

Analysis of Carbon Emission and Emission Reduction Potential in Shaanxi Province

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Abstract. The rapid development of China's economy and society is obtained at the cost of the consumption of energy, especially fossil energy. And the coal-based energy consumption structure enables China to become the largest carbon dioxide emitter in the world. With the enhancement of global greenhouse effect, ecological environment deterioration is becoming increasingly serious. Carbon emission reduction has become one of the most important international issues. As one of the fastest growing economies in the world, China has also actively responded to energy conservation and emission reduction. As a major energy province in China, Shaanxi province plays a critical role in the national energy supply, and it was also listed as the first batch of low-carbon pilot areas in 2010. In recent years, relying on its own energy advantages, Shaanxi has witnessed rapid economic growth, but the resource stock and environmental carrying capacity cannot withstand the high intensity of resource consumption and environmental pollution under the traditional resource mode. As the first batch of "low-carbon development" pilot provinces, adjusting the industrial structure, changing the mode of economic development and realizing "low-carbon economy" have become the urgent problems to be solved in Shaanxi Province.

1 Background

In today's world, climate warming, environmental pollution and energy crisis have become the most important problems that seriously threaten the survival and development of human beings, arousing widespread concern all over the world. High temperature caused by climate change leads to the deterioration of ecological environment such as glacier melting and sea level rise, which breaks the balance of global natural ecosystem; high temperature also increases the frequency and intensity of natural disasters, like drought and insect pests, resulting in the reduction of global agricultural production; drought and water shortage also pose serious threat to human health and cause epidemic diseases. Climate warming not only aggravates the vulnerability of natural ecological environment, but also produces serious impact on economy. Global warming serves as the most important one among the top ten environmental problems in the world. Global warming seriously threatens the living environment of human beings, profoundly affects the global industrial development and changes the pattern of people's production and life.

Leading scholars believe that carbon dioxide and other greenhouse gas emissions are responsible for global warming, and carbon emission reduction has become one of the most important international issues. As one of the fastest growing economies in the world, China has maintained a momentum of rapid economic growth in

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recent years. However, energy plays an important part in China's economic growth, but China's energy utilization efficiency is very low. As the world's largest energy consumer, China's current per capita emissions have exceeded the world's per capita level, and the total emissions have surpassed it in the United States. These changes make China become the world's largest emitter.

China's regional economic development is extremely unbalanced, and the western region of China has been in backward for a long time. Both the resource stock and the environmental carrying capacity cannot withstand the high intensity of resource consumption and environmental pollution under the traditional resource mode. The pilot work was officially launched in August 2010, and five provinces and eight urban districts were selected as low-carbon pilot areas. Economic development areas at provincial level are the priority of the implementation of China's greenhouse gas emission reduction policies. Low-carbon Shaanxi Province of National Development and Reform Commission is the only western province, and is also a big energy producer and consumer. The study of carbon emission and emission reduction potential of Shaanxi Province has a certain reference value for the low-carbon development of other provinces.

2 Literature Review

In recent years, many domestic scholars have analyzed the carbon emission and its influencing factors and emission reduction potential of provincial economic regions. Wang

Zhen pointed out that the analysis of the development of the provincial low-carbon economy is of great significance for China to achieve carbon emission reduction, develop low-carbon economy and realize sustainable economic development. Based on the analysis of the current situation of economic growth and energy consumption in Shaanxi Province, Hu Qiongzhi (2017) used statistical analysis and econometric analysis to calculate the changing of total carbon dioxide emissions and the intensity from 2003 to 2015, and pointed out that energy structure and energy intensity produce a significant inhibitory effect on industrial carbon emissions in Shaanxi Province, and economic development is the leading factor of per capita carbon dioxide emission growth in Shaanxi Province^[1]. Su Yongle and other scholars further claimed that the industrial production efficiency plays a significant role in promoting the industrial carbon emissions in Shaanxi Province. Therefore, accelerating the supply-side structural reform and scientific and technological innovation on energy and boosting energy efficiency have become the main path for the implementation of low-carbon economic development in Shaanxi Province.^[2]

