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Research on System Dynamics Simulation for NIMBY Risk Diffusion of the 'One Belt and One Road' Energy Investment

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Abstract:

Under the background of China's 'one belt and one way' energy cooperation, overseas energy investment has been increasing, but at the same time, there is also a serious problem on Not In My Back Yard risk. How to reduce the loss brought by the diffusion of NIMBY risk to the overseas energy investment of Chinese enterprises, it is the key to deeply explore the main diffusion mechanism of this risk formation. Based on this, on the basis of making in-depth analysis of the main factors affecting the NIMBY risk diffusion of energy investment, this paper constructs an analysis model on the NIMBY risk diffusion mechanism with system dynamics, and combines with an example, uses Vensim-PLE software to simulate and analyze the sensitivity. The results show that the related stakeholder behaviors, including the information openness of construction enterprises, the credibility of the host government and the satisfaction of the host residents, have positive effects on alleviating the diffusion of NIMBY risk of energy investment. Based on the change of the function rules among the elements by the simulation results, from the perspective of improving the benefit compensation mechanism and communication mechanism of NIMBY risk of energy foreign investment, the satisfaction of the host residents can be improved by promoting the credibility of the host government and the information openness of the construction enterprises, and then the probability of the NIMBY risk diffusion can also be reduced.

Keywords*: The One Belt and One Road, energy investment, NIMBY risk, diffusion mechanism, SD mode.*

I. INTRODUCTION

According to the Blue Paper of Foreign Investment and Risk: the Report on China's Foreign Direct Investment and National Risk, it can be drawn that the foreign investment of energy industry has become a crucial issue and breakthrough in promoting the construction of the One Belt and One Road in China. However, the increasingly complex environment faced by the energy investment projects overseas has to a certain extent dominated the changing trend of energy investment risks, which has created a huge challenge to the effectiveness of China's energy investment. For example, the construction of China-Myanmar oil pipeline project started in October 2013 was forced to stop for two years due to the opposition of people along the route. In September 2016, the Belgian National Security Agency strongly

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warned the Belgian government to be extremely careful about China's attempt to acquire the Belgian power grid on the grounds of national security. It is fair to say that the large-scale foreign investment of China's energy enterprises under the One Belt and One Road initiative has caused the anxiety and even panic in some resource countries in which the public is worried that the resources sold will be undervalued and the lifeline of the country's resources will be bought out by China. Some people are worried that the construction of energy infrastructure will have an enormous impact on the surrounding environment, and China's enterprises will grab local resources and so on. The continuous evolution and diffusion of these concerns will arouse more psychological aversion of resource countries and their people who may take strong, resolute and sometimes highly emotional collective opposition and even resistance, eventually resulting in the termination of energy investment cooperation by the investee. When the energy investment in the One Belt and One Road has entered a new comprehensively pragmatic stage, the diffusion effect of NIMBY risks has become the weakness of energy investment of Chinese enterprises at present. However, the current research on the energy investment risk of the One Belt and One Road is mainly based on the identification of macro risk factors and evaluates the energy investment risk rate of resource exporting countries from the national level [1], but it fails to identify the NIMBY conflict event appearing in the real energy investment as a key risk driver and bring it into the energy investment risk system. Additionally, the related research on the NIMBY risk of energy investment is scattered in the research of NIMBY facilities or NIMBY crisis. Moreover, the research on the NIMBY problem mainly focuses on inferring the reason of NIMBY risk from different single case event [2], and seldom integrates the characteristics of NIMBY, including complexity, instability and amplification effect to analyse its diffusion mechanism (key variables and their mutual relations, diffusion path).

Accordingly, on the foundation of in-depth analysis of the main factors affecting the NIMBY risk of energy investment of the One Belt and One Road, this paper constructs the NIMBY diffusion mechanism model of energy investment based on the basic principle of SD model, and analyses the diffusion mechanism by simulating the diffusion process of the NIMBY risk in the case of Letpadaung Copper Mine in Myanmar, so as to provide issue prospection and disagreement resolution for more types of participating investors in China to assist them to grasp the NIMBY phenomenon from the overall situation and process. (They should not only manage and control emergency, but also prevent the NIMBY risk from the source)

II. ANALYSIS ON INFLUENCING FACTORS OF THE DIFFUSION OF THE NIMBY RISK

According to the comprehensive analysis on various current cases of NIMBY risks, many scholars have made an in-depth study on the main reasons of NIMBY risk diffusion. On the one hand, based on the perspective of endogenous risk incentives, it is considered that the four major actors, including government, the public, enterprises and media of NIMBY conflicts have mutual influence and restriction on each other [3]. Based on the way of reconstructing risk cognition, Liu, et al. analysed the functions of popular science education propaganda, government credibility, public participation in NIMBY decision-making, and the positive role of media in reducing the deviation of public risk cognition and diffusion of NIMBY risk [4]. In addition, Gong, et al. analysed the essential influence of public demand satisfaction, risk cognition and government behaviour and attitude on diffusion of NIMBY risk through

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qualitative meta-analysis [5]. Additionally, it is known that the rumours of NIMBY facilities will be amplified in the spread, which will further aggravate the diffusion of NIMBY risks based on the analysis of infectious disease model [6]. In conclusion, the risk perception of negative external effects of NIMBY phenomenon in energy investment is resulted from several factors. First of all, the openness degree of military and civilian information in the host country by construction enterprises is low [7]. The second factor is the low degree of government information disclosure and public participation [8, 9]. Thirdly, the news that social media exaggerated or fabricated the phenomenon of NIMBY propagate through the media and the Internet, which will further aggravate resistance of the public, intensify the contradiction between the people and the government, enterprises, and improve the possibility of risk diffusion [10, 11]. On the other hand, it is analysed from the perspective of exogenous environmental variables, indicating that the diffusion process of NIMBY risk will also be affected by the negative externalities of NIMBY phenomenon and certain social, economic, cultural and political background [12]. Most scholars believe that the residents' NIMBY emotion in the host country is mainly related to the distance between the NIMBY facilities and the host community. The closer to the host community, the easier it is to generate the NIMBY emotion, especially for the polluting NIMBY facilities whose negative externalities will make the nearby residents perceive health and safety risks [13]. In addition, geographical incentives, including special terrain, geographical location, special resource endowment conditions and geographical groups, will also induce the spread of NIMBY risks in energy investment to a certain extent [14].

