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# Analysis of Mediating Effect of Green Technology Innovation on Pollutant Emission

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**Abstract***:* The internal mechanism of green technology innovation's impact on environmental pollutant emission is analyzed by taking industrial structure and energy utilization efficiency as intermediate variables.Two mediating effect models are established to study the effect of energy efficiency and industrial structure respectively. The research conclusions show that the mediating effects of two variables are significant. Green technology innovation mainly optimizes environmental quality and reduces environmental pollution emissions through the two mechanisms of energy efficiency improvement and industrial structure transformation. In addition, according to the regional differences , the environmental effects of green technology innovation are compared, and it is found that the green technology innovation in western China has a more significant effect on emission reduction than that in eastern and central China.

**Keywords** Green technology innovation, Pollutant emission, Mediating effect, Energy efficiency

## INTRODUCTION

In recent decades, China's economy has developed rapidly, but it is also facing increasingly severe ecological and environmental problems. Sulfur dioxide is one of the most important environmental pollutants in China, which brings great negative impact on the environment. China's emissions of Sulphur dioxide in 2006 increased by 75 per cent compared with 1990. At the same time, there are significant differences in different regions, with the highest sulfur dioxide emissions in the eastern region, followed by the central region, and the lowest in the western region. In terms of specific provinces, the top three emitters in 2017 are Shandong, Shanxi and Guizhou. The province with the lowest emissions is Hainan, followed by Shanghai and Beijing. Pollutant emission has a direct negative impact on the environment, and the fundamental way to solve the problem is green technology innovation and application.

Braun in 1994 for the first time clearly defined as "green technology", which refers to the technology, processes and products of the ecological principle and ecological economic rules, saving resource and energy, eliminating or mitigating the ecological environment pollution and destruction, the minimum ecological negative effects of "harmless" or "public nuisance". Green technological innovation is mainly characterized by improving energy efficiency and reducing or avoiding environmental pollution. It is different from traditional technological innovation in the following aspects: The motive of traditional technological innovation mainly comes from the pursuit of maximum profit, that is, through technological innovation to promote product upgrading, improve productivity, and thus create more economic profit. While pursuing economic benefits, green technological innovation also considers the impact of environmental factors, and the cost of pollution control needs to be calculated during the production of products. Under the constraints of strict environmental regulations, the cost of pollution control is high, leading to the crowding out of funds for other investment activities, which will stimulate enterprises to carry out green technology innovation to reduce the total amount of pollutant discharge and reduce the cost of pollution discharge.

As for the impact of technological innovation on environmental pollution, most scholars believe that technological innovation is conducive to reducing environmental pollution. Levinson (2009) analyzed the data from 1987 to 2001 in the United States and found that the index data related to environmental pollution of American manufacturing enterprises decreased through technological improvement[4]. Peng Shuijun and Bao Qun (2006) deeply discussed the impact of environmental policies and technological innovation on environmental pollution based on the environmental Kuznets curve. Through the inspection of panel data of all provinces from 1996 to 2002, it is confirmed that the increase of environmental scientific research funds and environmental technological progress bring about the improvement of environmental quality. Li Bo (2013) believed that the emission reduction effect of technological innovation has significant spatial spillover, and technological innovation can improve the reduction of carbon dioxide emissions in both

local and adjacent areas. Technological innovation has obvious spatial correlation to carbon emissions, but there is a certain lag. Lin Liguo and Lou Guoqiang (2014) compared the emission and environmental performance data of two types of enterprises in Shanghai and foreign-funded enterprises, and showing that foreign-funded enterprises have higher environmental performance than domestically funded enterprises, because foreign-funded enterprises have more advanced and clean technologies. Guo Bin, Liu Jia and Yao Xilong (2016) analyzed the impact of technological innovation on sulfur dioxide in six provinces in central China. Empirical research shows that dry learning, introduction of foreign advanced technology and independent research and development will increase sulfur dioxide emissions, and the interaction effect of economic scale, independent research and development and foreign technology introduction can promote the reduction of sulfur dioxide emissions. Chen Yang et al. (2019) hold that technological innovation can transform heavily polluted production equipment to reduce energy consumption and thus improve environmental quality. Liu Ruijie and Zhang Zhihui (2012) made use of China's industrial data and found that technological innovation, especially the effect of green technological innovation, is an important driving force for sulfur dioxide emission reduction. Li Bin and Zhao Xinhua (2011) decomposed the impact of environmental pollution into a variety of effects, and the study showed that new green technologies in pollution treatment and production can compensate for the negative impact of industrial structure on the environment.

