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An Empirical Study of the Policy of Low-Carbon City Pilot on the Level of Green Technological Innovation

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ABSTRACT

The low-carbon city pilot is an important policy for promoting sustainable development and addressing climate change. The level of green technological innovation is a significant driving force for China's transition to high-quality development and the realization of carbon peaking and carbon neutrality goals. This essay takes the panel data of 30 provinces in China from 2008 to 2020 as the research sample, regards the number of urban green invention patent applications as a quantifiable indicator of the level of urban green technological innovation, and takes the policy of low-carbon city pilot as a quasi-natural experiment, and uses the difference-in-differences model to test the impact of low-carbon city pilot on the level of urban green technological innovation, and to investigate the mechanism of action within. The main conclusions are as follows: (1) The policy of low-carbon city pilot has an outstanding promotion effect on the level of urban technological innovation. (2) Using the mediating effect to analyze, it is found that the low-carbon city pilot policy can improve the level of urban green technological innovation through the development of green finance.

KEYWORDS

Policy of Low-Carbon City Pilot; Green Technological Innovation; Difference-in-differences Model

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1. Introduction

Low-carbon city is an important policy for promoting sustainable development and coping with climate change. With the increase of economic development, climate warming has become a problem that cannot be ignored, and the low-carbon economy has gradually become the focus of attention of various countries. As the world's largest manufacturing country and one of the countries with the highest carbon emissions, China has actively assumed the responsibility of a large country in addressing climate change, and has made carbon emission reduction a crucial task in the construction of the national ecological civilization and high-quality development. In 2010, the Chinese government issued the "Notice on Carrying Out Pilot Work of Low-Carbon Provinces and Cities", which determined to carry out pilot work in five provinces, including Guangdong and Liaoning, and eight cities, including Tianjin and Chongqing. In this study, we take the policy of low-carbon city pilot as an example to investigate its impact and mechanism on the level of green technological innovation.

2. Literature review

In the process of carrying out low-carbon policies, due to the different economic development conditions in different regions of China, the problems encountered by different provinces and cities are also different, and correspondingly, the low-carbon work programs and countermeasures adopted by each province will also be different. Some scholars have studied and evaluated the different low-carbon policies implemented by different cities. Among them, Shenzhen, Hangzhou, Zhenjiang, Chengdu and other cities are taken as cases, and specific planning and construction measures taken by these low-carbon pilot cities are analyzed through macro-level and micro-level analysis (Zhuang Guiyang, 2020). The development process of China's low-carbon pilot cities is reviewed, and the status quo of the first eight low-carbon pilot cities in China is compared and analyzed (Khanna et al., 2014). At the same time, scholars made a specific analysis of the above types of low-carbon urban development policies in terms of policy change paths, innovation models, hierarchical design and structural types, etc., and outlined the shortcomings of the policies (Fu Lin et al., 2020).Through the study of when China's low-carbon pilot city development situation, pointed out that, in the context of China's market economy, we should go by the government-led market-oriented low-carbon policy reform. Some scholars focuses on the national, local and departmental aspects, discusses the corresponding measures for the implementation of green building in China, and puts forward corresponding strategies and suggestions for the development of different regions(Sheng Guangyao.,2016). Analyzing the situation of low-carbon governance in the Suzhou Industrial Park and pointed out that although the National Development and Reform Commission is trying to promote a pilot project led by the local government, the process is still in its preliminary stages of a top-down management mechanism (Liu.,2017). In the long term, the target accountability system remains a key functional institution for reducing CO_2 emissions per unit of GDP.

At present, the evaluation of the implementation effect of the low-carbon city pilot policy is mainly centered on economic development, energy consumption and so on. Through developing a set of evaluation index systems for low-carbon city construction in six dimensions: area, energy, industry, low-carbon life, resource environment, and low-carbon policy innovation, and concluded that the low-carbon pilot work has achieved positive results, and found out the regularity of low-carbon city evolution and issues like the existence of local imbalance, and that the effect of low-carbon policy has not been fully realized (Chen Nan et al.,2018). Studying the impact of the low-carbon city pilot policy on urban green total productivity, and concluded that the policy of low-carbon city pilot significantly promotes the growth of urban green total factor productivity, and pointed out that the low-carbon city pilot policy has a more significant effect on the urban technical efficiency and urban green technological progress(Wang Yafei et al.,2021).Through investigating the impact of the pilot policy of "low-carbon city" on urban green technology

