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Consumer attitudes towards renewable energy in China—The case of Shanghai

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ABSTRACT

In this paper, we study the consumers' attitudes towards green energy in China and their willingness to buy green electricity or renewable energy systems. A survey was conducted in the Shanghai region and 232 respondents answered the questionnaire. Generalized linear regression models were used in analyzing the results. The willingness to buy an own renewable energy system (e.g. solar water heater) is affected by age, how promising the renewable energy potential is seen and whether the person can choose the water heating and cooling system. The willingness to pay for a specific green electricity product is influenced by income, building type, how promising the renewable energy potential is seen, and whether the person can choose the water heating and cooling system.

Our results show that price and equipment issues (operation, maintenance) were often seen as barriers to buying green energy. Energy savings and energy security were most often chosen as motivations for buying green energy and environmental reasons were less frequently chosen. Yet, buying green energy would have a strong environmental meaning for many respondents. Several respondents mentioned that lower prices and government subsidies could motivate them to buy green energy, and that more information and advertisement campaigns are needed.

1. Introduction

The economic growth has been rapid in China and at the same time, the energy demand has also increased. Between 2002 and 2011, the electricity generation has almost tripled (IEA, 2013a) and the residential energy consumption has doubled since 1990 (Yuan, Wang, & Zuo, 2013). The emissions have also increased significantly: between 1990 and 2011 the Chinese CO_2 emission have more than tripled. Coal dominates China's electricity generation and IEA estimates that it continues to do so both in primary energy demand and in electricity generation (Yuan et al., 2013; IEA, 2013a,b). However, in the end of 2012 China had the highest capacity of renewable power in the world and approximately 20% of the electricity demand in China was met by renewables in 2012. China is also one of the top countries for solar heat capacity of all types (REN21, 2013).

Increasing attention is given to reducing carbon dioxide emissions and developing renewable energy use, and in 2014, China announced that it intends to achieve the peaking of emissions by 2030 (Yuan & Zuo, 2011; The White House, 2014). The Renewable Energy Law came into force in 2006 and it lays out the framework for the promotion of renewable energy development in China. The development of renewable energy is supported through feed-in tariffs and the Special Fund for Renewable Energy. The Twelfth Five-Year Plan includes energy intensity and carbon intensity targets. China has also set targets to increase the shares of renewable energy and non-fossil fuels in energy consumption (IEA, 2013a; The Chinese Central Government's Official Web Portal, 2012; Zhang & He, 2013; Fang, Honghua, & Sicheng, 2013).

This study focuses on the consumer attitudes towards green energy in a Chinese megacity, Shanghai. A survey was conducted in the Shanghai region and generalized linear regression models were used in analyzing the data. There is not one exact definition of green energy, but the term is often used of a specific electricity product which is produced with renewable energy sources or claimed to have other environmental benefits. Yet, green energy can also mean renewable energy systems like solar water heaters.

The literature about green electricity markets focuses mainly on Western countries with liberalized electricity markets where customers can choose their electricity supplier and product according to their preferences. In China customers cannot usually choose their electricity supplier or product even if there has been a voluntary-based green electricity pilot project in Shanghai. For this reason the questionnaire used in this study was designed so that the Chinese

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situation was taken into consideration and in addition to green electricity, also green energy technologies such as solar water heaters were taken into consideration in the survey.

The purpose of this study is to analyze what kind of potential there is for consumer demand of renewable energy products, such as green electricity or renewable energy systems, and to study what kind of role environmental aspects have in the consumers' energy related choices in Shanghai. We also investigate which factors influence the attitudes towards these products and what could motivate the respondents to buy green energy. The main research questions are as follows:

- Which factors influence the willingness to buy green electricity?
- Which factors affect the willingness to buy a renewable energy system?
- What kind of barriers are there to buying green energy?
- What could motivate the respondents to buy green energy?

In the next section, the literature about factors influencing willingness to pay for green electricity is reviewed in particular. Renewable energy applications used in Chinese households and the pilot green electricity scheme in Shanghai are also described in Section 2. In Section 3, the survey and methods that are used in analyzing the data are described. The survey results are presented and analyzed in Section 4. Concluding remarks and discussion are given in Section 5.