However, some scholars have found that technological innovation will increase environmental pressure to a certain extent. Li Fen et al. (2017) conducted PVAR analysis of panel data of 21 industrial industries in China to investigate the possible dynamic relationship between technological innovation and environmental pollution, and the results showed that technological innovation can significantly increase the amount of environmental pollution[12]. Ming Zhang et al. (2019) used the differential generalized distance estimation (GMM) analysis method to discuss the role of environmental regulations in haze control. Research shows that scientific and technological innovation will aggravate haze pollution, and thus aggravate the degree of environmental pollution. Through panel regression and threshold effect estimation, Liu Guomai and Yu Liping (2020) found that the elasticity coefficient of technological innovation on the environment was positive, indicating that technological innovation had a negative effect on environmental pollution.

Comprehensive analysis shows that at present, there are different conclusions about the impact of technological innovation on the environment, mainly because that existing literatures do not carry out detailed analysis on the internal mechanism of the impact of green technological innovation on pollutant emission. Green technology innovation has an impact on the emission of environmental pollutants, and its internal transmission effect is mainly realized through industrial structure and energy efficiency as intermediary variables. In this paper, the mediating effect model is established to analyze the influence mechanism of green technology innovation on environmental pollution.

## INFLUENCE MECHANISM AND BASIC DATA ANALYSIS

### Influence mechanism analysis

Green technology innovation belongs to a type of technology innovation. Green technology research and development activities can develop more environmentally friendly, greener and cleaner products or equipment, including the production level and pollution treatment level. However, some traditional enterprises will be phased out in the market competition if they cannot keep up with the market development trend, carry out innovative research and development of green technology or introduce new green technology in a timely manner, and still maintain the original high pollution and high energy consumption. Only enterprises which can actively carry out technological innovation or introduce green technology can gradually increase their market share. In the process of continuous transformation of traditional industries by green and advanced technologies, the industrial structure has gradually moved to a higher level and achieved transformation and upgrading of the industrial structure. On the other hand, in the context of green technological innovation, emerging industries such as new energy and new materials are gradually coming into people's sight, providing more choices of clean materials and clean energy for people's production and life. With the optimization and upgrading of industrial structure, pollution-intensive industries have been phased out in this process, and green advanced technologies have gradually penetrated into all industries. Therefore, green technology innovation can effectively promote the optimization of industrial structure. Through the development of high-tech industries and the gradual elimination of pollution-intensive industries, green technology innovation can reduce pollutants through the upgrading of industrial structure.

Environmental economists point out that the use of fossil fuels such as coal, oil and natural gas in the process of industrial development will produce a large number of pollutants, mainly sulfur dioxide. Chen Yang et al. (2019) hold that technological innovation can transform heavily polluted production equipment to reduce energy consumption and thus improve environmental quality. Green technology innovation aims at saving energy and improving energy efficiency. The products developed by green technology innovation generally have the characteristics of energy saving and consumption

reduction. Moreover, the active application of green advanced technology in production can encourage enterprises to continuously carry out research, development and use of green and clean technology, forming a positive virtuous cycle mode, thus promoting the improvement of environmental quality. Therefore, green technology innovation has emission reduction effect on pollutants by improving energy efficiency. To sum up, the mediation effect model can be established to comprehensively analyze the transmission mechanism of the impact of green technology innovation on environmental pollution from the perspectives of industrial structure and energy efficiency.

**Variable selection and basic data analysis**

Based on the data from 2003 to 2017 from 30 Chinese provinces (except Tibet, Hong Kong, Macao and Taiwan), this paper analyzes the impact of green technology innovation on regional environmental quality. On this basis, the mediation effect of industrial structure upgrading and energy efficiency improvement is analyzed in detail.

