Study on the Impact of Green Finance on Carbon Emission Intensity----An empirical test based on the mediating effect of green technology innovation

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Abstract. In order to support green technology innovation and achieve sustainable development, green money is a crucial driving factor. The adoption of sustainable development strategies is something that the Chinese government and the global economy both respect highly in recent years. The article chooses panel data of 30 Chinese provinces from 2010 to 2020 and conducts an empirical analysis using a mediating effect model to fully investigate the impact of green finance and green technology innovation on carbon emissions in China. The findings of the study indicate that green finance has a mediating influence on carbon emission reduction and that it can support the advancement of carbon emission reduction through the growth of green technology innovation.

Keywords: green finance; green technology innovation; carbon emission.

1 Introduction

In 2020, "carbon neutrality" has become a heated topic of global attention, which aims to reduce global greenhouse gas emissions and meet the challenge of climate change by taking measures to reduce or remove carbon dioxide from the atmosphere. Many countries and regions have taken action to set carbon neutrality targets and implement policies and measures. For instance, the European Union intends to reach carbon neutral by 2050 and has developed relevant regulations and policies. A national development policy put forth by China aims to achieve "carbon peaking" by 2030 and "carbon neutrality" by 2060. China is additionally stepping up its efforts to promote carbon neutrality, and China has also launched a series of policies and plans to support the development of a low-carbon economy. The importance of carbon neutrality varies from country to country. In a bid to combat climate change, certain industrialized countries and territories have made significant advancements toward carbon neutrality. Some developing countries, on the other hand, may be under pressure from economic development and growing energy consumption, and the implementation of carbon neutrality targets and policies is relatively more complex. However, with the growing global awareness and concern about climate change, more and more countries are

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gradually paying attention to carbon neutrality and have taken measures to foster the development of a low-carbon economy.

Green finance was first proposed by the United Nations Environment Programme in 2007 as a type of environmentally sustainable development-oriented financial operations and investment decisions designed to support a low-carbon economy and the protection and restoration of the ecological environment. Green financing may successfully promote carbon emission reduction, a low-carbon economy, the reduction of hazards to the environment, and sustainable development. Countries around the world have been paying increasing attention to green finance. Some developed countries and regions have introduced corresponding policies and regulations, established green financial markets and institutions, and promoted the development of green finance. For example, the European Union has introduced the European Green Agreement and established the European Green Agreement Fund; China is also gradually establishing a green financial system and promoting the development of green finance. By the end of 2022, 21 major Chinese banks had green credit balances of $20.6 trillion. However, Nevertheless, there remain several obstacles to the growth of green finance, such as inconsistent standards, incomplete data, and imperfect regulatory policies. With the strengthening of international cooperation and the joint efforts of all parties, green finance is expected to continue to develop and grow in the future, making greater contributions to the achievement of sustainable development.

The primary approach for reducing emissions of carbon while supporting green economic development is green technology innovation. China has made remarkable progress in green technology innovation such as new energy vehicle technology and smart energy technology, and has become an important player in the global green technology field. Green technology innovation is not an optimization of traditional technology, but an innovative environmental technology based on the concept of sustainable development, which incorporates resource conservation into the cost of the enterprise, thus exposing the enterprise to greater risk. Green finance therefore plays a very crucial role in green technology innovation, providing solutions and impetus for it. Green finance effectively relieves enterprises' financing pressure through financial tools such as green bonds and green credit, increases enterprises' investment in R&D of green innovation technologies, and guides them to green production.Innovation in environmentally friendly technologies promotes the advancement of innovations that decrease carbon emissions, lower the cost and price of green products, and lessen the pressure of environmental regulation. At the same time, it may motivate businesses to improve resource utilization rates and industrial green upgrading and transformation to achieve the synergistic high-quality development of society, economy, and environment, which has "double externality". The positive impact of green finance and green technology innovation can help China's economic and social development and low-carbon transformation of enterprises.

