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Analyzing public preferences and increasing acceptability for the Renewable Portfolio Standard in Korea

Jungwoo Shin [a], JongRoul Woo [b], Sung-Yoon Huh [b], Jongsu Lee [b], Gicheol Jeong [c,*]

[a] Department of Civil, Architectural and Environmental Engineering, The University of Texas at Austin, #1 University Station C1761, Austin TX 78712, United States
[b] Technology Management, Economics, and Policy Program, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul 151-742, South Korea
[c] Science and Technology Policy Institute (STEPI), Specialty Construction Center, 26 F, Shindaebang-dong, 395-70, Dongjak-gu, Seoul 156-714, South Korea

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ABSTRACT

In order to respond to the challenge of climate change, similar to other countries, Korea has announced various policies to vitalize the development and uptake of renewable energy. The Renewable Portfolio Standard (RPS) is the most striking example of a policy in this area. This study employs a conjoint survey and Bayesian mixed logit model to analyze consumer preferences for specific attributes of the RPS policy. It analyzes households' marginal willingness to pay (MWTP) for the RPS with specific attributes and simulates the degree of household acceptability of the policy through a scenario analysis. Comparison between costs and benefits of implementing the policy is also attempted by analyzing the households' MWTP with the actual transition expense of RPS implementation incurred by electricity supply companies. The simulation results provide implications for improving RPS policy implementation; households consider the creation of new jobs as the most important policy attribute, followed by increase in electricity prices, damage to forests, reduction in CO_2 emissions, and length of power outages. Moreover, the Korean household is willing to accept an increase of up to 1.39% in its electricity prices (relative to 2012), and the median MWTP of each household for RPS implementation is KRW 734.99/month (USD 0.67/month).

1. Introduction

Since the late 20th century, climate change has brought about an increase in the frequency of natural disasters occurring worldwide, such as typhoons, heavy rains, and storms. Such disasters cause untold losses, financial and otherwise. Stern (2007) estimated that about 1% of the global gross domestic product (GDP) is needed toward alleviating the effects of climate change. Moreover, in the absence of climate change mitigation, Stern (2007) estimates damages worth 5–20% of the global GDP would result. It has also been predicted that if the current trend of climate change continues in Korea, then around the year 2100, the average annual temperature of the Korean Peninsula will increase by 4 °C (15.71 °C) and the amount of precipitation will increase by 21% (1465 mm). As a result, the total cost of damages during 2008–2100 could reach about KRW 2800 trillion (USD 2.52 trillion),[1,2] (Korea Environment Institute, 2008).

Paying heed to similar warnings, governments worldwide are in the process of establishing various policies to mitigate the effects of climate change. Accordingly, most countries are establishing policies that help to expand the supply and use of renewable energy in order to reduce greenhouse gas (GHG) emissions. However, renewable energy has a higher initial investment and a higher unit cost of production compared to fossil fuels. Thus, analysis of consumer acceptance is critical to ensure the success of public policies concerning renewable energy.

Previous studies on the consumer acceptance of renewable energy, especially marginal willingness to pay (MWTP), can be divided into two major categories. The first analyzes preferences for renewable energy sources (i.e., green power), and the second, preferences pertaining to renewable energy policies (i.e., promoting renewable energy programs). Compared to the literature on conventional energy sources, studies pertaining to renewable energy sources and technologies are limited. Thus, previous studies are mostly based on stated preference data and in particular, the contingent valuation method (CVM) and conjoint analysis are widely employed to analyze consumer preferences for renewable energy sources or renewable energy policies and to derive MWTP. CVM is a standardized and widely used survey method for estimating MWTP (Mitchell and Carson, 1989). In use since the early 1970s, conjoint analysis is essentially a major set of techniques for measuring consumers' tradeoffs among multi-attributed products and services (Green and Srinivasan, 1990). Table 1 provides a summary of the

* Corresponding author. Tel.: +82 2 3284 1924; fax: +82 2 849 8014.
E-mail address: gcjeong@stepi.re.kr (G. Jeong).

[1] The acronyms "KRW" and "USD" mean "South Korean Won" and "United States Dollar" respectively.

[2] According to the Bank of Korea (www.bok.or.kr), USD 1 = KRW 1111.4 in September 2012.

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Table 1
Summary of previous studies on nation-wide preferences and WTP for renewable energy.