progress and green technology spillover, and then identified the sources, target goals and participating subjects of urban green technology progress. Finally, it is found that the pilot policy of "low-carbon cities" greatly promotes urban green technology progress and green technology spillover, and it also promotes cross-regional green technology progress and green technology spillover, and has a stronger impact on the pilot cities with high administrative levels and their neighboring pilot cities (Shao Shuai et al.,2022). By using the difference-in-differences method, Deng Rongrong, Zhan Jing(2017), Zhou Di, Zhou Fengnian(2019) and others assessed the low-carbon city pilot policy and found it has a significant inhibition effect on urban carbon emissions intensity, and the longer the pilot policy lasts, the stronger the inhibition effect is. Analyzing this policy effect through the synthetic control method, and found that the low-carbon city pilot policy, in general, has a significant effect on the reduction of electricity consumption and carbon emission, and the effect of reducing energy consumption intensity and carbon emission in pilot cities is increasingly remarkable(Lu Xianwei.,2017;Li Shunyi.,2018;Yang Bowen et al.,2020).Through taking 197 cities in 16 provinces in China as the research object, and using the double-difference method to analyze China's FDI empirically,the study found that the "low-carbon" pilot policy has a certain role in promoting FDI in the central and eastern regions, but has a certain inhibiting effect on FDI in the western region(Gong Mengqi.,2019). In order to verify the impact of low-carbon pilot on the urban economy, the second batch of pilot cities as a sample of the study, and pointed out that, for all the 36 pilot cities, the low-carbon pilot policy on its exports and imports of trade dependence on the degree of inhibition, while the dependence on the degree of export trade does not have a great impact. At the same time, the impact on the second batch of pilot cities is more significant than the first batch of pilot cities(Zhang Zhixin et al.,2019). Taking the three pilot low carbon cities from 2010 as an example, and used the double difference method to carry out an empirical analysis, and the results showed that the pilot policy of "low carbon city" can effectively improve the energy efficiency of the city, and carry out a positive spatial spillover effect on it(Zhang Bingbing.,2021).Using the double-difference method to study the impact of low-carbon pilot city policies on the local industrial structure, and found that the low-carbon pilot can indeed have a certain impact on the industrial structure of the pilot city through a certain market base(Lu J et al.,2020). On the other hand, analyzing from the perspective of the company and finding that China's scientific and technological progress can not only rely on the pilot to improve the strength of technological innovation, but also the differences in technology among the major cities will become bigger and bigger(Li Linhong.,2019) .

In addition, related literature has used different mediating variables in studying the impact path of low-carbon city pilot policy on the level of green technology innovation. By selecting the investment of policy research and development funds, the number of scientific and technological talents and industrial structure as the intermediary variables, this paper explores the impact path of low-carbon pilot policies on urban technological innovation, and finally believes that due to the geographical disadvantages such as ecological fragility, industrial structure singularity and weak innovation foundation, low-carbon pilot policies will hinder technological innovation in resource cities, big cities and western cities(Lu Jin et al.,2019).By choosing foreign direct investment as a mediating variable to analyze the influence path of low-carbon city pilot policy and green technology innovation level(Yang Yueyan.,2023). Using different types of policy tools and financing constraints as mediating variables to analyze and study through which mechanism the pilot policy of low-carbon cities induces enterprises' green technological innovation(Xu Jia et al.,2020).

To sum up, scholars have analyzed the impact of low-carbon city pilot policy on related indicators from different perspectives, with reference to the analytical methods and ideas from the above literature, this paper takes the level of urban green technological innovation as the research object, which enriches the theoretical system of the low-carbon city pilot policy. Therefore, based on the data of China's urban green technological innovation level in 2008-2020, this paper takes low-carbon city pilot policy as a quasi-natural experiment, and at the same time innovatively introduces green finance as an intermediary variable to study the theoretical role of low-carbon city

pilot policy on the level urban green technological innovation.

