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The Impact of Environmental Petition Letters on Alternative Energy under the Stimulus of Environmental Pollution

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Abstract

This study applies the pooled least squares (PLS) and fixed effect (FE) ordinary least square (OLS) to estimate the influence of disposable income, population density, scale of letters and visits, trade freedom, and human investment scale on the use and development of alternative energy in China, especially hydrogen-based renewable energy. Evidence shows that when the public cannot stand the polluted environment, it would prompt the government to develop and invest in cleaner energy. It shows that with the increase of the negative impact of environmental pollution on people's lives and welfare, the public's awareness of environmental protection will increase, and more and more people will actively participate in environmental protection. This public awareness can stimulate the government to carry out deeper development of alternative energy.

Keywords: alternative energy development, environmental petition letters, China's investment

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INTRODUCTION

Looking back at China's economic development over the past 40 years, China has experienced extremely high and sustained economic growth since 1978. According to the statistical data from World Bank, the economic growth rates of mainland China's is 9.75%, 9.99%, and 10.29% in every ten years (from 1980 to 2000). High-speed economic growth has made China the second largest economy in the world, and the increase in labor per capita output has also improved poverty among domestic regions. However, due to the rapid economic development accompanied by a large number of industrial production activities, as the Chinese economy develops, the public is paying more and more attention to the improvement of environmental quality, environmental pollution control and energy use in China's water resources, air, solid waste, and noise. Issues such as alternative energy development are getting more and more attention.

While China has achieved many economic and social achievements, it is facing increasingly severe resource constraints, serious environmental pollution and degraded ecosystems. Under the background of energy crisis and environmental pressure, China's demand for green energy is more urgent. Hydrogen energy is widely concerned because of its cleanliness, non-polluting, high calorific value and wide range of sources. Hydrogen energy has the advantages of high calorific value and recyclability. Its clean and pollution-free characteristics are in line with the concept of sustainable development. Compared with other new energy sources such as wind energy and solar energy, hydrogen energy will not be inefficient, discontinuous and so on. The possibility of the development of hydrogen energy is enormous.

Current hydrogen production technologies are mainly divided into "light green" technology based on fossil fuels and "dark green" technology based on renewable energy. Taking Air Products, for example, are based on fossil fuel, which are "light green" hydrogen production technologies, including tail hydrogen pressure swing adsorption purification, natural gas cracking and coal gasification. The tail hydrogen pressure swing adsorption purification

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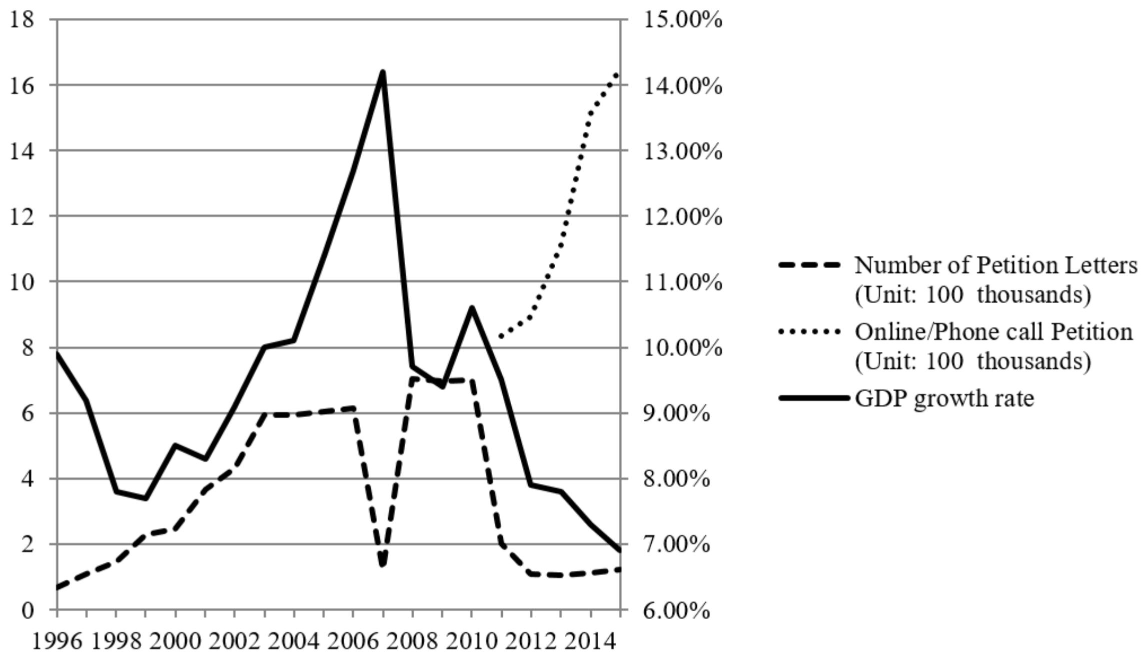

