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Status Quo of Energy Consumption Based on Intelligent Algorithms

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Abstract: Since the reform and opening up, my country's economy and society have been in a state of vigorous development, and the construction of various fields has also achieved fruitful progress. Energy has become the guarantee for the survival and development of contemporary society, but the massive consumption of energy has caused many adverse effects on the ecological environment in which we live, such as air pollution, land desertification, serious soil erosion, and destruction of ecological diversity, etc. Our country is facing a serious energy shortage crisis. The main purpose of this paper is to study the current situation of energy consumption based on intelligent algorithms. This paper analyzes the energy policy factors, and analyzes the Pearson correlation coefficient between the indicators of the national energy policy factors. The research results show that the energy industry fixed asset investment IFA, coal consumption ratio PCC, and electricity consumption TEC have strong correlations with China's natural gas demand greater than 0.8. The negative correlation between coal consumption ratio PCC and natural gas is in line with reality.

1. Introduction

Energy is one of the essential elements in production and life. In the past, the extensive economic development method relied on a large amount of energy input. Therefore, the elastic coefficient of energy consumption is used as a traditional method to predict the economic growth rate. In fact, with the advancement of science and technology, the improvement of energy efficiency and other factors, the energy consumption of various countries has fluctuated to varying degrees. In addition, energy conservation, emission reduction and sustainable development have basically reached a consensus on a global scale. The economic growth of some countries, especially developed countries The fluctuation between energy consumption and energy consumption is inconsistent with or even deviated from the traditional situation, and the coupling relationship between the two is

greatly weakened [1-2].

In related research, Hafeez et al. developed a fast and accurate hybrid electric energy prediction (FA-HELF) framework [3]. The proposed framework integrates two modules with a support vector machine (SVM) based predictor. These modules are data preprocessing and feature engineering, and an improved Enhanced Differential Evolution (mEDE)-based optimizer.

Khafaf et al. proposed a clustering index that can efficiently find the optimal number of clusters [4]. The proposed metric is an entropy-based measure obtained from the eigenvalue analysis of the correlation matrix of the consumption data time series. Genetic algorithm based feature selection is used to reduce the number of features which are then fed into the clustering algorithm.

Kalogeropoulos developed the Model Predictive Control method to solve two main problems that arise in power distribution systems, namely the congestion and balance problems of distribution lines [5]. The energy demand of consumers is divided into uncontrollable parts, and the controllable parts can either be stored in energy storage devices for later use, or transferred in time in the form of hourly consumption or maintain a certain regular consumption. Finally, these new developments are tested on the IEEE European low-voltage test feeder, highlighting the performance of the proposed control scheme.

This paper studies the current situation of energy consumption based on intelligent algorithms. This paper firstly analyzes energy consumption channels, conducts research on energy allocation theory, analyzes the relationship between energy, economy, environment and energy optimal allocation; then describes the paths of various factors affecting energy structure; then analyzes the influencing factors of energy consumption structure , including carbon emissions, economic growth, energy prices, industrial structure, population, technological innovation and energy conservation; finally, it analyzes energy policy factors, as well as energy production and consumption structure.

2. Design Research

2.1. Consumption Channels

First, financial development drives the growth of the national economy by reducing financial transaction costs, absorbing funds from individual savers to a greater extent, and deploying funds more effectively. People will spend more of their income on enjoyment-oriented consumption such as medical care, transportation, and entertainment, and thus the consumption structure has changed. Secondly, in line with the development of the market economy environment, financial development will also generate more diversified financial instruments to serve financial entities. For consumers, diversified financial derivatives will provide them with a variety of investment and wealth management options, increase residents' exposure, trust and holding of financial products, which is conducive to increasing income through investment in financial products in consumption. For groups with higher income, the effect of growth is more obvious, so living consumption will increase. With the improvement of the financial market, the liquidity constraints of consumption are reduced, and consumption is more free. At this time, consumers can better realize intertemporal consumption. Coupled with the development of financial intermediaries, the realization of credit is simplified, consumer demand increases, and living consumption From this increase [6-7].

