Research on green and low-carbon development paths under the dual-carbon background

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Abstract: In the context of "double carbon", this article establishes a PMC indicator model and quantitatively analyzes the content correlation relationships in policy texts. This model can clearly display the hierarchy of policy implementation effects and help decision-makers quickly judge the quality and impact of policies. The use of multi-input-output tables and text mining methods can effectively obtain important content in policy texts, reflect the correlation between variables, and provide strong support for green and low-carbon development paths. Research results show that it is expected that the energy structure adjustment will increase by 4% in 2025, and carbon emissions will be reduced by 3.51 million tons. The research results of this article have important practical significance and practical value in promoting high-quality economic development and building a strong country.

1. Introduction

As the economy continues to expand, climate issues have emerged as a pressing concern for humanity [1]. Notably, issues such as global warming, triggered by significant emissions of greenhouse gases like carbon dioxide and nitrogen oxides, have garnered widespread attention [2-3]. In response to the urgent challenge of global climate change, numerous countries and regions have set carbon neutrality targets, making green and low-carbon development a globally shared aspiration [4]. Aligning with these global trends, the Chinese government has introduced a "dual carbon" policy to advance sustainable development initiatives [5]. A thorough examination of green and low-carbon development paths in the context of this "dual carbon" framework will facilitate the advancement of energy reform and development efforts.

This article establishes a PMC index model in the context of the "dual carbon" policy and employs this model to conduct a multi-faceted evaluation and analysis of relevant policies. The first-level variables are meticulously calculated, followed by aggregation processing using the parameter values of the second-level variables. Subsequently, the PMC index is derived to assess the effectiveness of policy implementation. Efficient categorization through policy scoring levels and obtaining conclusive results via the PMC index calculation facilitate the effective promotion of green and low-carbon development paths.

2. Related Words

Wang C et al. found that Gansu Province is rich in natural resources and holds an important strategic position. After liberation, the province established many key industries. However, most of these industries have the characteristics of high carbon emissions and environmental impact, which exacerbates the fragility of the ecological environment and hinders the development of green and low-carbon industries in Gansu. An analysis was conducted on the current development status of green and low-carbon industries in the province over the past decade, and its performance was evaluated. A green and low-carbon development strategy was formulated [6]. Quan T et al. conducted in-depth research on the spatial correlation network of green and low-carbon development in the Xin'an River Basin based on the social network analysis data of prefecture level cities from 2006 to 2019. Using a dual difference model, the key role of BHEC in promoting green

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and low-carbon development was examined from the perspectives of production and consumption, and a detailed analysis was conducted on the ways in which BHEC promotes such development [7]. Rao C et al. focused on analyzing the future trajectory of carbon emissions in Hubei Province, aiming to predict peak carbon emissions and corresponding time frames. Initially, they proposed the Generalized Division Index Method (GDIM) model to determine the key driving factors of carbon emissions in Hubei. Subsequently, based on these influencing factors, a new STIRPAT model was constructed and enhanced with ridge regression for predicting carbon emissions. Finally, the parameters of the extended STIRPAT model were set using scenario analysis method, and the peak emission level and time in Hubei Province were predicted [8]. Deng Y et al. established a differential game model that includes local governments and enterprises. Through this model, they explored equilibrium solutions under different decision-making scenarios and conducted in-depth research on the role of income tax and low-carbon technology innovation incentives [9]. Meanwhile, Saraji M K et al. identified 17 challenges and categorized them into five categories. In order to measure the EU's performance in addressing these challenges, 53 indicators were selected. In addition, Fermatean's "progressive weighted rating analysis" method is used to determine the subjective weights of the identified challenges, while the standard elimination method is used to calculate the objective weights of the selected indicators. Subsequently, the order preference technique (TOPSIS) similar to the ideal solution was applied to evaluate the EU's performance in addressing the challenges of low-carbon energy transition in 2015 and 2020 [10].

3. Method

This article uses the PMC indicator model to quantitatively analyze the content correlation model in policy texts. When building a PMC model, first- and second-level variables are usually included to describe various aspects and characteristics of the policy [11].