Table 1. Variable selection and description

| | Variable symbol | Variable declaration |
|---|---|---|
| Dependent variable | Environmental pollution (pol) | so2 emissions |
| Kernel variable | green technology innovation (pat) | green patent grant |
| Control variable | level of economic development(G) | regional GDP |
| | fixed assets investment (I) | fixed assets investment |
| | population scale (H) | the total population |
| | environmental governance (V) | investment of pollution control/GDP |
| Mediator variable | industrial structure (IS) | tertiary industry output value/the second industry output value |
| | energy efficiency (EE) | energy consumption |

Selects the data of 30 provinces, autonomous regions and municipalities directly under the Central Government (excluding Tibet, Hong Kong, Macao and Taiwan) from 2003 to 2017. In order to alleviate the heterosexuality problem, natural logarithm processing is carried out on all variables except environmental governance level and energy efficiency. Descriptive statistics of each variable are shown in Table 2.

Table 2. Descriptive statistics of variables

| Variable | Mean | Standard deviation |
|---|---|---|
| pol | 68.23302 | 44.37003 |
| pat | 1646.549 | 2827.241 |
| G | 14697.13 | 14675.83 |
| I | 10039.49 | 10053.27 |
| H | 4401.193 | 2641.007 |
| V | 1.337867 | 0.668422 |
| IS | 0.970587 | 0.516238 |
| EE | 0.000144 | 0.000167 |

## MODEL SETTING AND RESULT ANALYSIS

Panel data models include fixed effect model, random effect model and mixed estimation model. F test and Hausman test are required for verification before regression analysis. Sulfur dioxide emission is taken as the explained variable, and the results show that the P value of f-test index is less than 0.01, rejecting the null hypothesis, indicating that the fixed effect model is significantly better than the mixed regression model. Hausman test results show that the P value is less than 0.01, suggesting that the individual fixed effect model should be adopted. The basic form of panel data model is as follows:

$$pol_{it} = \alpha_0 + \beta_1 pat_{it} + \beta_2 X_{it} + \lambda_i + \varepsilon_{it} \quad (1)$$

$pol_{it}$ represents the environmental pollution level of area i in period t. $pat_{it}$ represents the green technology innovation level of region i in period t. $X_{it}$ is the control variable vector, including: economic development level G, fixed asset investment I, population size H and environmental governance investment V. In addition, the quadratic term of GDP is added to the model. $\lambda_i$ is the unobservant individual fixed effect in region I, $\varepsilon_{it}$ as a random disturbance term.

**Regression results**

The fixed-effect model is applied in this study, and fixed-effect regression results are shown in Table 3.

Table 3. Fixed-effect regression results

| Variable | Model 1 |
|---|---|
| pat | -0.314005*** |
| G | 1.535574*** |
| $G^2$ | -0.105306*** |
| H | -0.740856* |
| I | 0.438631*** |
| V | 0.109*** |
| Intercept | 2.83293 |
| $R^2$ | 0.918517 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

According to the regression results, at the confidence level of 1%, green technology innovation

can significantly reduce sulfur dioxide emissions, which has an important role in improving environmental quality and is environment-friendly. This shows that China's technological innovation in recent years is mainly "green technological innovation", which has a direct effect on the improvement of environmental pollution. When other control variables remain unchanged, the emission of sulfur dioxide in the air will decrease by 0.3140% for every 1 unit increase in green technology innovation. Technological innovation in the field of ecological environment plays an important role in continuously improving the ecological environment and helping the economy "climb the hill". Under the joint action of continuous improvement of independent research and development level and continuous introduction and digestion, the level of green technology in the field of ecological environment in China is constantly improving, and the level and scale of technologies related to dust removal, flue gas depressurization and urban sewage treatment have gradually stepped into the international advanced ranks.