To sum up, consumers' living consumption will affect energy consumption and energy structure. Consumers' consumption of energy is divided into two categories: direct and indirect consumption, and the impact on energy consumption is also divided into two parts: direct and indirect. The direct use and consumption of energy commodities by consumers is a direct influence. Now that the economy is growing steadily and income levels are improving, people spend less on food as a

percentage of their income than before and are more inclined to use their disposable income to improve their living standards. On the one hand, for example, in terms of comfortable living conditions, the expansion of housing area, the corresponding demand for activities such as lighting, heating and cooling, and the accommodation area are constantly increasing, coupled with people's demand for durable goods such as air conditioners, refrigerators and computers. As the demand for electrical equipment increases, the consumption of energy-intensive and high-energy-consuming household appliances has gradually increased in the proportion of consumers' consumption structure. Moreover, this high-energy-consuming lifestyle characterized by too large housing area and excessive use of energy-consuming appliances is gradually becoming the lifestyle of most consumers. This means that direct consumption of energy by consumers has increased due to improved living conditions. In terms of fast transportation, the improvement of income level also has an impact on consumer travel characteristics such as leisure, tourism and other behaviors and travel preferences. People's consumption of private transportation, such as buying cars and motorcycles, will increase, which will also drive direct consumption of energy. But on the other hand, with the improvement of income level and quality of life, people no longer only focus on obtaining material satisfaction, but also spiritual needs are very important. This includes the pursuit of quality of living environment. Changes in thinking will change consumer preferences and consumer behavior. As people's awareness of environmental protection becomes stronger and stronger, the consideration of consumer products is more focused on whether they are friendly to the environment. Coupled with the government's publicity and guidance, the concept of energy saving, emission reduction and low-carbon travel is deeply rooted in the hearts of the people, and people's consumption is also changing to a green and low-carbon lifestyle, reducing energy consumption. Affected by consumers' consumption preferences, producers also pay more attention to the green environmental protection requirements of products when producing products. These are all conducive to the transformation of energy consumption from quantitative to qualitative. Various energy products and services purchased by consumers in food, clothing, housing and transportation will also indirectly affect energy consumption. For example, service consumption in food, medical care, education, culture and entertainment will indirectly increase energy consumption, because all equipment requires Energy manufacturing and operation [8-9].

2.2. Energy Allocation Theory

(1) The relationship between energy, economy and environment

Energy is a natural resource, but not a general natural resource. It plays a very important role in the national economic system as the driving force and foundation of economic development. Even with the increasing consumption of energy, the ratio of reserves and production is shortened, which is related to the economy and society. whether sustainable development can proceed smoothly. The distribution of energy production and consumption is directly related to the process of local industrialization, urbanization and modernization and related environmental and ecological conditions [10-11].

Energy has two direct effects on the economy, one is to influence and restrict the industrial structure, and the other is to affect the level of productivity. However, most of the energy, especially the currently dominant fossil energy, the total amount is basically fixed and limited, and will be more scarce in the future. Therefore, in the face of possible energy depletion in the future, it is necessary to optimize the allocation of energy while improving efficiency, not only to ensure the needs of the present, but also to consider the fairness of future generations. In addition, the

development of renewable energy It is an effective alternative to effectively solve the current gradual depletion of fossil energy [12-13].

The economic development and the use of energy will inevitably have an impact on the surrounding environment. China's extensive growth for more than 30 years has placed too great a burden on the environment, making the contradiction between energy consumption and environmental protection intensified. China's main energy source is coal, and its production bases are mainly in the central and northwestern regions, which are precisely ecologically fragile areas, and the situation of ecological and environmental protection is very serious while developing [14-15].

(2) Energy optimization configuration

The energy quality is not excellent, and the task of optimizing energy allocation, reducing the proportion of coal and increasing the proportion of natural gas and non-fossil energy is imminent. The goal of optimizing energy allocation is to ensure the balance of energy supply and demand, the minimization of energy production and consumption costs, and the maximization of benefits. The goal of ensuring energy supply and demand balance involves energy reserves and energy security. In order to ensure domestic energy security, renewable energy must be developed while building domestic energy reserves. In order to achieve the goal of minimizing the cost of energy production and consumption and maximizing the benefits, it is necessary to use economic means to assist the implementation [16-17].

2.3. Empirical Analysis and Research Conclusions

According to the above analysis, in the construction of the road map in Amos Graphics, "carbon emissions", "energy conservation" and "technical progress" are exogenous variables and are relatively independent factors; "economic growth", "energy price", "industry "Structure" and "population" are both affected by other factors and other variables. "Energy consumption structure" is an endogenous variable; "e4"-"e8" are residual variables, which belong to random interference items [18], as shown in Fig. 1 shown.