Since the implementation of the reform and opening up policy, especially the Development of West China, economy of Shaanxi province has developed rapidly. In 2020, the province's GDP reaches 2618.1 billion yuan. The existing industrial structure of Shaanxi Province carries strong regional characteristics and historical traces. The primary industry has a weak foundation, accounting for less than 10% in the long run, and has been experienced a downward trend, but this does not mean that the industrial structure of Shaanxi Province has been optimized and upgraded. Shaanxi Province has maintained the industrial structure featured by "the secondary industry is of the top priority, and followed by the tertiary and the primary industries" for a long time, rather than the optimized structure featured by "the tertiary industry is of the top priority, and followed by the secondary and the primary industries". This phenomenon is mainly attributed to the relatively large proportion of the secondary industry. In 2012, the secondary industry accounted for 55.8% of the output value, accounting for more than half of that in the whole province. By 2019, the proportion of the secondary industry declined slightly, but it was still close to half of the total output value. In the energy consumption composition of industrial sectors, power and heat production still represent the main energy consumption industries. As Shaanxi Province entering the middle and late stage of industrialization, industrial structure adjustment has a long way to go.

3 Analysis on current situation of carbon emission in Shaanxi Province

3.1 Current situation of industrial economy development in Shaanxi Province

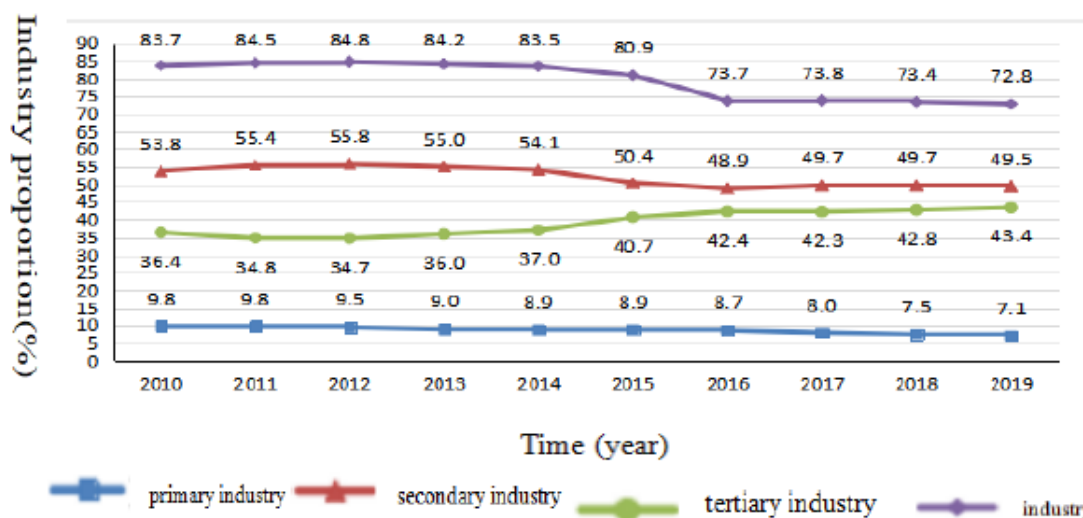


Figure 1 Changing trend of proportion of three major industries in Shaanxi Province from 2010 to 2019

3.2 Current situation of energy consumption in Shaanxi Province

3.2.1 Growing total energy consumption

It is predicted that the coal resource of Shaanxi, the important energy province in China, reaches 380 billion tons, ranking the fourth in the country; the cumulative proved reserves is 170 billion tons, ranking the third in the country. With the advantages of large reserves, high quality, complete varieties and easy mining, the proportion

of coal resources in energy consumption in Northern Shaanxi Province has always been high. As an important energy province in China, and based on its industrial strength, Shaanxi Province makes full use of its own resource advantages to vigorously develop coal power and other industries, and its economy has been constantly improved. In 2020, in the face of the impact of the epidemic, the GDP of Shaanxi Province stood at 2618.186 billion yuan, an increase of 2.2% over the previous year. Behind the rapid economic development of Shaanxi Province is a large amount of energy consumption. The large consumption of carbon based energy not only causes

energy waste, but also brings serious environmental problems.

3.2.2 Energy consumption structure mainly based on coal consumption

The abundance of coal resources determines the high coal consumption in the industrial energy consumption structure of Shaanxi Province. The 10th Representative Conference of the CCP in Shaanxi Province in 2017

clearly pointed out that “the energy structure of Shaanxi Province is the burning issue that needs to be gradually adjusted and continuously optimized”. However, according to the data of its Bureau of Statistics, the total energy consumption of Shaanxi Province in 2019 is 215 million tons of standard coal, of which coal accounts for 74.12% of the total energy consumption. At present, although the proportion of natural gas and non-coal-fired fossil fuels in energy consumption has increased, the consumption pattern of coal based energy industry has not been broken and remains high.

