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Analysis of the Status Quo of Suzhou's Digital RMB Promoting Energy Conservation and Emission Reduction under the Double Carbon

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Abstract

The digital renminbi is a legal currency in digital form issued by the central bank, which mainly meets the public's demand for digital cash and assists inclusive finance. At present, the digital renminbi has been piloted in many places and has achieved remarkable results. During the pilot process, the digital renminbi is applied in various scenarios. It can not only produce environmental protection effects from the currency materials, but also positively motivate residents' behavior and guide people to low-carbon travel and consumption. Therefore, we believe that the digital renminbi It has considerable energy-saving and emission-reduction effects. This project conducts research on digital renminbi's awareness, influencing factors, and future prospects of enabling green and low-carbon residents to promote popularization.

Keywords

Saving and emission reduction; Digital RMB; Ridge return.

1. Introduction

In recent years, with the vigorous development of my country's network technology and digital economy, e-commerce has become increasingly active, and electronic payment methods such as WeChat and Alipay have also become increasingly developed, creating an excellent development environment for my country's development of digital currency. Our country also attaches great importance to the research and development and promotion of digital renminbi, and established a research team to carry out pilot projects in Shenzhen and Suzhou to lay the foundation for the digitization of renminbi. However, with the rapid development of the economy and the obvious improvement of people's daily life, the amount of various types of garbage produced by human society is also increasing, which affects people's living environment and physical and mental health, and also greatly hinders the progress of my country's green development. the way. To this end, the state has proposed the development goal of "carbon peaking and carbon neutrality" to drive the green development of China's economy. The digital renminbi has the advantages of non-physical payment, which greatly reduces the cost of currency manufacturing, circulation and storage, is cleaner, more environmentally friendly, efficient and convenient, and has played a huge role in promoting citizens' green and low-carbon life and helping my country's green economic development. effect. Therefore, how the implementation of the digital RMB can effectively promote China's green and low-carbon development and the development of people's green lifestyle has become an urgent subject of investigation and exploration . Under this background, this article takes Suzhou City as the entry point to investigate Suzhou Citizens' awareness of digital renminbi to promote energy conservation and emission reduction and their willingness to use digital renminbi, and on this basis, study the multiple impacts of digital currency on energy conservation and emission reduction, so as to guide citizens to actively travel green, save

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energy and reduce emissions , and help China's "carbon economy" The early realization of the goal of reaching the peak and carbon neutrality.

2. Residents' understanding of digital RMB energy saving and emission reduction

2.1. Cognition of digital renminbi

On May 2, 2020, the central bank announced to pilot digital renminbi in Suzhou and other cities. As shown in the figure below, in the questionnaire survey of Suzhou residents' awareness of digital renminbi, the survey results show that nearly half of the residents are very concerned about digital renminbi, while the proportion of residents who occasionally pay attention to digital people and do not pay attention to them is almost the same. 1/10 respectively. This shows that the vast majority of residents still have a certain degree of concern for the digital renminbi, and it also shows that this pilot program has indeed had a certain impact on the lives of residents.

2.2. Digital RMB promotes awareness of energy conservation and emission reduction

Affected by the new crown epidemic in Suzhou, this survey is mainly carried out in the form of online survey, mainly through questionnaires, literature research and interviews.

Among the 156 valid questionnaires recovered, 138 people believed that the digital renminbi would help promote energy conservation and emission reduction, accounting for 88.462% of the total sample. Only 18 people think that the digital renminbi will not help promote energy conservation and emission reduction. This shows that most residents have realized the significance of the promotion of digital renminbi to energy conservation and emission reduction.

According to the survey results of residents on the promotion effect of digital renminbi energy conservation and emission reduction, it can be found that 31 questionnaires think the effect is very good, 79 questionnaires think the effect is good, and only four questionnaires think the promotion effect is not good. It is not difficult to find that during the pilot process of the digital renminbi, the vast majority of residents have fully realized its good promotion effect on energy conservation and emission reduction. Based on this cognitive atmosphere, it is more conducive to the further popularization and promotion of digital RMB.