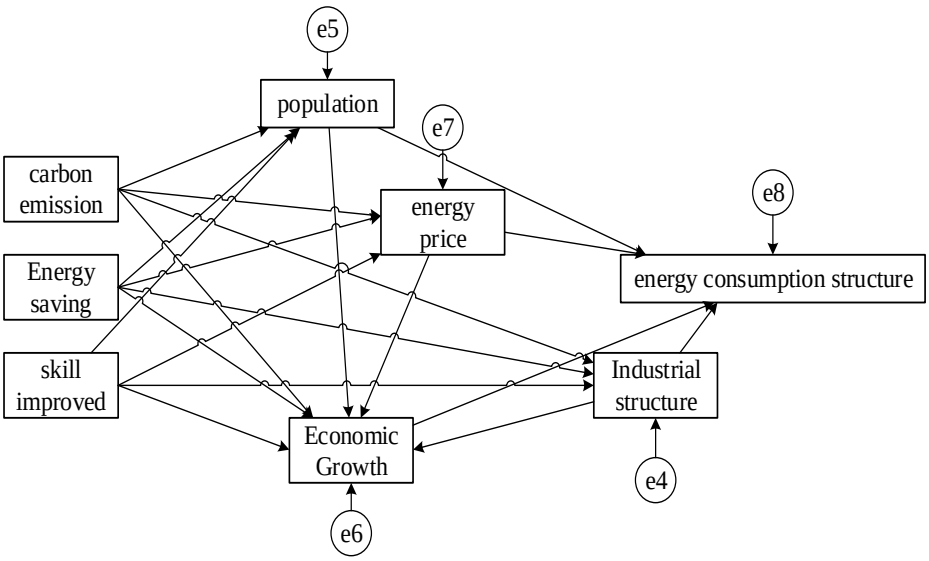

Figure 1. The road map of factors affecting the energy structure

2.4. Algorithm Research

Based on the support vector regression machine model, the temperature, wind speed, radiation and other meteorological elements are used as training data to predict the future energy demand on the load side under climate change. Process and run parameter selection.

(1) Data processing

The input training parameters of the support vector regression machine are meteorological data (temperature, wind speed and radiation), and the output parameters are the energy demand on the load side. The dimension between the input and output data is quite different. To normalize the data, the formula is:

$$X = \frac{X - X\min}{X\max - \min} \tag{1}$$

(2) Operating parameters

The penalty function parameter C affects the settlement accuracy of the model by determining the size of the weight loss value. In this paper, the penalty function parameter C is set to 10~100, and the loss function parameter ε is set to 0.01~0.001. Through the comparison of the results, the optimal setting option is selected.

(3) Evaluation indicators

The selection of operating parameters needs to pre-set evaluation indicators. The evaluation indicators set in this paper mainly include mean square error (MSE) and determination coefficient (R2).

$$MSE = \frac{1}{m}(y_i - Y_i)^2 \tag{2}$$

$$R^2 = 1 - \frac{\sum_i (Y_i - y_i)^2}{\sum_i (y_{e,i} - y_i)^2} \tag{3}$$

Among them, Yi is the predicted value, yi is the actual value, and ye, i are the mean. The smaller the MSE and the closer R2 is to 1, the higher the prediction accuracy.

3. Experimental Study

3.1. Influencing Factors of Energy Consumption Structure

Based on previous literature research, the influencing factors of energy consumption structure are summarized as follows:

(1) Carbon emissions

In recent years, the evolution of the energy structure is closely related to the macro trend of low-carbon economy and green development. The overall trend of the world's low-carbon ecology, the international cap on carbon emissions, and the commitment of various governments to save energy and reduce emissions have a direct impact on energy consumption. Therefore, in order to ensure the optimization of energy consumption structure is the key to the realization of emission reduction commitments.

(2) Economic growth

From the previous analysis, it can be found that energy supply and consumption are the driving force for China's economic growth, especially the rapid modernization and urbanization process. In addition to the reasons for resource endowment, the different stages of economic development also put forward new ideas for the energy structure. The development law of the major economic powers in the world also shows that economic growth is always accompanied by the continuous optimization and adjustment of the energy structure, and it has undergone a process of re-searching for growth points and gradually adapting.