III. CAUSALITY ANALYSIS OF DIFFUSION MECHANISM OF NIMBY RISK IN ENERGY INVESTMENT BASED ON SD MODEL

3.1 Causality Analysis of Factors Affecting Diffusion of NIMBY risk

According to the above analysis, it can be drawn that the diffusion of NIMBY risk in energy investment of the One Belt and One Road is mainly restricted by the interaction among host residents, host government and construction enterprises. Furthermore, the satisfaction of host residents with NIMBY facilities, the credibility of host government and the degree of information openness of construction enterprises become the key factors to determine the deterioration of NIMBY conflicts. Based on this, this paper includes the above-mentioned influencing factors in three subsystems, including the host resident subsystem, the host government subsystem, and the construction enterprise subsystem (see Figure 1), and the internal relations of the subsystems are as follows:

First of all, the host resident subsystem mainly describes that the residents' NIMBY emotions will extend to group NIMBY conflicts resulted from certain incentives, which will lead to the diffusion of NIMBY risks. The key reason for the phenomenon is that the negative externalities of infrastructure construction in energy investment will make residents recognize risk. When related rumours start to spread through the media, people will pay more attention to NIMBY facilities. After understanding the related risks and being affected by rumours, they will be aversive and resistant to NIMBY facilities. In addition, the host government and construction enterprises ignore the opposition of the host residents for their own benefits, causing the spread of residents' resistance, and the constant diffusion of NIMBY risk. When it

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reached peak, the host residents try to stop the construction of relevant NIMBY facilities by means of demonstrations, violent conflicts and so on.

Secondly, the host government subsystem mainly depicts the diffusion degree of NIMBY risk in energy investment caused by the different attitudes of the host government towards the NIMBY emotion of host residents. The main diffusion process happens in the early stage of NIMBY facilities construction. Due to the urgent pursuit for improvement of local GDP and incomplete consideration of people's opinions by the host government, people's trust in the host government is reduced, leading to the increase of public resistance to NIMBY facilities and the continuous diffusion of risks. When the construction of border facilities is stopped because of violent conflicts, its reverse effects will promote the increase of government's attention. At this time, in order to maintain social stability and keep local GDP unaffected, the host government will begin to channel the host residents' emotions and try to improve the government's credibility and residents' satisfaction with the government through reasonable and timely governance actions, resulting in the mitigation of NIMBY risks diffusion.

At last, the construction enterprise subsystem describes the influence of different decision-making approaches of construction enterprises on the diffusion degree of NIMBY risks. In the early stage of the construction of NIMBY facilities, because of their negative externalities, the host residents have the emotion of resistance and even NIMBY conflicts will be generated. In this case, considering of the sunk cost spent, the construction enterprise will choose to ignore residents' protests so as to reduce losses. However, with the accumulation of resistance, the risks spread continuously until it reaches peak, leading to violent conflicts and resistance of the host residents, which will cause the cessation of enterprise production. In order to reduce losses, construction enterprises adopt the same measures as the host government, namely improving compensation and promoting information disclosure to mitigate the risk of NIMBY.

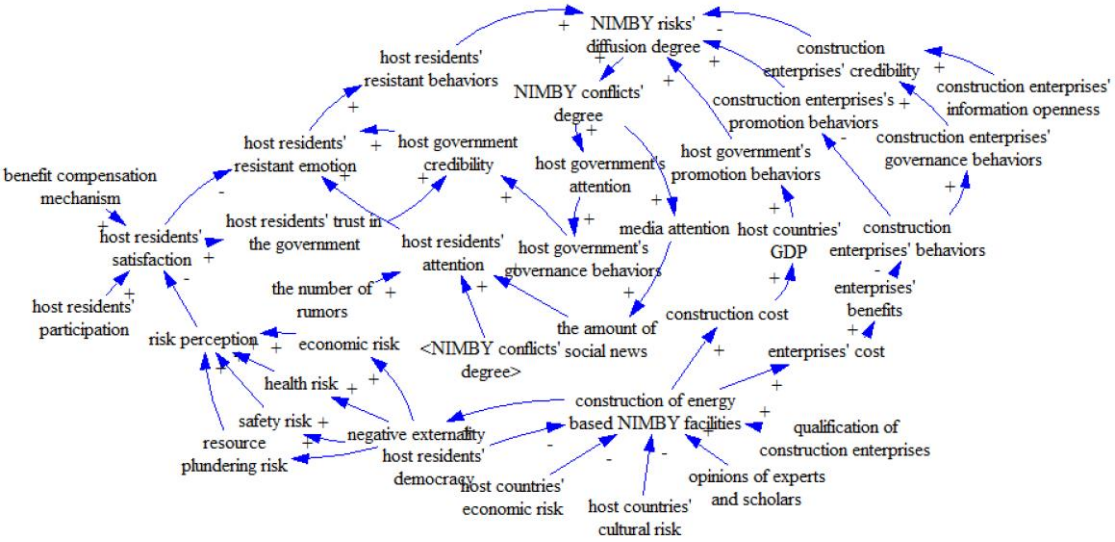

Figure 1: Causality diagram of diffusion factors of NIMBY risks

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3.2 The SD Flow Chart of Risk Diffusion Mechanism of NIMBY

(1) Basic information and assumptions of the model

According to the loop analysis results of the above causal relationship, the state variables, rate variables, auxiliary variables and constants are introduced into the system flow diagram of NIMBY risk diffusion in energy investment, as is shown in the figure 2.

Based on the basic principle of system dynamics equation and the practical significance of each system variable, the mathematical formula of each variable was set. In this system, there are 60 variables in total, including 5 state variables (L), 10 rate variables (R), 29 auxiliary variables (A) and 16 constants (C). Meanwhile, in order to ensure the accuracy and scientific nature of the model, this paper put forward the following assumptions. First, only the impact of the interaction among the directly related stakeholders (host residents, host government, construction enterprises and social media) in energy investment of the One Belt and One Road on the risk diffusion of NIMBY was considered, and other indirect stakeholders were not put into consideration. Second, considering comprehensively of the One Belt and One Road initiative, all related parties are a community of destiny under a cooperative atmosphere of friendly consultation. Therefore, the external political environment factors were not considered for the moment, and the host country was assumed to be a country with stable political situation and good government relations with China, which was not interfered by international political risks. Third, based on the analysis of NIMBY risk diffusion cycle of the "Letpadaung Copper Mine in Myanmar" case, this paper set the simulation cycle of NIMBY risk diffusion in energy investment as 18 months.