Using the multi-input-output table, the secondary variables are assigned 0-1 variables according to the text mining method and the binary method, so that their specific values are 0 or 1, so as to quantitatively analyze the content correlation in the policy text [12].

$$|X| \sim N(0,1) \tag{1}$$

$$X = \{XR : (0,1)\} \tag{2}$$

Operate on the first-level variable values, and then use the second-level variable parameter values for aggregation processing.

$$X_t = \sum_{j=1}^{n} \frac{X_{tj}}{T(X_{tj})} \quad t = 1,2,3,4,5,6,7,8,9,10 \tag{3}$$

Among them, t represents the first-level variable, j represents the second-level variable, and T represents the number of second-level variables in the first-level variable t.

Perform reasonable calculations on the final PMC index of relevant policies. The calculation formula is as follows:

$$PMC = \sum_{t=1}^{9} X_t = \left(\sum_{j=1}^{n} \frac{X_{1j}}{T(X_{1j})}\right) + \left(\sum_{j=1}^{n} \frac{X_{2j}}{T(X_{2j})}\right) + \left(\sum_{j=1}^{n} \frac{X_{3j}}{T(X_{3j})}\right) + \cdots \left(\sum_{j=1}^{n} \frac{X_{9j}}{T(X_{9j})}\right) \tag{4}$$

Implement grading operations based on the relevant policies set, as shown in Table 1.

Table 1 PMC index model policy score rating

Grade	Index	Scoring range (points)
Excellent	High-quality policy implementation significantly affects goal achievement	6.00~8.00
Good	Policy implementation is effective and has a positive impact on goal achievement	4.00~5.99
Acceptable	Policy implementation basically meets the requirements and plays a certain role in achieving the goals	2.00~3.99
Generally	Policy implementation is deficient and has limited effect on achieving goals	0~1.99

As can be seen from Table 1, the score of the policy is divided into four levels, and each level has a corresponding score range. These ranges provide quantitative evaluation standards for the effect of policy implementation [13]. Excellent Level: The policy score at this level is between 6.00 and 8.00, indicating that the quality of policy implementation is very high and has a significant impact on the achievement of goals. Such policies usually have clear goals, effective implementation mechanisms, and significant results. The score of a good grade policy is between 4.00 and 5.99, indicating that the policy implementation is effective and has a positive impact on the achievement of goals [14-15]. Although it may not be as outstanding as the excellent-level policies, it still shows good implementation effects. Policies with an acceptable grade score between 2.00 and 3.99 are considered to basically meet the requirements and have a certain role in achieving the goals. Such policies may require further optimization and improvement to increase their impact and effectiveness. Policies with general scale scores between 0 and 1.99 are considered deficient and have limited effect on goal achievement. Such policies may need to be re-examined and adjusted to ensure that they better serve goal achievement.

According to the operation value of the PMC index, select the first nine first-level variables and parameter value $X_1, X_2, \cdots X_9$. Summarize the three variable parameter values into one category and substitute them into equation (5) to get the formula:

$$PMC = \begin{pmatrix} X_1 & X_2 & X_3 \\ X_4 & X_5 & X_6 \\ X_7 & X_8 & X_9 \end{pmatrix} \tag{5}$$

4. Results and Discussion

In the dual-carbon context, in order to ensure the sustainable development of green and low-carbon paths, we must practice the path of clean development. As a basic condition for green and low-carbon development, resource policies encourage the development and utilization of new resources in the coal industry and reduce the consumption of fossil resources. The simulation of resource policy can be achieved through energy structure adjustment, so the energy structure adjustment rate is set as a resource policy regulation factor. The specific plan is shown in Table 2.

Table 2 Resource policy scenario settings

Scenario	energy structure adjustment rate
Initial value: current policy	5%
Option 1: Resource Policy	7%
Option 2: Resource Policy	9%

It can be seen from Table 2 that the initial value is 5% under the current policy, and the energy structure adjustment rate is 5%. This shows that under the current policy guidance, the adjustment speed of the energy structure is relatively slow and may be affected by a variety of factors, such as technical bottlenecks, economic costs, market demand, etc. Option 1 increases the energy structure adjustment rate to 7% under the resource policy. It shows that by implementing a series of resource policies, such as strengthening the development and utilization of clean energy and limiting the use of fossil energy, the energy structure can be adjusted at a faster speed. Option 2 further increases the energy structure adjustment rate to 9% under the resource policy. This shows a more active policy orientation, aiming to promote the rapid transformation of the energy structure through greater resource policies. The simulation results of resource policy scenarios are shown in Figure 1.