2 Literature review and theoretical mechanism

2.1 Green Finance and Carbon Emission Intensity

Green finance refers to the financial practice of promoting sustainable development and environmental protection through financial instruments and mechanisms, and is a new modern concept that has emerged along with global economic and environmental development. The primary influence of green finance on carbon emission intensity is the reduction of high-polluting firms and the promotion of environmentally friendly enterprises. According to the cost theory, enterprises will adopt greener production methods due to the reduction of costs, thus reducing carbon emissions. Green finance inhibits the growth of high-polluting businesses by increasing the financing costs and difficulties of high energy consumption and high pollution enterprises; at the same time, green finance directs the flow of funds to low-carbon environmental protection fields, such as preferential loans, lower interest rates, tax breaks and other methods, thus promoting the economic structure to a low-carbon economy and thus reducing carbon emission intensity. Ning Jinhui and Yuan Zeming (2021)[1] argue that green credit can significantly inhibit excessive investment in heavy polluting enterprises; Wang Qian and other scholars (2012)[2] tested the impact of carbon finance on low-carbon economy through a fixed-effect model based on data from several EU countries during 2005-2009, and The results of their research indicated that the development of carbon finance has a considerable positive impact on bolstering carbon emission reduction. According to the theory of sustainable development, green rivers and green mountains are not only examples of natural ecological richness, but also representations of prosperity in society and the economy. And green finance is an important tool to transform green mountains into silver mountains [3]. As a crucial component of the strategy for sustainable development, green finance has a positive policy-oriented role, Consequently, the objective of sustainable development is accomplished by directing financial resources into low-carbon environmental protection businesses. In conclusion, the research hypotheses stated below are suggested.

H1: Green finance development can effectively promote the reduction of carbon emission intensity.

2.2 Green finance and green technology innovation

It is essential for the development of green finance to take into account the quantity as well as the level of growth in the economy. Green finance and green technology innovation promote and support each other's sustainable development. Due to the fact that green financial institutions assist green technology innovation businesses financially through financing and green credit, green finance could promote green technology innovation. According to Porter's hypothesis (1995) [4], strict and reasonable environmental regulations can motivate firms to innovate, and The additional expense of adhering to environmental standards can be partially or even entirely compensated by the compensating advantages associated with innovation. Long cycle times, high levels of uncertainty, high risks, and high expenditures are characteristics of green

technology innovation for businesses, and at the same time its demand for capital is very high. Traditional financing sources are reluctant to invest large amounts of capital in green technology innovation because it runs counter to the fundamental pursuit of profit maximization, while green finance products usually have lower interest rates and better financing terms, enabling companies to obtain the required funds at more competitive costs. Companies supported by finance are more willing to go through the stages of R&D, experimentation, commercialization and production scale expansion, which help them to reduce carbon emissions and improve production efficiency, stimulate the innovation and market application of green technologies, and thus gain greater economic value. Wang Jing (2023) [5] conducted an empirical analysis of the relationship between green finance and green technology innovation using relevant data from A-share listed companies in China from 2008 to 2019. She introduced the enterprise life cycle theory and discovered that green finance can promote enterprise green technology innovation and that there is a significant positive relationship between the two. Secondly, green finance restricts the financing of high pollution enterprises to a certain extent, and Lu Jing et al. (2021) [6] pointed out that due to the restriction of green credit policy, companies with high pollution and energy consumption withdrew from the market due to the lack of sufficient liquidity, while green enterprises developed rapidly. In addition, when providing financing and investment to enterprises, green financial institutions will assess and review the environmental performance and sustainability of enterprises, and require relevant enterprises to disclose environmental information according to the law, prompting high-polluting enterprises to improve environmental management, reduce emissions and pollutant release to meet the requirements and standards of green finance and enhance corporate image; helping enterprises to identify and manage environmental risks and actively adopt corresponding green technological innovation as protection measures to improve corporate sustainability and social responsibility. Therefore, the following research hypothesis is proposed.

H2: Green financial development may contribute to advance innovations in green technologies and thereby lower the intensity of carbon emissions.