As can be seen from the table, each control variable has a significant impact on sulfur dioxide emissions. The primary coefficient of GDP is positive, and the quadratic coefficient is negative, indicating that the impact of green technology innovation on sulfur dioxide emissions presents an obvious "inverted U-shaped" environmental Kuznets curve. With regard to the impact of population variables, the results show that, at a confidence level of 10%, an increase in population size reduces so2 emissions. It is generally believed that as the size of the population increases, more human activities will increase emissions of pollutants. However, table 1 shows that the increase of China's population will reduce sulfur dioxide emissions. This may be because with the rapid development of China's productive forces, the quality of the population has been greatly improved, the growth of population size to ensure the level of labor force, China's population environmental negative effect is gradually disappearing. According to the regression results, it can also be found that the growth of fixed asset investment aggravates environmental pollution. This is because investment in fixed assets includes investment in capital construction, real estate development, manufacturing and other fixed assets. Large-scale construction will consume a lot of energy, and most provinces in China still rely on fossil fuels as their main source of energy, exacerbating emissions of pollutants such as sulfur dioxide. In addition, at the significance level of 1%, the improvement of the input level of environmental pollution control intensifies the emission of pollutants, which indicates to some extent that the existing input of environmental control has very limited emission reduction effect on pollutants. One possible reason is that environmental governance is difficult, the investment efficiency of environmental governance is low, which can not meet the needs of governance, and it is difficult to effectively play its pollution control effect. On the other hand, increased investment in environmental governance may represent the increase of environmental pollutants and deterioration of environmental quality. Because if the local environmental pollution level is high, the local government will often be forced by public opinion and superior pressure, increase the investment in environmental governance. From this point of view, the rising level of investment in environmental governance may be another manifestation of intensified environmental pollution.

**Robustness test**

In order to verify the stability of the model analysis results, the robustness of the model was tested by endogeneity, variable substitution, changing samples and heterogeneity.

(a) **Endogeneity test**

Considering that there may be a reverse causality between environmental pollution and green technology innovation, endogeneity problems appear in the model. The first-order lag variable of green technology innovation was used as instrumental variable and the regression model was re-estimated by two-stage least square method. The test results are shown in Table 4.

Table 4. Robustness test results

| Variable | Model 1 | Model 2 |
|---|---|---|
| pat | -0.314005*** | -0.278861*** |
| G | 1.535574*** | 1.559114*** |
| $G^2$ | -0.105306*** | -0.110427*** |
| H | -0.740856* | -0.950792** |
| I | 0.438631*** | 0.415971*** |
| V | 0.109*** | 0.122957*** |
| Intercept | 2.83293 | 4.737891 |
| $R^2$ | 0.918517 | 0.917904 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

Estimation results show that under the significance level of 1%, the coefficient of green technology innovation is significantly negative, other control variables (gross domestic product (GDP), gross domestic product (GDP) of secondary item, population scale, investment in fixed assets, environmental pollution control investment) coefficients and not before the adjustment model of the coefficient of symbols, model regression results.

(b) **Variable substitution test**

To further verify the robustness of the estimated results, this paper will replace the explained variables for analysis. In the base regression, sulfur dioxide emissions are used as the measurement index of environmental pollution. Then, industrial wastewater emissions are used to replace sulfur dioxide

emissions as the pollution index. Due to the availability of data, industrial wastewater discharge data from 2003 to 2015 were selected in this paper, which came from China Urban Statistical Yearbook. The results of model re-estimation are shown in Table 5.Model 1 is the baseline regression result, and Model 3 is the regression result after variable substitution.

Table 5. Variable substitution test results

| Variable | Model 1 | Model 3 |
|---|---|---|
| pat | -0.314005*** | -0.058289** |
| G | 1.535574*** | 1.364214*** |
| $G^2$ | -0.105306*** | -0.057545*** |
| H | -0.740856* | -0.858549*** |
| I | 0.438631*** | -0.130489*** |
| V | 0.109*** | 0.061439*** |
| Intercept | 2.83293 | 11.4496*** |
| $R^2$ | 0.918517 | 0.987093 |
| N | 450 | 390 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

Compared with the baseline regression results, although the coefficient of green technology innovation changes, it still has an improvement effect on industrial wastewater discharge at the significance level of 5%, and the determination coefficient $R^2$ also increases significantly. It indicates that the core conclusion of this paper is still valid after the replacement of explained variables. However, the coefficient of green technology innovation decreased significantly, indicating that green innovation technology has a weak effect on the improvement of industrial wastewater pollution. At present, green technology in China mainly focuses on the treatment and improvement of polluting gases.

(c) **Change sample robustness test**

Among provincial administrative units, Beijing, Shanghai, Tianjin and Chongqing are different in nature, enjoying special policy preference in economy, industry, ecological environment and other aspects, with obvious geographical advantages. Considering the particularity of municipalities directly under the central government, this paper removes the original samples of data from the four municipalities directly under the central government and conducted regression analysis again. The results are shown in Table 6. Model 1 is the baseline regression result, and Model 4 is the regression result after variable replacement.

