Nuclear Engineering and Technology xxx (2016) 1–12

Available online at ScienceDirect

Nuclear Engineering and Technology

journal homepage: www.elsevier.com/locate/net

Original Article

The Cognitive and Economic Value of a Nuclear Power Plant in Korea

Gil-Hwan Lim [a], *Woo-Jin Jung* [b], *Tae-Hwan Kim* [c], *and Sang-Yong Tom Lee* [c,*]

[a] *National Assembly Budget Office (NABO), 1 Uisadang-daero Yeongdeungpo-gu, Seoul 07233, South Korea*
[b] *Information Technology Research Center, Yonsei University, 50 Yonsei-Ro, Seodaemun-Gu, Seoul 120-749, South Korea*
[c] *School of Business, Hanyang University, 222 Wangsimni-Ro, Seongdong-Gu, Seoul 04763, South Korea*

ARTICLE INFO

Article history:
Received 7 June 2016
Received in revised form
23 September 2016
Accepted 13 October 2016
Available online xxx

Keywords:
Conjoint Analysis
Nuclear Power Plant
Ordered Logistic Regression
Segment Analysis
Willingness to Pay (WTP)

ABSTRACT

We studied the value of a nuclear power plant by considering Koreans' willingness to pay (WTP) for neutralizing the various problems caused by building and operating a new plant. For this, we used a conjoint analysis and ordered logistic regression. We then compared the WTP estimates between various segment groups. The results revealed that each household was willing to pay an additional 99,677 Korean Won (KRW)/mo on average to resolve the negative impacts from a nuclear plant. Therefore, the yearly cognitive and economic value of a nuclear plant in Korea was about 19 trillion KRW. Through a segment analysis, we found that the more educated, younger, and poorer groups gave higher cognitive values than the less educated, older, and richer groups, respectively. Also, people who lived far from a plant gave higher values than people living near a plant, and people with more knowledge about or interest in nuclear energy gave higher values than people with less knowledge or interest. People who felt that nuclear energy is necessary gave higher values to nuclear energy than those who did not. Our results can be used as bases to set targets for promoting nuclear energy and pursuing a national project of building a nuclear power plant.

1. Introduction

The beginning of the 21st century has seen debates on future energies. Existing energy generation and fossil fuel use are the major sources of anthropogenic greenhouse gases being released into the Earth's atmosphere. This includes carbon dioxide emissions, which are the greatest contributor to global warming. In turn, a major source of carbon emissions is electricity generation. Electricity generation is mostly based on fossil fuels, and electricity generation from fossil fuels is responsible for roughly 40% of all carbon dioxide emissions. Long-term strategies for mitigating global warming will soon necessitate alternative energies.

* *Corresponding author.*
E-mail address: tomlee@hanyang.ac.kr (S.-Y.T. Lee).

http://dx.doi.org/10.1016/j.net.2016.10.007

Please cite this article in press as: G.-H. Lim et al., The Cognitive and Economic Value of a Nuclear Power Plant in Korea, Nuclear Engineering and Technology (2016), http://dx.doi.org/10.1016/j.net.2016.10.007

The world has also been concerned about the increasing carbon dioxide emissions. The United Nations [1] noted that climate change is one of the greatest challenges of our time and its adverse impacts undermine the ability of all countries to achieve sustainable development. The United Nations has thus presented policies for mitigating the global annual emissions of greenhouse gases by 2020.

Another important issue related to climate change in Korea at present is fine particular matter, or so called fine dust problems. Fine particulate matters penetrate through the bronchial tubes directly into the alveoli, into the bloodstream, and deep into the body, causing cardiovascular disorders. It is widely believed that one of the most important causes of fine particular matters in Korea is air pollution coming from China. However, we are not able to neglect pollution from local thermoelectric power plants. These plants are using carbon power resources.

To alleviate the threats of climate change and cope with the increasing demand for energy, low-carbon power is needed as the major supply to meet the country's future electricity needs [2]. Nuclear power has been highlighted because of its distinct economic and environmental advantages over other energy resources [3]. Therefore, nuclear power can be considered a promising alternative that can achieve both a stable energy supply and mitigation of climate change.

