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Renewable electricity as a differentiated good? The case of the Republic of Korea

Jihyo Kim [a,1], Jooyoung Park [b,2], Jinsoo Kim [c,3], Eunnyeong Heo [d,*]

[a] Department of Energy Systems Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-744, Republic of Korea
[b] Hanwha Chemical, Hanwha Building, 1 Jangyo-dong, Jung-gu, Seoul 100-797, Republic of Korea
[c] Department of Natural Resources and Environmental Engineering, Hanyang University, 17 Haengdang, Seongdong-gu, Seoul 133-791, Republic of Korea
[d] Department of Energy Systems Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-744, Republic of Korea

HIGHLIGHTS

- We examine renewable electricity in Korea using contingent valuation.
- Korean consumers recognise renewable electricity to be a differentiated good.
- They do not perceive types of renewable technologies as differentiated goods.
- A cost-minimising portfolio is assumed to be preferred by Korean consumers.

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ABSTRACT

This paper examines the willingness for Korean consumers to pay a premium for renewable electricity under a differentiated good framework by applying the contingent valuation method. Korean consumers have been required to pay for their use of renewable electricity as of 2012. First, we find that Korean consumers recognise renewable electricity as a differentiated good from traditional electricity generated from fossil fuels or nuclear energy. The mean willingness to pay to use renewable electricity is USD 1.26 per month. Second, we confirm the existence of perfect substitution relationships among variant renewable technologies, which suggests that Korean consumers do not perceive them as differentiated goods. One reason for this perception is that Korean consumers are more inclined to favour economic feasibility over sustainability or the availability of the resource stock when choosing between renewable technology types. In sum, we can say that Korean consumers recognise renewable electricity as a differentiated good but that they do not differentiate between variant renewable technologies. Thus, the imposition of the cost of renewable electricity on consumers in the form of increased electricity charges would be acceptable to consumers as long as any price rise properly reflects their preferences.

1. Introduction

As renewable energy is not yet commercially profitable, there are two ways of subsidising the promotion of renewable energy. The first is that the government gives subsidies to renewable energy. The second is that consumers directly pay for the dissemination of renewable energy. Along with a switch from feed-in tariff (FIT) to renewable portfolio standards (RPS) in 2012, the Korean government decided to require consumers to pay for the dissemination of electricity generated from renewable energy (renewable electricity hereafter) through increased electricity bills. Before this decision, the Korean government had explicitly given subsidies for the dissemination of renewable electricity. Subsidisation of the promotion of renewable energy by electricity ratepayers is also made in some states of the United States and the United Kingdom (Connor, 2003; Wiser et al., 2007). It is necessary to consider consumers' preferences on renewable electricity if they should bear the extra expense of renewable electricity. Moreover, as it is the first time for Korean consumers to pay directly for renewable electricity, an investigation from the perspective of consumers should be conducted. The main purpose of this paper is to contemplate renewable electricity in the

* Corresponding author. Tel.: +82 2 880 8323; fax: +82 2 882 2109.
E-mail addresses: jihyokim02@gmail.com (J. Kim), gene55@hanwha.co.kr (J. Park), jinsookim@hanyang.ac.kr (J. Kim), heoe@snu.ac.kr (E. Heo).
[1] Tel.: +82 2 880 8284; fax: +82 2 882 2109.
[2] Tel.: +82 2 729 5405; fax: +82 2 729 5398.
[3] Tel.: +82 2 2220 2241; fax: +82 2 2281 7769.

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framework of a differentiated good (Caves and Williamson, 1985) from the perspective of consumers.

Based on the definition provided by Caves and Williamson (1985), renewable electricity is a potentially differentiated good because it can be both a close and an imperfect substitute for electricity generated from fossil fuels or nuclear power. In the framework of a differentiated good, there are two issues on renewable electricity from the perspective of consumers. The first issue is whether consumers recognise renewable electricity to be a differentiated good from the electricity generated from fossil fuels or nuclear power. If so, consumers are prepared to pay more for renewable electricity, and this amount of additional payment indicates the benefit of using renewable electricity assessed from the perspective of consumers. The second issue concerns the argument about an appropriate renewable portfolio. If consumers consider variant renewable technologies to be differentiated goods from each other, a portfolio that reflects their preferences, which is even more expensive than others, would maximise their utilities. Otherwise, a cost-minimising portfolio would maximise consumers' utilities.

Previous studies have mainly examined consumers' preferences on renewable electricity by applying a stated preference method such as contingent valuation (CV) or choice experiment methods (Abdullah and Jeanty, 2011; Batley et al., 2001; Ek, 2005; Kim et al., 2012; Ku and Yoo, 2010; Lee and Hwang, 2009; Mozumder et al., 2011; Nomura and Akai, 2004; Wiser, 2007; Yoo and Kwak, 2009; Zografakis et al., 2010). These studies analyse consumers' willingness to pay (WTP) for renewable electricity and characteristics of their preferences. However, all these studies except Mozumder et al. (2011) and Kim et al. (2012) have regarded renewable electricity produced as a homogeneous good. In particular, Kim et al. (2012) used the CV method to analyse the WTP for electricity generated from wind power, solar photovoltaic power (PV), and hydropower and found the differences in WTP by renewable type were not statistically significant. However, theirs study was limited to these three renewable technologies and its finding cannot be generalised to a discussion of which renewable portfolio is mostly preferred when consumers pay more for renewable electricity.