Besides, Suzhou residents believe that digital renminbi can promote energy conservation and emission reduction in the following aspects: most residents believe that digital renminbi can reduce production and circulation costs by replacing banknotes, and can guide people to save and green consumption in the field of consumption. low carbon. More than half of the residents believe that the digital renminbi can promote the development of green finance. This shows that the digital renminbi is increasingly improving people's lives, empowering energy conservation and emission reduction.

3. Gender, age, gender, etc. awareness of digital RMB energy conservation and emission reduction

3.1. Awareness of gender & digital RMB energy saving and emission reduction

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Table 1 Crosstabulation of Gender & Digital Currency's Promotion Effect on Energy Conservation and Emission Reduction

			it is good	very good	generally	total
gender	male	count	2 2	1 3	1 8	5 3
		% of gender	4 1.5%	2 4.5%	3 4.0%	1 00.0%
	Female	count	57	18	28	103
		% of gender	55.3%	17.5%	27.2%	100.0%
total		count	79	31	46	156
		% of gender	50.6%	19.9%	29.5%	100.0%

By analyzing and processing the data, we can get the above table. Observing the above table, we can know that 41.5% of men think that digital renminbi has a good effect on promoting energy conservation and emission reduction, 24.5% think that the effect is very good, and 34% think that the effect is average. 55.3% of women think that digital renminbi has a good effect on promoting energy conservation and emission reduction, 17.5% think that the effect is very good, and 27.2% think that the effect is mediocre. Whether the gender pair understands the impact of digital renminbi on energy conservation and emission reduction

There is no significant impact on the promotion effect, so we infer that gender has nothing to do with knowing the promotion effect of digital renminbi on energy conservation and emission reduction.

Table 2 Chi-square test of the promotion effect of gender & digital currency on energy conservation and emission reduction

	value	degrees of freedom	Progressive significance (two-sided)
Pearson chi square	2.743 a	2	0.254
likelihood ratio	2.748	2	0.253
Valid Cases	156		

Through the chi-square test, we concluded that Pearson's chi-square independence test corresponds to a P value greater than 0.05, accepting the null hypothesis that gender has nothing to do with understanding digital RMB to promote energy conservation and emission reduction.

3.2. Awareness of age & digital RMB energy saving and emission reduction

Through spss , we can get the following table. From the table, we can conclude that 51.9% of the people aged 18-30 think that digital renminbi has a good effect on promoting energy conservation and emission reduction, 18% think that the effect is very good, and 30% think that the effect is average . Among the people aged 31-45, 50% think that digital renminbi has a good effect on promoting energy conservation and emission reduction, 40% think that the effect is very good, and 10% think that the effect is average.

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Table 3 Crosstabulation of Age & Digital Currency's Promoting Effect on Energy Conservation and Emission Reduction

			The role of digital currency in promoting energy conservation and emission reduction			total
			it is good	very good	generally	
age	1 8-30 years old	count	69	twenty four	40	133
		% of age	51.9%	18.0%	30.1%	100.0%
	under 18 _	count	3	3	4	10
		% of age	30.0%	30.0%	40.0%	100.0%
	3 1-45 years old	count	5	4	1	10
		% of age	50.0%	40.0%	10.0%	100.0%
	4 6-60 years old	count	2	0	0	2
		% of age	100.0%	0.0%	0.0%	100.0%
	6 1 years old and above	count	0	0	1	1
		% of age	0.0%	0.0%	100.0%	100.0%
total		count		79	31	46
		% of age		50.6%	19.9%	29.5%

Through the chi-square test, we obtained that the Pearson chi-square independence test corresponds to a P value less than 0.05, rejecting the null hypothesis. Age has a significant impact on whether understanding digital renminbi promotes energy conservation and emission reduction, so we infer that age is related to whether understanding digital renminbi promotes energy conservation and emission reduction.