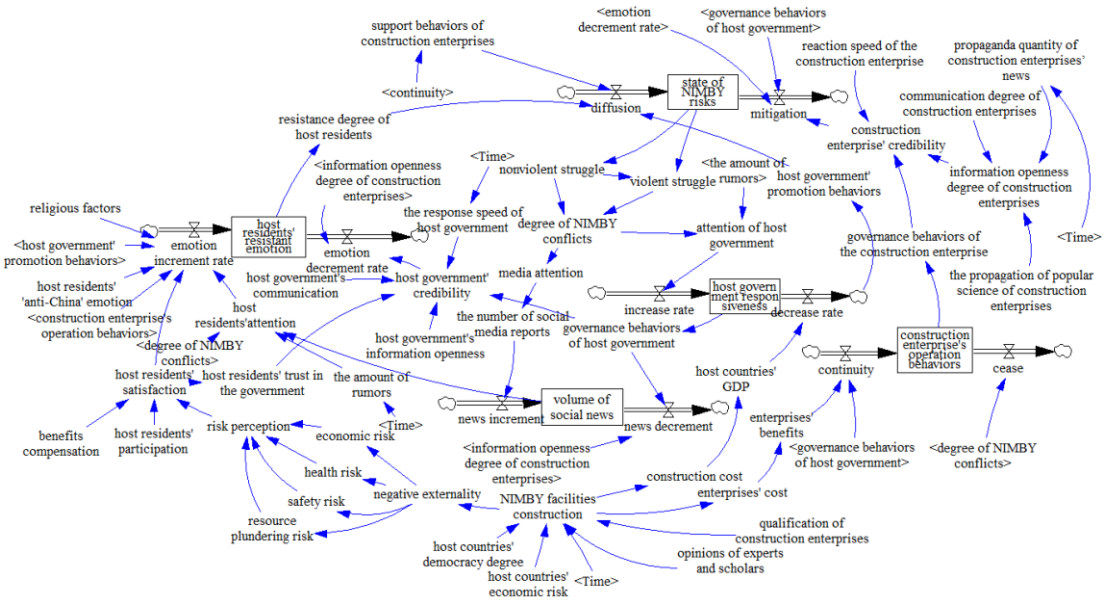

Figure 2: System Flow Diagram of Risk Diffusion Mechanism Analysis of NIMBY

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(2) Model parameter setting and main equation design

Due to the complexity of the main factors that induce the diffusion of NIMBY risks in the energy investment of the One Belt and One Road and the variability of social environment of the host country, it is extremely difficult to obtain relevant data, there is also no support of professional database. Therefore, the assignment of relevant variables of the model constructed in this paper and the initial value setting of simulation were determined by the equilibrium assignment method, and the authenticity and reliability of simulation results were analysed through simulation with examples. In the feature analysis based on the system dynamics method, the initial setting of the model will not affect the general trend of the interactions among the variables in the system. Therefore, in order to better reflect the overall state of NIMBY risk diffusion in energy investment, this paper took the risk diffusion cycle into the simulation time category.

At the initial stage of energy investment, the host residents can perceive that the NIMBY facilities invested by construction enterprises will have a certain negative impact on their health, safety and economy, so the host residents will possess a certain degree of resistance, and the possibility of diffusion of NIMBY risks always exists. Therefore, when setting the initial value, the host residents' latent resistance was comprehensively considered. Through many fitting experiments, it was proved that when the initial value of the host residents' resistance was set to 5 and the initial value of the NIMBY risk state was set to 10, the best simulation effect could be gotten, so the initial values of the two were set to 5 and 10 respectively. The initial value of the amount of social news was set on the basis of the average value of the total amount of social media posts in actual cases, which was calculated comprehensively with the result of 200. However, the initial value setting of the host government's responsiveness mainly integrated the openness of information to the public and the potential crisis prediction ability of the host government before the implementation of energy investment projects. Through many simulation experiments, it was proved that the simulation effect was best when the initial value was 100, so the initial value was set to 100. However, the operation behaviour of the construction enterprise did not occur at the initial stage of the proposed construction, so its initial value was set to 0.

Based on the above assumptions, this paper designed the equations of 5 state variables (L), 10 rate variables (R) and 29 auxiliary variables (A) of the system flow diagram. The main structural equations were as follows:

L resistance emotion of host residents =INTEG (emotion increment rate-emotion decrement rate, 5)

R emotion increment rate = religious factor /5+ host government's promotion behaviour /10+ construction enterprise's operation behaviour /60- host residents' "anti-China" emotion-host residents' attention /2000+ host residents' satisfaction /50+1

R emotion decrement rate = 0.3*DELAY3I(-0.5* host government credibility +0.2* information openness of construction enterprise,10, 0)

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A risk perception = 0.3* health risk +0.3* safety risk +0.3* economic risk +0.1* resource plundering risk

A construction of NIMBY facilities = (economic risk of host country + opinions of experts and scholars + qualification of construction enterprises + democracy degree of host country) /EXP(-0.078*Time)

A resistance degree of host residents = DELAY1I(EXP(-0.1* resistance emotion of host residents), 10,0)

L volume of social news = (news increment-news decrement, 500)

R news increment = the number of social media reports *2+110

R news decrement =5* (governance behaviours of host government +0.5* information openness degree of construction enterprises) +110

A degree of NIMBY conflicts= 0.36* nonviolent struggle +0.64* violent struggle

A the response speed of host government =DELAY3I(EXP(-0.1*Time),10,0)

L host government responsiveness = (increase rate-decrease rate, 100)

R increase rate = attention of host government

R decrease rate =8.75*DELAY1I(EXP(-0.78* host country's GDP),2 ,0)

A governance behaviours of host government=DELAY3I(EXP(-0.023* host government responsiveness), 10,0)

L operation behaviours of construction enterprises= (continuation-cessation, 3.2)

R continuation =1.5*(SMOOTH3I(EXP(-0.15* enterprise income), 10, 0)*2-10* governance behaviours of host government)

R cessation= degree of NIMBY conflicts /140

A propaganda quantity of construction enterprises' news = EXP(0.23*Time)

A construction enterprise credibility = information openness degree of the construction enterprise + governance behaviours of the construction enterprise + reaction speed of the construction enterprise

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L state of NIMBY risks = (diffusion-mitigation, 40)

