The Influence of Energy Investment on Green Economic Development

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Abstract. According to the data from the press conference of China Energy Administration in 2023, in the first half of the year, the domestic energy supply security capacity has steadily improved, the transition to green and low-carbon energy has been accelerated, and the country's energy supply and demand are basically stable and orderly. The research found that the development of China's green economy has been significantly improved with the support of energy investment. This research will help to continue to promote energy investment and make greater breakthroughs in promoting sustainable economic development.

Keywords: energy investment, green economy, sustainable development.

1 Introduction

The development of green economy is an important issue that is widely concerned by all countries in the world today. With the improvement of people's awareness of environmental protection and sustainable energy development, the development of green economy has become an important direction for the development of governments and enterprises. But the development of green economy has all kinds of problems.1. Waste of resources: Under the traditional economic model, resources are consumed and wasted due to irrational use of resources. 2. Environmental pollution: With the advancement of industrialization and urbanization, the problem of environmental pollution has become increasingly prominent. 3. Ecological balance: Some enterprises and governments ignore the problem of ecological balance in order to obtain economic benefits, resulting in the destruction of ecosystems and the loss of biodiversity. Therefore, the research goal of this paper is to analyze whether energy investment can solve the problems in the process of green economy development and the positive or negative impact on the development of green economy.

2 Research Background

Although China's economy has relied on the rapid development of industrialization since the reform and opening up, the price behind it is a variety of environmental

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problems. For example, the greenhouse effect caused by excessive carbon dioxide emissions, global warming, sea level rise and other problems. Over the past century, the atmospheric carbon dioxide concentration has risen by almost 20%. Scientists anticipate that when this concentration doubles, the average surface temperature could rise by approximately 3 degrees Celsius. According to the China Meteorological Administration, global carbon dioxide concentrations reached 410ppm in 2019, higher than at any time in 2 million years. Global temperatures are set to rise by 1.5°C or more over the next 20 years compared with the Industrial Revolution. Scientists say significant reductions in carbon dioxide and other greenhouse gases around the world over the next few decades could keep the temperature rise this century below 2°C. And strong mitigation measures to achieve net zero CO2 emissions around 2050 are likely to keep temperature rises below 1.6°C and 1.5°C by the end of the century. This also goes against China's green and sustainable development strategy. With the introduction of concepts like "carbon peak" and "carbon neutrality," there's a growing recognition of the severity of the issue, prompting a shift towards contemplating the path of green development. Consequently, the Chinese government has devised a range of environmental protection measures in response.

People gradually realize the seriousness of the problem and begin to think about the road to green development. To this end, the Chinese government has formulated a series of environmental protection. The Chinese government has strengthened investment in environmental protection and promoted innovation in environmental technology and the development of environmental protection industries. These measures provide a better guarantee for environmental protection. However, the best and most fundamental way to solve the problems caused by industrial development is to replace the traditional oil and other highly polluting energy with environmentally friendly and energy-saving clean energy. Reasonable regulation of the total amount of energy investment is of great significance for promoting the coordinated development of energy, economy and environment, and also has important theoretical and practical significance for relevant personnel to formulate and implement relevant policies in the future.

3 Literature Review

Feng Xiaohang (2023) constructs relevant models with energy investment as a variable, constructs multiple indicator systems, uses multiple methods to empower and record data for analysis [1].Shen Bin (2012) built a panel data regression model and found that increasing clean energy investment could reduce per capita carbon dioxide emissions [2]. Hu Xing (2019) Through the construction of provincial panel fixed effect model, the empirical study suggests that improving renewable energy can reduce carbon intensity through the indirect transmission mechanism of per capita GDP and energy intensity[3]. Zeng Jingjing et al. (2018) divided energy policies into three categories: open source, throttling and transformation, and found that all three effectively promoted green economy, among which open source and throttling policies were more effective [4].

On the economic impact of energy investments.

Chen Jie and Deng Xueping (2020) conducted an empirical study examining the influence of renewable energy investment on the green economy. They identified three thresholds for green credit, indicating the impact of renewable energy investments on the green development index[5]. Liu Jianglong (2020) analyzed the factors influencing and the efficiency of China's green economy development. He discovered variations in the impacts of economic growth, foreign direct investment, and energy intensity on manufacturing carbon emissions across different levels of manufacturing emissions and regions[6]. Pan Ting (2020) explored the positive and negative effects of various factors on industrial green economy development by investigating the influence of new energy investment on industrial green economy development[7]. In addition, Wang Mianbin et al. (2018) and Xiang Junyong et al. (2016) found that the development of electricity and other energy has a significant positive impact [8]. In summary, current research primarily concentrates on accelerating green economy growth, factors influencing it, and the positive and negative impacts of its development, often overlooking the role of energy investment in this process. Hence, the novelty of this paper lies in exploring the influence of energy investment on the green economy and elucidating their relationship. This research aims to address this gap, providing insights to aid relevant authorities in formulating more pragmatic and efficient policies and initiatives in this domain. Norouzi Nima; Bozorgian Alireza; Dehghani Mohammad Ali used the Vlse Kriterijumska Optimizacija Kompromisno Resenje (VIKOR) fuzzy hierarchical analysis method, combining economic, environmental, technological and social criteria, Different power plants in Iran for the period 2018-2040 are prioritized. It is found that the environmental pollution level has the greatest influence on the power plant priority among all the indexes studied [9].

