

CEEP-BIT WORKING PAPER SERIES



Determinants of public acceptance of tiered electricity price reform in China: Evidence from four urban cities

Zhaohua Wang
Bin Zhang
Yixiang Zhang

Working Paper 14

<http://ceep.bit.edu.cn/english/publications/wp/index.htm>

Center for Energy and Environmental Policy Research
Beijing Institute of Technology
No.5 Zhongguancun South Street, Haidian District
Beijing 100081
February 2011

This paper can be cited as: Wang Z, Zhang B, Zhang Y. 2011. *Determinants of public acceptance of tiered electricity price reform in China: Evidence from four urban cities*. CEEP-BIT Working Paper.

This study is supported by the Program for New Century Excellent Talents in University (Reference No. NCET-10-0048), the Fok Ying Tung Education Foundation (Reference No. 121079), National Natural Science Foundation of China (Reference Nos. 71173017, 70773008, 71172106, 71020107026), Doctoral Fund of Ministry of Education of China (Reference No. 20101101110034), State Key Development Program of Basic Research of China (Reference No. 2012CB95570003) and Nature Science Foundation of Beijing (Reference No. 9112013). The views expressed herein are those of the authors and do not necessarily reflect the views of the Center for Energy and Environmental Policy Research.

© 2011 by Zhaohua Wang, Bin Zhang and Yixiang Zhang. All rights reserved.

The Center for Energy and Environmental Policy Research, Beijing Institute of Technology (CEEP-BIT), was established in 2009. CEEP-BIT conducts researches on energy economics, climate policy and environmental management to provide scientific basis for public and private decisions in strategy planning and management. CEEP-BIT serves as the platform for the international exchange in the area of energy and environmental policy.

Currently, CEEP-BIT Ranks 121, top10% institutions in the field of Energy Economics at IDEAS (<http://ideas.repec.org/top/top.ene.htm>), and Ranks 157, top10% institutions in the field of Environmental Economics at IDEAS (<http://ideas.repec.org/top/top.env.html>).

Yi-Ming Wei

Director of Center for Energy and Environmental Policy Research, Beijing Institute of Technology

For more information, please contact the office:

Address:

Director of Center for Energy and Environmental Policy Research
Beijing Institute of Technology
No.5 Zhongguancun South Street
Haidian District, Beijing 100081, P.R. China

Access:

Tel: +86-10-6891-8551
Fax: +86-10-6891-8651
Email: ceeper@vip.163.com
Website: <http://ceep.bit.edu.cn/english/index.htm>

Determinants of public acceptance of tiered electricity price reform in China: Evidence from four urban cities

Zhaohua Wang^{a,b*}, Bin Zhang^{a,b}, Yixiang Zhang^{a,b}

^a School of Management and Economics, Beijing Institute of Technology, Beijing 100081, China

^b Center for Energy & Environmental Policy Research, Beijing Institute of Technology, Beijing 100081, China

Abstract:

Tiered electricity price (TEP) reform is a planning policy for household electricity conservation in China. Based on TEP, several price hierarchies are provided, and additional payment will be charged if the electricity consumptions exceed the upper bound of each hierarchy. Yet, the optimal level of each price tiers and the institutions for implementing TEP need further research, which are set on the basis of considering residents' affordability and willingness to pay. Therefore, this paper aims at exploring determinants of public willingness to accept TEP and finding out the acceptable range of premium. A questionnaire survey in four urban cities of China is conducted to collect data, and an ordinary regression model is adopted in our analysis to identify the drivers and barriers to general public's acceptance of TEP. The results show that middle income earners are the groups that are mostly opposed to TEP. Rather than just focusing on economic factors, public environmental awareness should be highlighted during the implementation of TEP, because cost is not a statistically significant determinant in this study. Moreover, the public acceptable rate of premium of TEP in the urban cities, according to our research results, may be below 0.05 RMB/kWh.

Keywords: Tiered electricity price; Public acceptance; Determinants; China

1. Introduction

China's booming economy drives rapid increases in energy consumption. It is shown that China's GDP amounts to 4% of global economic output, while China accounts to 8%, 10%, and 31% of the global consumption of crude oil, electricity, and coal, respectively [1]. In addition, rising income of residents brings large quantities of household electricity usage. According to Murata et al [2], there would be 28% reduction in electricity consumption by the year 2020, if residents could pay more attention to their energy efficiency of household appliances use. Rapid increases in energy consumption drive up energy costs, and give rise to energy shortfall and potential supply disruptions in many districts of China. For example, 17 provinces in China announced shortfalls in electricity supply between December 2007 and January 2008 [3]. The increasing energy cost and electricity shortage are striking the low-level price system of electricity in China.

However, the Chinese government has limited ability to raise retail electricity rates to recover rising costs. This limitation stems from historical rate setting practices of electricity. For one thing, the retail rates are relatively steady at a low level with tight governmental regulation, while the price of coal which is the main energy source for power generation in China is varied according to market demand. Since the increasing cost could not be transferred to the end users effectively, the residential rates are subsidized by commercial and, to a lesser extent, smaller industrial users. For another thing, residential rates are politically sensitive and the government has to be careful about increasing residential rates with the consideration of general public's acceptance. Meanwhile, there is a restriction on the size of the discrepancy between residential and non-residential rates. Thus, it is a bit difficult to always raise the

*Corresponding author. E-mail address: wangzhaohua@bit.edu.cn

non-residential rates to recover increasing cost with the residential rates staying at a stationary low level.