2.3 Green technology innovation and carbon emission intensity

Green technology innovation has become crucial for dealing with sustainable development, as well as for conserving energy and emission reduction. [7], and is able to achieve low-carbon, efficient and clean production methods, and encourage a win-win situation with regard to of economic growth and preservation of the environment. First, green technology innovation can achieve energy transformation, encourage the development and use of renewable energy sources(solar, wind, and hydro) to replace traditional high-carbon energy (e.g., coal, oil, and natural gas), and thus reduce carbon emissions during energy production and use; A Chinese limited company's installed clean energy share has risen to 41.6%, and clean energy power generation during the last five years is equal to a decrease in carbon emissions of 730. A Chinese company's percentage of clean energy installed has risen to 41.6%, and clean energy generation in the past five years is equivalent to 730 million tons of carbon reduction. [8]The Inter-

national Energy Agency (IEA) estimates that by 2030, the market value of key mass-produced renewable energy technologies would be around $650 billion annually. [9] Secondly, green technology innovations are driving the development of low-carbon transportation such as electric and hybrid vehicles, reducing carbon emissions from the exhaust of conventional fuel vehicles. According to estimates by the International Energy Agency, the share of biofuels in the mix of road transportation will reach nearly 15%, which will reduce oil demand by about 4.5 million barrels of oil equivalent per day. [10] In addition, green technology innovation can combine intelligent systems and data analysis to achieve more accurate energy management and carbon emission monitoring, such as the application of technologies such as smart grids, smart buildings, and intelligent transportation systems, which can optimize energy use and carbon emission management, improve energy efficiency and reduce carbon emissions. In general, green technology innovation fits the current ecological civilization development concept, attracts increasingly low green technology innovation talents to invest in it, and provides a strong guarantee to encourage business modernization and green transformation. According to the above theoretical analysis, the following hypothesis is proposed.

H3: Green technology innovation progress can improve resource utilization efficiency and further reduce carbon emission intensity.

3 Empirical test

3.1 Data smoothness test

3.1.1 Unit root test.

In order to reduce the case of pseudo-regression, unit root tests were conducted on the variables before the empirical analysis. Meanwhile, in order to ensure the reliability of the test results, four tests, Fisher, IPS, LLC, and HADRI, were selected in this paper to conduct unit root tests on each variable. The test results are shown in the Table 1, and all three tests show that the original hypothesis of the existence of unit root in the data is rejected for all variables at the significance level of 1 %, indicating that the data used in this paper are smooth.

Table 1. Unit root test

Unit root test		Eco2	Gfi	lngreenrd2	Urbanization	Road	Banking	Fdi
FISHER	Inverse chi-squared	268.751***	178.467***	262.476***	161.819***	156.454***	565.997***	227.053***
	Inverse normal	-2.951***	-0.291	0.9531	1.6589	1.937	-13.293***	-2.910***
	Inverse logit t	-9.674***	-3.689***	-4.8529***	-2.4947***	-1.293*	-26.407***	-8.376***
	Modi-	19.05	10.815**	18.4834	9.2947***	8.805**	46.191**	15.250***

	fied inv. chi-squared	6***	*	***		*	*	
LLC	Adjusted t	-5.769***	-9.798***	-7.8684***	-15.4667***	-2.558***	-5.910***	-7.414***
IPS	W-t-bar	2.379	-2.276**	1.7111	-1.1146	1.9421	1.8585	0.034
HADRI	z	11.986***	13.361***	12.6209***	12.6261***	12.307***	12.441***	12.878***

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

3.1.2 Panel cointegration test.

In this paper, we use pedroni and westerlund for panel cointegration test, according to the Table 2, we can get four test statistics for panel cointegration test using Pedroni and Westerlund, they are: Modified Phillips-Perron t, Phillips-Perron t, Augmented Dickey-Fuller t, and Variance ratio. for the three statistics Modified Phillips-Perron, Phillips-Perron, and Augmented Dickey-Fuller, their t-values are 6.718, - 10.415 and -15.223, and they are all significant at the 1% level, so we reject the original hypothesis that the panel data set does not have a cointegrating relationship and can proceed to the next step of analysis.

