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Influencing factors of public support for modern coal-fired power plant projects: An empirical study from China

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ABSTRACT

With the development of clean coal technology, modern coal-fired power plants have achieved the similar emission standards as gas power plants. However, due to the impressions of high pollution and high emission in traditional coal-fired power plants, such projects are often opposed by local residents, which hinder the promotion of this technology. This manuscript aims to investigate public attitudes toward these projects and to analyze the influencing mechanisms of the factors of public support. The conceptual model was built with sense of place, trust and environmental attitude as the independent variables, benefit and cost perceptions as the mediating variables and public support as the dependent variable. The model was tested and modified by structural equation modelling. The results revealed that sense of place had a slight indirect impact (−0.043) on public support through benefit perception, whereas trust had a direct impact (0.332) on public support and indirect impacts (0.298) through benefit and cost perceptions. Environmental attitude had indirect impacts on public support through benefit perception (0.180) and cost perception (−0.115). In addition, policy suggestions on decision-making, project publicity and compensation strategy are proposed to enhance public support for similar projects.

1. Introduction

Coal power occupies an important position in the structure of global power generation now, and it will continue to supply a considerable amount of energy over the next several decades. The International Energy Agency (IEA, 2015a) showed that 41% of the global electricity that was generated in 2013 was produced from coal. The proportion of coal-fired power generation in China and India were more than 75%, and the proportion in the United States and Germany were more than 40%. After the Fukushima nuclear accident, the proportion of coal-fired power generation in Japan increased to more than 30% in 2013. World Energy Outlook (IEA, 2015b) predicted that by 2040 the share of coal-fired power generation in the global electricity structure would be approximately 30%, which means that coal would still be one of the main energy sources in countries that are rich in coal reserves and some developing countries. However, coal-fired power projects are generally boycotted by the public because of the presence of NIMBY (Not in My Back Yard), which represents a characterization of opposition by local residents to the development of controversial technology (Burningham, 2000; Wolsink, 2006; Ellis et al., 2007).

China is in the initial phase of an energy transition with the goal of gradually replacing fossil energy with renewable energy. However, due to the features of intermittency and fluctuation (e.g., PV, wind power), difficulties in storage and complications in grid connectivity are the major obstacles of widely adopting renewable energy (Carrasco et al., 2006; Yu et al., 2011). In addition, high cost (Zhao et al., 2016; Lin and Li, 2015) and conflicts of interest (Yang et al., 2016) restrict the diffusion of renewable energy technology in China as well. At the same time, a technology that is referred to as “supercritical”, which allows steam parameters to exceed the critical point, has been in development for 20 years. Those plants which adopt this technology can reach the similar emission standards as gas power plants with an efficiency rating of 40–43% (Horbach et al., 2014). It is the primary form of clean coal technology in China, and it may be a promising solution for the sustainable development of China's coal-fired power generation (Tang et al., 2015; Chen and Xu, 2010; Wang and Nakata, 2009). However, due to the impressions of high emission and high pollution in traditional coal-fired power plants, boycotts against modern coal-fired power plant projects have frequently arisen in recent years.

A case of Pingjiang modern coal-fired power plant in Hunan Province of China was selected in this study. In the preparation stage of this project, the public opinions were not taken seriously by local government and the related publicity was not sufficient, resulting in a general attitude of resistance among local residents. Villagers who lived

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in the location of the project refused the compensation scheme for land requisition, and many people expressed their dissatisfaction on local government websites. After a protest march of more than ten thousand people, the government was ultimately forced to suspend this project. Based on this case, this study selected some important influencing factors and analyzed their impacts on public support.

Coal-fired power, nuclear power, garbage incineration, and wind power plants are typical NIMBY facilities that have two specific characteristics:

(1) NIMBY facilities have negative external effects including potential risks and pollution, which may cause adverse impacts for local residents (Popper, 1985). For example, nuclear power plants and nuclear waste repositories have the potential risk of nuclear radiation (Chung et al, 2008); garbage incineration power generation may produce secondary pollution and have negative effects on the surrounding environment (Chen, 2013); and the potential noise issues of wind power may affect residents and the wildlife around wind farms (Rajgor, 2011). These facilities may also lead to economic and social issues, such as a decline in property values and damage to community image (Sandman, 1986). Although modern coal-fired power plants can significantly reduce emission and pollution with a high efficiency, it may still have negative impacts on local environment at a certain extent.
(2) The costs and benefits of NIMBY facilities are not evenly distributed. According to the results of former studies, economic and social benefits of energy facilities are usually broadly shared, whereas the environmental and economic costs tend to be undertaken by local residents, which will likely generate an unfair distribution of the expected costs and benefits and cause the NIMBY conflict (Lober and Green, 1994; Lober, 1995). The situation of modern coal-fired power projects is similar with other NIMBY facilities in that the local residents undertake the negative impacts of the project, and the generated power would be transmitted to many other regions.

