



Research on the Acceptance for Waste to Energy Project Based on the Theory of the Planned Behavior-Taking Xiangtan City as an Example

LUO Li, CHENG Cheng

School of Public Administration, Beihang University, Beijing 100191, P.R.China

Abstract: As a controversial technology, the degree of public acceptance can be viewed as a key element for the development of waste-to-energy project. Based on the planned behavior theory, this paper proposes a model of public acceptance for generating electricity through refuse incineration, in which the Behavioral intention indicates the degree of acceptance, and discusses the role of two elements (perceived benefits and perceived risks) to public acceptance. This paper indicates that the elements of attitude, subjective norm and perceived behavioral control have significant effects on behavioral intention to use and among which, subjective norms plays the most important role. The perceived benefits and perceived risks of public have a significant impact on attitude and behavioral intention.

Keywords: perceived benefits, perceived risks, waste- to-energy project, the planned behavior theory

1 Introduction

In the 1990s, some major and coastal cities of China began to focus on the technology of generating electricity through refuse incineration. The first waste incineration power plant was Qingshuihe plant, which was built in the middle 1990s in Shenzhen. Then, a series of waste incineration power plants were built in Ningbo, Shanghai, and Guangzhou, and began to put into operation^[1]. Due to the rapid development of economy and the increasing population, the municipal refuse is also rapidly increasing. The processing method for the garbage began to transform from adopting the method of hygiene landfill to the method of burning.

The technology of generating electricity through refuse incineration can make the waste volume reduction decrease more than 85%, and the scale decrease more than 75%^[2]. What's more, the amount of heat that produced by the burning can also generates electricity. However, in the process of burning, a carcinogen named dioxin appears, which plays an negative effect on surrounding environment. Hence, the ratio of NIMBY events also increases. Recently, NIMBY events, those who against waste incineration power plant and protest for pollution happens in Beijing, Shanghai, Jiangsu and Guangdong. In order to achieve the goal of operating the plant regularly, public acceptance should be fully

evaluated, so that the possibility of NIMBY events can be reduced. The research on public acceptance is a cross subject between technology and public management, which focuses on the interaction between public and technology, aims to clarify the characteristics of public awareness of hazard ,and releases the conflict between the development of technology and society. The study of public acceptance involves psychology, sociology, and professional technology, and widely applies in the field of nuclear power, chemical industry, and medical science. With the development of economy and the improvement of the living standard, the influence of public awareness also enhances. Therefore, carrying out the research of public acceptance about generating electricity through refuse incineration, creating the better interaction between technology and society, will have a profound significance to China's waste incineration power plant project.

2 The review of planned behavior theory

This study is based on the planned behavior theory. The planned behavior theory originates from the theory of reasoned action. Because of the theory of reasoned action cannot supply a proper explanation about the behavior that is not fully controlled by human beings, Ajzen (1985) introduced the concept of perceived behavior control as the independent variable which influence the behavior intention , and proposed the planned behavior theory. The perceived behavior control reflects the degree of the actor's individual cognition. Hence, the influence of objective actors can be excluded.

In this theory, the behavior of whether to adopt the technology is subject to the user's behavior intention. If the actor has the strong intention, he usually tends to make the decision of adopting. If the actor has a weaker intention, is it difficult for him to make the decision. Behavior intention is determined by attitude, subject norms, and Perceived behavioral control. The relationships are as following fig.1.

The planned behavior theory describes the causal relationship structure, which affects the actor's behavior intention. The independent variable is behavior attitude, subjective norms, and perceived behavior control, and the dependent variable is behavior intention. This theory