Fig. 1. China's environmental petition letters and economic growth rates over the years

mainly removes the tail hydrogen from the industrial exhaust gas through the molecular sieve, and the cost is low and controllable. The hydrogen produced by the process has high purity and can even reach the standard of fuel hydrogen. China's tail hydrogen resources are very rich, mainly distributed in the Yangtze River Delta, Pearl River Delta, Beijing-Tianjin-Tangshan, Shandong Peninsula, Shanxi, Hubei and other areas with high population density. Natural gas cracking is also a safe and reliable hydrogen production process. Although China's current urban pipe network natural gas unit price is more expensive, hydrogen produced according to this price standard is still more economical than fuel. In fact, the cost of hydrogen production from natural gas cracking is significantly reduced as the capacity of the cracking unit increases, and the gas supply is controllable, and the stability is better than tail hydrogen purification. Coal gasification technology is a production process with Chinese characteristics. China is a country with more coal and less oil, and coal gasification mainly grinds high-sulfur coal, lignite, etc. into powder, and then carries out high-temperature and high-pressure gasification in a gasifier to become syngas. Its main component is hydrogen and Carbon monoxide. However, the syngas produced by coal gasification is mainly used in chemical production, and it is almost completely used for hydrogen production. The reason is that the demand for hydrogen energy is not large enough, and the supply and demand market is unstable. The above three hydrogen production technologies are the basis for laying the hydrogen energy market. From the perspective of cost efficiency, coal gasification is relatively low; from the perspective of supply stability, tail hydrogen purification is relatively lacking. Combined with the status quo of China's chemical industry, natural gas supply and distribution of coal chemical industry, tail water purification and natural gas cracking hydrogen production can be prioritized in coastal areas, and coal gasification can be combined with coal gasification in the central and western regions.

Under this situation, the requirements of the Chinese public for environmental management and protection have evolved environmental petition behaviors. Environmental petition Letters and Visits refers to citizens, legal persons or other organizations using forms of letters, e-mails, faxes, telephone calls, visits, etc., to report environmental protection to the environmental protection administrative departments at all levels, and to make suggestions, opinions or complaints. The scale of petition letters and visits about the Chinese citizens' suggestions on environmental issues for the government can be regarded as an important window for observing problems and contradictions in the ecological field and expressing and participating in ecological issues. According to the China Statistical Yearbook and the China Environmental Statistics Yearbook, the left vertical axis of **Fig. 1** indicates the scale of China's environmental letters and visits (Unit: 100 thousand), and the right vertical axis indicates the economic growth rate, which reflects the changes from 1996 to 2015. We can find that in addition to the 2007-2008 Chinese government's preparation for the Beijing Olympics, the Green Olympics will be promoted, and the ecological environment would be built to emphasize the sustainable regeneration to promote urban environmental protection. The scale of environmental petition letters and visits in China in other years is increasing year by year. In addition, **Fig. 1** shows that the economic growth rate is the leading indicator of environmental letters and visits. Since industrial production accounts for a relatively high proportion of China's economic activities, the increase in economic growth rate reflects the contribution of industrial production and the negative environmental impacts brought about by the production process, which indirectly affects the growth rate of letters and visits; on the contrary, as the economic growth rate slows down the scale of letters and visits has also decreased.