Table 2. Panel cointegration test

Modified Phillips–Perron t	6.718***
Phillips–Perron t	-10.415***
Augmented Dickey–Fuller t	-15.223***
Variance ratio	5.123***

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

3.2 Model Construction and Data

3.2.1 Model construction.

In order to study the impact of green finance development on carbon emission intensity in China's provinces and cities, green technology innovation is considered as a mediating variable. Among them, the relationship between the three is analyzed and a mediating effect panel model is constructed to gradually investigate the influence mechanism of green finance and carbon emission, green technology innovation and green finance, and green technology innovation and carbon emission. The model is as follows:

$$Eco2 = \beta_0 + \beta_1 Gfi + +\beta_2 Urbanization + \beta_3 Road + \beta_4 Banking + \beta_5 Fdi + \varepsilon \quad (1)$$

$$Lngreenrd2 = \beta_0 + \beta_1 Gfi + \beta_2 Urbanization + \beta_3 Road + \beta_4 Banking + \beta_5 Fdi + \varepsilon \quad (2)$$

$$Eco2 = \beta_0 + \beta_1 Gfi + \beta_2 Lngreedrd2 + \beta_3 Urbanization + \beta_4 Road + \beta_5 Banking + \beta_6 Fdi + \varepsilon \quad (3)$$

In equation (1)(2)(3), Eco2 is the core explanatory variable, representing carbon emission intensity; Gfi is the core explanatory variable, representing the comprehensive index of green financial development level; Urbanization represents urbanization rate; Road represents road access intensity; Banking represents financial development level; and Fdi represents foreign direct investment level.

3.2.2 Explanation of variables.

(1) Explained variables

Carbon emission intensity (Eoc2). In order to study the change of carbon emission intensity, this paper selects per capita carbon dioxide emission as a measure of carbon emission intensity. Per capita carbon dioxide emissions are the average of carbon dioxide emissions contributed by each resident of a country or region at a specific time, and can be used to measure the extent of a country's or region's contribution to carbon emissions. The calculation of carbon dioxide per capita used in this paper is the total amount of carbon dioxide emissions divided by the total number of people at the end of the year.

(2) Explanatory variables

Green financial development level composite index (Gfi). In order to enrich the evaluation system of green financial development level, based on the analysis of the current situation of the development of China's green financial system, reference to existing research and consideration of data availability, this paper measures the comprehensive index of green financial development level of 30 provinces in China from four levels: green credit, green securities, green investment and green insurance, based on a macro perspective.

(3) Mediating variables

Green technology innovation (Lngreenrd2). The main purpose of green technology innovation is to improve the efficiency of resource utilization in the production process and at the same time reduce the cost of enterprise operation. Green patent, as an important tool for the country to promote the development of green technology innovation, can reflect the level of green innovation more directly. Therefore, this paper takes the natural logarithm of the number of green utility model patents obtained by each prefecture-level city in that year for analysis.

(4) Control variables

In addition to the core variables in this paper, there are many other influencing factors. In order to ensure the scientificity and credibility of the empirical analysis, some variables will be selected as control variables in this paper, mainly including: road access intensity (ROAD), which is measured by the proportion of road kilometers

to land area, and the data comes from the National Bureau of Statistics. The urbanization rate, determined by the ratio of the regional population to the urban population., is obtained from the National Bureau of Statistics. The level of financial development (banking)is calculated as the provincial GDP divided by the total deposit and loan balances of financial institutions, which is obtained from the China Statistical Yearbook.Using statistics from the China Statistical Yearbook, we can determine the level of foreign direct investment (Fdi) by dividing it by the GDP.