3. Theoretical mechanisms

(1) Low-carbon city pilot can enhance green technological innovations

The low-carbon city pilot policy, a decentralized environmental governance model that implements differentiated measures for regional environmental problems, has both weak incentives and weak constraints compared with other pilot policies. On the one hand, during the low-carbon pilot process, the central government provided limited incentives to the pilot cities, except for a few supporting special funds for infrastructure capacity building projects, but increased the legitimacy of local governments. On the other hand, the central government also did not impose a strong top-down constraint mechanism, did not set a clear responsibility system for energy saving and emission reduction targets and assessment methods, and gave local governments great autonomy, which prompted them to seek the best green development paths according to their own industrial structure, economic model, and stage of development to fulfill the low-carbon targets. Against the background of the central government's weak incentive and light control implementation measures, this paper further analyzes and explores whether the implementation of the pilot low-carbon city policy affects the innovation level of low-carbon technologies in China's cities, based on the Porter's hypothesis.

First of all, the Porter's hypothesis suggests that a reasonable environmental policy will stimulate technological innovation , and the implementation of this policy will certainly bring about a strong market selection effect, which will reduce the enterprise's resource utilization, and the enterprise will be forced to carry out inefficient technological innovation in order to reduce the cost of enterprise operation. If the total amount of resources of the enterprise can not be increased, it will certainly reduce the energy consumption generated in productive activities and adopt energy-saving and emission reduction methods of production, but this will also lead to an increase in the production costs of the enterprise. The rising cost of incumbent enterprises increases the risk of exit of incumbent enterprises, especially those with low efficiency, high pollution and high energy consumption, which will bear the brunt of the three choices of shutting down production, relocating offsite, or through independent innovation. If the first two choices are chosen, the large amount of productive or service investment already invested by the enterprise will become sunk costs, which is not conducive to the long-term development of the enterprise. Therefore, rational enterprises will consider choosing the third way to improve productivity and energy saving and emission reduction through independent innovation. Second, the pilot policy of low-carbon cities makes technological innovation less risky, increases the value of investment, and improves the willingness of individuals to make innovative investments. Although in the long run, innovation is the optimal choice to maximize profits, in the short run, firms face many challenges, such as increased costs, increased innovation expenses, and unpredictability in the future, which may reduce their motivation to take the initiative in energy saving and emission reduction, and refuse to implement low-carbon technological innovations. If the government can adopt optimal pilot policies for low-carbon cities, it can guide enterprises to realize that technological innovation can gradually achieve the win-win situation of energy saving, emission reduction and productivity enhancement, which is also known as the "innovation compensation effect", in order to promote enterprises to carry out proactive technological innovation. In short, the government's implementation of low-carbon city pilot policy is to increase the possibility of independent research and development by improving the market selection effect and optimizing the allocation of enterprise resources, so as to achieve the ultimate goal of technological innovation.

Hypothesis 1: Low-carbon city pilot policy can enhance the level of green technology innovation.

(2) Low-carbon city pilot policy promotes the improvement of green technology innovation through the level of green finance.

The strong correlation between green finance development and low carbon. The reason why "green finance"

has attracted so much attention stems from its incentive and constraint effects on strengthening corporate social responsibility and promoting energy conservation, emission reduction and sustainable development. This role and influence is complex and complex, both direct and indirect; both long-term and sometimes downstream; both actual and potential. In order to avoid the discipline of green finance and win the corresponding development opportunities, many entrepreneurs will be more involved in the field of low environmental risk, and many successful enterprises will be listed on the financing and refinancing more inclined to the green industry, environmental protection industry, thus optimizing the investment structure to promote the environmental protection of the industry. For those high-input, high-consumption, high-pollution industries, the green financial policy for its survival and development of the formation of a huge external pressure to increase technological innovation efforts to break through technological bottlenecks and optimize product design and production processes to reduce the unit of product energy consumption, consumption and waste emissions to improve the output level of the unit of resources.

In the field of green finance, carbon finance is an important part of green finance, with the role of simultaneously promoting energy conservation and emission reduction and environmental protection. Thus, from the point of view of quantitative relationship, the data of the whole country show that the development of green finance is closely related to the reduction of carbon emissions. The development of green finance has led to the improvement of the level of green technological innovation. Unlike general enterprises, financial institutions themselves have very low carbon emissions and hardly produce pollution directly, but influence the real economy through a series of financial functions such as capital financing, information provision and risk management. It is increasingly recognized that the financial sector should assume environmental responsibility, and that the mechanism of green finance's impact on economic development is multidimensional, including promoting the green allocation of resources, supporting cleaner and emission reduction technologies, urging other enterprises to assume environmental responsibility, providing information on the environmental risks of enterprises, and helping enterprises to control environmental risks.