As environmental pollution has aggravated the negative impact on people's lives and welfare, the public's awareness of environmental protection has increased, and more and more people are actively participating in environmental protection. This paper wants to discuss whether the environmental changes caused by China's economic growth process and the public's awareness of environmental protection will stimulate the government's investment in hydrogen-related energy, thereby promoting China's use of hydrogen energy. The structure of this paper is as follows, the first section is introduction, the second section is about combing the relevant literature, the third section is the empirical method, data source and empirical result analysis of this study. The fourth part is about the hydrogen energy development revolution in China and the final section is the conclusion of this paper.

LITERATURE REVIEW

Compared with many developing countries and post-socialist countries, China's market transformation in just two or three decades has also led to dramatic social changes, which led to frequent social protests. The following are the Western social movement theory and current research results of Chinese scholars are reviewed. And the essay would discuss these theories combined with the prospect of China's future use of hydrogen energy to replace existing fossil energy.

The theory of social movement is related to the use of energy development. In social science research, the theory of social movement and revolution is extremely complicated. In terms of subject specialty, sociology emphasizes the functionalist school and class conflict path, psychologist on the basis of the theory of "aggregation psychology", the importance of cognitive dissonance and the "frustration-aggression theory" model is emphasized. The research oriented to economics focuses on the rational choice path, while the political science faces what is advocated is the political conflict of social movements (Taylor 1984, Tilly and Tarrow 2007). Not only the heterogeneity of subject research, but also the different "generations" (Goldstone 1980). The important issue facing the current economic development of human society is the energy issue, which is the material basis for human progress. The progress of human civilization is a history of progress in energy technology and energy structure. Advances in energy use technology have always been accompanied by the development of human civilization. Without the advancement of energy technology, there will be no material ecological prosperity today. In the 50 years from 1945 to 2016, the world economy grew by 4.6 times, and the growth rate of energy consumption was 2.5 times during the same period, indicating that energy growth is supporting the growth of the human economy and civilization.

From the perspective of the development of energy, hydrogen energy will become the world's best energy in the second half of the 21st century and one of the strong driving forces for future economic and social development. China's goal is to achieve the "hydrogen economy" industrial revolution ahead of the world in the 1930s and 1940s. Its strategic significance in the academic community is mainly focused on the following points: First, hydrogen energy can completely replace ore energy (Shen 2004). At present, China has decided to vigorously develop wind power generation, solar power generation and tidal power generation, but these renewable energy sources have the following disadvantages: intermittent, difficult to store and cannot be used on vehicles (Cao 2017). If China can use wind, solar and tidal energy to generate electricity and use this electricity to produce hydrogen from water, all the problems are solved. Valuable coal, oil and natural gas would serve as a chemical raw material for the benefit of the Chinese people for a long time, and the ability of China's sustainable economic development will be greatly enhanced. The "hydrogen economy" will completely rid itself of dependence on ore energy. China will not compete for energy with any country, and the safety of the offshore energy transportation line will no longer exist, so as to achieve maximum energy security, China's air pollution emissions will drop significantly (Wang 2017).