3.3 Empirical analysis

3.3.1 Multicollinearity Test and Baseline Regression.

Before the main regression, the variance inflation factor (VIF) test was conducted on each variable to prevent the problem of multicollinearity. According to the Table 3,it was found that the VIF of each variable was less than 10, and the maximum value was 2.40, indicating that there was no serious multicollinearity.

Then, the baseline regression of hypothesis testing was performed, and from the results, it is clear that green finance is significantly and negatively related to carbon emissions. Specifically, the estimated coefficient of green finance Gfi is -8.298, which is significant at the 1% statistical level, which indicates that the degree of green finance innovation reduces the level of corporate carbon emissions by about 8.298 units on average, validating the research hypothesis. The coefficient of the effect of the level of foreign direct investment (Fdi) on carbon emission intensity has a negative sign in the test, which indicates that the increase of foreign direct investment is beneficial to reduce carbon emission intensity, and the advanced production technology and management methods, etc. that foreign direct investment will bring to China improve the production efficiency while reducing energy consumption, which in turn reduces carbon emission intensity.

Table 3. Multicollinearity Test and Baseline Regression

Variable	Multicollinearity	VIF	1/VIF	Benchmark regression	y
Gfi	-8.298***	2.40	0.416	-8.298***	-8.298***
	(1.046)			(1.046)	(1.046)
Urbanization	4.063***	2.40	0.416	4.062***	4.062***
	(0.925)			(0.925)	(0.925)
Road	-1.285***	1.38	0.722	-1.285***	-1.285***
	(0.175)			(0.175)	(0.175)
Banking	0.133**	1.05	0.956	0.133***	0.133***
	(0.667)			(0.067)	(0.067)
Fdi	-14.389***	1.10	0.909	-14.389***	-14.389***
	(4.136)			(4.136)	(4.136)
_cons	2.549***			2.549***	2.549***
	(0.468)			(0.467)	(0.467)

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

3.3.2 Mediating effect test.

In order to verify whether there is a mediating relationship, rather than a pseudo-regression or pseudo-mediating relationship, sober test and self-sampling bootstrap test were conducted to analyze whether the mediating effect of green technology innovation exists between green financial development and carbon emission intensity, where _bs_1 denotes the mediating effect and _bs_2 denotes the direct effect, and the confidence interval contains 0, which means the positive and negative effects may cancel each other out, so the confidence interval does not contain 0 means the direct effect effect or mediating effect is significant. The results of the test are shown in the Table 4.

Table 4. Mediating effect test

	Lngreenrd2
_bs_1	-1.946***
	(0.616)
_bs_2	-6.352***
	(1.378)
soble	-1.946***
	(0.467)
Goodman-1(Aroian)	-1.946***
	(0.470)
Goodman-2	-1.946***
	(0.463)

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

As shown in Table 4, the results of the mediating effects test using Bootstrap and sobel methods include five statistics of _bs_1, _bs_2, sobel, Goodman-1 (Aroian), and Goodman-2. _bs_1 and _bs_2 are the standard errors of the two regression coefficients of the Bootstrap resampling distribution; they are -1.946 and -6.352, respectively, and are significant at the 1% level for each statistic. This indicates that reliable estimates of the standard errors of the Bootstrap sampling distribution were obtained. the value of the Sobel statistic is -1.946 and is also significant. The Goodman-1 (Aroian) and Goodman-2 statistics also have a value of -1.946. They are both used to test whether the distribution of the binomial sampling error of the mediation effect is symmetric. If the distribution is symmetric, then we can use the Sobel test to test the significance of the mediation effect. Here, since the values of Goodman-1 (Aroian) and Goodman-2 are the same as those of Sobel, the mediation effect can be considered significant. Combining the above test results, it can be concluded that the mediating effect is statistically significant in the case of mediating effect test using bootstrap and sobel method. This means that the mediating variable plays a significant role between the explanatory and dependent variables, and this role is not random.