We conduct a CV analysis, which derives the WTP for renewable electricity assuming that consumers are asked to pay more for renewable electricity, based on a sample of 495 households covering the entire region of the Republic of Korea (Korea hereafter). Our result was then compared with that of Kim et al. (2012), which also studied the case of Korea. Through this process, we especially focus on the following two research questions. First, do Korean consumers recognise renewable electricity as a differentiated good from electricity generated from fossil fuels or nuclear energy? If so, they are willing to pay more for renewable electricity, and their WTP represents the benefit derived from renewable electricity. To answer this question, we analyse Korean consumers' WTP for renewable electricity. Second, do they also perceive various renewable technologies as differentiated goods from each other? Otherwise, they prefer a cost-minimising portfolio. Testing the hypothesis on the substitution relationships among renewable technologies allows us to answer this question. In addition, respondents' opinions on the decision-making criteria for the conditional choice of renewable source are included to explain our result.

The remainder of this paper is organised into five sections. Section 2 briefly presents the background to the changes in the policies for promoting renewable energy in Korea. Section 3 describes the CV method for testing the substitution relationships among renewable sources and the CV questionnaire design. Section 4 presents our empirical results and discusses our two research questions. Finally, Section 5 concludes and offers some policy implications.

2. Changes in the policies for promoting renewable electricity in Korea

The total primary energy supply (TPES) of Korea has a 229.2 million tonnage of oil equivalent (TOE), which was the ninth highest in the world in 2010 (BP, 2011). However, the share of renewable energy in the TPES was only 0.7%, which is lower than the average share of OECD countries, namely 7.5% (IEA, 2011). To respond to energy and environmental crises and seek a new growth engine, the Korean government has endeavoured to foster renewable energy industries and to expand the use of renewable energy. It has set a target to increase the share of renewable energy in the TPES to 11% by 2030; this would account for approximately 33 million TOE (MKE, 2008b). To meet this target, the government has actively implemented an array of policies to improve the financial situation surrounding renewable energy, aiming at increasing its use and building up the dissemination infrastructure for renewable energy industries. The following seven renewable energy promotion policies have thus been implemented in Korea (REN21, 2012): (a) RPS with tradable renewable energy certificates (RECs); (b) net metering; (c) biofuel obligation/mandate; (d) capital subsidies, grants, and rebates; (e) investment or production tax credits; (f) reductions in sales, energy, CO_2, VAT, or other taxes; and (g) public investment, loans, or grants. As mentioned in Section 1, the Korean government decided to transition from FIT to RPS in 2012.

RPS requires electricity suppliers source a certain amount of renewable electricity in their power generation portfolios. This obligation can be satisfied either by owning a renewable energy facility or by purchasing renewable electricity from another company. In general, RPS minimises government involvement and incentivises renewable energy producers to reduce their costs (Berry and Jaccard, 2001; Chandler, 2009; Wiser et al., 2007). Price competition among power-generating firms can trigger price competition among renewable technologies. Further, power-generating firms that produce electricity under RPS are expected to compose cost-minimising portfolios. In addition to expecting these general effects of RPS, there were two structural changes in Korean renewable energy policy in 2012 behind the transition from FIT to RPS.

The first is that recovery of incremental policy costs was shifted from the government budget to electricity ratepayers. Until 2012, the Korean government budgets were used for FIT and this cost became a burden (Kim, 2009). FIT in Korea had set a fixed guaranteed price at which power producers could sell renewable power to a monopolistic public enterprise controlled by the Korean government. Fig. 1 depicts the total government budget assigned to an array of renewable promotion policies as well as that separately assigned to FIT from 2003 to 2011 (MKE, 2005, 2006, 2008a, 2011). The total budget increased more than eight times during this period, from USD 71 in 2003 to USD 611 million in 2011.[4] The budget assigned to the renewable promotion policies except FIT has been approximately USD 250 million since 2006. The budget assigned to the FIT subsidy in 2003 was only USD 5 million, which was only 7% of the total government budget for the promotion of renewable energy. However, it increased explosively up to USD 342 million in 2011, which was more than half of the total budget. With a switch from FIT to RPS, the government attempted to shift the responsibility for funding renewable electricity onto consumers through increases in their electricity bills. The justification for this shift was to decrease the

[4] The average standard trading rate (KRW 1156.0 per USD 1) in 2010, as announced by the Bank of Korea, was applied in this paper.