From the perspective of social development, Yu (2018) believes that the realization of the transition from the mineral energy economy to the "hydrogen economy" is a revolution, so we must emancipate our minds and eliminate unnecessary concerns and historical inertia. This kind of concern and inertia has been widely discussed by scholars. The main points of discussion are: First, the use, transportation and storage technologies of hydrogen energy are complicated and unsafe (Cao 2017). Humans have a good understanding of the physicochemical properties of hydrogen and can completely solve the problem of safe use of hydrogen. Secondly, it is considered that hydrogen energy technology is not mature. For example, hydrogen fuel cell vehicles do not run as far as gasoline vehicles. Therefore, the development of hydrogen energy is not determined. When you look at others, there are not many people (Zhang et al. 2017). Third, the price of hydrogen energy is considered to be high. This is a prejudice. The generation of hydrogen energy should mainly rely on wind and solar energy. We should look at the cost of hydrogen energy in conjunction with the cost of wind and solar power (for hydrogen production). (l) The price of ore energy power generation does not calculate the social cost of ore energy use, such as pollution control costs, environmental damage costs, health loss costs, etc., so electricity prices appear to be low. The social cost of using ore energy saved by wind energy and solar energy is not deducted from the relevant electricity price, so the electricity price appears high (Jing 2018). (2) The depreciation period of wind energy and solar power generation equipment is set too short, and the corresponding electricity price is raised. (3) Household wind power and solar power generation equipment require transformers, frequency converters and batteries, which increases equipment cost and electricity price. The production of hydrogen by direct current electrolysis of water from wind and solar energy can eliminate transformers, frequency conversion and power storage equipment, and the electricity bill will be reduced accordingly (Li 2017).

In addition, there are relatively few discussions about the promotion of policies by the masses in the existing literature. Most of the literature focuses on the reasons for public participation in public participation in environmental protection, and the impact of public participation on environmental governance. For example, Persson and Tabellini (2009) and Fosten et al. (2012) argue that the deepening of democracy and the accumulation of tangible capital have a positive impact on economic development; Bättig and Bernauer (2009) point out that with the participation of the masses in public affairs. Improvement, social welfare and public finance supply are receiving increasing attention in democratic polities; Fredriksson et al. (2005) found that political competition and accountability mechanisms in the government affect the promotion of a country's pollution control or social welfare policies.

In recent years, countries have successively proposed to reduce greenhouse gas emissions and promote environmentally sustainable development while maintaining stable economic growth. Renewable energy (hereafter RE), especially hydrogen-based renewables, which can be considered as a substitute for fossil fuels, is vital for social development from the aspects of environmental benefits, climate change and clean production (Azapagic 2004, Akella et al. 2009, Ren et al. 2014, Ren et al. 2015, Wang et al. 2018). In the rapid development of hydrogen energy, there is already a complementarity and mutual substitution between hydrogen energy and traditional energy sources, as well as supplements and substitutions between different varieties of hydrogen energy. There is also the common development of energy intelligence, integration and systemization. This is a major trend in energy development. It is also to vigorously develop hydrogen energy while achieving mutual complementation, intelligence, integration and systematization of multiple energy sources.

METHODOLOGY

Suppose the individual-specific effects model describes as follows:

$$y_{it} = x_{it}'\beta + z_i'\delta + u_i + \varepsilon_{it} \quad (1)$$

where z_i is an individual characteristic that does not vary in time; x_{it} can vary with time and time, u_i and are ε_{it} the composite error term. Where u_i represents the intercept of individual heterogeneity item. For the fixed effect model (FE), the average of the two sides of the Equation (1) is available.

$$\bar{y}_i = \bar{x}_i'\beta + z_i'\delta + u_i + \bar{\varepsilon}_i \quad (2)$$

Subtract the average of Equation (1) mean-differencing or time demeaning:

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)'\beta + (\varepsilon_{it} - \bar{\varepsilon}_i) \quad (3)$$

Define $\tilde{y}_{it} \equiv y_{it} - \bar{y}_i$, $\tilde{x}_{it} \equiv x_{it} - \bar{x}_i$, $\tilde{\varepsilon}_{it} \equiv \varepsilon_{it} - \bar{\varepsilon}_i$, so

Table 1. Descriptive statistics

Variable	Definition	Mean
Investments	Total investment in hydrogen energy and other alternative energy sources (unit: 100 million RMB)	101.539
Population e	Total people in the district region (unit: ten thousand).	4208.432
Disposable income	Per capita disposable income (unit: RMB).	13214.760
Letters	Total number of environmental protest (letters).	11814.970
Protest	Total number of environmental protests (people).	3091.106
Trade open	The ratio of exports to GDP in the region.	0.025
Protect input	Total input of labor force in environmental investment construction.	5538.806