(3) Energy prices

As one of the factors of production, energy can be substituted for each other under the premise of technical feasibility, and energy prices largely determine the choice of types of energy factors, the fluctuation of prices in the energy market affects the adjustment of supply and demand, and Changes in energy consumption structure. China's current coal-dominated consumption structure is closely related to the unreasonable price mechanism in the current world energy market and the inadequate price reform in China's domestic energy market, in addition to the resource endowment. The price distortion in the energy market will cause the price elasticity of energy to deviate from its normal trajectory, which will have a significant impact on the respective demand shares of energy, which in turn will affect the composition of the energy consumption structure.

(4) Industrial structure

With the continuous development of China's national economy, the industrial structure has been gradually adjusted and upgraded. At present, it has entered the late stage of industrialization. The output value of the tertiary industry has surpassed that of the secondary industry, and continues to increase, gradually replacing the industrial output value and occupying the dominant position. It also puts forward new requirements for China's future energy structure adjustment.

(5) Population

People are both producers and consumers. Their unique dual identities determine the multi-faceted and complex impact on energy consumption. The population size is constantly changing, the living standards of residents are constantly improving, and the transformation of household consumption structure can not only directly affect energy consumption. energy consumption, such as the use of high-energy-consuming home appliances and automobiles, and can also indirectly affect energy consumption through production, technology trade, etc., such as the production of high-energy-consuming products, the research and development of patents, and the transfer of use, all of which affect energy consumption. The formation of dynamic influence not only affects the quantity of energy consumption, but also affects the structure of energy consumption more deeply. For example, per capita direct coal burning is becoming less and less, per capita oil and natural gas consumption is steadily increasing, and so on.

(6) Technological innovation

Technological innovation can affect energy consumption from two aspects. On the one hand, it can directly affect the field of energy consumption, such as adopting new production combinations, developing emerging industries or transforming traditional technologies with the introduction of new technologies, so as to improve energy consumption efficiency, save energy, Reduce consumption, and can also promote energy revolution by developing new renewable energy sources, replacing traditional fossil energy, and affecting energy market prices and energy demand. On the other hand, technological innovation will also optimize and adjust the industrial structure, indirectly affecting energy consumption. However, China's technological innovation force in the energy field is still relatively weak, and its progress is relatively slow, which urgently needs to be strengthened.

(7) Energy saving

At present, China is in the middle and late stage of industrialization, and the secondary industry, especially the industry, is still in a state of high energy consumption, and the gap is still obvious. Especially after China proposes the upper limit of total energy consumption and the increasingly strict environmental constraints, energy saving will reach a very important key position. The substantial improvement of energy utilization efficiency will help to slow down the rigid growth of energy and alleviate the contradiction between supply and demand. Taking this as a breakthrough point can effectively promote the upgrading of the economic structure and the optimization of the energy structure, and enable the saved energy to be used as a factor input. More economic output increases, forming a virtuous circle.

3.2. Analysis of Energy Policy Factors

(1) Energy Industry Fixed Asset Investment (IFA)

Investment in energy fixed assets is the basis for the infrastructure construction of the energy industry, and its main funds are used for project construction, technology research and development and infrastructure purchase good development and stimulate energy demand. Investment in the energy industry can intuitively reflect the investment in the country's multi-energy industry, and it is also an intuitive manifestation of policies. Therefore, fixed asset investment in the energy industry can be selected to reflect one of the variables of a country and a region's energy policy.

(2) Proportion of coal consumption (PCC)

Energy consumption is increasingly urgently transformed to low-carbon and green, and the proportion of coal consumption can reflect the country's macro-control policy on energy. The proportion of coal consumption can reflect the country's policy orientation towards natural gas-related clean energy, so the proportion of coal consumption can be taken as one of the variables reflecting the national energy policy orientation.

(3) Electricity and energy consumption (TEC)

Electric energy has the advantages of cleanliness, low pollution, wide sources, wide applications, and many transformation situations. Electricity and natural gas are both clean energy sources and have received considerable support in the national energy policy. The power system and the natural gas system are inextricably linked. At present, my country's electricity mainly comes from thermal power, up to 80%, through the cross relationship of complementary energy sources such as natural gas power generation my country's natural gas-related clean energy policy can be grasped through electricity consumption, so the growth trend of electricity consumption can reflect the country's policy orientation towards clean energy.