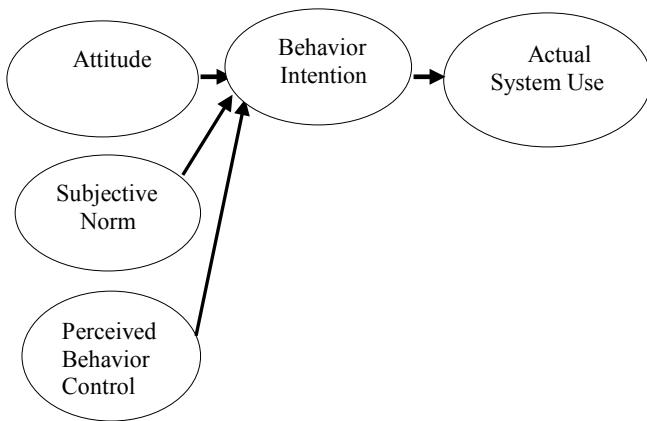


Fig.1 The planned behavior theory

indicates that behavior intention is subject to the influence of behavior attitude, subjective norms, and perceived behavior control. The positive behavior attitude exerts a positive influence on the behavior intention, that is to say, the actor who is holding a favorable impression tends to support the behavior; subjective norms also imposes a positive impact, that is to say, the more the actor is encouraged by his relatives, the higher opportunity he will make the decision; perceived behavior control plays a positive role in influencing behavior intention. If the actor feels that he is capable of arranging the relevant resources, and controlling his behavior, he will tend to adopt the behavior.

3 The construction of the acceptance model for waste to energy project

Based on the planned behavior theory, this paper develops the acceptance model for waste to energy project. Usually, the planned behavior theory is applied in the field of information. As to requiring the problem of public acceptance of waste to energy project, the planned behavior theory needs to be reformed.

The four variables (behavior intention, attitude, subjective norms, and perceived behavior control) in the technology model can be directly paraphrased in the research of acceptance of waste to energy project. The variable of behavior intention in the research of waste to energy acceptance can be explained as public acceptance intention for the technology, attitude can be viewed as the trust-worth degree for the technology, subjective norms mean an actor's personal perception for the surrounding's cognition, perceived behavior control means individual perception about the estimation and the following behavior for the technology.

In order to make the planned behavior theory applicable to the construction of the acceptance model for waste to energy project, we introduce two external variables, they are perceived benefits and perceived risks. Perceived benefits represents the appreciable benefits for the public, and perceived risks represents the appreciable

risks for the public. Supposing that both of the two variables affect the peripheral residents, these improvements have two advantages. For one thing, after the improvements, the model is more suitable for the essence of the theory of planned behavior, for another, the improvements enrich the model's extension and connotation, hence, the scope of technology can be expanded from information technology to a broader field.

With the planned behavior theory, this paper utilizes the relevant useful variables, and then reorganizes the traditional model with introducing two new variables, perceived benefits, and perceived risks. Hence, the new model is adapted for the field of controversial technology, and provides a significance explanation for understanding the problem of technology acceptance and modifying the relevant theory. The entire acceptance model for waste to energy project can be depicted as following:

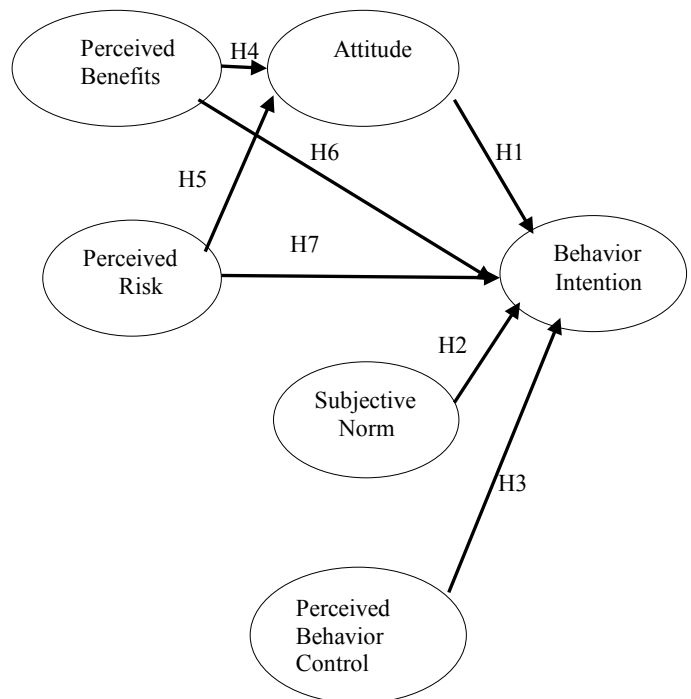


Fig.2 The acceptance model for waste to energy project

3.1 Hypothesis:

Based on the planned behavior theory, we assume that:

H1: The public's attitude for the waste to energy project plays a positive role for their behavior intention.