Table 6. Change sample robustness test results

| Variable | Model 1 | Model 4 |
|---|---|---|
| pat | -0.314005*** | -0.338713*** |
| G | 1.535574*** | 1.55421*** |
| $G^2$ | -0.105306*** | -0.096759*** |
| H | -0.740856* | 0.445812 |
| I | 0.438631*** | 0.336777*** |
| V | 0.109*** | 0.108806*** |
| Intercept | 2.83293 | -6.676417 |
| $R^2$ | 0.918517 | 0.915677 |
| N | 450 | 390 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

It can be seen from the table that in the regression results after removing the four municipalities, the coefficient estimation value of the core explanatory variable increases from 0.3140 to 0.3387. It can be seen that excluding the data of regions with location advantages, the direct inhibition effect of green technology innovation on environmental pollution in China is still significant.

(d) **Heterogeneity test**

According to the classification of the National Bureau of Statistics, China is divided into three economic zones: eastern, central and western. Limited by the availability of data, 30 provinces (cities and regions) except Xizang, Hong Kong, Macao and Taiwan were grouped by east, central and west to analyze the regional differences of environmental impact of green technology innovation. The results are shown in Table 7.

Table 7. Heterogeneity test results

| Variable | East | Central region | West |
|---|---|---|---|
| pat | -0.246** | -0.152** | -0.43*** |
| G | 1.161** | 5.918*** | 2.86*** |
| $G^2$ | -0.085*** | -0.32*** | -0.16*** |
| H | -1.914*** | -6.37*** | 0.51 |
| I | 0.508*** | 0.042 | 0.22 |
| V | 0.068 | 0.174*** | 0.19*** |
| Intercept | 13.29*** | 31.51*** | -12.1 |
| $R^2$ | 0.958 | 0.821 | 0.88 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

As can be seen from the regression results in Table 7, for sulfur dioxide emissions, regardless of whether the economy is developed or not, green technological innovation has a significant inhibitory effect on pollutant emissions. At the same time, it can be seen that due to the long-term policy and economic differences, different regions have different industrial

structures, so the environmental effects of green technology innovation and the emission reduction effect of pollutants are also different. Specifically, the emission reduction effect of green technology innovation shows a decreasing trend in the west, east and central regions. The western region is the most sensitive to green technology innovation, which may be because the industrial structure of the western region is dominated by energy development, which will produce a large number of air pollutants. Therefore, the innovation of clean technology can significantly reduce the emission of pollutants. The eastern region is at the forefront of economic construction and the vanguard of reform and opening up, with a high level of economic foundation, rich industrial structure and high level of technological innovation. Therefore, green technology can effectively play its emission reduction effect. The central region is not only under the pressure of economic development, but also faces the problem of a single industrial structure, which makes it difficult to make a more obvious response to new green technologies.

## MEDIATING EFFECT ANALYSIS

In order to further explore the internal mechanism of the effect of technological innovation on environmental pollution, the mediation effect model is used to judge the conduction effect of mediation variables. Specifically, the improved stepwise method is used for significance test, while the properties of other control variables remain unchanged. After the introduction of mediation variables, the mediation effect model is as follows:

$$me_{it} = \alpha_0 + \theta_1 pat_{it} + \theta_2 X_{it} + \gamma_j + \varepsilon_{it} \quad (2)$$

$$Y_{it} = \alpha_0' + \beta_1' pat_{it} + \beta_2' me_{it} + \beta_3' X_{it} + \gamma_j + \varepsilon_{it} \quad (3)$$

$me_{it}$ is the intermediary variable. Referring to the research of Wen Zhonglin and Ye Baojuan [15], the specific methods for testing the mediation effect are summarized. Table 8 and 9 show the indirect effect estimation results of the two mediation variables.

Table 8. Mediating effect estimation results(1)

| | (1) | (2) |
|---|---|---|
| pat | 0.000025*** | -0.407003*** |
| EE | | -2099.293*** |
| IS | | |
| Intercept | 0.001694*** | 13.71264*** |
| $R^2$ | 0.92166 | 0.906385 |
| N | 450 | 450 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

Table 9. Mediating effect estimation results(2)

| | (3) | (4) |
|---|---|---|
| pat | 0.13449*** | -0.194076*** |
| EE | | |
| IS | | -0.72328*** |
| Intercept | -11.28275*** | -9.570659*** |
| $R^2$ | 0.794925 | 0.929928 |
| N | 450 | 450 |

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively.