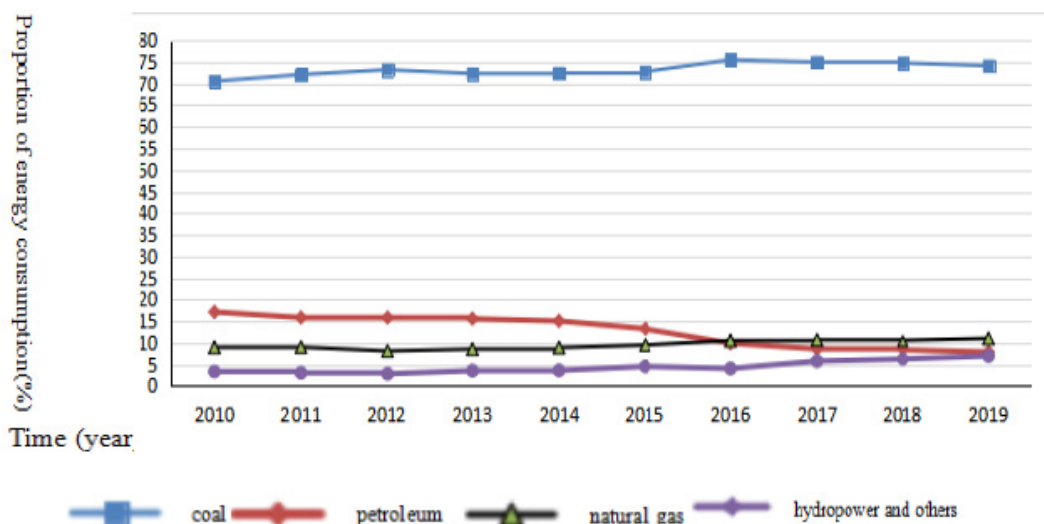


Figure 2 Energy consumption proportion in Shaanxi Province from 2010 to 2019

3.3 Total amount and the changing trend of carbon emission in Shaanxi Province

We calculate carbon dioxide emissions based on the energy consumption in Shaanxi Province. With the rapid development of economy and the increasing energy

consumption, the total carbon dioxide emission of Shaanxi Province is also increasing, from 60.018 million tons in 2010 to 89.2342 million tons in 2019. Among them, energy industry and industrial departments are the main sectors of carbon emission. It can be seen that the economic development of Shaanxi Province is at the cost of high input and high emission.

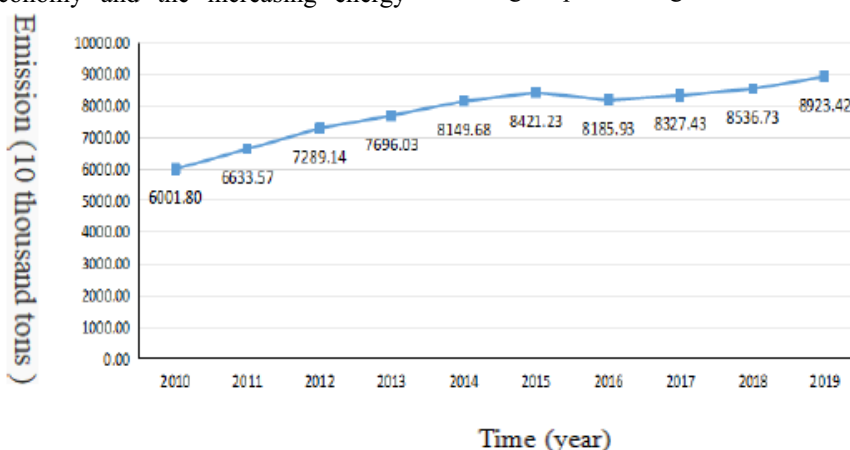


Figure 3 Trend of carbon dioxide emission in Shaanxi Province from 2010 to 2019

3.4 Analysis of energy utilization in Shaanxi Province

The total amount of energy consumption is not only related to the speed and mode of economic growth, but

directly related to the technology level of energy utilization. We use energy conversion efficiency to measure the its utilization. Energy processing and conversion efficiency refers to the ratio between the quantity of energy products and the quantity of energy input after energy processing and conversion. As an

important index to observe whether the energy processing and conversion equipment and production technology are advanced or backward, and whether the management is qualified or not. Shaanxi Province has been giving more preference to energy technology and processing technology in recent years. By 2019, the energy

conversion efficiency has reached 82.01%, of which the energy conversion efficiency of heating, coal washing, coking and refining is higher than the average level, but that of thermal power generation is low, only occupying 42%.