Table 2. Model specification for robustness check on Hydrogen-based renewable energy production

Model	Variable included
M1	ln(population), ln (disposable income), ln(letters), trade open, protect input
M2	ln(population), ln (disposable income), ln(protest), trade open, protect input
M3	ln(population), ln (disposable income), ln(letters), trade open, protect input, year dummy
M4	ln(population), ln (disposable income), ln(protest), trade open, protect input year dummy

Table 3. Empirical Outcomes in OLS Estimation

	(1)	(2)	(3)	(4)
	ln (Investments)	**ln (Investments)**	**ln (Investments)**	**ln (Investments)**
ln (population)	0.258**	0.209*	0.224*	0.215*
	(0.115)	(0.114)	(0.117)	(0.116)
ln (disposable	1.446***	1.562***	1.339***	1.419***
income)	(0.129)	(0.127)	(0.321)	(0.307)
ln(letters)	0.152***		0.195***	
	(0.0311)		(0.0373)	
ln(protest)		0.117***		0.120***
		(0.0330)		(0.0351)
Trade open	2.429*	3.414***	2.304	4.220**
	(1.390)	(1.288)	(2.091)	(2.019)
logprotect_men	0.618***	0.639***	0.609***	0.631***
	(0.111)	(0.106)	(0.113)	(0.109)
Year dummy	No	No	Yes	Yes
_cons	-18.142***	-18.511***	-17.181***	-17.133***
	(1.222)	(1.181)	(3.041)	(2.934)
N	259	258	259	258
R2	0.777	0.784	0.786	0.784

Standard errors in parentheses: $^{*}P<0.1$, $^{**}P<0.05$, $^{***}P<0.01$

$$\tilde{y}_{it} = \tilde{x}'_{it}\beta + \tilde{\varepsilon}_{it} \quad (4)$$

where Equation (4) has eliminated u_i, assuming that $\tilde{\varepsilon}_{it}$ is not related to $\tilde{x}_{it}$, the fixed least estimator $\hat{\beta}_{FE}$ can be evaluated by applying identical least square.

DATA AND EMPIRICAL RESULTS

The data used in our study are drawn from two databases, first, the relevant hydrogen energy and related alternative energy data in this paper are derived from the China Environmental Statistics Yearbook. The relevant economic data of each province are taken from the China Statistical Yearbook, and the relevant usage variables are compiled in **Table 1**.

In the empirical estimation, we use Hydrogen-based renewable energy investment as the explanatory variable to explore variables such as disposable income, population density, the size of letters and visits in the year, trade freedom, and the scale of investment in environmental investment among them. We used the number of letters to be compared. **Table 2** organizes the relevant estimation model combinations.

Table 3 summarizes the empirical results. First, taking M1 as an example, it can be found that population density, disposable income, batch number of letters, trade degrees of freedom, and scale of environmental inputs have a significant impact on the dependent variables. Among them, the population density and the scale of input of the disposable reaction economy, the higher the population density, the greater the use of reactive energy or natural resources; the empirical results show that in the process of economic development, when the population input density is higher, stimulating economies to develop alternative energy sources such as hydrogen. Secondly, the disposable income represents the per capita economic strength. When the income is higher, it will promote the public to pursue a higher environmental quality of life. Therefore, the influence of this variable should be positive for the explanatory variable.