Table 4 Chi-square test of the promotion effect of age & digital currency on energy conservation and emission reduction

	value	degrees of freedom	Progressive significance (two-sided)
Pearson chi square	9.680 a	8	0.032
likelihood ratio	10.526	8	0.035
Valid Cases	156		

3.3. Educational background & cognition of digital RMB energy saving and emission reduction

From the data in the table below, we can see that people with different educational backgrounds have quite different perceptions of digital renminbi to promote energy conservation and emission reduction. Only a quarter of those with a junior high school education or below believe that digital currency is effective in promoting energy conservation and emission reduction, while more than half of those with a college degree or above believe that digital currency is effective in promoting energy conservation and emission reduction. Therefore, we infer that academic qualifications are related to understanding whether digital renminbi promotes energy conservation and emission reduction.

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Table 5 Cross-tabulation of education & digital currency's promotion effect on energy conservation and emission reduction

			The role of digital currency in promoting energy conservation and emission reduction			total
			it is good	very good	generally	
academic qualifications	junior high school and below	count	0	1	3	4
		% of education	0.0%	25.0%	75.0%	100.0%
	college or undergraduate	count	63	16	31	110
		% of education	57.3%	14.5%	28.2%	100.0%
	high school	count	6	5	3	14
		% of education	42.9%	35.7%	21.4%	100.0%
	other	count	0	1	0	1
		% of education	0.0%	100.0%	0.0%	100.0%
	Postgraduate and above	count	10	8	9	27
		% of education	37.0%	29.6%	33.3%	100.0%
total		count		79	31	46
		% of education		50.6%	19.9%	29.5%

Through the chi-square test, we found that the P value of the Person chi-square independence test is less than 0.05, so we reject the null hypothesis, that is, the level of education is related to whether the understanding of digital renminbi promotes energy conservation and emission reduction.

Table 6 Chi-square test on the promotion effect of educational background & digital currency on energy conservation and emission reduction

	value	degrees of freedom	Progressive significance (two-sided)
Pearson chi square	16.170a _	8	0.040
likelihood ratio	16.292	8	0.038
Valid Cases	156		

3.4. Household Monthly Income & Awareness of Digital RMB Energy Conservation and Emission Reduction

From the data in the table below, we can see that different monthly household incomes are relevant to understanding whether digital renminbi promotes energy conservation and emission reduction. People with an income of 15,000-20,000 yuan have a good effect on energy conservation and emission reduction of digital currency. Accounted for 57.1%, while people with an income of 8,000-15,000 yuan accounted for 82.4% of the people who believed that digital currency had a good effect on energy conservation and emission reduction. Therefore, we infer that the monthly household income is related to whether they know about the harmless disposal of garbage.

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Table 7 Cross-tabulation of educational background & digital currency's role in promoting energy conservation and emission reduction

			The role of digital currency in promoting energy conservation and emission reduction			total
			it is good	very good	generally	
monthly family income	15000-25000 yuan	count	69	twenty four	40	133
		% of monthly household income	51.9%	18.0%	30.1%	100.0%
	More than 25,000 yuan	count	3	3	4	10
		% of monthly household income	30.0%	30.0%	40.0%	100.0%
	8000-15000 yuan	count	5	4	1	10
		% of monthly household income	50.0%	40.0%	10.0%	100.0%
	Below RMB 8000	count	2	0	0	2
		% of monthly household income	100.0%	0.0%	0.0%	100.0%
total		count		79	31	46
		% of monthly household income		50.6%	19.9%	29.5%

Through the chi-square test, we found that the P value of the Person chi-square independence test is less than 0.05, so we reject the null hypothesis that the monthly household income is related to whether or not the digital RMB promotes energy conservation and emission reduction.

Table 8 Chi-square test on the promotion effect of educational background & digital currency on energy conservation and emission reduction

	value	degrees of freedom	Progressive significance (two-sided)
Pearson chi square	14.635 a	6	0.023
likelihood ratio	13.676	6	0.033
Valid Cases	156		

3.5. Use experience & cognition of digital RMB energy saving and emission reduction

From the data in the table below, we can see that people who have used digital renminbi better understand the role of digital renminbi in promoting energy conservation and emission reduction. Conversely, those who have no experience in using digital renminbi have a lower understanding of digital renminbi energy conservation and emission reduction. Therefore, we infer that the use experience is related to whether or not we understand the promotion of digital renminbi to promote energy conservation and emission reduction .

