

## Energy Structure Optimization and Economic Growth

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**Abstract.** In China's energy structure, coal still accounts for the most important part. China's demand for coal remains high. With the development of economy, such energy structure gradually shows irrationality. In order to deal with energy supply, safety and environmental issues, China should further adjust the energy structure in the future, making it more high-quality, more reasonable. Energy and economic growth have a mutually reinforcing role. In order to achieve sustained, stable and rapid economic development, we should give full consideration to the impact of energy.

### Introduction

At present, China's energy consumption accounts for the proportion of the world's total reserves are higher than the proportion of China's total energy is relatively low, accounting for a low proportion of the world's storage. Although China's coal resources are rich, the per capital recoverable reserves is only 89.8 tons, equivalent to the world average of 55.26%, equivalent to 22.49% in developed countries, equivalent to 10.18% of the United States, the outlook is very optimistic. China's oil and gas resources is also a serious shortage. According to the 2000 survey data, China's oil resources per capital recoverable reserves of only 2.6 tons, equivalent to the world average of 11.06%. At present, China's annual output of 160 million tons of oil is expected to recoverable for 118-158 million tons. Mining years up to several decades. Conservative estimates, in 2010 China's oil demand will reach 320 million to 350 million tons, the import volume will reach 160 million tons to 190 million tons in 2020, China's oil imports may reach 300 million tons, most will depend on imports. Natural gas per capital recoverable reserves of only 1074m<sup>3</sup>, equivalent to the world average of 4.33%. Even though the proven reserves are expected to reach 4 trillion m<sup>3</sup> in 2010 and 70.740 billion m<sup>3</sup> per annul (from a large gap in market demand), the mining life is less than 60 years. Therefore, the energy capacity of the limitations and the growing consumer demand makes our search for alternative energy buffer time is pressing. To maintain sustained and stable economic growth, the need to expand energy supply, or a huge energy demand will bring energy crisis, and in the limited total energy, only through the improvement of energy structure and improve energy quality to ensure stable economic growth. China's energy resources structure, supply structure and demand structure there is a sharp contradiction between, and with the pace of industrialization to speed up the energy supply and demand structural contradictions intensified. Energy "bottleneck" and the inefficient use of energy there is a sharp contradiction between the energy shortage has become a constraint to the development of the national economy, "the bottleneck", and our energy efficiency is very low. The contradiction between energy resource structure, supply structure and demand structure has been manifested in the form of intensification of coal surplus. Therefore, it is necessary to study energy structure optimization.

### Research Status

Energy likes a double-edged sword, as an important part of economic growth can promote economic development, when it can not meet the requirements of economic growth, will hinder economic growth.

Existing research shows that China's energy structure optimization is mainly reflected in the necessity of energy distribution, structure and other aspects of the status quo [1] [2]. China's energy and energy distribution is not reasonable: China's energy resources in the region is less than the North North, West rich East poor, economically developed, concentrated coastal areas lack of conventional energy sources. Energy structure and energy quality is poor, China's energy structure to low-energy-based; the contradiction of China's energy structure, the most fundamental lies in the resource structure, production structure and consumption structure of the contradiction between. In general, the current situation of China's energy situation is not optimistic. There are contradictions in terms of storage volume, distribution, production structure, or consumption structure, forcing us to optimize the energy mix.

How to optimize the energy structure, there are two main views: First, change the coal-based energy structure, and second, coal-based, on this basis, the diversification of the development of other energy sources. In the two main points of view, the former focus on change, which focuses on improvement, both in reality and development on the basis of optimization, but on the actual situation, improve the existing energy structure is a More reasonable and good way.

### **Energy Consumption, Environmental Protection and Economic Growth**

Economic growth has two meanings. On the one hand, economic growth means mass production, and the more the large amount of production is produced under certain production technologies, the more resources and energy inputs are needed, the more waste is discharged. On the other hand, economic growth also means the introduction of high value-added technology, through the introduction of technology can improve energy efficiency, promote industrial upgrading and conversion, the industry to less polluting, high technology intensive industries change all this Will reduce the amount of inputs per unit of output and waste discharge, so as to alleviate or resolve limited non-renewable energy and the contradiction between the unlimited human needs, mitigation and even solve the ecological and environmental problems.

Energy as an important material basis, in the economic system has an important role. As consumer goods, investment consumption mix used in people's lives; as an input element for the production sector to provide the necessary raw materials, runs through the economic operation of each link. For a country's economy, due to its basic status, energy supply and demand, structure, price and other aspects of any small changes will bring a series of chain reaction. At the same time, social-economic development. Including industrial and agricultural construction, urbanization, the improvement of living standards and other aspects also contributed to the growing demand for energy and energy supply. The greater the energy consumption, the greater the amount of pollutant emissions, the greater the pressure on the ecological environment.