4. Experiment Analysis

4.1. Analysis of Policy Factors

The Pearson correlation coefficient analysis is carried out among the national energy policy factors selected above, and the analysis results are shown in Table 1:

Analysis of the above figure shows that the energy industry fixed asset investment IFA, coal consumption ratio PCC, and electricity consumption TEC all have strong correlations with China's natural gas demand greater than 0.8. The negative correlation between coal consumption ratio PCC and natural gas is in line with reality.

Table 1. Correlation coefficients between national energy policy factors and indicators

	NGD	PCC	IFA	TEC
NGD	1.000	-0.8745	0.9729	0.9717
PCC	-0.8745	1.0000	-0.8591	-0.8424
IFA	0.9729	-0.8591	1.0000	0.9937
TEC	0.9717	-0.8424	0.9937	1.0000

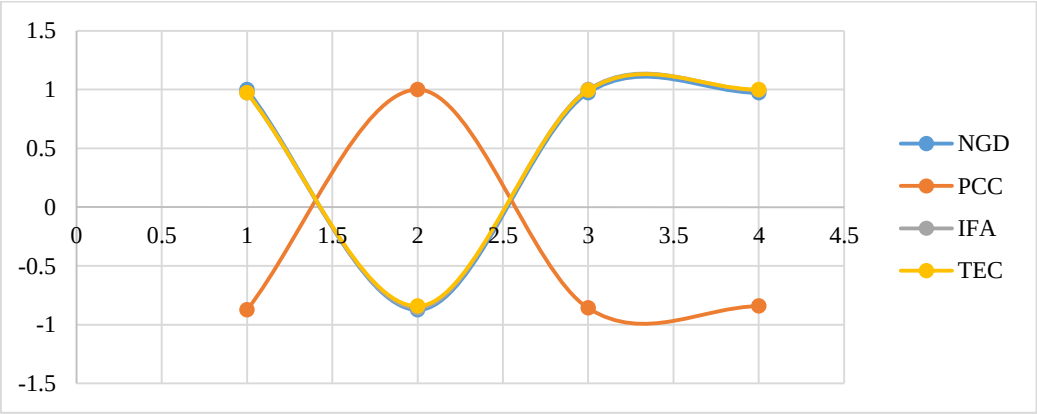

Figure 2. Analysis of the correlation coefficient between national energy policy factors and indicators

4.2. Analysis of Energy Production and Consumption Structure

(1) Proportion of energy production structure

Table 2. The proportion of my country's energy production structure

Time	Proportion of raw coal (%)	Crude oil proportion (%)	Proportion of natural gas (%)	Proportion of hydropower, nuclear power and wind power (%)
1	76.7	12.2	2.7	8.4
2	77.4	11.3	2.9	8.4
3	77.5	10.8	3.2	8.5
4	77.8	10.1	3.5	8.6
5	76.8	9.8	3.9	9.5
6	76.8	9.4	4.0	9.8
7	76.2	9.3	4.1	10.4
8	77.8	8.5	4.1	9.6
9	76.2	8.5	4.1	11.2
10	75.4	8.4	4.4	11.8
11	73.5	8.3	4.7	13.5
12	72.2	8.5	4.8	14.5
13	69.8	8.3	5.2	16.7
14	69.6	7.6	5.4	17.4
15	69.2	7.2	5.4	18.2