H2: The public's subjective norms for the waste to energy project plays a positive role for their behavior intention.

H3: The public's perceived behavior control for the waste to energy project plays a positive role for their behavior intention.

H4: The public's perceived risks for the waste to energy project plays a negative role for their attitude.

H5: The public's perceived benefits for the waste to energy project plays a positive role for their attitude.

H6: The public's perceived risks for the waste to energy project plays a negative role for their behavior intention.

H7: The public's perceived benefits for the waste to energy project plays a positive role for their behavior intention.

3.2 Constructive measurement

Construction is the most abstract definition in the research. Usually, a research should explore the logical relationship among different constructions. These constructions cannot be measured directly, hence, they should be transformed into operable and measurable questions, and then, form a questionnaire. From the questionnaire, we can conduct an investigation, and acquire the relationship among constructions by statistical analysis. The constructive measurement of the research is as follow:

Tab.1 Scale for the model construction

Variables	Contents	Provenance
Behavior intention	1. When I choosing a domicile, I should make sure that there is no w-t-e project nearby 2. what is the possibility for you to support the W-t-e project? 3. The intention for you to support the w-t-e project nearby is?	1. Alexa Spence, and Ellen Townsend (2006) ^[3] 2. Nina Michaelidou and Louise M. Hassan (2008) ^[4]
Attitude	1. I trust the w-t-e technology 2. what do your think of conducting a w-t-e project nearby? 3. what do your think of conducting a w-t-e project for the country?	Alexa Spence, and Ellen Townsend (2006) ^[3]
Subjective norms	1. The person that I respected will not take offense for the technology 2. My relatives will not take offense for my supporting 3. What is my relative's attitudes toward w-t-e project	Alexa Spence, and Ellen Townsend (2006) ^[3]
Perceived behavior control	1. I am quite familiar with the technology of w-t-e project 2. I can play a positive role in developing local w-t-e project 3. I can control my own behavior in local w-t-e project	Alexa Spence, and Ellen Townsend (2006) ^[3]

Perceived benefit	1. Generally speaking, building the w-t-e project nearby will impose a positive influence on the surrounding environment, my relatives, and I. 2. For the long-term diminution, successful w-t-e technology will contribute to the development of economy. 3. Utilizing the technology of w-t-e will be proved to play an positive role for the surrounding environment, my relatives, and I.	Mei-Fang Chen, Hsiao-Lan Li, (2007) ^[5]
Perceived risks	1. Generally speaking, agreeing to build the w-t-e project nearby will make me suffer a loss. 2. Generally speaking, building the w-t-e project nearby will impose a hazard on the surrounding environment, my relatives, and I. 3. Generally speaking, building the w-t-e project nearby will be proved to impose a negative influence on the surrounding environment, my relatives, and I.	Mei-Fang Chen, Hsiao-Lan Li, (2007) ^[5]

4 The empirical study for the acceptance of waste to energy project

The questionnaire uses likert 5-grade rating scale. In order to ensure the reliability and availability, the question draws the experience from the widely used measurement in the related literature. However, some of the questions are revised according to the characteristics of w-t-e technology.

The survey was conducted in Xiangtan city, Hunan province. Xiangtan jiuhua jingmai yuan waste to energy project was built in Xiangtan Jiuhua representative industrial area, covering the area of 3360 mu. The entire project can be divided into four parts, they are waste to energy sub-project, restaurant-kitchen garbage disposal sub-project, percolate disposal sub-project, and sludge drying sub-project.