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Table 9 Cross-tabulation of use experience & promotion of digital currency on energy conservation and emission reduction

			The role of digital currency in promoting energy conservation and emission reduction			total
			it is good	very good	generally	
Experience	none	count	44	13	25	82
		% of usage experience	53.7%	15.9%	30.5%	100.0%
	Have	count	35	18	twenty one	74
		% of usage experience	47.3%	24.3%	28.4%	100.0%
total		count	79	79	31	46
		% of usage experience	50.6%	50.6%	19.9%	29.5%

Through the chi-square test, we found that the corresponding P value of the Person chi-square independence test is 0.012, which is less than 0.05. Therefore, we reject the null hypothesis, that is, the use experience has a significant impact on whether to understand the digital RMB to promote energy conservation and emission reduction. RMB promotes energy conservation and emission reduction.

Table 10 Chi-square test of the promotion effect of using experience & digital currency on energy conservation and emission reduction

	value	degrees of freedom	Progressive significance (two-sided)
Pearson chi square	1.774 a	2	0.012
likelihood ratio	1.775	2	0.013
Valid Cases	156		

4. Analysis of influencing factors of residents' perception of digital renminbi and energy conservation and emission reduction

Through the research analysis in the third part, we can know that gender, age, education, monthly family income and experience of use all have an impact on residents' cognition of digital renminbi and energy conservation and emission reduction. In this chapter, we will use principal component analysis and ridge regression The method is used to further explore and analyze the influencing factors of residents' cognition of digital renminbi and energy conservation and emission reduction.

4.1. principal component analysis

We use SPSS software to obtain the correlation coefficient matrix of the five independent variables as shown in the following table:

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Table 11 correlation matrix

		age	academic qualifications	Experience	monthly family income	gender
relevant	age	1.000	-.748	-.798	.172	-.532
	academic qualifications	-.748	1.000	.706	-.156	.609
	Experience	-.798	.706	1.000	-.134	.542
	monthly household income	.172	-.156	-.134	1.000	-.049
	gender	-.532	.609	.542	-.049	1.000

We can read from the table that the correlation coefficients between education and age, experience and age are around 0.75, which is relatively large. The calculated weights of each principal component are as follows:

Table 12 Description of Total Variance

element	total	% of variance of starting eigenvalues	accumulative %	total	Extract squares and load % of variance	accumulative %
age	3.012	60.244	60.244	3.012	60.244	60.244
academic qualifications	.979	19.575	79.818	.979	19.575	79.818
Experience	.530	10.608	90.426	.530	10.608	90.426
monthly household income	.286	5.719	96.145			
gender	.193	3.855	100.000			

Through the data in the above table, we get that the first three principal components account for 90.426% of the total, and we can use the three principal components to refer to other elements of the whole.

Through principal component analysis, the main factors that affect residents' awareness of digital renminbi and energy conservation and emission reduction and the weights of each factor are obtained, and the factors and weights that ultimately affect residents' awareness of digital renminbi and energy conservation and emission reduction are obtained.

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Table 13 Composition Matrix

	element	
	1	2
age	-.902	.002
academic qualifications	.891	.034
Experience	.888	.045
monthly household income	-.224	.968
gender	.753	.198

Table 14 Composition matrix after rotation

	element	
	1	2
age	-.890	.144
academic qualifications	.886	-.107
Experience	.884	-.096
monthly family income	-.069	.991
gender	.774	.077

Table 15 The weight of each component

element	starting eigenvalue		
	total	% of variance	accumulative %
age	3.012	60.244	60.244
academic qualifications	.979	19.575	79.818
Experience	.530	10.608	90.426
monthly family income	.286	5.719	96.145
gender	.193	3.855	100.000

It can be seen from the data in the above table that age is the most important factor, accounting for 60.244 %, followed by education , accounting for 19.575 %, use experience accounting for 10.608 %, monthly family income accounting for 5.719%, and gender accounting for 3.855 % .