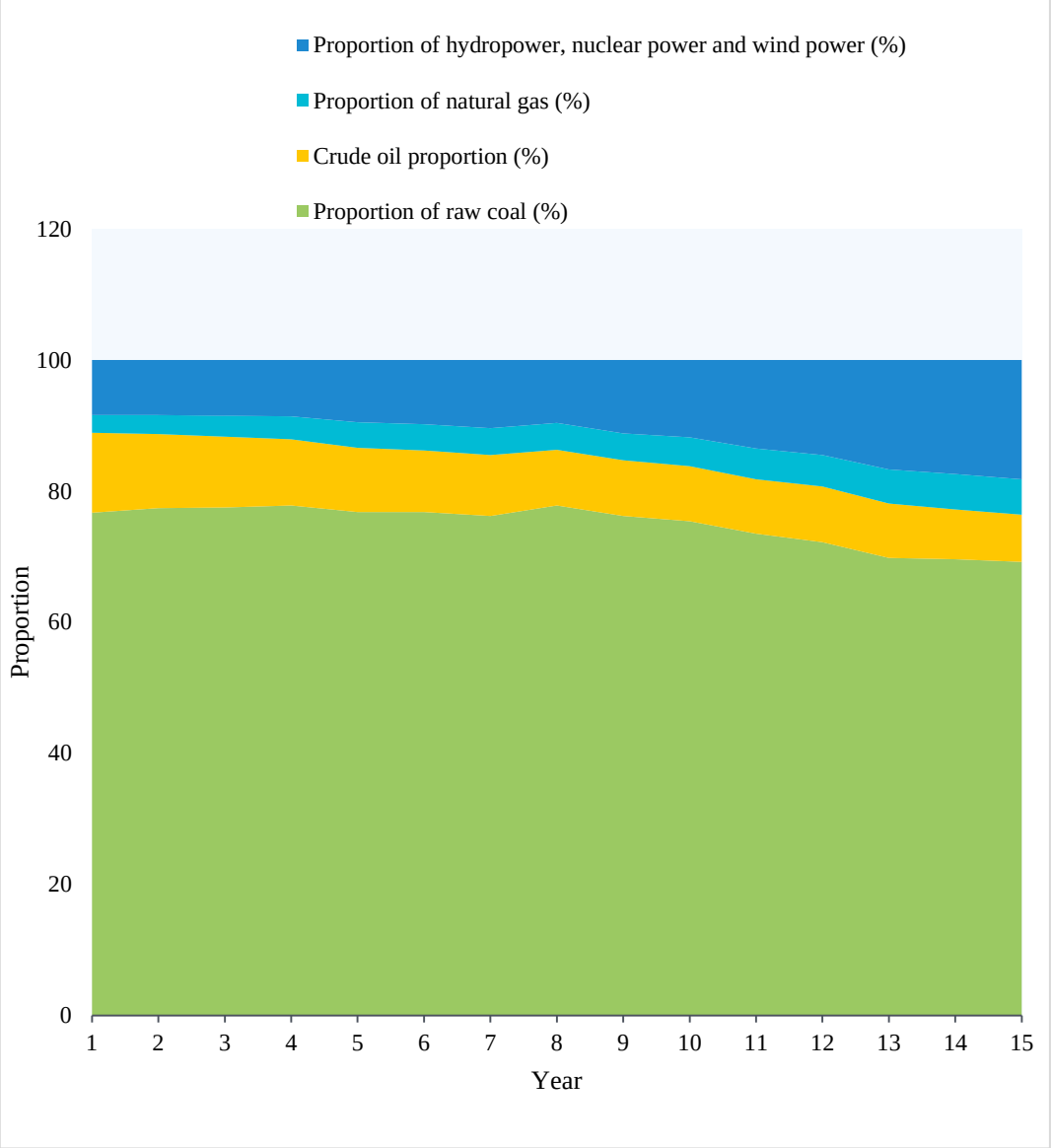

Figure 3. Analysis of the proportion of my country's energy production structure

As shown in Figure 3, in terms of structure, both productivity and proportion have increased, accounting for 204.59 million tons of standard coal and 5.4% respectively; the production of hydropower, wind power and nuclear power increased from 173.13 million tons of standard coal in the first year. By the 15th year of 689.52 million tons of standard coal, the proportion of total station energy production has also increased from 8.4% in the first year to 18.2% in the 15th year. These data show that my country's energy production structure is in a state of continuous optimization. Because my country attaches great importance to building a resource-saving and environment-friendly society, the proportion of highly polluting traditional energy sources such as raw coal has gradually decreased, while the proportion of energy production such as natural gas, which represents clean energy, has continued to increase.

(2) Proportion of energy consumption structure

Table 3. The proportion of my country's energy consumption structure

Time	Proportion of raw coal (%)	Crude oil proportion (%)	Proportion of natural gas (%)	Proportion of hydropower, nuclear power and wind power (%)
1	70.2	19.9	2.3	7.6
2	72.4	17.8	2.4	7.4
3	72.4	17.5	2.7	7.4
4	72.5	17.0	3.0	7.5
5	71.5	16.7	3.4	8.4
6	71.6	16.4	3.5	8.5
7	69.2	17.4	4.0	9.4
8	70.2	16.8	4.6	8.4
9	68.5	17.0	4.8	9.7
10	67.4	17.1	5.3	10.2
11	65.8	17.3	5.6	11.3
12	63.8	18.4	5.8	12.0
13	62.2	18.7	6.1	13.0
14	60.6	18.9	6.9	13.6
15	59.0	18.9	7.6	14.5