4 Research on Measuring Methods of Green Economy Development Level

This paper takes energy investment as independent variable and the quality and degree of green economy development as dependent variable, constructs a model and indicator system, separates independent variable and dependent variable, and discusses the impact of energy investment on green economy development. By referring to the analysis of the influential factors of green economy development by relevant scholars in recent years and relevant models, combined with the weight ratio of different indicators in the index system and the positive and negative attributes, the types of investment energy, applicable regions and the increase or decrease of GDP are obtained. Since energy investment and green economy are recent concepts, the availability of relevant data on energy investment is limited, which may introduce errors in the conclusions derived from the index system. Consequently, this paper constructs the index system of green development to measure the level of green economy by the method of classification and equal ratio and weighted average.As shown in Table 1.

Table 1. Green development index system table

Primary index	Serial number	Secondary index	Unit of measurement	Index type	Weight (%)	Data source
1.Resource utilization (weight =29.3%)	1	Total energy consumption	Tons of standard coal	◆	1.83	National Development and Reform Commission (NDRC) and NBS(NBS)
	2	Lower energy consumption per unit of GDP	%	★	2.75	NDRC and NBS
	3	Carbon dioxide emissions per unit of GDP decreased	%	★	2.75	NBS and NDRC
	4	Proportion of non-fossil energy in primary energy consumption	%	★	2.75	NBS, National Energy Administration
	5	Total water consumption	Million cubic meters	◆	1.83	Ministry of Water Resources (MWR)
	6	Water consumption per ten thousand yuan of GDP fell	%	★	2.75	NBS and MWR
	7	Reduction rate of water consumption per unit of industrial added value	%	◆	1.83	NBS and MWR
	8	Effective utilization coefficient of farmland irrigation water	—	◆	1.83	MWR
	9	Cultivated land reserve	Hundred million mu	★	2.75	Ministry of Land and Resources of China
	10	The amount of new construction land	Ten thousand mu	★	2.75	Ministry of Land and Resources
	11	Construction land area reduction per unit GDP	%	◆	1.83	Ministry of Land and Resources, NBS
	12	Resource output rate	10,000 yuan/ton	◆	1.83	NBS, NDRC
	13	General industrial solid waste comprehensive utilization rate	%	△	0.92	Ministry of Industry and Information Technology and MEP

	14	Crop straw comprehensive utilization rate	%	△	0.92	Ministry of Agriculture
2.Environmental governance (weight =16.5%)	15	Total chemical oxygen demand emissions decreased	%	★	2.75	Ministry of Environmental Protection (MEP)
	16	Total ammonia nitrogen emissions were reduced	%	★	2.75	MEP
	17	Total sulfur dioxide emissions were reduced	%	★	2.75	MEP
	18	Total nitrogen oxide emissions were reduced	%	★	2.75	MEP
	19	Utilization rate of hazardous waste disposal	%	△	0.92	MEP
	20	Harmless treatment rate of household garbage	%	◆	1.83	MEP
	21	The proportion of investment in environmental pollution control in GDP	%	△	0.92	NBS,Ministry of Housing and Urban-Rural Development (MHURD) and MEP
	22	Rate of centralized sewage treatment	%	◆	1.83	MHURD
	23	Percentage of days with good air quality in prefecture-level and higher cities	%	★	2.75	MEP
3.Environmental quality (weight =19.3%)	24	The concentration of fine particulate matter (PM2.5) fell in cities that failed to meet the standards at prefecture level and above	%	★	2.75	MEP
	25	The ratio of surface water meeting or exceeding Class III standards	%	★	2.75	MEP, MWR
	26	Proportion of surface water of inferior V class	%	★	2.75	MEP, MWR