It can be seen from the estimation results in column (1) that green technology innovation has a significant promoting effect on improving energy use efficiency. In column (2), the regression coefficient between energy efficiency and sulfur dioxide emissions is significantly negative at the significance level of 1%, indicating that green technology innovation can indirectly reduce sulfur dioxide emissions by improving energy use efficiency and achieve the effect of improving environmental quality. Under the condition that other factors remain unchanged, the total effect is -0.3665 according to the sum of direct effect (-0.3140) and indirect effect (-2099.293 *0.000025) of the test procedure, in which the indirect effect accounts for 14.32%. The results in columns (3) and (4) show the indirect impact of industrial structure mediating variable transferring technological innovation on sulfur dioxide emissions. The results show that technological innovation can significantly promote industrial upgrading and industrial structure upgrading can reduce sulfur dioxide emissions. The mediating effect is significant, and it can be considered that green technology innovation can achieve the emission reduction effect of sulfur dioxide through industrial structure upgrading. Specifically, the mediating effect was -0.0973, accounting for 23.65% of the total effect.

The mediating effect of energy use efficiency and industrial upgrading is significant, indicating that green technology innovation has a conduction effect on pollutant emission through the mediating effect of energy use efficiency and industrial structure. Among them, the mediation mechanism of industrial structure upgrading is more obvious than that of energy use efficiency. This is mainly because the green technology research and development of enterprises not only promotes the improvement of their own energy utilization level, but also pushes other enterprises to reduce energy consumption through technology spillover, thus reducing the energy consumption of the whole city. With green, clean technology, emerging industries such as new energy, new material gradually into people's horizons, to provide more clean and the choice of material and clean energy, further promote the transformation and upgrading of industrial structure, leading to the

second industry development of "three wastes" emissions down accordingly.

## RESULTS AND CONCLUSIONS

Green technology innovation plays an important role in changing China's extensive economic development mode and building a beautiful China. Combined with the environmental Kuznets curve, this paper takes energy efficiency and industrial structure as intermediate variables to deeply analyze the internal mechanism of the impact of green technology innovation on sulfur dioxide emissions, the main environmental pollutant, through the intermediary effect transmission.The findings are as fellows:

(1) China's green technology innovation can reduce sulfur dioxide emissions and improve environmental quality. Heterogeneity analysis results show that green technology innovation has different effects on environmental pollution in different regions. Clean production technology and pollution control technology are the fundamental starting point and foothold to promote environmental protection and sustainable economic development. The government should vigorously support technological innovation, especially the development of green and clean technological innovation, and guide enterprises to actively change the mode of production, research and development and use of energy-saving technology, renewable energy technology and pollution control technology. The government encourages the development of the science and technology industry, helps solve the problems existing in the science and technology industry from the perspective of policy, such as lack of funds, lack of talents and so on, and promotes the continuous updating of industrial technology. The government can promote the industrialization of innovative technologies, promote the horizontal and vertical extension of the industrial chain, give play to the exemplary role of enterprises in technological innovation and the synergistic development force, and encourage technological exchanges and cooperation between regions. Local governments should build technical information exchange platforms to promote the rapid flow and exchange of regional scientific and technological information, industrial information and environmental protection information, and provide an excellent information and institutional environment for regional cooperation in green technology innovation.

Technological innovation can reduce environmental pollution through improving energy efficiency and optimizing industrial structure, and industrial structure upgrading has stronger mediating effect. The government can give corresponding subsidies to promote a virtuous cycle of production and pollution control, and transform traditional industries with green advanced technologies and encourage and support the development of green industries. The optimization and upgrading of industrial structure depends on the innovative research and development of green technology, the application and diffusion of actual production scenes. For pollution-intensive industries, the government should regulate such industries and force industrial enterprises to carry out green technology innovation. The transformation and upgrading of such industries can reduce pollution emissions and promote high-quality economic development. It should be noted that the process of upgrading the industrial structure is not a one-size-fits-all regulation of all pollution-intensive industries, but a differentiated treatment bases on the actual situation of different industries and regions, according to the actual development status of the elimination of enterprises with extremely bad pollution emissions.

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