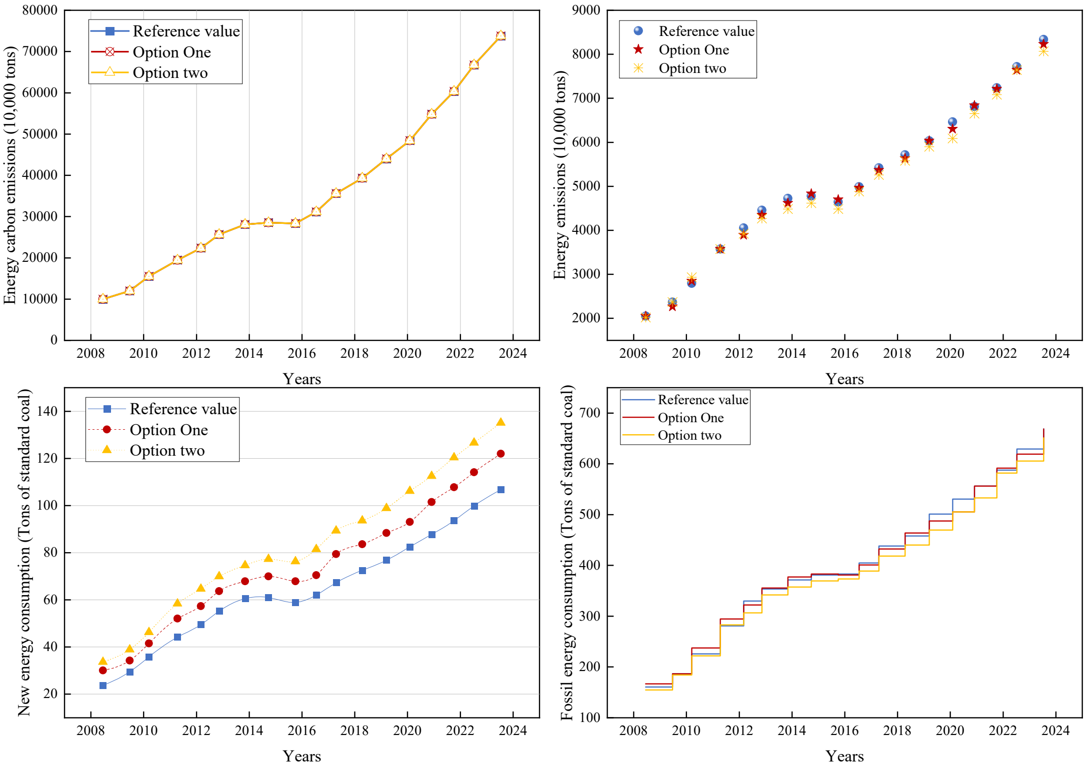

Figure 1 Resource policy scenario simulation results

It can be seen from Figure 1 that with the implementation of resource policies, it can be seen that fossil resource consumption, resource carbon emissions and coal industry carbon emissions have all been reduced to a certain extent compared with the current policy, and the reduction is very small, and the consumption is very small. This shows that the energy structure adjustment in the coal production process has a green, low-carbon new energy effect, and emissions are not sensitive to the implementation of resource policies. In 2025, the energy structure adjustment will increase by 4%, and carbon emissions are expected to be reduced by 3.51 million tons. Because most of the carbon emissions in the coal industry are generated during the consumption process, the reduction in resource consumption is generated during the coal production process. Therefore, the short-term impact of energy structure adjustment on the coal industry is not yet obvious, but in the long term, the government and coal companies should increase investment in research and development of new resource technologies, promote the utilization of new resources, and replace high energy reserves. It can effectively reduce energy consumption and high-pollution fossil resources. Future resource demand gap pressure will be beneficial to green and low-carbon ecosystems.

5. Conclusion

In the context of "dual carbon", green and low-carbon development has become an important measure for China's economic and social transformation. By using the PMC indicator model, this article can gain a deeper understanding of the mechanism of policy and provide scientific basis for policy formulation and optimization. The research results show that there is huge potential for energy structure adjustment. By 2025, the extent of energy structure adjustment is expected to increase by 4%, which will bring significant benefits of reducing carbon emissions by 3.51 million tons. It is hoped that the research in this article can provide a practical path for China to achieve green and low-carbon development under the "double carbon" background, and contribute to building a beautiful China and achieving sustainable development.

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