In May 2014, under the publicity period, the project was boycotted by the local residents of Xiangtan city, and sooner, was laying-off by the local government. Hence, the case of Jingmai yuan waste to energy project can be viewed as a representative case for the public acceptance research. This survey delivers 300 questionnaires to the teachers and students in Xiangtan University and Hunan University of Science and Technology close to the waste to energy project, 279 replies, and the ratio is 93%. The valid questionnaires are 247, and the validity ratio is 82.3%. This research adopts SEM to make confirmatory factor analysis for the model and hypothesis, and utilizes Amos 18.0 software to check the matching degree, reliability, validity, and path coefficient.

4.1 Over roll model matching degree test

After data processing, we acquire an over roll fitting index. This index was used to calculate the extent to which the theoretical model and the actual data have been met. The result is shown as table 2. From Tab.2, we can see that all the research results have been matched the acceptable number. The matching degree of the over roll model for the research is in a high quality, and the theoretical model is trustworthy.

Tab.2 The fitting index of model

Index	Accepted value	Fitting index of model
NC	0-4	3.14
NFI	> 0.90	0.95
RFI	> 0.90	0.94
IFI	> 0.90	0.97
CFI	> 0.90	0.97
PNFI	> 0.05	0.79
PCFI	> 0.05	0.74

4.2 Analysis for reliability and validity

In order to confirm that the data can precisely represent the reality and make the result sensible, we first check reliability and validity of the questionnaire. Reliability check aims to ensure the reliability, consistency, and stability for the data. The numerical value of Cronbach's α is shown in Tab.3.

Tab.3 The reliability statistics

Variables	Cronbach's Alpha
Behavior intention	0.854
attitude	0.869
Subjective norms	0.831
Perceived behavior control	0.843
Perceived benefit	0.834
Perceived risks	0.862

All the numbers of Cronbach's α are above 0.7, and the ratio of explain is over 70%. The results of the reliability check reveal a high explain from the data. As to the validity check, based on the theory, we consulted the previous research, formed a new version, and have a deep discussion with relevant researchers to revise it. Hence, the validity for the questionnaire should be acceptable.

5 Analysis for the hypothesis of SEM model

The result of path coefficient and significance for the SEM model is shown in Tab.4 and Fig.3.

Tab.4 The result on the structural equation hypothesis

hypothesis	significance	result
H1: attitude +) behavior intention (path coefficient:0.66)	significance **	support
H2:subjective norms → behavior intention (path coefficient:0.73)	significance **	support
H3:perceived behavior control +) attitude (path coefficient:0.12)	significance **	support
H4:perceived benefits → attitude(path coefficient:0.18)	significance **	support
H5:perceived risks +) attitude (path coefficient:-0.47)	significance **	support
H6:perceived benefits → behavior intention(path coefficient:0.15)	significance **	support
H7:perceived risks +) behavior intention(path coefficient:-0.44)	significance **	support

Note: **: P<0.001

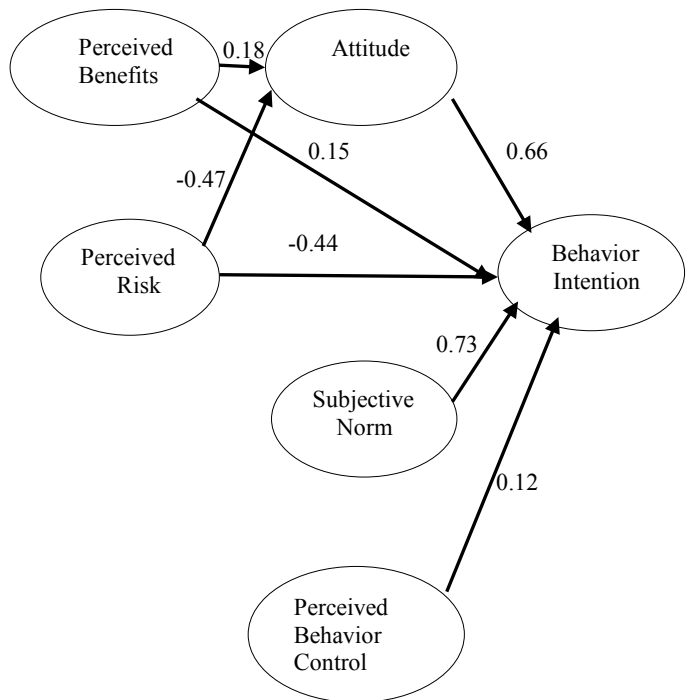


Fig.3 The path coefficient for w-t-e model

6 Conclusion

From the structure model, we can see that all seven hypotheses are confirmed, and shares a significant path coefficient ($P < 0.001$). Hence, the entire model is trustworthy.