R diffusion =DELAY1(6*(0.01* resistance degree of host residents +5* promotion behaviours of host government-support behaviours of construction enterprises) +7, 3)

R mitigation=DELAY3(0.15* (credibility of construction enterprises +35* emotion decrement rate-governance behaviours of host government), 3)

A violent struggle = 0.3* nonviolent struggle +0.7* state of NIMBY risks

IV. SIMULATION ANALYSIS ON DIFFUSION MECHANISM OF NIMBY RISKS OF ENERGY INVESTMENT

4.1 Case Analysis of Letpadaung Copper Mine

In June 2010, Letpadaung Copper Mine, one of the landmark projects in the energy investment of the One Belt and One Road, started construction, and then officially started building in March 2012. However, in June of the same year, the project was opposed by the residents of the host country due to unfair compensation for demolition, serious environmental pollution and so on. Furthermore, through the propagation and reports of medias, it gradually developed into a protest by local residents against the Chinese Embassy in the host country, and then the police of the host country dealt with them by suppression. However, the protests by the host residents about the construction of Letpadaung Copper Mine project did not decrease, but became increasingly fierce. In the end, the conflict escalated and even worse incidents occurred, resulting in the interruption of the project. In December 2012, the host government set up a special committee to carry out investigation on the Letpadaung Copper Mine project. In March 2013, it was found that the main reasons for the current situation caused by the Letpadaung Copper Mine project were the lack of transparency of information disclosed to the public by the government and the lack of communication among developers, local residents and the local government. In October 2013, the host government considered local economic, social and environmental factors comprehensively, and decided to take corresponding improvement measures to continue the project, and then the Letpadaung Copper Mine project resumed work in a low-key manner.

Combined with the case, it is not difficult to find out that the system flow chart portrayed by the analysis of the NIMBY risk diffusion mechanism in energy investment of the One Belt and One Road in this paper basically coincides with the NIMBY risk diffusion process in the case. Therefore, this paper systematically simulates the diffusion mechanism of NIMBY risk of energy investment in the One Belt and One Road with this case.

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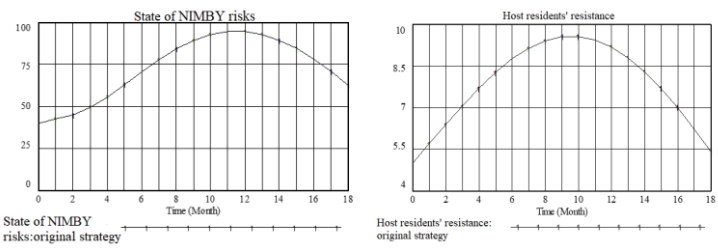
4.2 Dimensional Consistency Test of Variables

In view of the different representation meanings of various variables in the system dynamics model and the inconsistency of variable measurement unit, the interaction between various variables in the system needs to be reflected based on distinct structural equation expressions. Therefore, when the model of NIMBY risk diffusion mechanism of the energy investment is built, it is bound for the researchers to ensure the consistency of variable measurement unit on both sides of the equation. In the process of constructing the model, if the variable dimension is undefined or there is inconsistency between the defined variable dimension and the actual dimension, the system will automatically report the error and point out its originalities. The model may be simulated after continuous correction until no error occurs. The incentive variables of NIMBY risk diffusion of energy investment in this paper are qualitative descriptive data without specific values, so there is no difference in variable dimensions, and the model test process also indicates that the dimensions of various variables are consistently unified.

4.3 Model Validity Analysis

According to the basic idea of model theory test, this paper verified the fitting degree of the NIMBY diffusion mechanism model of Letpadaung Copper Mine event to reality, namely verifying the consistency between fitting results and the process and regularity of NIMBY risk diffusion based on the basic principle that system structure determines system behaviours. The accurate test results are presented in Figure 3. According to the trend analysis of the curve in Figure 3, the NIMBY risk state of energy investment rises from the initial low degree to a peak and then drops, which is fundamentally consistent with the diffusion of the NIMBY risk in the case. The following is the specific performance:

The first stage: the generation period of NIMBY risks (1-3 months). At the initial stage of the energy investment project in the One Belt and One Road, the negative externalities and risk inducements produced by the relevant NIMBY facilities made the host residents perceive the NIMBY risks in the project construction. In this case, the rumours propagated by some non-professional media platforms further improve the residents' attention to the projects under construction. After recognizing the hazards of the related risks through their own channels, the host residents' satisfaction with the project construction is continuously decreasing due to the silent attitude of the host government and construction enterprises, stimulating the resistance and aversion of them to the construction of NIMBY facilities related to energy investment projects, promoting the diffusion of NIMBY risks and forming the antecedent fuse of NIMBY conflicts.



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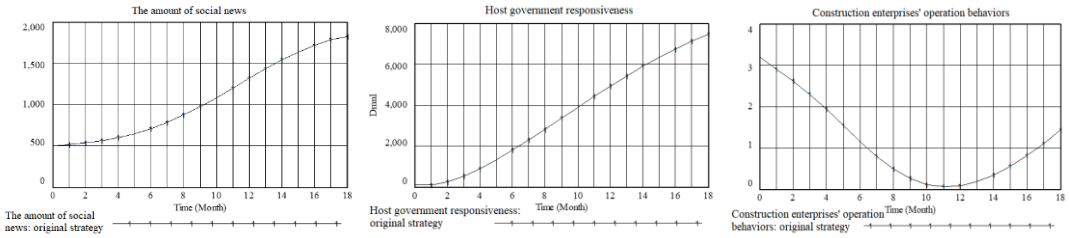

Figure 3: Effectiveness Fitting Results of NIMBY Risk Diffusion Mechanism Model

The second stage is the outbreak period of NIMBY risks (4-11 months). In the early stage of the outbreak of NIMBY risks, in order to interpret some rumours from medias, the host government only issues relevant statements on its website and the construction enterprises does not provide professional scientific guidance. Although both of them have respond, their responses were insufficient to dispel the doubts of the host residents, thus causing the resistance of the host residents around the NIMBY facilities to spread continuously. Moreover, a unified cognition is gradually formed, which prompts more people to take flexible means such as petitioning, marching and even "collective walking" to resist the business behaviour of the construction enterprises in the host country. The rational resistance behaviour of the host residents at this stage will be paid a great deal of attention by some mainstream media and the amount of news reported by media starts to increase gradually, resulting in a slowdown in the projects promotion of construction enterprises. However, in consideration of the benefits and costs, the action of the host government and construction enterprises to continue the operation of the project of NIMBY facilities under construction in the absence of direct communication with the host residents will further accelerate the diffusion of NIMBY risks of energy investment projects. In the 13th month, the NIMBY risk of the whole energy investment project has reached its peak and exists in a full-scale outbreak period. The original NIMBY risk has evolved into a NIMBY conflict, and the resistance of the host residents has been highly intensified. They choose to resist the behaviour of the host government and construction enterprises through violent approaches. This violent conflict will attract great attention from various mass media, leading to the result that the amount of social news increases exponentially. Furthermore, the violent conflict has caused the suspension of the operation of construction enterprises. At this time, the host government realizes the seriousness of these events. They begin to make more responses and understand the demands of the host residents, trying to ease the resistance of the host residents. In addition, they take targeted measures to cope with the contradictions of the incident.