Object analyzed	Research methodology	Author and year	Country/ region	Target renewable source	Major results
Renewable energy sources (green power)	CVM	Nomura and Akai (2004)	Japan	General renewables	Median WTP of Japanese households for renewable energy was estimated to be about 2000 JPY (around 17 USD) per month per household.
		Bollino (2009)	Italy	General renewables	WTP for Renewable Energy System in Italy was estimated to be around 50% of the total subsidy cost.
		Yoo and Kwak (2009)	Korea	General renewables	The monthly mean WTPs for green electricity using parametric and nonparametric methods were KRW 1681 (USD 1.8) and KRW 2072 (USD 2.2) respectively.
		Savvanidou et al. (2010)	Greece	Biofuel	The reported average WTP was EUR 0.079/liter over and above the fuel market price.
		Zografakis et al. (2010)	Crete	General renewables	Mean WTP per household was EUR 16.33, and it was to be paid quarterly as an additional charge in the electricity bills.
		Abdullah and Jeanty (2011)	Kenya	Grid Electricity and Photo Voltaic system	The total monthly payments for households over 5 years were USD 32 million and USD 24 million for GE and PV systems respectively.
		Bigerna and Polinori (2011)	Italy	General renewables	WTP was estimated to range between 19% and 67% of the total subsidy cost.
		Kim et al. (2012)	Korea	Electricity generated by wind, PV system, and hydropower	The average WTP for all three energy types was KRW 1562.7 (USD 1.350) per month per household.
	Conjoint analysis	Roe et al. (2001)	US	General renewables	US consumers valued the environmental benefits resulting from changes in electricity generation methods.
		Scarpa and Willis (2010)	UK	Micro-generation technologies	The value of renewable energy adoption was not sufficiently large to cover the higher capital costs of micro-generation technologies.
		Ku and Yoo (2010)	Korea	General renewables	WTP was calculated for several attributes.
Renewable energy policy (promotion)	CVM	Wiser (2007)	US	General renewables	WTP for renewable energy was higher under a collective payment method than under a voluntary one.
	Conjoint analysis	Longo et al. (2008)	UK	Policy for the promotion of renewable energy	Respondents attached a high value to a policy that brings private and public benefits in terms of climate change and energy security benefits.

literature review in terms of explored topics, research methodologies, and results.

We perceive that most of the existing literature only analyzes consumer preferences for renewable energy sources and technologies; there is limited analysis regarding consumer preferences for renewable energy policies per se. In addition, studies on the latter focus on analyzing consumer preferences for surcharge collection methods or for hypothetical renewable energy policies. By contrast, our study is unique in that it examines consumer acceptance and MWTP for a specific policy, namely, the Korean Renewable Portfolio Standard (RPS). Further, our study also differs from other studies as it conducts a comparison between costs and benefits in an attempt to provide guidance toward effective policy implementation.

Since the Korean RPS came into effect from January 2012, analyzing consumer preference and MWTP at this point in time is very meaningful. Moreover, as Korea is one of the leading countries in relation to renewable energy, analyzing RPS implementation can yield several implications for other markets planning to introduce similar policies. Although this study's empirical analysis is restricted to Korea, RPS policies are currently enforced in many countries, and their impact and consumer response deserve scrutiny. Therefore, the main results of this study, such as the relative importance of specific policy attributes and MWTP, can provide meaningful implications in the case of other markets as well.

This remainder of this paper is organized as follows. Section 2 presents the current status of renewable energy policies in Korea. Section 3 discusses the conjoint survey design and data collection and outlines the model used. Section 4 contains details of the comparison between costs and benefits and the acceptability simulation analysis of the RPS policy based on the results of the consumer preference analysis. Section 5 presents the conclusions and limitations of this study.

2. Current status of renewable energy policies in Korea

Korea relies on imports for 97% of its energy needs. Globally, it was the eighth largest energy consumer and the seventh largest carbon dioxide (CO_2) emitter in 2012 (Enerdata, 2013). Korea has been making a number of concerted efforts to respond to climate change. In 2008, Korea pledged to reduce its GHG emissions by 30% below the business as usual (BAU) baseline by 2020. Moreover, the Korean government declared low-carbon green growth as its top priority. Therefore, the government is adopting various policies and systems in various fields, such as electricity, transportation, waste management, agriculture, and weather forecasting, designed especially for climate change mitigation and/or adaptation. Notably, the Korean government actively promotes renewable energy dissemination because such policies could not only reduce Korea's carbon emissions and its dependence on overseas energy sources, but also create new markets for renewable energy. For instance, in 2013, the Korean government introduced the Building, Home, and Regional Deployment Subsidy programs,[3] the Loans and Tax Incentive program,[4] Certificate of Renewable Energy Systems,[5] Mandatory Use for Public Building,[6] and the Renewable Portfolio Standard (RPS) for promoting renewable energy (Korea Energy Management Corporation, 2012). Moreover, the Korean government introduced the Renewable Fuel Standard (RFS)[7] in June 2013 and has discussed introducing various renewable energy dissemination policies, including the Renewable Heat Obligation (RHO)[8] (Korea Energy Economics Institute, 2012). Of the various such policies being implemented in Korea presently, we focus on the RPS.

The RPS obligates electricity supply companies to produce a specified fraction of their electricity from renewable energy sources. In Korea, the Feed In Tariff (FIT)[9] policy, enforced since 2002, was replaced

[3] These government subsidy programs provide subsidies to buildings, homes, and regional projects respectively, for facilitating the installation of renewable energy facilities.
[4] This government incentive program provides long-term low-interest loans and tax incentives for customers and manufacturers of renewable energy systems that have been completely commercialized.
[5] As the name suggests, the government certifies renewable energy systems by guaranteeing their quality of manufacture or import and enhancing its reliability for users.
[6] The government obligates new public institution buildings with a floor area exceeding 1000 m^2 to generate more than 10% of their total expected energy uses from renewable energy systems.
[7] This government regulation obligates all transportation fuel to contain a minimum specified volume of renewable fuels.
[8] This government regulation obligates heat suppliers to produce a minimum specified quantity of heat using renewable energy systems.
[9] This government program was designed to compensate for the difference between the electricity costs of renewable energy and those of fossil fuel power generation, in order to promote the production and use of the former.