Green technological innovation cannot be separated from the support of green finance, which is the financial innovation of green technological innovation and can influence the development of the level of green technological innovation.

Hypothesis 2: Low-carbon city pilot policy promotes the level of green technological innovation through the level of green finance.

4. Empirical research

4.1. Model selection and data sources

This paper selects the low-carbon city pilot policy as the low-carbon economic policy implemented in China, and adopts the empirical method of difference-in-differences to analyze the changes in the level of green technological innovation between low-carbon pilot cities and non-pilot cities in the years before and after the implementation of the policy, and to explore the impact of the low-carbon city pilot policy on the level of green technological innovation. The period before 2011 is taken as the period before the policy implementation, and 2011 and after is taken as after. Seven provinces, including Chongqing, Tianjin, Hubei, Shanghai, Guangdong, Beijing, and Fujian, are used as the experimental group, and the other 23 non-pilot provinces except Tibet, Hong Kong, Macao, and Taiwan are used as the control group. The model is constructed as follows:

$$GRE_{it}=\alpha_0+\alpha_1 Did_{it}+\alpha_2 control_{it}+\mu_i+\lambda_t+\varepsilon_{it}$$

GRE_{it} is the explained variable, which represents the number of green patent applications of the city i in year t; *Did,* a dummy variable, shows the status of the implementation of the low-carbon city pilot policy, and when Did=1

is, it represents that city i is a low-carbon pilot city in year t; when Did=0, it represents that city i has not implemented the pilot policy of low-carbon cities in year t. $Control_{it}$ is some control variables that will have an impact on the level of green technology innovation level. μ_i is an individual fixed effect, λ_t is a time fixed effect, and $\varepsilon_{i,t}$ denotes a random disturbance term.

To control the influencing factors affecting the growth of green technology innovation in more cities, this paper introduces the following control variables: urbanization rate (the proportion of the urban population in the year-end resident population), the marketization rate (marketization index), and the industrial structure (the proportion of added value of the tertiary industry in the regional GDP).

Table 1. Variables and Their Explanation.

Green Technology Innovation Level （GRE）	the number of green patent applications ln(1+patent)
Urbanization Rate （UR）	the proportion of the urban population in the year-end resident population
Marketization Rate （MAR）	marketization index
Industrial Structure （IND）	the proportion of added value of the tertiary industry in the regional GDP

Table 2. Descriptive Statistics of Major Variables.

Variables	Control Group			Experimental Group		
	N	mean	sd	N	mean	sd
GRE	299	0.00955	0.00542	91	0.0155	0.00564
UR	299	0.539	0.0797	91	0.722	0.136
IND	299	0.469	0.0542	91	0.567	0.133
MAR	299	5.767	1.650	91	8.045	1.368
GFI	299	0.144	0.0489	91	0.195	0.0934

Notes: Data for all variables are obtained from China Statistical Yearbook, China Industrial Statistical Yearbook, and China Insurance Yearbook of past years.

4.2. Basic Regression

Table 3. Benchmark Regression Result.

	(1)	(2)
Variables	GRE	GRE
Did	0.576***	0.744***
	(0.105)	(0.116)
UR		0.0149***
		(0.00402)
IND		1.689
		(1.359)
MAR		0.0048***
		(0.037)
Constant	0.0111***	0.0151***

	(0.000135)	(0.00460)
TIME	Yes	Yes
CITY	Yes	Yes
Observations	390	390
R-squared	0.910	0.915

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.*

Regression analysis of the constructed model, as can be seen from the data in Table 3, no control variables are added in column (1), only the interaction term policy variables are added, and the location and year are fixed, the estimated coefficient of the interaction term policy variable DID is 0.576, and it is significantly positive at 1% level, indicating that the pilot policy of low carbon cities significantly promotes the growth, the reason is mainly that the government controls the emissions of high polluting enterprises and sets taxes, and gives various financial and tax subsidies to low polluting enterprises, which reduces pollution and converts energy to a certain extent. Highly polluting enterprises emissions, and set taxes, for low-polluting enterprises to give a variety of financial and tax subsidies, to a certain extent, to reduce pollution, conversion of energy structure to achieve the growth of the level of urban green technology innovation. To a certain extent, it shows that the pilot policy of low-carbon cities has a positive promotion effect on the level of urban green technological innovation. Verify hypothesis 1.

