



Research on Environmental Protection of Promoting Urban Ecological Civilization Construction in Northeast China Through Energy Transformation

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Abstract. To form the spatial pattern, industrial structure, production mode, and lifestyle of saving resources and protecting the environment, this paper, based on the energy transformation of Northeast government, society, and enterprises and the exploration of promoting the construction of environmental protection mechanism as the background, puts forward the problems of excessive energy demand growth and fossil energy consumption in Northeast China. Coal consumption in northeast area GM (1, 1) model as the guidance, and put forward suggestions and countermeasures.

Keywords: ecological civilization construction · Renewable energy development · The environmental protection · GM · (1,1) model

1 Introduction

Promoting the construction of ecological civilization requires the development of an energy economy in northeast China. The purpose of the transformation is to make Northeast China's energy industry completely break the open consumption development mode, break the supply mode that only relies on expanding product quantity and increasing production capacity, and break the unsustainable development mode that ignores natural resources and the environment. And transformation task is in the comprehensive summary of the world's major developed countries and demonstrate the energy transformation in our country, based on advanced experience, according to the actual circumstance of the northeast, in determining the future of northeast China's basic energy supply ability and the level of the national energy security situation, more consumption of the energy industry, to change, to control energy consumption scale, strengthen energy conservation and emissions reduction, to promote Green and low-carbon economic development.

2 Energy Structure in Northeast China

2.1 Excessive Growth of Energy Demand

Since the founding of the People’s Republic of China, Northeast China has always been responsible for the major mission of the national heavy industry foundation. However, the exposed energy waste generated by heavy industry for a long time is the main reason for the rapid rise of fuel costs in Northeast China. From 2010 to 2020, China’s fuel consumption increased from 1.46 billion tons of standard coal to 3.25 billion tons of standard coal, an average increase of 8.4 percent, which is 2.6 times higher than the average global economic growth rate of 2.6 percent during the same period [1].

The following is the GM(1,1) model of total coal consumption in Northeast China in 2020:

When the system is impacted, the interference is continuously amplified due to the movement behavior of the system itself, and finally, the predicted data will be distorted. The buffer operator is proposed to solve the problem that the disturbance impact makes the data deviate from the true value. By weakening the distortion part of the operator, the information of the effective data is strengthened, to eliminate the impact of the shock disturbance on the system, so that the running law of the model can be truly reflected in the predicted data.

If the original order is X, let XD be the buffer order, and Z) be the weakened buffer operator, namely:

$$X = (x(1), x(2), \dots, x(n))^T, \quad XD = \{x(1)d, x(2)d, \dots, x(n)d\}^T$$

$$X(k)d = 1/n - k + 1[x(k) + x(k + 1) + \dots + x(n)], \quad k = 1, 2, 3, \dots, n \quad (1)$$

The total coal consumption data from 2016 to 2020 in China Statistical Yearbook 2020 was used as the original sequence to establish the model of GM(1,1).

$$X^{(0)} = (100670.34, 105771.96, 116160.25, 138352.27, 161657.26, 189231.16, 207402.11, 225795.45, 229236.87, 240666.22, 249568.42, 271704.19, 275464.53, 280999.36, 279328.74, 273849.49)$$

After the first-order average weakening buffer operator is used to data process the original sequence, the buffer sequence can be obtained according to Eq. (1):

$$XD = (209116.16, 216345.89, 224244.02, 232558.16, 240408.65, 247567.87, 253401.54, 258512.59, 262602.23, 267368.71, 271819.12, 276269.26, 277410.53, 278059.20, 276589.12, 273849.49)$$

For buffer sequence modeling, $a = -0.016619$, $b = 222965.472$, then the corresponding formula of time is:

$$X^{(1)}(k + 1) = 13517286.01e^{0.016619k} - 13416615.67, \quad k = 1, 2, \dots, n$$

Cumulative reduction of

$$X^{(0)}(k + 1) = X^{(1)}(k + 1) - X^{(1)}(k) = 222782.2e^{0.016619k}, \quad k = 1, 2, \dots, n$$

Table 1. Error check table after first-order weakening of total coal consumption from 2016 to 2020 [Owner—draw]

year	The original sequence (Ten thousand tons)	Weaken the sequence (Ten thousand tons)	Simulation value (Ten thousand tons)	residual (Ten thousand tons)	The relative error (%)	Precision (%)	Level than partial (%)
2016	271704.19	276269.26	269613.63	6655.63	2.41	97.59	-0.04
2017	275464.53	277410.53	274131.68	3278.85	1.18	98.82	-1.26
2018	280999.36	278509.2	278725.43	-666.23	0.24	99.76	-1.44
2019	279827.74	276589.12	283396.13	-6807.04	2.46	97.54	-2.22
2020	273849.49	273849.49	288145.16	-14295.67	5.22	94.78	-2.69

