ISSN 2706-6827 Vol. 4, Issue 3: 102-106, DOI: 10.25236/IJFS.2022.040316

Evaluation of Energy Consumption and Countermeasures in Hebei Province under the Background of Double Carbon

Wenyu Gao

Department of Economic Management, North China Electric Power University, Baoding, 071000, China

Abstract: *Against the background of the strategic guidance of carbon peaking and carbon neutrality, regional development has ushered in new opportunities and challenges. As a large energy consuming province, Hebei Province has a strong energy demand with its economic development dominated by heavy industry. Through the analysis of the energy consumption situation in Hebei Province, it can be concluded that Hebei Province presents the characteristics of fast growth of total energy consumption, single structure and over-reliance on coal. Therefore, the optimization of energy structure and the sustainable development of low-carbon economy are particularly important, and the corresponding policy recommendations are presented below.*

Keywords: *Energy Consumption, Low Carbon Economy, Structural Optimization*

1. Introduction

In recent decades, the massive consumption of non-renewable resources such as coal, oil and natural gas has brought about economic growth, while at the same time bringing about a large number of ecological and environmental problems. Energy production and consumption have attracted great attention. As an important energy and basic industrial base in China, Hebei Province has resource advantages in coal, however, the industrial structure of Hebei Province is unreasonable in energy consumption and the proportion of investment in coal-fired-based power development is too large. It must be clearly known that this development method of consuming energy resources will make the already shortage of energy resources and fragile ecological environment face more pressure, therefore, this paper provides suggestions for the optimization of energy utilization and energy structure in Hebei Province through the analysis of energy consumption related indicators.

2. Energy consumption in Hebei Province

Since the reform and opening up, China's economy has achieved remarkable results and made great leaps. The special production capacity structure of Hebei Province has brought about the deterioration of ecological environment along with its rapid economic development. With a large population and relatively limited non-renewable energy resources, the development of heavy industry has challenged the carrying capacity of the ecological environment step by step, and the rapid development of the economy has brought a severe test to the ecological environment of Hebei Province.

The total energy consumption in Hebei Province is large and increasing year by year, the following table lists the total energy consumption and consumption of major energy products for 10 years from 2010-2019, it can be seen that the total energy consumption increased from 262,011.41 thousand tons in 2010 to 30,574.56 thousand tons in 2019, the energy consumption in Hebei Province in 2010 accounted for 7.26% of the total energy consumption in the country,and slightly decreased to 6.27% in 2019, coal consumption increased from 274.6472 million tons in 2010 to 287.3844 million tons in 2019, it has increased 104.6%, natural gas consumption increased from 2.947 billion cubic meters in 2010 to 16.548 billion cubic meters in 2019, an increase of 561.5%, and electricity Consumption is also on the rise, energy consumption in Hebei Province has been dominated by coal, wind power, photovoltaic is the inevitable choice for electricity to achieve carbon neutrality, but there are certain difficulties in the large-scale development of wind power and photovoltaic, which can not be popularized in a short period of time. Due to the lack of flexibility of the power system, power plants are still dominated by

ISSN 2706-6827 Vol. 4, Issue 3: 102-106, DOI: 10.25236/IJFS.2022.040316

thermal power units. And at this stage, the daily load in Hebei Province shows the characteristics of the afternoon peak and evening peak, and the development of new energy sources also has randomness and instability, short-time local power shortage and system stability problems are highlighted.

Table 1: GDP and energy consumption in Hebei Province, 2010-2019

Year	GDP (Billion)	Total energy consumption(million tons of standard coal)	Electricity consumption (Billion kWh)	Gas consumption (Billion m3)	Coal consumption (million tons)
2010	18003.6	26201.41	2692.00	29.47	27464.72
2011	21384.7	28075.03	2984.90	35.09	30792.00
2012	23077.5	28762.47	3077.70	45.13	31359.00
2013	24259.6	29664.38	3251.20	49.86	31663.27
2014	25208.9	29320.21	3314.11	56.08	29635.54
2015	26398.4	29395.36	3176.00	72.97	28943.13
2016	28474.1	29794.40	3264.52	70.45	28105.65
2017	30640.8	30385.88	3441.74	96.70	27417.13
2018	32494.6	30483.11	3665.66	133.07	29593.75
2019	34978.6	30574.56	3856.00	165.48	28738.44

3. Analysis of the Relationship between Energy Consumption and Economic Growth

3.1. Model Building

$$Y = \beta_0 + \beta_1 \mathrm{x}_1 + \mu \tag{1}$$

First, define all variables. Explained variables: GDP (Y); explanatory variables: total energy consumption (X_1), random error term (μ), statistics selected (Table 1).

