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Factors influencing the public intention to use renewable energy technologies in South Korea: Effects of the Fukushima nuclear accident

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HIGHLIGHTS

- The factors influence public intention to employ renewable energy technologies.
- Fukushima accident made significant differences of public perceptions.
- Perceived benefits and risks are employed as key determinants of public attitude.
- Perceived cost and attitude are found as antecedents of the intention to use.
- Perceived trust is a notable motivation of public perceptions.

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ABSTRACT

The Fukushima accident has influenced public attitudes toward energy sources and technologies, including not only nuclear energy, but also other energy sources. Therefore, it is worth investigating how the accident influenced public perceptions of renewable energy and its technologies, between the time before the accident and after the accident. This study aims to explore the effects of the Fukushima accident on the public perceptions of renewable energy technologies in South Korea, the closest nation to Japan. This study found that there were notable differences of public perceptions, including public attitudes, perceived benefits, trust, intention to use, knowledge and risks between before and after the earthquake. In addition, the perceived cost of renewable energy technologies was the primary determinant of the intention to use the technologies before the accident, whereas public attitudes toward the technologies became the main antecedents of the intention after the accident. After the accident, we found that there is a multi-dimensional matrix of perceived trust-benefits (with risks)-attitude-intention to use, in explaining the public acceptance of renewable energy technologies. Moreover, we found significant roles of the perceived trust, benefits and risks in the research model. Based on the empirical findings, both implications and suggestions are presented.

1. Introduction

In the first week of March 2011, shocking news from Japan hit worldwide. An undersea earthquake of 9.0 moment magnitude from about 80 miles off the east coast hit Japan. This earthquake caused a huge tsunami, which penetrated about 6 miles inland. Due to this disaster, Japan recorded huge loss of life, with the known death of 15,000 people, and with about 8000 people missing (National Police Agency of Japan, 2011).

Moreover, together with the huge damage for humans, the whole world worried about other critical issues. Among the issues, nuclear power plants came to the fore as threats to global society. Tokyo Electric Power Company, named as TEPCO, has two nuclear plants in critical regions (Aoki and Rothwell, 2013). Because the tsunami caused over 15-meter-height waves, and the average sea defenses of Japan were designed to overcome about 6-meter high sea waves, two nuclear power plants were broken and inundated by sea waves. Therefore, all installed boiling water reactors, called BWRs, were stopped, by following the guidelines of the emergency manual, but they were overheated by a breakdown of the nuclear fuel control systems. Due to the overheated nuclear power plants, several parts of the nuclear reactors melted. There were also radiation releases to the outside of the reactors, and hydrogen explosions (National Regulation Authority of Japan, 2013).

The radioactive matter from this accident has spread throughout the whole northern hemisphere (Hirose, 2012). In April 2011, the Fukushima nuclear power plant accident was considered as the top emergency level of the International Nuclear and Radiological Event Scale, Level 7, from the International Atomic Energy Agency (International Atomic Energy Agency, 2011). Later,

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the level of the Fukushima nuclear accident was adjusted to Level 8, by creating new criteria. This means that this accident was the most serious nuclear-related accident in world history. Compared to the well-known nuclear accident from Chernobyl in 1986, it was highlighted for two reasons; more than a seven fold of radioactive matter was spilled, while the accident has not yet finished. Radionuclide matter is still being released from the Fukushima plants. To prevent the plants from spilling, TEPCO has so far attempted to achieve cooling status on two occasions, in July 2011 and January 2012 (Tokyo Electric Power Company, 2011), but nobody can ensure that there is no further damage from the radionuclide.

This accident has had significant industrial, political, and national impacts worldwide. For example, it led the German government to crucially change its nuclear power policies, to opt out of making nuclear power energy in future energy policies (Wittneben, 2012). The accident also prompted other countries to have deep discussions about whether they should develop or use nuclear plants (Bradford, 2012; Thomas, 2012). In particular in Asia, there are already many nuclear power plants in South Korea (20 plants), China (13 plants) and India (six plants). In the case of South Korea, because of its regional characteristics, there is drastic resistance to nuclear energy and related facilities (Kang, 2012).

Therefore, because nuclear energy and plants can directly affect crucial negative threats on humans' health, many nations and institutes have aimed at finding substitute sources of energy. With this trend, renewable energy is considered as one of the most possible solutions, to provide an alternative to nuclear energy.