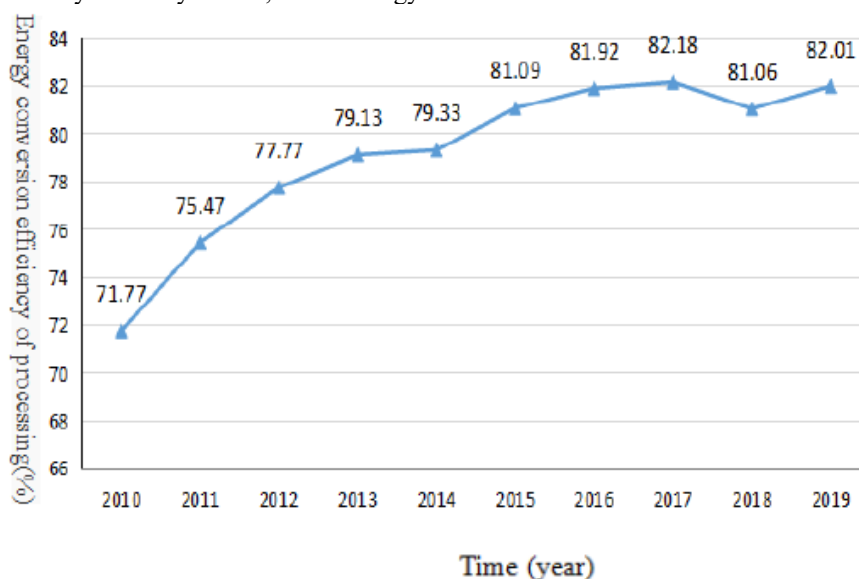


Figure 4 Energy processing conversion efficiency of Shaanxi Province from 2010 to 2019

4 Analysis on the problems of carbon emission in Shaanxi Province

4.1 The unreasonable industrial structure and the high proportion of secondary industry

After the reform and opening up, the economic and social development of Shaanxi Province has made great progress, but the overall level of economic and social development is still lag behind. With the continuous development of economy, the pressure of uncoordinated regional development on ecological environment is gradually increasing. Research shows that industrial structure has significantly inhibited industrial carbon emissions, but the current situation of Shaanxi Province indicates that economic growth is over dependent on the secondary industry, while the tertiary industry with low energy consumption accounts for a small proportion, and the resource intensive industries in the secondary industry account for a too high proportion.

4.2 The large total energy consumption and the coal-based consumption structure

Energy production largely determines the structure of energy consumption. The coal reserves in Shaanxi Province account for the highest proportion of energy reserves. Of 13 large-scale coal national programmed bases, the Shendong, Shanbei and Huanglong coal bases are located in Shaanxi Province. And the resource endowment presents a typical feature named “more coal, less oil and less gas”. In recent years, with the continuous

growth of GDP in Shaanxi Province, the total amount of industrial energy consumption has also increased dramatically, and the energy consumption has appeared linear upward trend. Among them, coal consumption accounts for a high proportion, reaching 70% in the energy consumption structure in the past decade. Although the relative proportion of oil and natural gas consumption is increasing year by year, the expansive economic growth mode of resource input is still the main obstacle for Shaanxi Province to achieve sustainable development and low-carbon economic growth in a short term.

4.3 The relatively backward energy processing and conversion device and the production process, and the low energy utilization efficiency

The massive consumption of carbon-based energy and the extensive production in Shaanxi Province lead to serious waste and low energy utilization in the process of mining, processing, conversion, storage, transportation and utilization. In Shaanxi Province, there are large regional differences in energy technology. As the only national energy and chemical industry base in China, Northern Shaanxi energy and chemical industry base has a simple resource development mode mainly based on mining, which causes many increasingly prominent problems such as short product chain, environmental pollution and ecological deterioration. In Northern Shaanxi, where technology is relatively backward, technological progress is mainly reflected in the improvement of labor production efficiency. Since there are lots of industries with high energy consumption and high pollution, higher labor productivity equals increased carbon emissions. The nature of energy conversion efficiency means a transition

from resource consumption to its sustainable development. Therefore, with more scientific and educational resources and water resources, Guanzhong energy connecting area and southern Shaanxi green energy area have more advantages in developing new energy utilization technologies and improving energy utilization efficiency than northern Shaanxi.