3.2. Test of Data Stability

First of all, the unit root test is performed for both variables, and since the data selected are time series that change over time, we have to do a unit root test to test whether the two sets of data are smooth.（*Figure 1 Figure 2*）From the analysis of the data obtained, the unit root exists under the level data of each variable, the results show that after doing the first order difference for each variable, the absolute value of ADF is greater than the T value, and the P value is less than 5%, so there is no unit root in the series, it can be shown that the series of each variable shows the smoothness of the first order single integer. Thus, the original hypothesis is rejected, indicating that the GDP series of China from 2010-2019 is smooth.

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.161370	0.0069
Test critical values:	1% level	-2.937216	
	5% level	-2.006292	
	10% level	-1.598068	

Figure 1: Results of GDP smoothness test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.223729	0.0014
Test critical values:	1% level	-2.937216	
	5% level	-2.006292	
	10% level	-1.598068	

Figure 2: Results of total energy consumption smoothness test

ISSN 2706-6827 Vol. 4, Issue 3: 102-106, DOI: 10.25236/IJFS.2022.040316

3.3. Cointegration test of the Series

The results in the above graph derived from Eviews show that the model P-value is significantly less than the 95% significance level $\alpha = 0.05$, so the model is overall linearly correlated. Its value is 0.8789 so the model fits well and the total energy consumption index X can explain 87.89% of the Y explained variables and there is a significant positive correlation. The ADF test on the residuals again shows that the residuals are smooth, indicating that there is a cointegration relationship between GDP and total energy consumption, there is a long-term equilibrium relationship between them.（*Figure 3*）

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.712378	0.0147
Test critical values:	1% level	-5.119808	
	5% level	-3.519595	
	10% level	-2.898418	

Figure 3: Residual ADF test results

3.4. Granger Causality Tests

From the test results, it can be concluded that total energy consumption is not the Granger cause of GDP, while GDP is the Granger cause of energy consumption. It shows that GDP growth is a causal factor of energy consumption growth, and GDP growth stimulates energy consumption growth. This means that more energy is consumed in order to seek high GDP growth. This development model is crude and needs a change of mind to change the way of economic growth.

3.5. Conclusion

There is a linear correlation between GDP and energy consumption in Hebei Province, and most of the economic growth in Hebei Province is brought by the growth of energy consumption, the economic growth depends on energy consumption, this development model is crude. The use of reduced energy consumption to protect the environment may have a negative impact on economic growth. Economic growth will bring an increase in energy consumption, so we must better coordinate the relationship between them and not just develop the economy regardless of the negative impact of excessive energy consumption.

4. Countermeasures and Suggestions

4.1. Adjustment and Optimization of Energy Structure

Optimization of energy structure means that under certain resources and technical conditions, the proportion of various energy sources to the total energy tends to be reasonable, in order to achieve the goal of improving the overall efficiency of energy development and utilization. The economic structure of Hebei Province are unreasonable, and the coal-based energy consumption structure will not change in the short term. The traditional crude fossil energy development model has been difficult to adapt to the needs of sustainable development, replaced by low emissions, low consumption, high value-added clean energy. Therefore, the pace of structural adjustment should be accelerated to promote energy saving and consumption reduction. Achieving the goal of carbon peaking and carbon neutrality, adhering to low-carbon development, adjusting industrial energy structure, driving economic growth and transformation, is conducive to improving the competitiveness of traditional industries, cultivating new industrial growth and employment opportunities, and achieving coordination between economic growth and resource utilization.