Additionally, there is a growing discrepancy in electricity use between high using and “average” using households. According to Liu (2010), the consumptions of 10.3% high electricity users account for 53.7% of total household electricity usage in Hubei province [4]. Since household electricity price is subsidized in China, it seems that the more electricity residents use, the more subsidies they would get. This goes against with distributional fairness. As a result, it is necessary to force higher users to internalize some of the costs of higher consumption for the reasons of fairness.

Under such a circumstance, Chinese government is planning to promote a TEP reform in household sector to deal with above problems. TEP is one kind of price discrimination, and different prices are charged according to consumers’ electricity consumption. That is, there are several price tiers according to household electricity consumption. Additional payment would be charged if the electricity consumptions exceed the upper bound of each tier. The purpose of implementing TEP reform is to induce household electricity conservation [5]. TEP could increase revenues from residential consumption while keeping rates low for most households, discouraging higher electricity consumption, and accommodating perceptions of fairness in rate setting.

However, due to its unprecedented form in China, little was known about how well TEP reform would achieve its objective. In addition, the successful implementation of TEP would largely be determined by the public attitude towards TEP reform. Fiorio (2011) indicated that utility reform is “in the forefront of public debate”; public attitudes could raise “vocal support or opposition” which could affect the decisions of policy-makers and regulators on the implementation of the reforms [6]. Herter (2007) also provided evidence that the “retail demand response of electricity” of residents is “a potential tool for stabilizing market price, managing system reliability and maintaining system resource adequacy” [7]. The tariff rates of the electricity reform and relative subsidy mechanism should be designed considering residents’ demand and attitudes. Therefore, it is necessary to investigate how residents respond to TEP reform and find out the drivers and barriers to implement TEP from the general public perspective. Specifically, this study tries to solve the following three problems:

- public acceptance of TEP;
- which determinants do really influence public acceptance of TEP;
- what is the acceptable premium in TEP for majority of residents.

This study attempts to solve these problems by building a theoretical model and testing it using data collected from four urban cities of China. The whole paper is organized as below. To begin with, we introduce the TEP concept, followed by development of hypothesis framework with the theoretical lens of TPB in Section 2. Section 3 describes the research design and measures developed for this study. Data analysis and results are presented in Section 4. And we conclude this study in Section 5.

2. Theoretical development

2.1 Literature review of TEP

The issue of TEP has drawn great attention around the world. It could be classified as two types according to different principles of tiered setting. One of them is called responsive pricing, which has several price tiers and each tier is designed in response to the electricity consumption demand or production cost in different time intervals [8]. Peak-load pricing which charges higher electricity price in the peak hours of electricity consumption and seasonal pricing whose price tiers are designed based on different seasons [9], are representative examples of responsive pricing of electricity. The price tiers of the other type are designed according to electricity consumption. The marginal rate that a residential customer pays increases if consumption increases over the upper bound of consumption level of each tier. China is now planning to implement this type of TEP in household sector.

Many regions have implemented TEP around the world. California adopted increasing-block electricity tariffs with two-tiered block residential rate structures in 1980s and then changed to adopt five-tier increasing block electricity price after California electricity crisis [10]. Japan and Korea also implemented TEP in their household sector with 3-tier and 6-tier tariff rate structure respectively [11]. The experience of TEP obtained in other countries could provide implications for implementing TEP in China. However, the experience of other regions should not be simply copied in China due to different national conditions:

For one thing, the electricity rates setting principle is somewhat different. Reneses et al. (2011) showed two crucial principles of electricity tariff design: ensuing cost recovery and avoiding cross-subsidies between different customer categories [12]. Based on these two principles, efficient tier design is often based on estimating demand elasticity of residential customers, so as to necessitate setting prices close to marginal cost of power generation and transmission, and allow the power firms to cover their cost [13]. In many countries, as a result, the electricity rates are set on a revenue requirement basis. The utility revenue often requires reasonable return of investment. However, there is not a strong connection between revenues and system costs in China, and the cost allocation process is ad hoc. Household electricity rates are relatively stationary during the past few years, which are not designed based on estimating demand elasticity and considering the changes in supply and demand. As a result, electricity users in China have less faith that their rates are set to be fair and reasonable. High profit margins of grid companies in China make many people think that raising electricity price is a “gift” to state-owned enterprises rather than reflecting actual increases in costs of energy resources. It is said that total operation revenue of grid companies reached to 21.9 trillions RMB in the first 11 months of 2010 [42]. And the average power purchase price of grid companies is 3.84 RMB/kWh, while their terminal sales price reaches to 5.71 RMB/kWh [42]. It is indicated that rate of gross profit of grid company could reach to 32.82%. Therefore, it is somewhat reluctant for the final users to accept rate increases. Therefore, it is important to understand public willingness to accept TEP in China, and find out solutions to better propel the implementation.