Next, the path of the effect of green finance on carbon emissions is verified using green technology innovation as a mediating variable. The first column of the Table 5 is the baseline regression, and the composite index of green finance development level has a strong adverse correlation with per capita carbon dioxide emission at the 1% level with a coefficient of -8.298, which means that the composite index of green finance development level has a strong effect on per capita carbon dioxide emission; the second

column indicates that green finance and green technology innovation are significant at the 1% level with a positive coefficient, which means that green The third column indicates the regression results after putting the mediating variable green technological innovation into the benchmark model, and both green technological innovation and green financial development level composite index are significant at the 1% level, indicating that green technological innovation plays a mediating effect between green finance and carbon emissions, and the mediating effect accounts for about 23.5% of the total effect (4.403*(-0.442) /(-8.298)).

The urbanization rate plays a positive role in all three paths; the ecological modernization theory and the urban environmental transformation theory both suggest that with urbanization, the urban environmental quality shows an inverted U-shaped curve of "deterioration followed by improvement"; however, China's urbanization development has not yet reached an advanced level, and the energy utilization rate is low and the industrial structure needs to be optimized. However, China's urbanization has not yet reached an advanced level, the energy utilization rate is low, and the industrial structure needs to be optimized, so urbanization plays a positive role in promoting carbon emission intensity, which is consistent with the research results of Zhang Tengfei [11] and others; with the development of new urbanism in China, more attention is paid to the coordinated growth of society, economy, population, natural resources, and environment, and more attention is paid to the development of green economy, the market demand for green technology increases, and the green technology innovation of some enterprises makes the industry accumulate certain innovation achievements, through technology spillover, thus influencing the whole industry [12], and promoting the industry to continuously develop and apply green technologies, thus reducing carbon emission intensity.

Table 5. Pathways of green finance to carbon emissions

Variable	Path(a) Eco2	Path(b) Lngreenrd2	Path(c) Eco2
Lngreenrd2	-	-	-0.442*** (0.079)
Gfi	-8.298*** (1.046)	4.403*** (0.702)	-6.352*** (1.059)
Urbanization	4.063*** (0.925)	1.126*** (0.622)	4.560*** (0.890)
Road	-1.285*** (0.175)	1.318*** (0.118)	-0.702*** (0.197)
Banking	0.133*** (0.067)	0.101*** (0.044)	0.178*** (0.064)
Fdi	-14.389*** (4.136)	-6.320*** (2.778)	-17.182*** (3.987)
_cons	2.549*** (0.467)	4.639*** (0.314)	4.598*** (0.578)

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

3.3.3 Robustness test.

In order to avoid endogenous problems and further enhance the reliability of the research findings, this paper re-runs the regression analysis by adding control variables, replacing explanatory variables, two-stage least squares and one-period lagging tests, and then incorporating the green financial development level composite index (Gfi) into the mediating effects regression model. The Table 6 show that after using different methods and examining different factors, the coefficient signs of the core explanatory variables remain unchanged and significant, indicating that the empirical results are robust.

Table 6. Robustness test

Variable	M1	M1	M2	M3	M4
Gfi	-8.464***	-8.187***	-45.420***	-8.418***	-8.366***
	(1.010)	(1.253)	(4.831)	(1.095)	(1.075)
Urbanization	5.279***	5.164***	51.003***	5.306***	4.727***
	(1.051)	(1.091)	(4.276)	(1.050)	(0.968)
Road	-1.152***	-1.163***	-5.923***	-1.283***	-1.319***
	(0.183)	(0.185)	(0.810)	(0.187)	(0.186)
Banking	0.104(0.067)	0.106	0.413	.169**	0.152***
		(0.308)	(0.308)	(0.722)	(0.700)
Fdi	-14.953***	-14.983***	-62.485***	-17.362***	-16.050***
	(4.113)	(4.119)	(19.110)	(4.839)	(4.248)
_cons	2.089***	1.919***	-5.075**	1.668***	2.186***
	(0.502)	(0.660)	(2.162)	(0.548)	(0.482)

Standard errors in parentheses; * p<0.l, *p<0.05,*** p<0.01.