The path coefficient from attitude to behavior intention is 0.66, which means the public's attitude plays an important role for their behavior intention about the w-t-e project. The higher the trustworthy is, the more the public holds a positive attitude for the w-t-e project, and vice versa.

Subjective norms play a significant role for the behavior intention of use. Public's behavior intention is subject to the impact of their surroundings. If the relatives hold a positive toward the w-t-e project, the actor tended to support the project. Conversely, the actor tend to adopt the conflict behavior. This result conforms the ordinary peoples' value of collectivism. When they are not familiar with the technology of w-t-e, people tend to follow the trends with their relatives.

Perceived behavior control do effect the behavior intention of use, however, the number of path coefficient is only 0.12. Public's perceived behavior control affects behavior intention, however, the degree is much less than attitude and subjective norms. Two reasons is accountable. First, at present, our citizens' cognition to the w-t-e project is insufficient, most of which do not fully understand the developing history of it. Second, due to their group psychology, even the citizen have a better understanding about the technology, they still tend to make their decisions following the way most people did.

The path coefficient from perceived benefit to attitude is 0.15, to behavior intention is 0.19, which means the perceived benefit has an effective influence on public's attitude and behavior intention about the w-t-e project. If we wish to improve the public acceptance about the technology, we have to focus on the real benefit that the project can bring in, and to actualize the local residents' benefits through the project.

The path coefficient from perceived risk to attitude is -0.47, to behavior intention is -0.44, which means public's feeling about the potential risk have a distinctive influence on their attitude and behavior intention of the W-T-E project. The higher the index of perceived intention is, the lower the positive attitude is. Hence, the public tends to against the technology. It clearly shows that public's perceived intention can be viewed as the crucial factor for their attitude and behavior intention. Therefore, if the local government wants to gain support from the local residents about the W-T-E project, they should take measures in controlling the public's perceived risks on W-T-E project.

The conclusion indicates that subjective norms do have a strong impact on behavior intention, which sufficiently embodies the characteristics of our citizens. Local residents pay much attention to their relatives' decision, which extremely important for them to make a judgment. Compared with relatives' mouth to mouth

news, the influence of scientific publicity and advertisement is far below. Attitude plays an important role for behavior intention. As a controversial technology, public's trustworthy about W-T-E technology directly reflect on their behavior about whether to accept it. The factor of perceived behavior control do have an effect on behavior intention, however, compared with other factors, it works less. This phenomenon might be affected by the public's low recognition of W-T-E technology.

Both perceived risks and perceived benefits become the determinant factors for attitude and behavior intention. For one thing, it clearly shows that as a controversial technology, W-T-E project shares the reputation coexistence of risks and benefits. For another, it reflects that introducing two new variables is effective for modifying the model. However, we should notice that even though both of the variables have a distinctive effect on attitude and behavior intention, the abstract value of perceived benefits is far less than perceived risks. For the W-T-E technology, the influence of perceived risks is much more strong than perceived benefits, and public's avoiding from risk is much more severe than their expectation for benefit. Hence, the government should pay much attention to the supervision and control of risks, under the premise of safely utility for W-t-E technology, and then maximizing the benefits.