The energy consumption is the main reason for the current environmental pollution, the above-mentioned urban dust, sulfur dioxide, the greenhouse effect is brought about by energy consumption. Therefore, in order to sustainable economic development, in the development of energy industry, enhance energy consumption, promote economic growth must be combined with the current level of technology to consider environmental issues.

Economic growth can be achieved through changes in factors of production such as labor, capital, and technology, and the effect of technology on economic growth can be achieved through the input-output efficiency of these factors. Technological progress can reduce the proportion of the use of certain elements (such as energy resources), thereby conserving resources, according to a certain proportion of production factors in the production process in a specific form of together. The effect of technological progress on economic growth can be expressed by the movement of production function. Figure 1 shows the relationship between technological progress and production function [3].

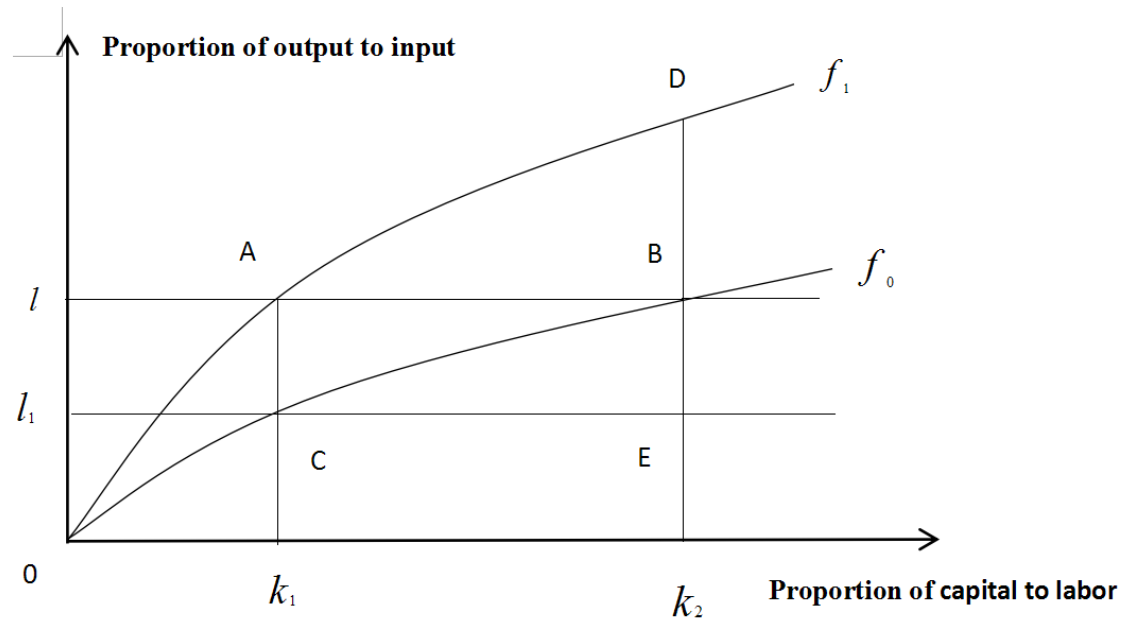


Figure 1 .Technical progress and energy conservation, economic growth

As can be seen from Figure 3, both before and after technological progress, with the growth of energy consumption, the scale of production gradually expanded, in order to achieve economic growth. However, the introduction of science and technology, so that input into the output with a multiplier effect. At this input level, technological progress has brought DB production for the entire production. For energy consumption and economic growth, the same energy consumption to obtain a greater economic scale. In the economic scale of 1, technological progress to save the amount of AB input, that is to achieve a certain economic growth. In the participation of technological progress can be significant savings in resource investment.

From the above economic growth theory, we can see that with the continuous economic development, energy consumption, technological progress, environmental issues are increasingly about economic growth. Energy is an irreplaceable element of economic growth, and technological progress, environmental issues and so are closely related with the energy issue. In order to ensure environmental improvement and economic growth. We either accelerate energy efficiency improvements or optimize the energy mix.

### Current Situation of Energy Structure in China

China's energy reserves are relatively rich, per capital mining reserves is relatively insufficient. China has a moderate level of energy in the world, accounting for about one tenth of the world's total energy, but its share of the world's total population of 1/4 of the head, the per capita energy recoverable reserves.