4.2. Ridge regression

$$\text{make}J_{\beta} = \sum(y - x\beta)^2 + \|\beta\|_1 = \sum(y - x\beta)^2 + \sum|\beta|^2 \quad (1)$$

Among them $\lambda\|\beta\|_1$is the penalty item of the objective function, $\lambda$is the penalty item coefficient, and $\|\beta\|_1$is $\beta$the l 2 regularity of the regression coefficient, indicating the sum of the absolute values of all regression coefficients.

Since the penalty term of the objective function is the sum $\beta$of the absolute values of the regression coefficients, the penalty term is not derivable at the zero point. In order to obtain

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the ridge regression coefficient, the method of coordinate axis descent is used for iteration. This method makes a partial derivative of one of the objective functions β_j, that is, when the other 4 parameters are controlled unchanged, the derivative is obtained along the direction of one axis, and so on, and then the partial derivative is obtained for the remaining 4 parameters. Finally, let the derivative function under each component be 0, so that the objective function can reach the global minimum.

$$J(\beta) = ESS(\beta) + l_1(\beta) \tag{2}$$

$$ESS(\beta) = \sum_{i=1}^{n} - (y_i - \sum_{j=1}^{13} \beta_j h_j(x_i))^2 \tag{3}$$

Partial derivatives for $ESS(\beta)$doingβ_j

$$\frac{\partial ESS(\beta)}{\partial \beta_j} - 2\sum_{i=1}^{n} h_j(x_j)\left[y_i - \sum_{k\neq j} \beta_k h_k(x_i)\right] + 2\beta_j \sum_{i=1}^{n} h_j(x_j)^2 \tag{4}$$

$$m_j = \sum_{i=1}^{n} h_j(x_j)(y_i - \sum_{k\neq j} \beta_k h_k(x_i) \tag{5}$$

$$n_j = \sum_{i=1}^{n} h_j(x_j)^2 \tag{6}$$

$$\frac{\partial ESS(\beta)}{\partial \beta_j} = -2m_j + 2\beta_j n_j \tag{7}$$

For a certain component β_j, the penalty term can be expressed as $\lambda|\beta j|$, so $\beta_j$the sub-derivative function at is:

$$\frac{\partial \lambda l_1(\beta)}{\partial \beta_j} = \begin{cases} \lambda, when \beta_j > 0 \\ [-\lambda, \lambda], when \beta_j = 0 \\ -\lambda, when \beta_j < 0 \end{cases} \tag{8}$$

In order to solve the final ridge regression coefficient, it is necessary to combine $ESS(\beta)$the $\lambda l_2(\beta)$component derivative functions of and, and make the derivative function 0 :

Finally, the model coefficients of ridge regression are obtained, and the coefficients can λget three different results from different values .

$$\frac{\partial ESS(\beta)}{\partial \beta_j} + \frac{\partial \lambda l_1(\beta)}{\partial \beta_j} = \begin{cases} -2m_j + 2B_j n_j + \lambda = 0 \\ [-2m_j - \lambda, -2m_j + \lambda] = 0 \\ -2m_j + 2\beta_j n_j - \lambda = 0 \end{cases} \tag{9}$$

$$B_j = \begin{cases} \frac{m_j - \frac{\lambda}{2}}{n_j}, m_j > \frac{\lambda}{2} \\ 0, m_j \in \left[-\frac{\lambda}{2}, \frac{\lambda}{2}\right] \\ \frac{m_j + \frac{\lambda}{2}}{n_j}, m_j < \frac{\lambda}{2} \end{cases} \tag{19}$$

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Finally, the model coefficients of ridge regression are obtained, and the coefficients can λget three different results from different values.

4.2.1. 4.2.1 model solving

(1)Visualization

By drawing a line graph of different values and regression coefficients as shown in Figure 1, a reasonable value can be judged.