References

- [1] Mei Guang-xin Du Bao-yu. Discussion on environmental problem, environmental ethic and environmental protection. *Heilongjiang Environmental Journal*, 2008, 32(4): 5-6. (in Chinese)
- [2] Zhang Ying-min, et al. Technologies status and management strategies of municipal solid waste disposal in China. *Ecology and Environmental Sciences*, 2011, 20(2): 389-396. (in Chinese)
- [3] Spence Alexa, Townsend Ellen. Examining consumer behavior toward genetically modified (GM) food in Britain. *Risk Analysis*, 2006, 26(3): 657-670.
- [4] Nina Michaelidou, Louise M. Hassan, The role of health consciousness, food safety concern and ethical identity on attitudes and intentions towards organic food. *International Journal of Consumer Studies-Int J Consum Stud*, 2008, 32(2): 163-170.
- [5] Chen M F, Li H L. The consumer's attitude toward genetically modified foods in Taiwan. *Food Quality and Preference*, 2007, 18(4): 662-674.
- [6] Alhakami A S, Slovic P. A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk Analysis*, 1994, 14(6): 1085-1096.
- [7] Ajzen I. From intention to actions: A theory of planned behavior. *Risk Analysis*, 1985, 94(6): 35-41.
- [8] Ball D W. What the action is: A cross cultural approach. *Theory Soc Behavior*, 1972(2): 121-143.
- [9] J M Doderlein. Understanding risk management. *Risk Analysis*, 1983(3): 17-21.

- [10]Carissa Schively. Understanding the NIMBY and LULU phenomena: Reassessing our knowledge base and informing future research. *Journal of Planning Literature*, 2007, 21(3): 255-266.
- [11]Paul Slovic. Perception of risk. *Science*, 1987, 23(6): 280-285.
- [12]Ellen Peters, Paul Slovic. The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology*, 2006, 16(5): 41-49.
- [13]Abhishek Tiwari. The politics of space and NIMBY: The construction of the poor and local resistance to affordable housing. Irvine: University of California, 2009.
- [14]Marks G, Von Winterfeldt D. Not in my back yard: Influence of motivational concerns on judgements about ARISKY technology. *Journal of Applied Psychology*, 1984, 35(3): 88-96.
- [15]O'Hare M. Not on my back, you don't: Facility siting and the strategic importance of compensation. *Public Policy*, 1977, 25(4): 407-458.
- [16]Corianne Payton Scally. The nuances of NIMBY: Context and perceptions of affordable rental housing development. *Urban Affairs Review*, 2013, 49(2): 718-747.
- [17]Lois M Takahashi. Information and attitudes toward mental health care facilities: Implications for addressing the NIMBY syndrome. *Journal of Planning Education and Research*, 1997, 17(9): 119-130.
- [18]Zung W W K A. Rating instrument for anxiety disorders. *Psychosomatics*, 1971(6): 12-15.
- [19]Wildavsky A, Dake K. Theories of risk perception: Whofears what and why? *Daedalus*, 1990, 21(4): 41-60.
- [20]Ajzen L. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 1991, 50(8): 179-211.
- [21]Bove L L, Johnson L W. A customer-service worker relationship model. *International Journal of Service Industry Management*, 2000, 11(5): 491-511
- [22]Brooker G. An assessment of an expanded measure of perceived risk. *Advances in Consumer Research*, 1984, 11(1): 439-441.
- [23]Cunningham S M. *The major dimension of Perceived risk*. Boston; Harvard University Press, 1967: 82-108.
- [24]Cunningham L F. Perceived risk and the consumer buying process: Internet airline reservations. *International Journal of Service Industry Management*, 2005, 16(4): 357-372.
- [25]Davis E D. Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, 1989, 13(3): 319-339.
- [26]Dowling G R. Perceived risk: The concept and its measurement. *Psychology and Marketing*, 1986, 3(3): 193-210.
- [27]Finster Busch. *Understanding social impacts, assessing the effects of public projects*. Calif: Sage Publications, 1980.
- [28]Fortm D R, Renton M S. Consumer acceptance of genetically modified foods in New Zealand. *British Food Journal*, 2003, 105(1/2): 42-58.
- [29]Viktor Grcas. The Self-concept. *Annual Review Social*, 1982, 26(8): 1-33,
- [30]The social amplification of risk a conceptual framework. *Risk Analysis*, 1988, 19(2): 177-178.