China's energy distribution is not reasonable. The regional distribution of energy resources in China is less than that in the north and the west is rich in the east. Economically developed and densely populated coastal areas lack conventional energy sources. The northwest coal and coal transportation pattern, the northwest coal and natural gas reserves is rich, resulting in the situation of West-East Gas Transmission; Southwest is extremely rich in hydro power resources, Resulting in the pattern of west to east. This kind of energy resources trans-regional deployment, has brought huge "transportation" costs.

China's energy structure is characterized by rich coal, lean oil, less gas. Among the world's proven reserves of fossil energy resources, oil, coal and natural gas have structural relations of 20%, 60% and 20%, compared with 5%, 91% and 4% in China (Figure 2). The figure shows that the amount of oil and natural gas resources and the world average was significantly less than normal.

This energy structure determines the pattern of energy production in coal-dominated in the future for a long period of time will not fundamentally change. China's energy quality is not high. One of the most significant is the quality of coal resources in China is not high, in the proven coal reserves. Anthracite (high-quality thermal coal) accounted for 12%, lignite accounted for 13%, coal resource structure on the environment significantly negative, more polluting (Figure 3).

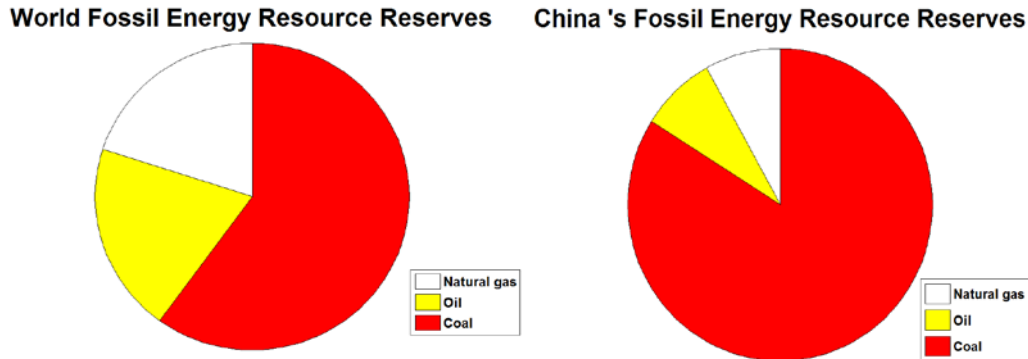


Figure 2. World and China fossil energy resource reserves

#### Coal Resources Structure in China

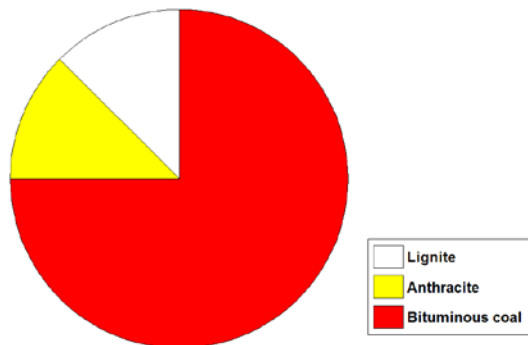


Figure 3. China's coal resources structure

### The Relationship between Energy Structure Optimization and Economic Growth

General energy and economic growth are based on the relationship between energy consumption and economic growth, and on energy structure optimization will need to compare the energy consumption in different years to draw the energy structure optimization and economic growth. Here, the quantitative analysis of the elasticity of energy consumption is made. The elasticity coefficient of energy consumption is used to measure the relationship between energy consumption growth and economic growth, and to study the energy consumption efficiency and economic development level of the economic system. The relationship between the growth rate of energy consumption and the rate of economic growth is usually synchronized with the growth rate of growth in advance of the law of synchronous growth.

Energy consumption elasticity formula:

$$\beta = (\Delta E / E) / (\Delta Y / Y) \quad (1)$$

$\beta$ : the energy consumption elasticity coefficient;

$E$ : the amount of energy consumption growth;

$Y$ : gross domestic product.

The following are coal, oil, natural gas and electricity as an example for elastic analysis. The consumption elasticity coefficient of coal has been declining since the beginning of the reform and opening-up to 1992, and rising continuously from 1993 to 1996. In 1997 to 1998, the elasticity coefficient has been reduced to negative, so we can be before 1998, the consumption elasticity of coal as a total decline, that is, coal consumption and economic growth is a negative correlation. In other words, coal consumption in the process of economic growth in reducing the role. Since 1998,