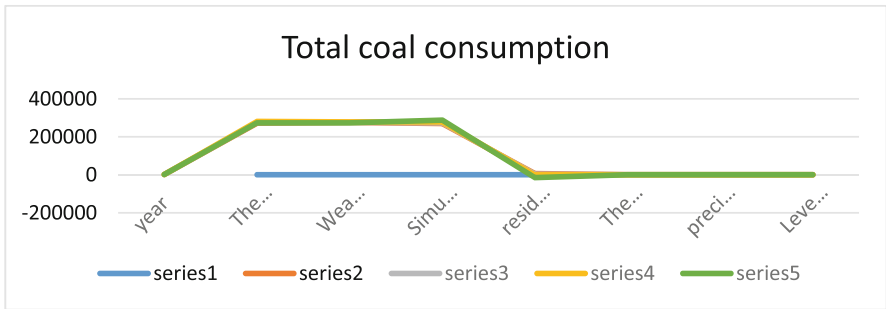


Fig. 1. GM(1,1) optimization simulation results of total coal consumption in Northeast China from 2016 to 2020 [Owner—draw]

After testing the model, the average relative error is 2.36%, the average accuracy is 97,64%, the backward disparity ratio is 0.2996, the small probability error is 1, and the model accuracy is level 2. The error test results are shown in Table 1. The simulation results are shown in Fig. 1, and the simulated growth rate is 1.68%.

2.2 The Total Consumption of Fossil Energy is Huge

At present, the energy consumption base of northeast China is very large, but if the relatively low growth rate of energy consumption is maintained, the annual new energy consumption demand of northeast China will still exceed 70 million tons of standard coal. In 2020, China produced 3.38 billion tons of coal itself and imported 220 million tons of net coal from overseas [2]. According to preliminary statistics from the National Bureau of Statistics, China’s total coal demand was about 3.75 billion tons. If the difference is taken into account, the actual coal consumption in China is now very close to 4 billion tons, which is almost the maximum acceptable limit for China’s domestic ecological

environment. The actual consumption in northeast China has always exceeded 2 billion tons or even exceeded 50% of the total. If production and consumption are not strictly controlled, they will soon continue to rise. If the proportion of coal production is too large, the domestic environmental pollution risk of reducing greenhouse gases will be higher [3].

3 Countermeasures to Promote Ecological Civilization Construction Through Energy Transformation in Northeast China

3.1 Restrain Excessive Growth of Energy Demand

Pay more attention to the importance of the market economy management mechanism in promoting the government's energy conservation and emission reduction work. The government will promote energy conservation and emission reduction work of various policy measures organically integrated into the reform of the market economy mechanism [4, 5]. To give full play to the function of the market mechanism, it is necessary to promote the reform of energy marketability, build a pricing system that reflects the shortage degree of various resources, the relationship between supply and demand, and promote the goal of saving and reducing emissions as soon as possible, to give full play to the decisive role of the market economy in optimizing the allocation process of energy resources. Therefore, IT IS NECESSARY TO PUSH FORWARD THE REFORM of resource tax and consumption tax AS soon as possible, so that energy price not only reflects the marginal value of production but also fully reflects the externality value of the ecological environment. It is also necessary to gradually improve the system of differentiated electricity prices, punitive electricity prices, and differential gas prices, and further expand the implementation field so that it can better play the role of incentive and constraint.

3.2 By Reducing the Consumption of Low-Efficiency and High-Consumption Coal and Improving Resource Efficiency, the Main Body of COAL's Medium-Term Energy Transformation Can Be Transformed

By limiting or gradually reducing coal consumption, the utilization of clean technologies of coal resources can be strengthened to improve the utilization efficiency of coal resources [6]. At present, the northeast area is given priority to coal resource consumption, this is the objective fact, but the development of science and technology and promote the research and application of clean coal technology, make coal energy use can properly regulate and reduce pollutant emissions, makes the coal energy expenditure and natural risks to the environment in a safe range.

4 Summary

Energy is an important material guarantee for social and economic development, and the corresponding use of energy will bring environmental pollution, energy consumption, and natural ecological imbalance. Especially in northeast China, coal is the main energy

source, supplemented by oil and natural gas. With social progress and economic development, people have higher and higher requirements for clean air and a healthy living environment. Energy transformation and clean use have become the inevitable trend of social and economic development in Northeast China. We should shorten the time for the transition from coal energy to oil and natural gas energy, build a comprehensive energy development strategy dominated by clean and new energy sources, and speed up the protection of the ecological environment so that the ecological environment of Northeast China can be green protected while developing the economy. Finally, realize the harmonious coexistence between man and nature.

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