There are two types of low-carbon power generation sources: renewable energy and nuclear power [4]. Each has advantages and disadvantages as alternatives to fossil fuels. Although it has a controversial reputation, nuclear power is efficient and reliable [5]. It helps to reduce environmental degradation due to electricity-generation activities. For example, carbon dioxide emissions from nuclear power are much lower than those from fossil fuel power. Nuclear power is cheap, can be steadily supplied, and may have lower external costs [6]. Producing more nuclear power implies less dependency on foreign energy sources and a relatively sustainable supply, thereby reducing prices and increasing physical availability to ensure future energy security. Therefore, nuclear power is expected to be a promising alternative energy source in view of global warming and unstable energy supply, especially in South Korea. However, nuclear power entails risks, such as the environmental impact of radioactive waste, and damage to human health in the event of a catastrophe.

Renewable energy, as the other main alternative energy source, includes generation from natural resources such as solar heat, geothermal heat, and so on [7]. The main advantage of renewable energy is that it does not contaminate the environment and can be reused almost unlimitedly. Therefore, renewable energy, with its consistent availability and nonpollution, will be an effective and clean alternative energy in the future development of the world. For these reasons, renewable energy technologies are sometimes regarded as substitutes. However, in the technology field, renewable energy needs a particular solution to transform natural resources into useful energy forms and store the energy, but the current technologies have many limitations [8,9]. Also, economic feasibilities are considered the issues for the development of renewable energy [10]. Reddy and Painuly [11] noted that only a few renewable energy technologies, such as solar water heating and small-scale biomass power generation, can compete with conventional energy sources due to the generation cost.

People are worried about nuclear safety and risk of environmental destruction, especially after the Fukushima accident in March 2011. From the second half of the 2000s until this accident, nuclear power had been gaining popularity due to increasing concerns over global warming as a result of fossil fuel use [12]. However, this accident raised concerns regarding the trade-offs involved in replacing fossil fuels with nuclear power to meet climate change goals. In particular, people are troubled by the trade-off between the risks of nuclear power generation and the increased retail cost of other electricity sources [13,14]. Although the downside of nuclear power cannot be overlooked, it has an important role to play in slowing the pace of global warming without increasing costs. Thus, an important issue is the perceived danger of nuclear power and how people valuate it.

Judging the value and risk of nuclear power has two dimensions. First, the professional knowledge of specialists is important because understanding nuclear power requires various kinds of advanced knowledge. Second, the public's opinions and preferences are also important [15–17] because the public is subject to the risks that accompany any energy source [18]. Therefore, public opinions about an energy source cannot be ignored. Yet, relatively little is known about these social valuations [19], which crucially affect social acceptance management [18]. Empirical studies addressing the social acceptance of nuclear power have mostly been conducted from sociological perspectives or through comparisons among countries. Studies quantitatively evaluating the cognitive value of public perceptions of nuclear power, meanwhile, have been scarce. Hence, in the present work, we focused on estimating people's willingness to pay (WTP) to avoid building a nuclear power plant nearby, and evaluating public perceptions of nuclear power.

Concretely, this study aimed to evaluate the cognitive value of nuclear power in view of its social acceptance, in order to contribute to effective application of nuclear power policy. For this, we estimated the WTP for a nuclear power plant using the conjoint analysis method, considering three determinant factors (economy, safety, and environment). These determinant factors are important in understanding WTP for nuclear power [20–27]. Also, we aimed to suggest policy directions to promote the use of nuclear power by confirming the changes among various segment groups (demographic group, geographic proximity groups, and groups with different levels of knowledge and interest regarding nuclear energy).

Most related previous studies, except for that of Roe et al [22], have focused on the WTP for renewable energy. In the present work, we report WTP based on a consumer questionnaire survey and a statistical analysis. Nuclear power is a nonmarket commodity, the value of which cannot be directly determined by a market price. In this kind of case, the WTP can reflect public acceptance of a nonmarket commodity, because people are asked to valuate that product. We estimated the public cognitive value of nuclear energy, by measuring the WTP to reverse the negative

Please cite this article in press as: G.-H. Lim et al., The Cognitive and Economic Value of a Nuclear Power Plant in Korea, Nuclear Engineering and Technology (2016), http://dx.doi.org/10.1016/j.net.2016.10.007