Table 4. Empirical Outcomes in Fixed Effect Estimation

	(1)	(2)	(3)	(4)
	ln(Investments)	**ln(Investments)**	**ln(Investments)**	**ln(Investments)**
ln(population)	-0.343	-0.360	-0.208	-0.321
	(0.760)	(0.720)	(0.768)	(0.733)
ln (disposable	1.509***	1.497***	1.909***	1.631***
income)	(0.132)	(0.126)	(0.324)	(0.314)
ln(letters)	0.0100*		0.0427**	
	(0.0061)		(0.0243)	
ln(protest)		0.0244*		0.0148
		(0.0137)		(0.0287)
Trade open	-3.308	-2.096	-2.932	-1.835
	(4.473)	(4.190)	(4.585)	(4.360)
logprotect_men	0.575*	0.716**	0.566*	0.719**
	-0.343	-0.360	-0.208	-0.321
Year dummy	No	No	Yes	Yes
_cons	-11.943**	-13.142**	-16.529**	-14.709**
	(5.637)	(5.331)	(6.845)	(6.528)
N	259	258	259	258
Within R2	0.660	0.690	0.668	0.713

Standard errors in parentheses: $^{*}P<.1$, $^{**}P<0.05$, $^{***}P<0.01$

In the estimation of letters and visits, we found that the scale of letters and letters of the letters was positive and significant, indicating that the greater the pressure on the public to improve the environmental quality, the government will be encouraged to develop and invest in alternative energy sources such as hydrogen. In addition, other factors such as trade freedom and environmental investment have a positive and significant impact, indicating that when the economy develops to a certain level, the public's requirements for environmental quality and pressure to improve will prompt local governments in China to develop alternatives. The development of energy, or the stimulation of government investment in energy.

In the M2 estimation in **Table 3**, we use the substitution variables of petitions and the number of petitioners, and we can find that their influence is also positive and significant; only if compared with the M1 estimation results, we will find trade freedom and environmental investment scale. The coefficient estimates will not be able to reject the null hypothesis of statistical verification. Finally, we additionally control the time variable in the M3 and M4 empirical estimation combinations in **Table 3**. The empirical results are consistent with the estimation results of M1 and M2. The results show that the scale of letters and visits will drive the development of alternative energy sources and the scale of hydrogen energy investment by local governments in China.

Table 4 uses the panel analysis model for evaluation. From the estimation of M1, it can be found that compared with **Table 3**, the number of batches of only disposable income and petition letters in the estimation is influential. In addition, the coefficient estimates of other variables affect the direction and are not consistent with **Table 3**. According to the estimated results of **Table 4**, M1 show that the increase in disposable income has an important impact on hydrogen energy development investment, indicating that the improvement of economic strength has an impact on the development of alternative energy. In addition, the form of letters and visits and regulations reflect the Chinese citizens' suggestions on environmental issues for the government, and the expression of ecological issues will indeed drive the government's energy policy. Finally, the estimation results of M2, M3, M4, etc. are compared, and the empirical results are consistent with M1, showing the stability of the estimation results.

ECONOMIC IMBALANCE AND SOCIAL PROBLEMS BROUGHT ABOUT BY THE HYDROGEN ENERGY DEVELOPMENT REVOLUTION: CHINA'S EXAMPLE

The rapid economic development driven by China's reform and opening up mainly comes from mobilizing the enthusiasm of local and various departments. The incentives of the government sector come from the various economic and political gains brought about by the development, and the "great leap forward" of economic growth has become the goal of competing pursuit (Wu et al. 2018, Zhou 2007), this brings positive effects such as the improvement of national income, the prosperity of rural economy, and the promotion of foreign trade in the Chinese mainland economy, and the integration of the Chinese economic system with the international economic system (Marquis et al.

2018). However, this "GDP-centered" growth model has caused various economic and social problems to occur simultaneously, including the so-called various types of demolition and "enclosure" issues, "three differences" and "three rural issues", laid-off workers, environmental pollution, the spread of infectious diseases and the occurrence of various catastrophes.

The various social problems caused by serious social problems have also triggered academic warnings about the development of China's imbalances, including China's entry into a "high-risk society" (Li 2004), and various social classes in China are happening Break" (Sun, 2004), China has stepped into the path of "underdevelopment" or "Latin Americanization" (Gilboy and Heginbotham 2006).