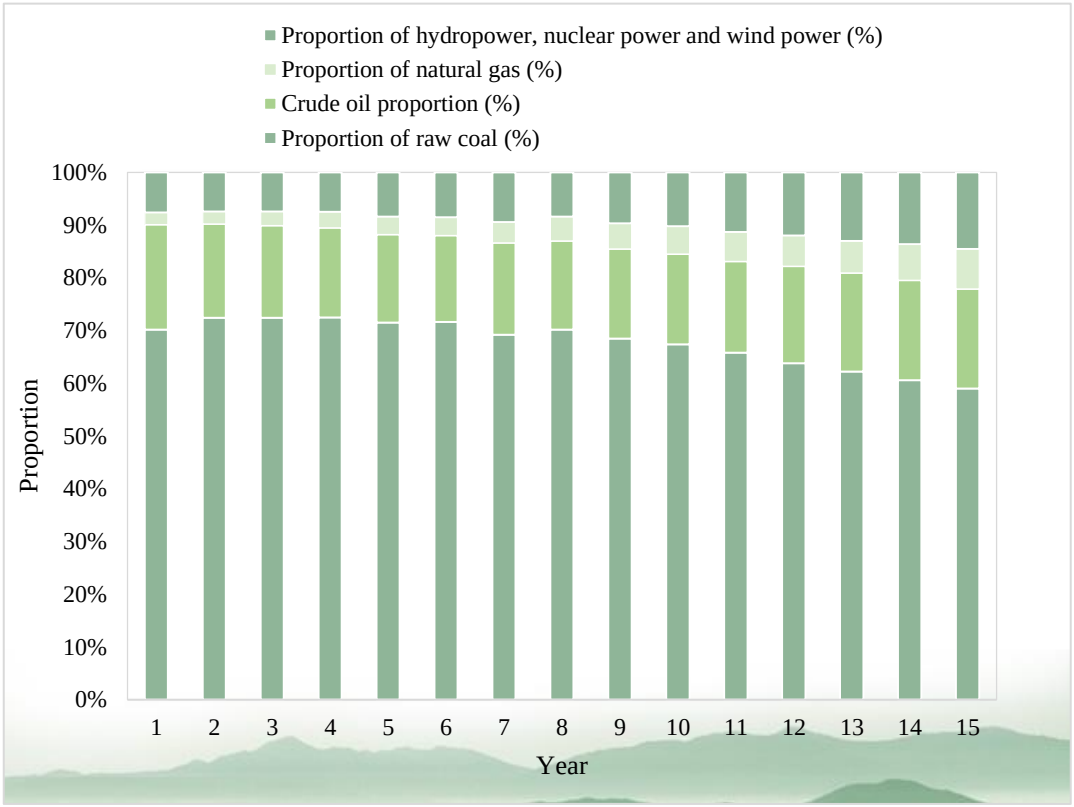

Figure 4. The proportion of my country's energy consumption structure

Analysis of Figure 4 shows that the structure of energy consumption is being optimized and

adjusted, and the proportion of coal and crude oil consumption is slowly declining. my country's energy consumption structure is developing towards the trend of "de-coalization".

5. Conclusion

This paper comprehensively considers the influencing factors of energy consumption structure and its mechanism of action, combined with empirical analysis and discovery theory, the energy structure is dominated by fossil energy, the dominant position of coal consumption is difficult to change in the long run, and energy consumption patterns and energy utilization efficiency are full Criticized, the "Eleventh Five-Year Plan" proposed energy intensity constraints, and the "Twelfth Five-Year Plan" proposed specific reduction targets, which were guaranteed by legislation. In addition, the domestic regional consumption structure is unbalanced. The main sources of energy are in the central and western regions, and the developed eastern regions require huge amounts of energy. This difference not only increases the cost of energy transportation, but also affects economic development due to the frequent occurrence of contradictions between supply and demand. In the future, to cope with climate change, reduce carbon emissions, economic development and upgrading of industrial structure will also lead to changes in the energy structure. In the future, the demand for low-carbon and clean energy will gradually increase, and the proportion of high-carbon energy mainly dominated by coal will be gradually replaced by new energy.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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