Column (2) adds three control variables UR, MAR and IND based on column (1), at which time the regression result is 0.744 and significant at a 1% level of significance. The estimated value of the coefficient of UR is 0.0149 and significant at a 1% level of significance, and the estimated value of the coefficient of MAR is 0.048 and significant at a 1% level of significance. This shows that when other factors are controlled, the urban green technology innovation level will increase by 1.49% and 4.8% on average, when the urbanization rate and marketization rate increase by 1% separately. The coefficient of IND is 1.689, but it is not significant, which indicates that the industrial structure does not have a significant effect on the development of the level of green technological innovation in the city. The regression values of the above did coefficients are all positive, indicating that the conclusion that the pilot policy of low-carbon cities can significantly improve the level of urban green technological innovation is somewhat robust.

4.3. Parallel Trend Test

According to the results from 4.2, the low-carbon city pilot policy has a promoting effect on the level of green technology innovation. Then, the parallel trend assumption needs to be satisfied before adopting the difference-in-differences model, i.e., the experimental group and the control group have the same features and trends before the implementation of the low-carbon city pilot policy, so as to ensure the accuracy of the empirical results. Although it can be seen from the data in this paper that the trend of changes in the explained variables of the experimental group and the control group before the implementation of the policy is basically parallel, in order to more accurately verify the parallel trend assumption, this paper adopts empirical analysis to test it.

From the test results in Table 4, it can be seen that before the launch of the pilot policy of low-carbon cities, the effect on the level of urban green technological innovation is not obvious, and after the implementation of the policy, there is a significant impact on urban green technological innovation in that year, and the impact remains significant 2 and 3 years later, and the estimated coefficients are significant at the level of significance of 1% and 5%, respectively. Therefore, the study passed the parallel trend test, and the low-carbon city pilot policy has a significant effect on the level of urban green technological innovation.

Table 4. Parallel Trend Test

Independent Variables	Dependent Variable: GRE
pre_4	0.00123
	(0.00118)
pre_3	0.000584
	(0.00117)
pre_2	0.000275
	(0.00116)
current	0.00855**
	(0.00116)
post_1	0.00533***
	(0.00117)
post_2	0.00838***
	(0.00118)
post_3	0.00736***
	(0.00119)
post_4	0.00805***
	(0.00118)
Constant	0.0236***
	(0.00444)
TIME	YES
CITY	YES
Observations	390
R-squared	0.918

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.*

4.4. Robustness Test

To further test the robustness of the results, this paper uses the method of redefining the explained variables to test the robustness of the difference-in-differences regression model. Since the time of green patent application tends to be different, to avoid its impact on the estimation, this paper re-does the regression to test the effectiveness of the policy by dividing the explained variables separately into the number of green patents applied and the number of green patents granted. With Table 5, it can be seen that after replacing the explained variables, the regression estimates of did are 0.576 and 0.744, which are both significant at the 1% significance level, further illustrating the robustness of the low-carbon city pilot policy in promoting the level of green technological innovation.

4.5. Mechanism Analysis

The promotion effect of low-carbon city pilot policy on the level of urban green technological innovation has been verified above, fully verifying hypothesis 1. On this basis, this paper uses the mediating effect to verify hypothesis 2, taking green financial development as the mediating variable, and exploring how the pilot policy of low-carbon cities acts on the level of green technological innovation. This paper draws on the research results of Wen Zhonglin et al., and constructs the mediating effect test model as follows:

$$GRE_{it}=\alpha_0+\alpha_1 Did_{it}+\alpha_2 control_{it}+\mu_i+\lambda_t+\varepsilon_{it}$$

$$GFI_{it}=\beta_0+\beta_1 Did_{it}+\beta_2 control_{it}+\mu_i+\lambda_t+\varepsilon_{it}$$

$$GRE_{it}=\gamma_0+\gamma_1 Did_{it}+\gamma_2 GFI_{it}+\gamma_3 control_{it}+\mu_i+\lambda_t+\varepsilon_{it}$$

GFI is the level of green financial development, as the mediating variable in this paper. The green financial development level will be measured from four aspects: green credit, green securities, green insurance and green investment.

Table 5. Robustness Test.