The third stage: the decline period of NIMBY risks (12th-18th month). Through investigation and analysis, the host government has identified the root cause of the host residents' resistance and the outbreak of neighbouring conflicts. They commence to strengthen the information disclosure of energy investment projects and carry out deep communication with the host residents so that they can increase the government's credibility, improve the satisfaction of the host residents and mitigate their resistance Additionally, construction enterprises publicize and promote the popular science of NIMBY facilities in energy investment from the professional perspective and undertake the social responsibility of enterprises in the local area, so as to establish a good corporate image and reduce the estrangement between host

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residents and construction enterprises. With the implementation of remedial measures taken by the host government and construction enterprises, the resistance of the host residents has been alleviated to a certain extent, and tends to decline in the overall trend. Moreover, the social media has begun to issue positive reports rather than negative reports, which further accelerates the mitigation of NIMBY risks of energy investment projects. After the construction enterprises get more people's understanding, they gradually resume their business operations.

At this stage, the host government and construction enterprises focused on taking targeted remedial measures to improve the satisfaction of the host residents, reduce their resistance, alleviate the NIMBY risk and eventually resume the production of construction enterprises.

4.4 Sensitivity Analysis of the Model

By continuously debugging the system of energy investment NIMBY risk diffusion model and analysing the case of Letpadaung Copper Mine, it was found that the NIMBY risk diffusion system is most sensitive to the changes of three variables, including the satisfaction of host residents, the credibility of host government and the information openness degree of construction enterprises. Therefore, based on many simulation verifications, this paper recognized the most significant value of the sensitivity change of each variable’s parameter value and carried out systematic simulation on the sensitivity of the above three key variables.

(1) sensitivity analysis of information openness degree of construction enterprises

According to the relationship among structural elements in the system and the case analysis of Letpadaung Copper Mine, it can be drawn that the information openness of construction enterprises is the indispensable and fundamental factor affecting the NIMBY risk diffusion of energy investment in the One Belt and One Road. In the incident of Letpadaung Copper Mine, due to the high information asymmetry between the construction enterprises and the host residents and the auxiliary role of relevant social media and some rumours, the misunderstanding of the host residents on NIMBY facilities in energy investment increased, thus accelerating the diffusion of NIMBY risks. Furthermore, the degree of information disclosure of construction enterprises mainly depends on the methods to make the host residents have greater right to know, namely how to strengthen the communication between construction enterprises and host residents and boost the propagation of science for the NIMBY facilities established in energy investment. Based on this, under the condition of keeping the communication degree of construction enterprises unchanged, this paper first adjusted the parameter value of popularization of science to host residents from 5 to 9, which is recorded as strategy 1. Then the paper adjusted the communication degree of construction enterprises from 5 to 9, and recorded it as strategy 2. The simulation results are shown in figure 4.

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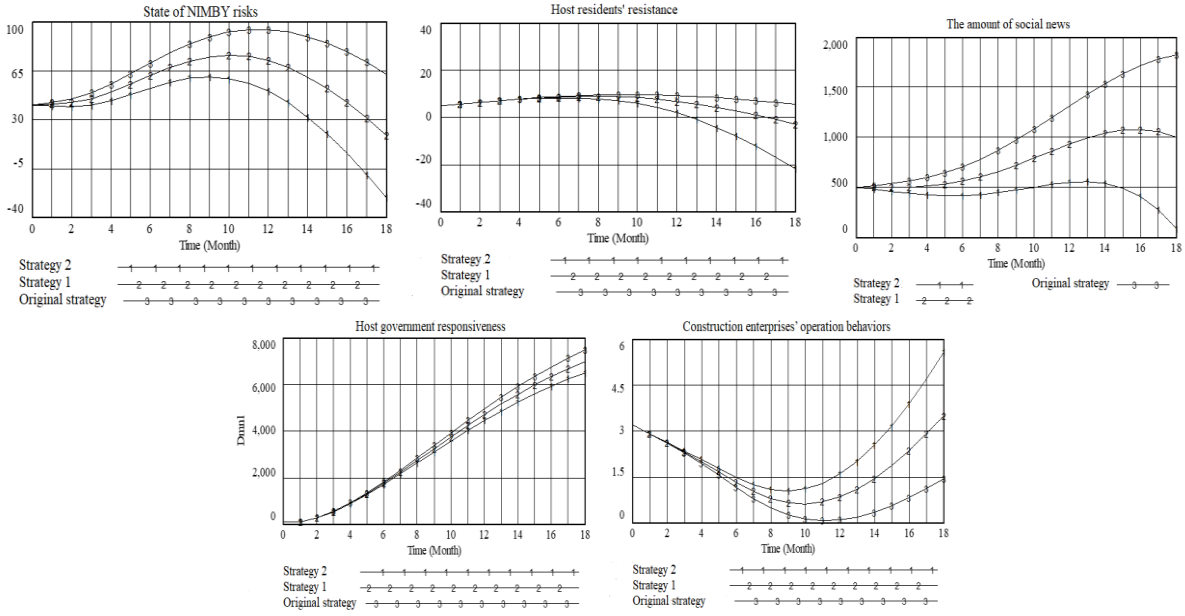

Figure 4: Sensitivity analysis of information disclosure of construction enterprises