4.2. Promote the Clean Use of Traditional Energy Sources and the Development of Renewable Energy

Improve the development quality of traditional industries, accelerate the technological progress of traditional energy sources, improve the clean utilization of traditional fossil energy sources such as coal, oil and natural gas, promote the transformation and upgrading of iron and steel, coke, building

ISSN 2706-6827 Vol. 4, Issue 3: 102-106, DOI: 10.25236/IJFS.2022.040316

materials and other industries, and improve the efficiency of coal utilization. optimize the structure of coal consumption, and promote the clean, efficient and circular development of traditional energy sources. Develop green low-carbon energy and accelerate the construction of renewable energy bases, strengthen the use of energy from waste, promote the use of hydrogen energy actively, integration of advanced technologies to achieve interaction between supply and demand, and lay the foundation for the innovative development of renewable energy.

4.3. Reform the Assessment System and Dilute the GDP Assessment Index

To realize the development mode of low-carbon economy, we must abandon the traditional practice of sacrificing the environment for economic growth and coordinated development of economy, resources and environment. Firstly, we should innovate the management concept, adjust the assessment method, improve the incentive mechanism, and make low-carbon economy, green GDP and people's happiness index the main content of the assessment; secondly, designate relevant policies and guidelines for the development of low-carbon economy, and form a long-term mechanism for the development of low-carbon economy to ensure that the work and measures can be implemented smoothly, while gradually establishing the index system and supervision system of low-carbon economy, and putting forward specific and feasible statistics and assessment indicators of low carbon economy.

4.4. Build a Low-Carbon Industrial System In Line With the Characteristics of Hebei

Starting from the main energy-consuming industries in Hebei Province, we will improve the relevant production capacity policies and technological innovation to achieve green development; optimize the energy structure and energy efficiency, promote energy-saving and low-carbon technologies, build a low-carbon industrial system in line with regional characteristics, grasp the characteristics of energy-consuming industries in Hebei Province that are concentrated in energy consumption, use network technology for intelligent control, and also cooperate with green low-carbon industries in neighboring areas to jointly explore Low-carbon development model and effective operation mechanism, cooperation and synergistic development between regions, Establishing a good industrial ecology.

4.5. Accelerate the Pace of Scientific and Technological Progress in Hebei Province

Technological progress and innovation is the key to solving China's energy problems, improve energy use efficiency, energy conservation and reduce consumption must rely on scientific and technological progress. develop high technology industries, modern service industries, and use high technology to transform traditional production processes with high energy consumption and high emissions to reduce environmental pollution. Accelerate the development of new technology related to carbon governance, on the one hand, establish a science and technology innovation system for the development of a low-carbon economy, increase the investment in the research, innovate production processes and improve production and operation methods. On the other hand, the introduction of advanced foreign production processes, through learning and study to accelerate the development of technological innovation.

References

[1] Department of Economics, Illinois State University, Normal, IL 61790-4200,United States
[2] Yao, Z.C. and Liang, N.F. (2018) Research on the Relationship between Guangdong Express Industry and Economic Development Based on Grey Relation Analysis. Economy and Management, 5, 108-109
[3] Robinson, James A. & Torvik, Ragnar & Verdier, Thierry, 2006. "Political foundations of the resource curse," Journal of Development Economics, Elsevier, vol. 79(2), pages 447-468, April.
[4] LIU Xiaojing, SONG Lifei, LI Qifen, HUANG YUE. Challenges and Suggestions for Green and Low Carbon Waterways in the Yangtze River Delta under the Background of "Double Carbon". Shanghai Energy Conservation
[5] XU Yongjun. The road of regional low-carbon industry development under "double carbon" strategy. Zhangjiang Science and Technology Review, 2022(01):14-15.
[6] XIAO Jincheng, WEI Mengju, LIU ZHAO. Countermeasures for the optimization and adjustment of

ISSN 2706-6827 Vol. 4, Issue 3: 102-106, DOI: 10.25236/IJFS.2022.040316

energy structure in Hebei Province under the background of carbon peaking and carbon neutrality. China Electricity Enterprise Management, 2021(34):60-62.
[7] WANG Hengxu, WANG JIAO, XUE YE. Study on the relationship between coal consumption and economic growth in Shanxi Province--based on co-integration analysis and Granger causality test. Coal Economic Research, 2020, 40(06):13-18.DOI:10.13202/j.cnki.cer.2020.06.003.