Based on this reality, China should adopt clean coal technology. The progress of energy technology is mainly reflected by energy consumption intensity and carbon intensity. As shown in Figure 1, the decline rate of energy intensity in the benchmark scenario is obviously lower than that in the policy scenario and the enhanced low-carbon scenario, and the gap has become wider and wider since 2014, and the energy consumption per unit GDP is obviously higher than that in the policy scenario and the enhanced low-carbon scenario in the corresponding year; Due to the deepening of industrial structure optimization under the scenario of strengthening low carbon, the energy consumption per unit GDP began to be lower than that under the policy scenario. Under the three scenarios, the energy consumption per unit GDP in 2020 decreased by 12%, 16% and 9% respectively compared with that in 2018, which basically achieved the goal of reducing energy intensity in

## China's low-carbon economic development.



**Figure 1.** Changes in energy consumption intensity under different scenarios

As shown in Figure 2, the energy consumption in all three scenarios shows an increasing trend year by year, but the energy consumption in the baseline scenario is significantly higher than that in the policy scenario and the enhanced low-carbon scenario, with an average growth rate of 5.68%, which is higher than the 5.57% in the policy scenario and 3.6% in the enhanced low-carbon scenario, and the gap is becoming larger and larger. The energy consumption in 2022 is 6.676 billion tons of standard coal, which is 600 million tons higher than the policy scenario and 700 million tons higher than the strengthened low-carbon scenario. Based on China's resource reserves and exploration and development level, the energy supply level will not meet the energy demand and there will be a significant energy shortage.



**Figure 2.** Changes in energy consumption under different scenarios

The renewable energy model refers to the mode of mutual conversion of resources, products, waste, and renewable resources, and is the connotation development model of circular economy. The renewable resource industry refers to a new type of market product manufactured through the recycling and processing of product waste. Increase the economic benefits of enterprises and other major coal

consuming industries. Therefore, focusing on the development of clean coal technology is the most realistic choice to promote the improvement of China's energy production and utilization methods, and to develop a low-carbon economy.

### 3.3. Optimize the energy structure

There is a strong correlation between China's energy intensity and the energy utilization efficiency of various industries. We should control China's energy intensity based on industrial energy utilization efficiency. From the perspective of China's sectoral energy structure, although the utilization of industrial energy has declined, it is still the largest energy consumer in China in the short term, while the construction industry and transportation industry have become the fastest growing consumers of energy consumption in China. The total energy is increasing. In this case, to optimize and adjust China's energy structure, we must first strictly control the excessive expansion of the total energy, especially the consumption of coal and oil, so as to minimize the consumption proportion of high-carbon energy. This inefficient mode of economic growth must be changed. We should fully explore ways to change China's traditional backward industrial structure, and focus on developing low-carbon related industries and strategic emerging industries in combination with China's actual technological situation, technological upgrading and industrial structure transformation. Developing innovative new energy technologies is the driving force to realize low-carbon economy. Only by constantly innovating and applying new energy can the application structure of energy in production and life be transformed, and gradually from high pollution and high emission to low pollution and low emission.

## 4. Conclusions

In summary, developing new and clean energy, diversifying and optimizing energy structure are requirements for ensuring the coordinated development of energy, economy, and environment in China. They are important guarantees for the transformation of China's economic growth mode from extensive to intensive, and are inevitable choices for achieving healthy and sustainable development of China's economy. The optimization principles of China's energy structure based on a low-carbon economy include sustainable development, prioritizing conservation, diversified development, two markets, and a combination of market regulation and macroeconomic regulation; The optimization approach is towards diversified, balanced, and low-carbon development; The optimization goals include economic growth, energy conservation, and pollution reduction. Therefore, China needs to formulate relevant measures based on its national conditions, change the current mode of energy management, and enable energy to develop towards conservation, cleanliness, and safety. Develop low-carbon consumption habits and eliminate the luxury and waste caused by Chinese style face consumption. From the perspective of a low-carbon economy, optimizing China's industrial structure can be achieved by guiding industrial direction, achieving low-carbon industries, optimizing energy structure, achieving clean energy, promoting low-carbon technologies, fully utilizing energy, developing low-carbon industries, advancing industrial structure upgrading, and cultivating circular economy. At the same time, we should rely on fossil fuels to maximize the research and development

of new energy, and systematically optimize the energy structure in the context of low-carbon and environmental protection, in order to ensure the sustained, stable, and healthy development of China's economy.

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