It can be known from Figure 4 that in the whole diffusion cycle of NIMBY risks of energy investment, enhancing the spread of science popularization to the host residents can effectively reduce the diffusion speed of resistance emotion of the host residents. Through the professional popularization of enterprises, the host residents clearly understand the principles of NIMBY facilities of which their inner fear can be reduced. Moreover, the diffusion of resistance emotion may be alleviated in the early stage and the diffusion speed of NIMBY risks will slow down. At this time, the attention of social media to the energy investment projects under construction in the One Belt and One Road maintains a relatively stable trend. Because of the proactive information disclosure behaviour of construction enterprises, the response of the host government in the initial stage of construction does not increase rapidly. In this case, the construction enterprises fully consider the acceptance of the host residents to the NIMBY facilities of energy investment projects. They slow down the construction of enterprises in an appropriate time rather than blindly accelerate it. With the active public response from the host government and positive reports from the social media, the host residents have a deeper recognition of the benefits of the energy investment projects under construction and their resistance sentiment is on a downward trend, which leads to the mitigation of the NIMBY risks of the whole energy investment project and the reduction of the possibility of NIMBY conflicts. At this time, the business of the construction enterprises may be gradually recovered. Especially, on the premise of enhancing the popularization of science among the host residents, increasing the communication between the construction enterprises and the host residents can greatly restrain the spread of their resistance emotions. Without reaching the threshold of generating NIMBY conflicts, the state value of NIMBY risk begins to decline until the probability of NIMBY conflict eruption becomes zero. Meanwhile, due to the favourable communication among the host residents, construction enterprises and the host government, the hot spots of news concerned by the media gradually decrease, leading to a decline in the coverage of social media in the later period. After the operation behaviour of construction

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enterprises is accepted by the host residents, the construction will be accelerated. In conclusion, improving the information openness of construction enterprises through two paths is more conducive to controlling the spread of the risk of NIMBY in energy investment and reducing the possibility of NIMBY conflicts, which means that strategy 2 is better than strategy 1. Especially at the end of the simulation, the difference of simulation results formed by such factors is more obvious.

(2) Sensitivity analysis of host residents' satisfaction

According to the case analysis of the incident of Letpadaung Copper Mine, it can be seen that the people around the energy investment project bear the negative external costs brought by the construction of NIMBY facilities, but the benefits compensation given by the construction enterprises and the host government to the host residents do not meet their psychological expectations. Meanwhile, during the project construction process, the people around the NIMBY facilities do not participate in the demonstration process of the project construction. All of these lead to their low satisfaction to the facilities and then induces the NIMBY risks of energy investment. Therefore, it is not difficult to find out from the analysis of this case that improving the compensation to the host residents and increasing the participation of them are the important factors affecting the NIMBY risk diffusion of energy investment. Based on this, this paper first adjusted the benefit compensation value from 4 to 8 under the condition of keeping the participation of host residents unchanged, which was recorded as strategy 1. Then it adjusted the number of residents' participation from 4 to 8, which was recorded as strategy 2. The simulation results obtained are shown in figure 5.