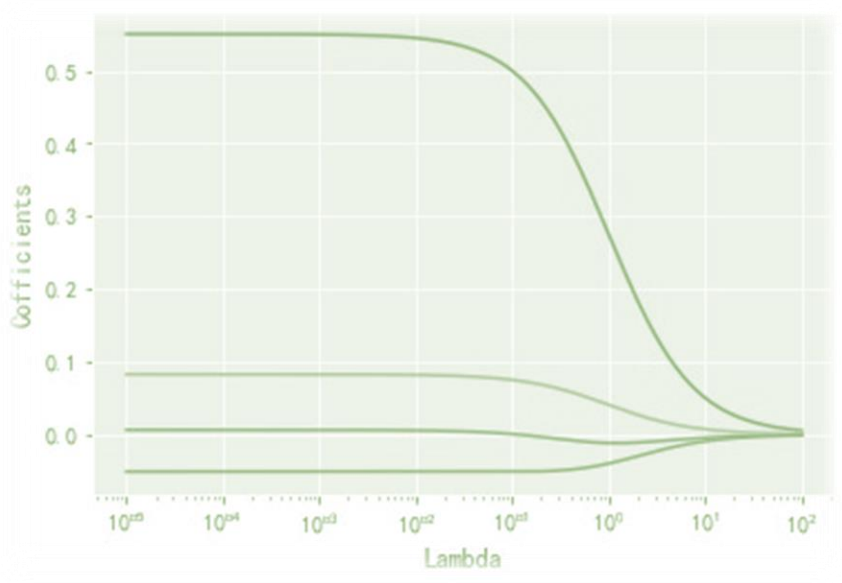

Figure 1 λDetermination of value

(2)Cross-validation method to determine the λvalue

From $K$the sample data $k-1$set for model training, and the remaining set of data sets are used to test the accuracy of the model ; finally, a $k$training set and a test set are obtained. In the process of model testing, the mean square error is selected as the good evaluation standard of the model.

Through the iterative λvalue and combined with the cross-validation method, the smallest average mean square error is selected, and finally a reasonable λvalue of 0.0203 is obtained . According to the best value, the ridge regression model is reconstructed, and the mean square error is 0.248 . The model is:

$$R = 0.358\,ln(X_1) + 0.539\,ln(X_2) + 0.005\,ln(X_3) + 0.081\,ln(X_4) - 0.051\,ln(X_5) - 33.27 \quad (20)$$

(3)Auxiliary regression

Among the five variables, considering that the variables cannot change independently, the following correlation coefficient diagram is shown in Figure 2 to preliminarily judge the degree of mutual influence between the five variables.

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Figure 2 Correlation coefficient heat map

Taking Suzhou citizens' attention to digital RMB as an example, and other relatively controllable indicators include X_4: use experience , X_5: understanding of digital RMB , and make X_2auxiliary regressions on $X_4$and as follows:X_5

$$ln(X_2) = 0.184\,ln(X_4) - 0.46\,ln(X_5) - 63.067 \tag{20}$$

regarded $ln(X_2)$as an independent variable, an X_2increase of 1% can X_4increase by 5.435% alone or decrease by 2.174 X_5% alone , that is, for every 1% increase in Suzhou citizens' attention to digital RMB , people 's choice of using digital renminbi will increase by 5.435% , except In addition to the direct impact on awareness , you can also get cumulative effects by applying the Rchoice of using digital renminbi and the degree of understanding of digital renminbi to different projects.

5. Result analysis

From the perspective of the general public, the launch of the digital renminbi is related to the interests of every group. If the pilot goes well, it will have a profound impact on our payment methods and lifestyles. Therefore, the general public should actively understand the impact of the launch of the digital renminbi. The significance of my country's promotion of energy conservation and emission reduction will increase the awareness of digital renminbi, thereby promoting the effective achievement of my country's dual carbon goals.

From a social point of view, the effect of digital renminbi is reflected in the social field to a certain extent. The experience of using digital renminbi in all sectors of society also affects residents' awareness of digital renminbi and energy conservation and emission reduction. Therefore, digital renminbi is widely promoted in various fields of society. The important role of the RMB in energy conservation and emission reduction is necessary to enhance awareness.

From the perspective of the government, the government can increase the promotion of digital renminbi to increase the attention of Suzhou citizens and even the people of the whole country to digital renminbi. Through the results of ridge regression analysis, it can be seen that it is very important for improving residents' awareness of digital renminbi and energy conservation and emission reduction. Intellectual ability has a better effect .

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