	(1)	(2)
Variables	GTI	GTI
Did	0.270***	0.244***
	(0.105)	(0.116)
MAR		-6.156
		(12.24)
UR		4.747***
		(1.538)
IND		1.689
		(1.359)
Constant	6.231***	2.686**
	(0.0253)	(1.056)
Observations	390	390
R-squared	0.963	0.965

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.*

Table 6. The Mediating Effects test

	(1)	(2)	(3)
Variables	GRE	GFI	GRE
Did	0.744***	0.125***	0.612***
	(0.116)	(0.038)	(0.0592)
GFI			0.0412**
			(0.0532)
TIME	YES	YES	YES
CITY	YES	YES	YES
Observations	390	390	390
R-squared	0.915	0.982	0.944

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.*

According to the mediating effect analysis, the results shown in Table 6, column (1) can be seen that the coefficient between the pilot policy of low carbon cities and the level of urban green technological innovation is significant at the 1% level, which indicates that the pilot policy of low carbon cities can effectively promote the level of urban green technological innovation. After adding the green financial intermediary variable, the data in columns (2) and (3) are all significant at the 1% level, which indicates that green finance acts as an intermediary variable to influence the level of green technological innovation. The low-carbon city pilot policy eases the financing pressure and reduces the innovation risk by improving the development level of green finance. This means that the low-carbon city pilot policy can effectively promote the development of the level of urban green finance, thus promoting the level of urban green technological innovation, and Hypothesis 2 is verified.

5. Conclusions and policy recommendations

The level of green technological innovation is a vital driving force for China's transformation to high-quality development and the realization of carbon peaking and carbon neutrality goals. This paper takes the panel data of 30 provinces in China from 2008 to 2020 as the research sample, uses the number of urban green invention patent applications as a quantifiable indicator of urban green technological innovation, and takes the pilot policy of low-carbon cities as a quasi-natural experiment, and uses the difference-in-differences model to test the impact of this policy on the level of urban green technological innovation, and inspect the mechanism of action within. The main conclusions are as follows: (1) Low-carbon city pilot policy does have a significant promotion effect on the level of urban technological innovation. After a series of robustness tests such as the parallel trend test and the replacement of explained variables, the above conclusion still holds. (2) After further analyzing the model and applying the mediating effect analysis, it is found that the low-carbon city pilot policy can improve the level of urban green technological innovation through the development of green finance.

Based on the research development of this paper, four suggestions to further develop the level of urban green technological innovation are obtained as follows: (1) Continuously promote the pilot policy of low-carbon cities to push the transformation of urban development forward. Based on the conclusions in the last paragraph, China should actively explore the development mode of low-carbon cities, summarize the relevant development experience, and our government should actively formulate policies and plans for the construction of low-carbon cities, improve the low-carbon legal system, form a set of effective low-carbon policies and institutional mechanisms, and enhance the impact of the pilot cities, radiating surrounding cities to drive regional development, and ultimately achieve the high-quality development nation-wide. (2) Optimize and improve urban green financial policies to break the financing constraints of enterprises and other innovative subjects. The findings of this paper show that the pilot policy of low-carbon cities can improve the level of urban green technological innovation through the development of green finance. For starters, innovate the development mode of green finance, set up special funds for low-carbon development, cooperate with the government's policy and mechanism, improve the diversity and sustainability of the safeguard mechanism of green credit, and broaden the financing channels of enterprises. Secondly, increase the investment of green finance in low carbon technology research and development, develop a series of green financial products, and at the same time broaden the financing channels for enterprises and other innovative main bodies through financial subsidies and tax incentives. Moreover, green credit funds should support the development of low-carbon industries, especially tilting to the industries, research institutions and enterprises specializing in low-carbon core technologies, accelerating the development of low-carbon core technologies, thus enhancing urban green technological innovation. Finally, establish a wholesome green financial supervision system. The development of green finance will inevitably bring the corresponding financial risks and social risks, so, to ensure that green finance promotes the level of green financial innovation in the city, the green financial supervision system and the development of the evaluation system should also be improved, therefore ensuring the effective operation of the pilot policy of low-carbon cities. (3) Achieve high-quality urban development, by considering both innovation and environmental protection. Efforts will be made to promote the upgrading of industrial structure, strengthen low-carbon technological innovation capacity, cultivate independent technological innovation in each region, and accelerate the realization of low-carbon innovation-driven development and high-quality economic development. Continuously improve the level of technological innovation and promote the sharing and dissemination of low-carbon technologies, so as to realize mutual reference and common progress in every pilot region.

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Conflict of interest

The authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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