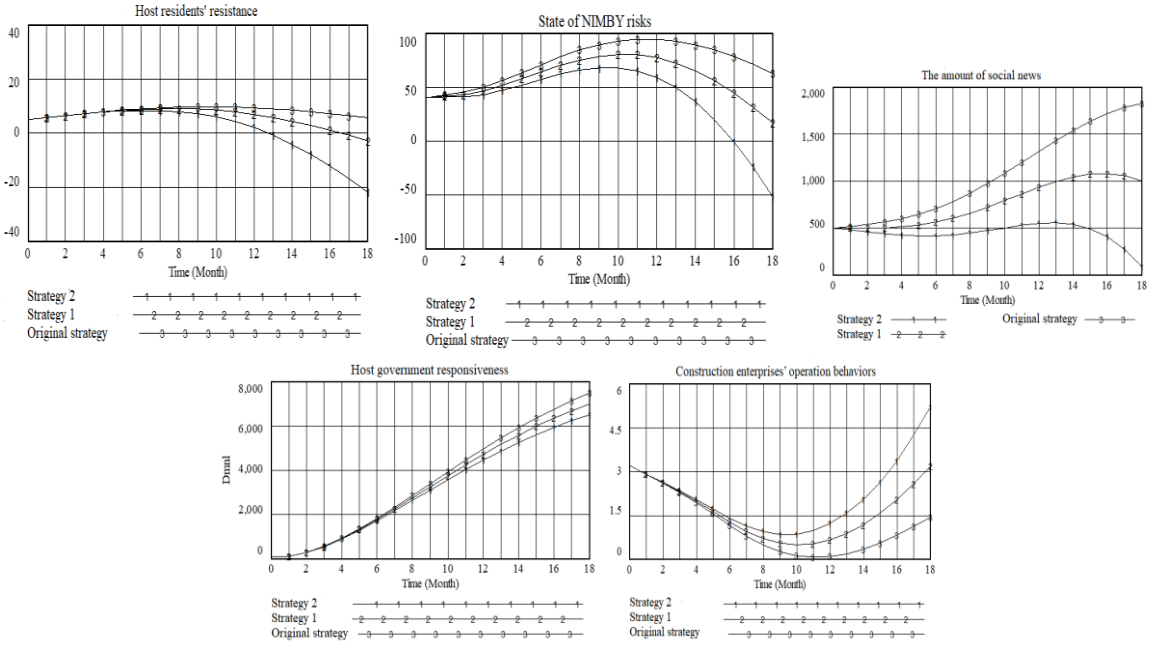

Figure 5: Sensitivity analysis of host residents' satisfaction

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The simulation results in Figure 5 show that the host government and construction enterprises actively cater to the demands of the host residents and increase the amount of benefit compensation, which can effectively mitigate the diffusion of NIMBY risks and reduce the occurring possibility of NIMBY conflicts. In the period of energy investment and construction, with the enhancement of the response of the host government, if the host residents acquire the compensation that meets their psychological expectation, they will accept the loss resulted from the negative externalities of NIMBY facilities in energy investment. Besides, their psychological resistance to the project itself and the construction enterprises will not be intensified and enlarged, which will remain in a relatively stable state for a long time. In this case, the state value of energy investment NIMBY risks is also in a relatively stable threshold range with a small possibility of outbreak of NIMBY conflicts. Additionally, with the NIMBY risks and resistance of host residents becoming increasingly stable, the total volume of news of social media also remains in a stable state. However, the business of construction enterprises is not promoted rapidly after the host residents receive satisfactory benefits compensation. Instead, on the premise of rational analysis of the host residents' satisfaction, it is accelerated when the resistance of the host residents is increasingly weak and the NIMBY risk is mitigated. The host government not only provides compensation to satisfy the host residents, but also further enhance the participation of the host residents, so as to improve their in-depth understanding of energy investment projects. At the initial stage of the host residents' participation, although they cannot fully understand the original intention of the project construction, their resistance will not fluctuate with the driving of satisfactory benefit compensation (1-6 months). In this case, the diffusion of NIMBY risks has further slowed down due to a series of active response of the host government and construction enterprises. With the increase of the participation of host residents, their hostility to the energy investment project disappears and their resistance is alleviated, and the possibility of the spread of NIMBY risks drops sharply. At this time, the active response of the host government and construction enterprises is positively reported by social media, and the power of social media has increased for a short time (10-13 months). Later on，because the whole situation is in a steady development trend, the attention of media decreases sharply (14-18 months). Furthermore, the operation of construction enterprises is officially restored and accelerated after being highly recognized by the host residents. In conclusion, compared with increasing only one element, improving host residents' satisfaction through two paths is more conducive to controlling the spread of NIMBY risks in energy investment and reducing the possibility of NIMBY conflicts, namely strategy 2 is better than strategy 1. Especially near the end of simulation, in the condition of adding compensation, the increase of participation of host residents can effectively prevent the diffusion of NIMBY risks.

(3) Sensitivity Analysis of the Host Government's Credibility

Combined with the Letpadaung Copper Mine incident, it can be drawn that the host government lacked effective communication with the host residents in the early stage of the construction of NIMBY facilities in energy investment, and did not let the nearby host residents get effective information in time during the project construction, which eventually caused fierce NIMBY conflicts. Therefore, the timeliness, accuracy and authority of government information are beneficial for residents to form a correct cognition of NIMBY projects. Furthermore, the government's enhanced communication with host residents can effectively

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alleviate NIMBY conflicts. Based on this, this paper first raised the communication degree of the host government from 5 to 9 on the premise that the information openness of the host government remained unchanged, which was recorded as strategy 1. Then it increased the information openness of the host government from 4 to 8, which was recorded as Strategy 2. The simulation results obtained are shown in figure 6.

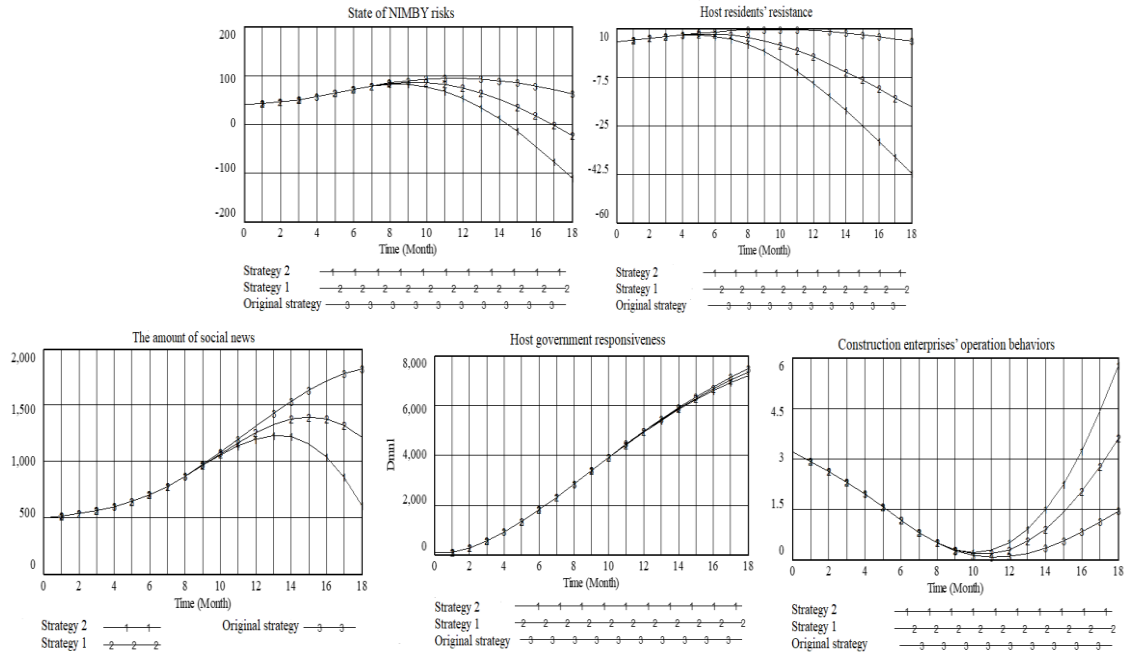

Figure 6: Sensitivity analysis of government credibility

It can be known from Figure 6 that the sensibility of the state of energy investment NIMBY risks in the One Belt and One Road to the host government's credibility possesses a certain time lag. When the response level of the host government exists in the middle and lower state, it is impossible to effectively eliminate the resistance of the host residents at a superficial level by issuing a statement in the official website of the host government or holding a related project conference. It can only inhibit the resistance of the host residents from being further intensified to a certain extent and prevent the social media from exaggerating the relevant news reports (1-8 months). The whole NIMBY risk state is in a high and stable state. After the government completely discloses the information and the host residents fully understand the NIMBY risks of energy investment projects, the resistance of the host residents is eased and begins to decline (9-18 months). With the initiative of the host government to disclose information, social media news reports begin to shift from negative ones focusing on events to positive ones, and the amount of social news increases. Moreover, with the decrease of NIMBY risks of energy investment, the amount of reports gradually decreases until it is back up to the initial level. However, during the period when the information disclosure of the host government is delayed, the construction enterprises does not blindly expand the projects under construction. Instead, they consider the high running state of the host residents' resistance and stop the project promotion until the government fully discloses the information of the

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projects under construction, communicates with the people in depth and gains full trust from residents and social media, and then they begin to promote the construction of energy investment projects。This simulation process itself is a measure taken by the host government, which has increased its responsiveness, so the responsiveness curve of the host government has not greatly changed in the three strategies In conclusion, compared with increasing only one element, improving the credibility of the host government through two paths is more conducive to controlling the spread of NIMBY risks in energy investment and reducing the possibility of NIMBY conflicts, namely strategy 2 is better than strategy 1. Especially, near the end of simulation, the effect of preventing NIMBY risks from spreading is more remarkable