Many studies have been conducted to explore the influences of the perceived costs and benefits on energy projects. For example, Park and Ohm (2014) examined the influencing factors for public intention to use renewable energy technologies, and they found that benefit and cost perceptions were the determinant factors for public attitudes. Other scholars also found that the perceived benefits and costs had positive and negative impacts, respectively, on public intention to use renewable energy (Whitfield et al., 2009; Tanaka, 2004; Chung and Kim, 2009).

Additionally, other studies showed that perceived trust in energy technology, government and project enterprises also play an important role to influence public attitudes (Ansolabehere and Konisky, 2009; Bronfman et al., 2009; Chung et al., 2008). Mah et al. (2014) analyzed the impact of public trust on nuclear decision-making in Hong Kong, and they found that enhancing trust in government and operators could reduce risk perception and have a positive impact on public support for nuclear power projects. A sense of place was also introduced to explain public attitudes toward energy projects (Carlisle et al., 2014; Devine-Wright and Howes, 2010). Many former researches have proven that the changes to the places by human events normally lead to the feelings of loss and resistance (Brown and Perkins, 1992; Dixon and Durrheim, 2000; Bonaiuto et al., 1996). The worry about environmental disruption is one of the most significant negative factors during the construction of energy projects. Studies on the relationship between environmental attitude and public support for clean energy have indicated that members of the public with higher environmental attitude are more willing to accept clean energy (Tarigan et al., 2012; Sherry-Brennan et al., 2010; Roche, 2010).

Modern coal-fired power plants have shown promising prospects for countries that are abundant in coal reserves. However, due to the significant effect of NIMBY, these projects are generally rejected by the public. Therefore, it is necessary to analyze the action mechanisms of related influencing factors. However, most of the previous research has only focused on the influence of individual factor on public attitudes toward energy facilities. Few studies have assessed the relative importance of a series of potential factors and their inter-relationships. Based on a literature review, this manuscript selected several key factors and distinguished their influences on public support using structural equation modelling (SEM).

This paper is divided into six sections. The next section formulates the research hypotheses and develops the theoretical model. The research methods and survey are introduced in Section 3. Then, Section 4 mainly focuses on testing related paths based on model optimization. Section 5 discusses the research results. And the main conclusions and some policy implications are provided in Section 6.

2. Hypotheses and model

As the stakeholders and potential risk takers, local residents' perceptions will largely determine their attitudes and behaviors toward modern coal-fired power plant projects. Public support represents a positive attitude that is mainly affected by related perceptions. If local residents perceive more benefits than costs, they will tend to have a positive response, and vice versa. In the following section, some of the most representative factors were chosen to test their impacts on benefit perception, cost perception and public support.

2.1. Sense of place

A sense of place generally represents the interaction between people and places, which reflects an emotional connection. It is composed of two closely related concepts of place identity and place attachment. Place attachment can be defined as positively experienced bonds that are developed over time from the behavioral, affective and cognitive ties between individual and sociophysical environment (Devine-Wright, 2011; Hernández et al., 2007). When place-related symbolic meanings are changed, place attachment will be disrupted (Daniel and Michael, 1996), giving rise to place-protective attitudes and behaviors (Stedman, 2002). Place identity refers to a positive sense of identity that comes from the symbolic attributes of certain places and interaction between human and their living environment (Twiggerross et al., 2009; Proshansky et al., 1983). When place identity is threatened by NIMBY facilities, it will turn into negative attitudes toward such events as a reaction to the unsatisfied changes (Bonaiuto et al., 2002). So the sense of place would have a direct negative impact on public support in the modern coal-fired power projects (Devine-Wright, 2013).

Residents with a sense of place tend to perceive the positive impact of energy projects on the local economy and social development. However, aside from economic and social development, energy projects also have large negative externalities, which can easily lead to a NIMBY conflict. In this case, residents with a stronger sense of place will perceive more costs than benefits from environmental impact and land requisition and consequently prefer not to support local energy projects (Devine-Wright and Howes, 2010; Devine-Wright, 2009).

Therefore, the following hypotheses were proposed and tested:

H1a. Sense of place has a direct negative impact on benefit perception.

H1b. Sense of place has a direct positive impact on cost perception.

H1c. Sense of place has a direct negative impact on public support.

H1d. Sense of place has an indirect negative impact on public support through benefit perception.

H1e. Sense of place has an indirect negative impact on public support through cost perception.