the increase in the elasticity coefficient of coal consumption shows that the role of coal consumption in China's economic growth is increasing, and the increase is very large: from the negative in 1998 to 1.886 in 2003. This fully shows that from 1988 to 2003, coal consumption in China's economic development in the role of increased. But the same with the "energy-saving emission reduction" and "eliminate backward production capacity" policy implementation, after 2003, the elasticity of coal consumption decreased year after year. Oil, gas and electricity have one thing in common: their consumption elasticity coefficient after a long period of increase, there is a short fall, fall after a long rise. Therefore, without considering the effect of industrial policy under the premise, we can put the three consumption elasticity of the change attributed to has been on the rise, see Figure 4. The increase of the elasticity coefficient shows that their three kinds of energy consumption in China's economic growth in the proportion is increasing. Its importance is also increasing. And this shows that in China, oil, natural gas and electricity consumption and economic growth is a positive relationship between the relationship. At the same time we can say: in the future economic development. China's oil, gas and electricity will become increasingly important role. But it can not be ignored that the recent market situation shows that the supply of oil and electricity will become more and more difficult, which will restrict its role in economic growth [4].

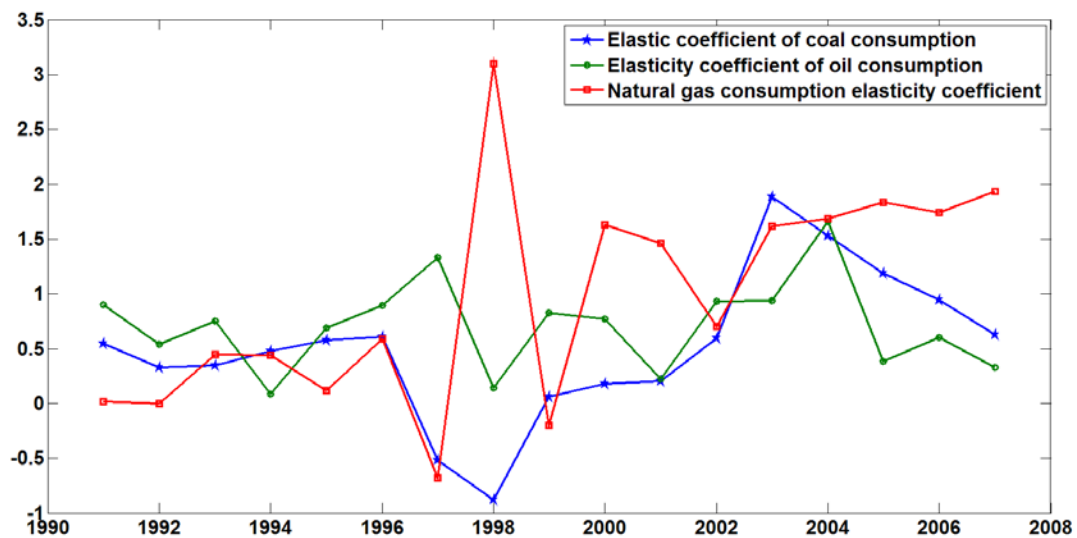


Figure 4. the energy elasticity coefficient charts

In summary, the two methods of the conclusions are exactly the same. Therefore, before 1998, China's energy consumption and economic growth showed a negative correlation between the 1998-2003 years, China's energy consumption and economic growth show a positive correlation between the relationship. But for the specific energy sector, consumption in the oil, gas and electricity sectors has been on the rise (albeit in some cases, but generally on the rise), while coal has been declining. This shows that oil, natural gas and electricity consumption and economic growth is a positive correlation between the three, while the coal is negatively correlated. Between 1998 and 2003, the four major energy consumption are on the rise, making the four kinds of energy consumption and economic growth, the relationship between all into a positive correlation. From the above analysis we can see that the energy structure changes and economic growth is bound to have. With the process of industrialization, the energy of coal has been replaced by high-quality energy in a certain extent. [5] In this process, the economy has developed continuously. The continuous development of the economy has improved the utilization of coal, including the development of new technologies. Oil, natural gas and other energy utilization ratio of consumption continues to increase, which is an inevitable trend of economic development. Can be seen in the future, the direction of structural optimization are: coal-based, pluralistic development, the economy is also such energy structure to continue to develop.

## **Conclusions and Suggestions**

Rely on coal for diversified development. To develop alternative energy sources. Based on the domestic market, to strengthen international cooperation.

The development of energy can not be separated from the actual economic growth, the development of energy can not lag behind the economic growth, nor too much ahead of economic growth, only to ensure that energy can meet the needs of economic growth and not relative surplus in order to promote the national economy sustained, Healthy growth.

To develop appropriate financial support and incentive policies to promote the stable development of energy conservation and renewable energy.

Popularize ecology education, accelerate the development of circular economy.

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