5 Analysis of emission reduction potential in Shaanxi Province

5.1 Optimize the industrial structure

The research shows that the inhibition effect of industrial structure on carbon emissions is only weaker than that of energy intensity. At present, Shaanxi Province is facing the strategic opportunity brought about by “the Silk Road Economic Belt and the 21st century Maritime Silk Road”^[3]. At the same time, the State implements a new round of Western development Strategy, vigorously supports Western China to develop and expand characteristic industries relying on resource advantages. Given this rare historical opportunity, our province will optimize the industrial structure, accelerate the transformation and upgrading of traditional industries, build a diversified industrial system, and adhere to the focus point of promoting supply side reform. Specifically, relying on the abundant resources, Northern Shaanxi should adhere to the principles of large-scale, internationalization and sustainable development, thoroughly implement the strategy of “the three transformation”. We should vigorously develop projects for comprehensive utilization and deep transformation of resources, steadily increase the output of primary energy products, and focus on the integration of coal, electricity and chemical industry, oil refining and chemical industry, and energy equipment. Besides that, we have to strive to create low-carbon and deep processing of chemical products, give priority to the development of high-end products and meticulous products, extend the industrial chain, and realize the green transformation of traditional advantageous industries by increasing the added value of products. The green energy zone in southern Shaanxi has orderly developed new energy based on hydropower, wind power and solar energy, and actively expanded and strengthened green agricultural products and other innovative biomedical industries.

5.2 Reduce the proportion of coal consumption and vigorously develop and utilize new energy

In the process of development, we should take high-quality development as the main line, technological progress as the support, and interconnection and sharing of energy resources as the link to reduce the total amount of energy consumption. Meanwhile, based on the national pilot requirements of energy saving and emission reduction, the total coal consumption control should be formulated, the target responsibility management should be implemented. After that, the proportion of coal in the

energy structure will be reduced. At the same time, we should orderly develop the new energy mainly based on hydropower, wind power and solar energy, actively implement energy livelihood projects such as “gasification of Shaanxi”, constantly increase the proportion of high-quality energy, promote the fundamental transformation of resource utilization, greatly improve the comprehensive utilization efficiency of resources and energy utilization efficiency. By doing that, the goal of energy conservation and emission reduction will be achieved.

5.3 Actively develop advanced low-carbon technologies to improve energy efficiency

Shaanxi's resource endowment determines its dependence on industrial energy, but its low energy efficiency has brought serious carbon emission pollution problems. Actively developing advanced low-carbon technologies and improving energy efficiency are the key to boosting low-carbon development, implement the national total carbon emission control requirements, and realize the balanced development of environment and energy. Shaanxi Province, as a big energy province and a strong province in science and education, should make full use of its advantages in scientific research, introduce technical talents, increase R & D investment, support the construction made by enterprises' technology centers in renewable energy and key energy-saving products, and build technology innovation and application demonstration projects, like the Internet plus smart energies.

6 Conclusion

As a sustainable development model with low energy consumption, low pollution and low emissions, low-carbon development is an important way to alleviate energy and environmental problems. Shaanxi Province, as an important energy province in my country, and as the first batch of "low-carbon development" pilot provinces, is also actively exploring low-carbon development methods. The article points out that Shaanxi Province has the following problems in the process of carbon emission reduction through the current status of carbon emissions, energy consumption and energy utilization: First, the industrial structure of Shaanxi Province is irrational, and economic growth is overly dependent on the secondary industry; Second, the energy consumption structure of Shaanxi Province is single, with coal consumption as the main source; The third is that Shaanxi Province's production and processing equipment and technology are relatively backward, and the promotion of energy-saving and emission-reduction technologies is not high. Therefore, the energy usage rate in the production process is low, causing energy waste. Therefore, accelerating the upgrading of industrial structure, advancing structural reforms on the energy supply side, and technological innovation are important ways for Shaanxi Province to accelerate the development of a low-carbon economy strategy.

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