It is also closely associated with climate change. Recently, climate change has become one of the most crucial threats to human life and the environment of the earth (Handmer and Dovers, 2013). Compared to the potential threats of climate pollution from nuclear energy, renewable energy sources can mitigate greenhouse gases, which mainly lead to climate change of the earth (Trainer, 2010).

In spite of the rapidly increased interest in renewable energy, only a few studies have investigated the public's attitude toward renewable energy technologies, including their costs, potential risks and benefits (Devine-Wright, 2005). Moreover, there are few studies that have aimed to explore the public's psychological, cognitive, and economic factors, and knowledge and information of renewable energy technologies regarding their acceptance and attitude of the technologies (Mallett, 2007; Wüstenhagena et al., 2007).

Therefore, this study aimed to investigate the following research questions:

- Is there any difference in the public's attitude toward renewable energy technologies between the time before the Fukushima accident and after the accident?
- What kinds of factors determine the public's attitude towards, acceptance of, and intention to employ renewable energy technologies?

Regarding the first question, this study attempted to track the significant differences of public perceptions toward renewable energy technologies. Because citizens could know the potential risks and possible damage from nuclear energy, which is in a substitutional relationship with renewable energy via the Fukushima accident, there could be significant changes of public perceptions toward renewable energy and its technologies.

Regarding the second question, although a large number of prior studies have aimed to explore the factors determining a particular technology acceptance, only a few studies have aimed to propose a comprehensive framework for renewable energy technologies and their applications (Devine-Wright, 2005; Krohn and Damborg, 1999). Therefore, the current paper aims to introduce a framework for the acceptance of renewable energy technologies that is able to be applied to enhancing the understanding of the technologies, to improve the social and environmental factors of the technologies.

The proposed integrated model highlights psychological and perceived factors that affect the public's attitude and behavior toward the technologies. The logicality and universal validity of the factors and relationships in the integrated model will be assisted by the findings of previous studies and the main survey.

First, we attempt to identify and seek the potential key determinants of public attitudes toward renewable energy technologies. Second, we aim to explore how these factors have changed between before the Fukushima nuclear plant accident and after the accident. Then, we discuss and explain whether these factors contribute to public attitudes toward renewable energy technologies. These factors may be significantly associated with general evaluations and attitudes of the particular technology. Finally, this study presents conceptual evaluations and relationships of the framework, which are significantly related to technological acceptance. We also explore the implications and applicability of the proposed framework.

The remainder of the current study is constructed as follows. We describe the brief trends of renewable energy technologies, and the general energy status of South Korea. Then, the literature review, hypotheses and research model are presented. After that, the research methodology is demonstrated. The results are shown in the following section. Finally, the discussion, conclusion, limitations and future research are presented.

2. Literature review and hypotheses

2.1. Trends and overview of renewable energy

Renewable energy is defined as "energy generated by sources whose supplies are regenerative and virtually inexhaustible" (Arizona Solar Center, 2013). Sunshine, water, wind and the heat from the earth are representative sources of renewable energy.

Although investment in renewable energy technologies and related systems has gradually increased in the world, the present contribution of renewable energy to global energy supplies is moderate. In 2008, the Intergovernmental Panel on Climate Change (IPCC) indicated that renewable energy accounted for about 13% of the primary energy supply in the whole world (Intergovernmental Panel on Climate Change, 2011). However, excluding the use of agricultural and traditional biomass, other renewable energy technologies, such as wind and solar, comprised a very minimal share in the global energy supply (Gross et al., 2003; IEA, 2000). In 2000, these 'new' renewable energy technologies contributed only about 2% of the global energy supply (IEA, 2000). This rate was about 3.0% of the global energy supply in 2009 (KNREC, 2011).

However, after the Fukushima accident, several nations have started to change their energy policies. As mentioned above, the reactions of nations are very varied. For instance, Germany, where nuclear power is one of the major providers of energy supplies, plans to stop all nuclear power plants in 2020, while the policies of the Korea government have not significantly changed (Fauzen and Schiller, 2011).

2.2. Nuclear energy

Nuclear energy plays a significant role in providing energy and electricity to a large number of nations. In 2009, nuclear energy provided approximately 14% of the electrical power in the world.

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