	27	The water quality of important river and lake functional areas reaches the standard rate	%	◆	1.83	MWR
	28	The quality of centralized drinking water sources in prefecture-level and above cities reaches or is better than the proportion of Class III	%	◆	1.83	MEP, MWR
	29	Percentage of coastal waters with satisfactory water quality (first and second class)	%	◆	1.83	SOA, MEP
	30	Utilization rate of polluted cultivated land meeting safety standards	%	△	0.92	Ministry of Agriculture
	31	Fertilizer application rate per unit of cultivated area	Kilogram per hectare	△	0.92	NBS
	32	Pesticide application rate per unit of cultivated land area	Kilogram per hectare	△	0.92	NBS
	33	Forest coverage rate	%	★	2.75	State Forestry Administration (SFA)
	34	Forest stock volume	Million cubic meters	★	2.75	SFA
	35	Comprehensive vegetation coverage of grassland	%	◆	1.83	Ministry of Agriculture
4.Ecological protection (weight =16.5%)	36	Natural shoreline retention rate	%	◆	1.83	State Oceanic Administration (SOA)
	37	Land nature reserve area	Ten thousand hectares	△	0.92	MEP, SFA
	38	Wetland protection rate	%	◆	1.83	SFA, SOA
	39	Marine protected area	Ten thousand hectares	△	0.92	SOA
	40	The area under control of soil erosion was increased	Ten thousand hectares	△	0.92	MWR

	41	Control rate of desertified land	%	◆	1.83	SFA
	42	The area under restoration and control of new mines was added	hectare	△	0.92	Ministry of Land and Resources
	43	Rate of growth in per capita GDP	%	◆	1.83	NBS
	44	Disposable income per capita	RMB/person	◆	1.83	NBS
5. Quality increase (weight =9.2%)	45	Value added of tertiary industry as a proportion of GDP	%	◆	1.83	NBS
	46	Contribution of strategic emerging industries to Gross Domestic Product (GDP)	%	◆	1.83	NBS
	47	R&d expenditure as a percentage of Gross domestic product	%	◆	1.83	NBS
	48	Reduction rate of energy consumption per capita in public institutions	%	△	0.92	State Administration Bureau
	49	Market share of green products (Market share of energy-efficient products)	%	△	0.92	NDRC, Ministry of Industry and Information Technology, AQSIQ
6. Green Life (weight =9.2%)	50	Growth rate of new energy vehicle ownership	%	◆	1.83	Ministry of Public Security
	51	Green travel (urban public transport ridership per 10 thousand population)	10 thousand passengers/10 thousand	△	0.92	Ministry of Transport, National Bureau of Statistics
	52	Urban green buildings accounted for the proportion of new buildings	%	△	0.92	MHURD
	53	Green land rate in urban built-up areas	%	△	0.92	MHURD
	54	Rural access to tap water	%	◆	1.83	MWR

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Note:

(1) The symbol ★ denotes the resource and environmental constraint indicators specified in the Outline of the 13th FYPNESD. Meanwhile, the primary monitoring and evaluation indicators suggested by both the 13th FYPNESD and the Opinions of CCCPC and the State Council on Accelerating the Construction of Ecological Civilization are denoted by ◆. The marked △ represents other important monitoring and evaluation indicators for green development. According to its importance, according to the total weight is 100%, the weight ratio of the three types of indicators is 3:2:1, the index weight of the standard ★ is 2.75%, the index weight of the standard ◆ is 1.83%, and the index weight of the standard △ is 0.92%. The weights of the six primary indicators are generated by summarizing the weights of the secondary indicators they contain.

(2) The green development index system adopts the comprehensive index method for calculation. During the 13th Five Year Plan period, taking 2015 as the base period, combined with the 13th Five Year Plan outline and relevant departmental planning goals, calculate six classification indices. The Green Development Index is calculated by weighting the average of 54 individual indices, excluding "public satisfaction"

The calculation formula is:

$$Z = \sum_{i=1}^{N} WiY \ (N = 1,2,3,4.\ldots.54) \tag{1}$$

Among them, "Z" represents the index of green development, "Yi" represents the individual index of indicators, "N" represents the number of indicators, and "wi" is the weight of indicator "Yi". Green development indicators are categorized into positive and negative based on their evaluation function, and into absolute and relative based on their data properties. Each indicator requires non-dimensionalization. The methodology employed in this article involves initially transforming absolute number indicators into relative number indicators, then converting reverse indicators into positive ones, subsequently shifting total quantity control indicators into annual growth control indicators, and ultimately computing individual indices. (Data source: NDRC)

5 Experimental Results and Conclusions

According to the above data, energy investment has improved the level of China's green economic development and the trend of significant improvement is significant. The healthy development of energy can become the "green engine" of China's development in the new era.

Therefore, energy investment should pay more attention to building a "green engine", developing and utilizing new energy, and promoting the transformation of traditional energy. As a new economic activity, energy investment positively contributes to promoting economic growth and improving the environment. The advancement of ecological civilization construction, along with the commitment to carbon peak and carbon neutrality targets, underscores China's resolve and assurance in fostering green economy development. Investing in new energy industries stands out as a vital strategy for enhancing environmental quality and decreasing energy consumption per unit of GDP,

aligning with the objectives of green development. In the new era's imperative for green development, amplifying investments in the new energy sector will prove instrumental in realizing China's green development objectives.

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