To sum up, the diffusion of energy investment NIMBY risk in the One Belt and One Road will be negatively affected by the satisfaction of host residents, the credibility of host government and the information openness of construction enterprises. Among them, the benefit compensation given by the host government and construction enterprises to the host residents and the sense of participation of the host residents directly affecting their satisfaction are the key inducement to trigger the resistance of the host residents and have significant impact on the diffusion speed of the NIMBY risk of energy investment, that is, increasing the amount of benefit compensation and enhancing the sense of participation of the host residents can curb the diffusion of the NIMBY risk at the early stage of energy investment projects, decrease the probability of NIMBY conflicts, and then reduce the losses of construction enterprises. Furthermore, the active communication between the construction enterprises and the host residents and the effective propagation of science popularization play a positive role in mitigating the initial risk perception of energy investment projects by the host residents. Namely they are beneficial to reduce the resistance of the host residents due to the bias of listening to the information of informal media channels, promote the public trust through interactive communication, alleviate the public's psychological risk perception and have a certain inhibitory effect on the NIMBY risk spread of energy investment. Additionally, the credibility of the host government is the core factor that determines whether the residents' perception of NIMBY risks will be upgraded. The host government, as the transmitter of public information, should disclose the relevant information of energy investment projects to the residents in a timely and accurate manner, which is the key for the government to win public trust. In other words, the deeper the response behaviour, namely the communication with the public, led by the host government, the more timely and accurate the disclosure of information related to energy investment projects will be, and the easier it is to win public trust. Moreover, the improvement of public trust can reduce the possibility of the surge of host residents' resistance caused by external adverse information to a certain extent, thus inhibiting the spread of NIMBY risks.

V. CONCLUSION AND SUGGESTION

In this paper, the system dynamics simulation model of energy investment NIMBY risk diffusion in the One Belt and One Road is established, and the NIMBY diffusion system is divided into three subsystems: host residents, host government and construction enterprises. Based on the interaction among various influencing factors in the subsystems, the diffusion mechanism of the NIMBY risk of energy investment in

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the One Belt and One Road is analysed and simulated. The simulation results suggest that (1) At the time of improving the benefit compensation, strengthening the participation of host residents can improve their satisfaction, reduce their resistance, and inhibit the spread of NIMBY risks. (2) The more government's information disclosure and communication with residents result in the higher trust of them in the government. Besides, it is also easier for them to accept the government's regulation, thus alleviating the spread of NIMBY risks. (3) The degree of information disclosure of construction enterprises has an important impact on the diffusion degree of NIMBY risks. To intensify the propagation of popular science and enhance communication and interaction with host residents is of great significance for enterprises to mitigate the diffusion of NIMBY risks. According to the conclusion drawn from the above simulation results, the following aspects should be emphasized when Chinese energy enterprises invest overseas at present

First of all, the benefit compensation mechanism of NIMBY risks should be improved. Based on the analysis of the diffusion mechanism of NIMBY risks in the energy investment, it can be known that the direct factors that determine the diffusion speed of NIMBY risks first come from the compensation mechanism given by the host government and construction enterprises to the host residents. From the analysis of simulation results, we can recognize that in addition to paying attention to the economic compensation that satisfies the host residents, we should concentrate on the compensation for the interaction between the host government, the construction enterprises and the host residents, because the economic compensation can only temporarily alleviate the resistance of the host residents. Furthermore, how to win more media recognition and public trust depends on the non-economic benefit compensation given to the entire host community network. Construction enterprises should first enhance their sense of social responsibility. In the past, many overseas investment enterprises only paid attention to the in-depth investment and integration with the government and the elite of the host residents, but ignored the bottom host residents who are often the first ones to generate resistance. Therefore, from this perspective, the host residents can be compensated with non-economic benefits from the following two aspects. On the one hand, construction enterprises can take the initiative to build hospitals, schools and other public service facilities for the residents near their NIMBY facilities, so as to create a favourable living environment for the residents in the area where the NIMBY facilities are located, improve the satisfaction of the host residents, and establish a good public image. Meanwhile, it can make more public to spread positive news and opinions when the host residents' resistance is stimulated, thereby reducing the possibility of spread of NIMBY risks. On the other hand, they should try to solve the employment problem of the host residents in the place where the energy investment projects are located, which not merely reflects the social responsibility of the construction enterprises, but also makes some host residents have more opportunities to directly participate in and deeply understand the energy investment projects so as to gain public trust and rebuild the trust of enterprises, alleviate the psychological risks of the public, and effectively prevent and control the diffusion of NIMBY risks.

Secondly, to elaborate the communication mechanism of NIMBY risks. Overseas energy investment risk communication is an important means to guide host residents to objectively cognize risks, prevent risk diffusion and avoid the outbreak of risk conflicts, which runs through the whole process of risk

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management. By analysing the unending NIMBY events of overseas energy investment, it can be drawn that the reason for inducing NIMBY risks lies in the negative externality of NIMBY facilities built by energy investment, which brings health, economy and security threats to the host residents and intensifies the resistance of them who will often make some irrational behaviours. Based on this, how to effectively make the host residents have a correct understanding of energy investment projects has become the key to establish the NIMBY communication mechanism. First, the construction enterprise and the host government should strengthen the establishment of real-time communication mechanism with the host residents and broaden the participation channels of the host residents, such as holding symposiums, hearings, round tables, establishing an information communication platform, etc., which provide risk communication paths for the host residents so that they can find ways to appeal in real time. On the one hand, all stakeholders can reasonably express their basic interest demands; on the other hand, they can seek suggestions and solutions for the stimulation point of NIMBY risks in an effective way. Additionally, the informal communication between construction enterprises and host residents should be strengthened. Through professional science popularization and inviting representatives of host residents to visit NIMBY facilities, the host residents can have a full rational cognition of the development of energy investment projects, and the credibility of the enterprises can be enhanced.

Although the analysis model of NIMBY risk diffusion mechanism of energy investment in the One Belt and One Road constructed in this paper can reflect the law of NIMBY risk diffusion of energy investment to a certain extent, there are still some problems which need to be improved. Firstly, for the determination of system boundary, some external influencing factors are not introduced into the model. In addition, the diffusion of NIMBY risks of energy investment is a complex dynamic process, facing complicated and changeable scenario elements. Therefore, it is necessary to further analyse examples to find the relationship equation of variables and test the main conclusions of the simulation model, so as to further elaborate and revise the existing system model.

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