The emergence of social resistance in mainland China has now attracted a lot of attention from the academic community (Perry and Selden 2000, Perry 2002). In recent years, Chinese scholars have gradually increased their research on social resistance, except that they have intensively studied rural and peasant resistance (O'Brien and Li 2005, 2006, 2008), Feng (2007, 2008) explores internal resistance, unit division and environmental resistance. Zhou (2011) uses the "PX incident" as an example to illustrate China's environmental movement. The comparison of cases has been carried out by Yu (2012), and so on.

The severe environmental situation has made the public pay more attention to environmental protection, and the number of petition letters and visits about the environment has increased significantly. According to data released by the State Environmental Protection Administration of China, in the context of increased pollution, petition letters and visits on environmental issues have increased year by year throughout the country. The number of environmental letters and visits has increased rapidly since the 1990s. The number of "petition letters" accepted by China's environmental protection system was 283,000 in the 1990s, and in 2001 it reached more than 367,000, more than the sum of the above five years and 6 times more than of that in 2006 (about 58,000), it increased further to nearly 600,000, which is more than twice that of 2000 and 10 times that of 1995 (Zhang et al. 2018). The number of environmental petitions has also increased from more than 50,000 batches in 1995 to 80,000 to 90,000 batches per year since 2001. Through the above empirical analysis, we can know that the surge in the number of environmental letters and visits will lead the government to pay more attention to the use of hydrogen energy to replace fossil energy. To increase the use of hydrogen energy, it is necessary to increase investment in the development of hydrogen energy technology.

China's use of hydrogen energy to replace fossil energy has become the trend of the times. In 2017, it can be said that China has carried out the most vigorous and strict environmental supervision work, and the punishment for "scattering pollution" enterprises is unprecedented, as well as coal to gas and coal to electricity. The vigorous reforms have clearly demonstrated China's determination and perseverance in environmental protection, energy efficiency and green development. Under the background of the accelerated pace of energy transformation in the world and the strictest ecological and environmental protection system in China in 2018, investment institutions and enterprises in the field of environmental protection and energy conservation are facing huge development space and policy dividends, and future investment in hydrogen energy development. It is a big force for the company.

The trend of energy utilization to green regeneration is irreversible. As an efficient energy carrier, hydrogen is easy to store, easy to convert, safe and environmentally friendly, and is expected to play a more important role in energy supply side reform. As a new energy vehicle that can charge quickly and efficiently, and has a longer range than pure electric vehicles, and with zero emissions of "hydrogen and water", the industry is generally optimistic about its development potential. According to the Blue Book of China's Hydrogen Energy Infrastructure, by 2020, the total value of China's hydrogen energy industry is expected to reach 300 billion, of which the number of hydrogen energy refueling stations will reach 100 (Deng and Benney 2017, Wong 2016).

In order to encourage the development of the hydrogen energy industry, China has also issued a number of supportive policies. At the same time, it should also be noted that China has a gap with the international advanced level in the key technologies of hydrogen energy vehicles (Ying 2018). For example, core components such as fuel cells and hydrogen storage tanks cannot be industrialized in China, and related technologies are also in Japan and Canada. In the hands of the United States and other countries, the construction of infrastructure such as hydrogen refueling stations still lags behind market requirements.