4 Conclusions and Recommendations

Based on the panel data of 30 provinces in China from 2010 to 2020, this paper empirically analyzes the influence of green finance on carbon intensity, and the main findings are as follows: First, green finance and green technological innovation can suppress carbon emissions; second, the degree of green technology innovation has substantially improved as a result of the promotion of green finance on green technology innovation, and green technological innovation can be used as a mediating variable for green financing to increase the effectiveness of carbon emissions.

The following recommendations are put forward in this paper based on the results mentioned previously. First, to establish a sound green finance development system, to establish a corresponding public supervision mechanism for green finance, to build a unified green finance standard, to publicize the environmental protection information of enterprises, to improve the transparency of green finance, and then to reduce the financing cost of enterprises, to guide the flow of capital to the low-carbon field, and to attract more investment enterprises to participate in it; second, to establish a strict and scientific green technology innovation evaluation, require relevant institutions to provide professional risk assessment services for green innovation technology, vigorously promote the development of green technology innovation insurance products to pro-

vide protection for economic losses caused by the possible failure of green technology research and development; create a good social atmosphere for green technology innovation to attract more technical talents to invest in it.

References

1. Ning, J. F., Yuan, Z. M. [1] Ning, J. F., Yuan, Z. M. & Wang, X. Q.. (2021). Green credit policies and corporate overinvestment. Financial Forum (06), 7-16. doi:10.16529/j.cnki.11-4613/f.2021.06.002.
2. Wang Qian, Shuang Xing & Huang Rui. (2012). Analysis of financial functions in the development of low carbon economy. Journal of Social Sciences (01), 116-119. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=SHKK201201024&DbName=CJFQ2012
3. Cheng, Cuiyun, Li, Yating, & Dong, Zhanfeng. (2020). Research on the innovation of green financial mechanism to open up the transformation channel of "two mountains". Environmental Protection, 48(12), 5. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HJBU202012012&DbName=CJFQ2020
4. Porter, M.E., & Linde, C.. (1995). Toward a new conception of the environment-competitiveness relationship. Journal of Economic Perspectives, 9(4), 97-118. DOI:10.2307/2138392
5. Wang, J.. (2023). Green finance and corporate green technology innovation - A new perspective based on corporate life cycle. Small and Medium Enterprise Management and Tecnolgy(06),40-42. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZXQY202306009&DbName=CJFQ2023
6. Lu Jing, Yanyun & Wang Taoxuan. (2021). A study on the micro effects of green credit policy - based on the perspective of technological innovation and resource reallocation. China Industrial Economics (01), 174-192. doi:10.19581/j.cnki.ciejournal.2021.01.010.
7. Lu, Na, Wang, Weidong, Wang, Miao, Zhang, Cai & Lu, Hualiang. (2019). Breakthrough low-carbon technology innovation and carbon emissions:direct impacts and spatial spillovers. China Population-Resources and Environment(05),30-39. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZGRZ201905004&DbName=CJFQ2019
8. Zhou, Xiaomeng (2023-03-30). The development of clean energy is a "must-answer" question for green development. Hainan Daily, A09. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HLRB20230330A093&DbName=CCND2023
9. International Energy Agency. (2023). Energy Technology Outlook 2023 (Report No. IEA/ETP/2023). Retrieved from [URL]
10. International Energy Agency, Global Energy Sector Roadmap to Net Zero Emissions by 2050
11. Zhang Tengfei,Yang J & Sheng Pengfei. (2016). The impact of urbanization on carbon emissions in China and its role channels. China Population-Resources and Environment (02), 47-57. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZGRZ201602007&DbName=CJFQ2016

12. Li Gingran. (2016). Research on green technology innovation for new urbanization construction (Master's thesis, Changsha University of Technology). https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202202&filename=1017299757.nh & Wang Xiaoqi. (2021). Green credit policy and corporate overinvestment. Financial Forum (06), 7-16. doi:10.16529/j.cnki.11-4613/f.2021.06.002. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202202&filename=1017299757.nh