2. Literature review

2.1. Willingness to pay for green electricity—Literature from other countries

In liberalized electricity markets, where consumers can choose their electricity product freely according to their preferences, many suppliers offer voluntary green energy products to customers and the willingness to pay (WTP) for green electricity is also studied in many countries. These studies represent thus different situations considering the renewable energy policies, electricity production structures as well as the different time periods and stages of electricity market opening. Most of the existing literature focuses on Western countries, and there are only few studies (discussed in Section 2.2) viewing the situation of voluntary green energy in China. Table 1 summarizes the findings of studies on green electricity. As can be seen from Table 1, consumer behaviour is influenced by several factors at the same time, and for example characteristics such as income, age and education have been found to have impact on the consumer willingness to pay for green electricity. In addition, environmental awareness, the type of renewable energy, price and how promising renewable energy is seen in general can affect the willingness to buy green energy. On the other hand, lack of information, consumer confusion and old habits can hinder purchase of green energy.

It has also been pointed out that the energy production structure in the country has influence on how important the role of green electricity products is regarded; in a study from Norway it was found that energy efficiency is seen as a more important environmental action than buying green electricity due to the already high share of renewables in the electricity production (Aasen, Westskog, Wilhite, & Lindberg, 2010). The type of participation mechanism can also affect participation as revealed by (Kotchen & Moore, 2007). In addition, the types of voluntary green energy products available and especially their real additional environmental impacts can influence the demand (Hast, Syri, Jokiniemi, Huuskonen, & Cross, 2015). Green energy can be viewed as an example of public good and the possible additional costs of it are paid by voluntary individuals. Since consumers buying green energy cannot solely capture the benefits, there is a strong incentive to free-ride as stated by (Batley, Colbourne, Fleming, & Urwin, 2001; Wiser, 1998).

2.2. Green energy in China

2.2.1. Renewable energy policy in China

The Renewable Energy Law came into effect in 2006 and was revised in 2009. The law is the main legal foundation of renewable energy use in China and it was intended e.g. to establish a financial guarantee system for renewable energy, to remove market barriers and to create markets for renewable energy. After the implementation of the law, several renewable energy policies have been put into place but only few policy instruments have been implemented for end-users (Zhang & Wu, 2012). The law for example sets targets for the development of renewable energy, requires grid companies to purchase all generated renewable electricity and establishes an on-grid electricity price for renewables. Additional financial support for research and projects related to renewable energy are financed by the Special Fund for Renewable Energy (Li, 2011; IEA, 2014; Martinot, 2010; Zeng, Li, & Zhou, 2013; Zhang & He, 2013). After introducing the Renewable Energy Law, China has increased the renewable energy subsidies significantly. Even if renewable energy has developed rapidly and the potential of carbon-free energy sources is significant, the share of renewables is still small in the whole energy consumption and there are problems related to the renewable energy tariff policy (Dittrich, 2011; Andrews-Speed, 2013; Ming, Ximei, Na, & Song, 2013; IEA, 2014).

The Twelfth Five-Year Plan (2011–2015) for Renewable Energy includes targets of increasing the share of renewable energy in total energy consumption to 9.5% and of increasing the share of non-fossil fuels in primary energy consumption to 11.4% by 2015 (in 2010, the share of non-fossil energy was 9.1%). There are specific targets for the development of different types of renewable energy by 2015 and the Twelfth Five-Year Plan also includes targets for carbon and energy intensities (IEA, 2014; Zhang, Qi, & Karplus, 2013). An analysis of the 12 Five-Year Plans shows that increasing attention is given to energy efficiency improvement, carbon dioxide emission reduction and development of renewable energy use (Yuan & Zuo, 2011). In 2014, China and the United States announced their post-2020 emission targets. Under the agreement, the United States aims to reduce its emissions by 26–28% below its 2005 levels in 2025 and China intends to achieve the peaking of emissions by 2030. China also plans to increase the share of non-fossil fuels in primary energy consumption to 20% by 2030 (The White House, 2014).

2.2.2. Attitudes towards renewable energy and willingness to pay for green energy

A study on Jiangsu Province showed that the most important factors influencing the green electricity consumption intention were information dissemination, green value and bandwagon effect i.e. that consumer behaviour is largely influenced by the choices of other consumers. The consumption intention was not affected by characteristics such as occupation, economic conditions or education. The actual purchase behaviour was influenced by the subscription intention but not by economic factors (Zhang, Jiang, & Lin, 2011). A survey among urban residents in China showed that respondents with higher income and education preferred higher WTP. The results also suggest that green electricity is considered a luxury product and that the Veblen effect (i.e. consumers prefer higher-priced products) exists in certain population segments (Zhang & Wu, 2012).

Liu et al. have studied the rural acceptance of renewable energy in China, and found that most of the rural residents showed

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