In this context, it is not easy to understand the role of a certain kind of energy, and to separate the main body of hydrogen energy consumption from the main body of hydrogen energy production, because the main body of production and the main body of consumption sometimes change or change each other. The drivers of renewable energy development are at the heart of sustainable development (Golusin et al. 2013, Zhang 2018, Zheng and Shi 2017). Future hydrogen-based renewable energy systems require technological change and infrastructure. In the hydrogen energy utilization, hydrogen compression, liquefaction, storage and transportation processes, hydrogen station hydrogen handling, compression, hydrogen filling process have high technical requirements for process operation and equipment, materials and instruments. Foreign countries have conducted relevant technical research, and Chinese research is relatively late. There are also significant gaps between the design specifications and standards of hydrogen refueling stations that have been formulated in China and the standards of foreign standards. There is no design standard for the long-distance pipeline transportation of hydrogen in China, so we should study it as soon as possible. If these problems are not solved well, they will become the limiting factors for the development and utilization of hydrogen energy. In short, the development and utilization of hydrogen energy is a systematic project. It must have complete and systematic technical support. It must address the problems and gaps in China, increase investment in research and development, carry out collaborative innovation, organize joint research, and form a support for hydrogen energy development and utilization. Series of technologies. In the aspect of hydrogen energy development, it is necessary to develop high-efficiency hydrogen production technology for fossil energy efficient hydrogen production and water electrolysis. High-efficiency hydrogen production technology for fossil energy includes high-efficiency gasification technology for fossil energy, synthetic gas desulfurization and decarbonization, water vapor gas conversion, hydrogen synthesis, new technology, and low-cost purification to produce high-purity hydrogen. Water electrolysis low cost and high efficiency hydrogen production technology includes new electrode and membrane technology and electrolyte modification technology. Future-oriented technologies also include thermochemical hydrogen production, photocatalytic hydrogen production, photoelectrochemical hydrogen production, and solar direct hydrogen production. In terms of hydrogen storage technology and equipment research, compressed hydrogen storage and liquefaction hydrogen storage are feasible hydrogen storage and hydrogen transportation methods in the near-term. The focus of technology and equipment research is on the production of low-cost carbon fiber materials for 70MPa and 90MPa hydrogen cylinders. Technology and hydrogen bottle manufacturing process and equipment technology, high-pressure hydrogen bottle and liquid hydrogen storage tank life testing and evaluation technology. The long-term hydrogen storage technologies include chemical hydrogen storage technology and porous material adsorption hydrogen storage technology.

CONCLUSION

This study applies the pooled least squares (PLS) and fixed effect (FE) ordinary least square (OLS) to estimate the influence of resident disposable income, population density, the size of letters and visits in the year, trade freedom, environmental investment, manpower scale, etc. Variables for China's use and development of alternative energy sources such as hydrogen energy. Our empirical results show that population density, disposable income, number of letters to petition letters, trade freedom, and scale of environmental inputs have a significant impact on the variables.

In the estimation of letters and visits, we find that when the public's pressure on the improvement of environmental quality is greater, it will prompt the government to develop and invest in alternative energy sources such as hydrogen energy. Such results have also been shown to be significant in the data analysis of the panel, indicating that the type of petition, the rules and other models reflect the Chinese citizens' suggestions on environmental issues for the government, and the expression of ecological issues will indeed drive the government's energy policy.

Hydrogen energy is the most effective way to achieve efficient use of primary energy. It is the cleanest secondary energy source. The development of hydrogen energy will strongly promote industrial innovation and industrial transformation. The safety risks in hydrogen energy development and utilization are controllable, and the system is complete. Support is the key to achieving hydrogen energy development and utilization. China should focus on the gap between hydrogen energy development and utilization technology and foreign countries, carry out high-purity hydrogen and water electrolysis, high-efficiency and low-cost hydrogen production technology, hydrogen storage technology, hydrogen storage equipment and hydrogenation station equipment materials and manufacturing technology. Research and development of power density low-cost automotive fuel cell technology, home and industrial fuel cell technology, and the establishment of a national technical standards system for the safe and efficient development and utilization of hydrogen energy. Photocatalytic hydrogen production and microbial hydrogen production have good prospects, and hydrogen storage materials have also achieved great development in recent years. With the development of hydrogen production technology and hydrogen storage technology, hydrogen energy will play a greater role in the future energy market. We believe that with the increase in the negative impact of environmental pollution on people's lives and welfare, the public's awareness of environmental protection has increased, and more and more people are actively participating in environmental protection. This public awareness will stimulate the government to carry out deeper alternative energy development and technology applications such as hydrogen energy.

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