For another thing, fairness is also an important factor when TEP is implemented in many other countries. Borenstein (2008) identified the redistribution effect of increasing block tariffs, and developed an approach that yields upper and lower bound of steeply-tiered rate structure in consideration of income redistribution effect [10]. Schoengold and Zilberman (2010) synthesized the above factors and identified conditions under which economic efficiency and cost recovery can be achieved in a manner that reduces inequality. The historical low and stationary household electricity rates in China which get large subsidies from commercial and industrial electricity customers give rise to unfair distribution between large and small household electricity users [4]. It is indicated that the higher of electricity consumption the more subsidies residents would get. This unfair situation should be dispelled when implementing TEP in China. Therefore, it is important to understand whether the majority of residents feel fair about the proposed TEP, and find out the public acceptable payment.

The previous researches enrich our understanding of TEP. And most of these literatures inclined to analyze the operational mechanism from the perspective of price elasticity of demand. However, few studies have investigated the process of TEP reform in China. And the public willingness to accept TEP reform has not received enough research attention of scholars. This leaves much space for us to explore TEP problems from the residents' perspective.

2.2 TEP reform in household sector of China

After several years of brewing, TEP reform in household sector of China was put on the agenda with the promulgation of consultation draft on October 9, 2010 [5]. Corresponding pilots have been conducted in several provinces such as Sichuan, Fujian and Zhejiang since 2004 [14]. There are several reasons for Chinese government to promote TEP reform actively. Firstly, the electricity price of household sector is

relatively at a low level. As shown in Figure 1, the household electricity price is only 0.06 U.S. dollar per kWh in China, which is much lower than the prices in America, France, Germany and other OECD countries. The low price requires great subsidies for household electricity use every year. However, the large amounts of high electricity use in household sector are attributed to the consumption of high-income residents [4]. This indicates that the rich residents share more subsidies of household electricity consumption, which is actually unfair. In order to preserve social fairness and stability, it is necessary to conduct TEP reform. Secondly, the low price also puts inadequate pressure on household electricity conservation and results in plentiful of high electricity consumption in household sector. The implementation of TEP could raise the cost of high consumption and reduce high electricity use. Thirdly, the low electricity price brings increasing financial burden to the government, along with rising power generation cost. Raising electricity price of households directly is difficult, as it is unfair for low income residents and would be opposed by most of them. TEP reform allows the government to increase electricity revenues from household sector, while maintaining subsistence consumption of low income residents.

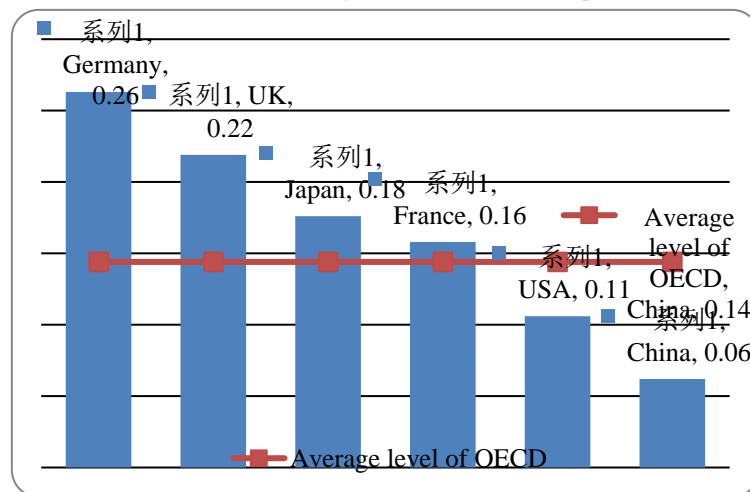


Fig.1. The electricity price of some countries in 2007 (Unit: dollar/kWh)

Note: The data is referred to IEA [15].

TEP reform is a reform policy that requires discriminated electricity price tiers for different amounts of electricity consumption in household sector. Additional tariff would be added to the price for the electricity consumption exceeding the upper bound of each tier. It is designed to induce electricity conservation with higher price for more electricity consumption. According to the consultation draft of TEP reform in China, there are two proposed schemes of TEP reform, both of which have three price tiers for household electricity consumption (see in Figure 2). According to the first scheme, the price of the first tier stays the same as the present household electricity price, and the upper bound of electricity consumption of this tier is 110 kWh. The range of electricity consumption of second tier is between 110 kWh and 210 kWh. The price of this tier is at least 0.05 RMB higher than the present price. The lower bound of the third tier is 210 kWh, and the price is at least 0.2 RMB higher than the present price. The second scheme of TEP reform is a bit different with the first one. The upper bound of the second scheme rises to 140 kWh, and the price of the second tier is at least 0.01 RMB higher than the present price. The required prices in the second tier and third tier are the same as the first scheme, but the frontiers of the two tiers are changed. The bound of the second tier ranges from 140 kWh to 270 kWh, and the lower bound of third tier rises to 270 kWh.

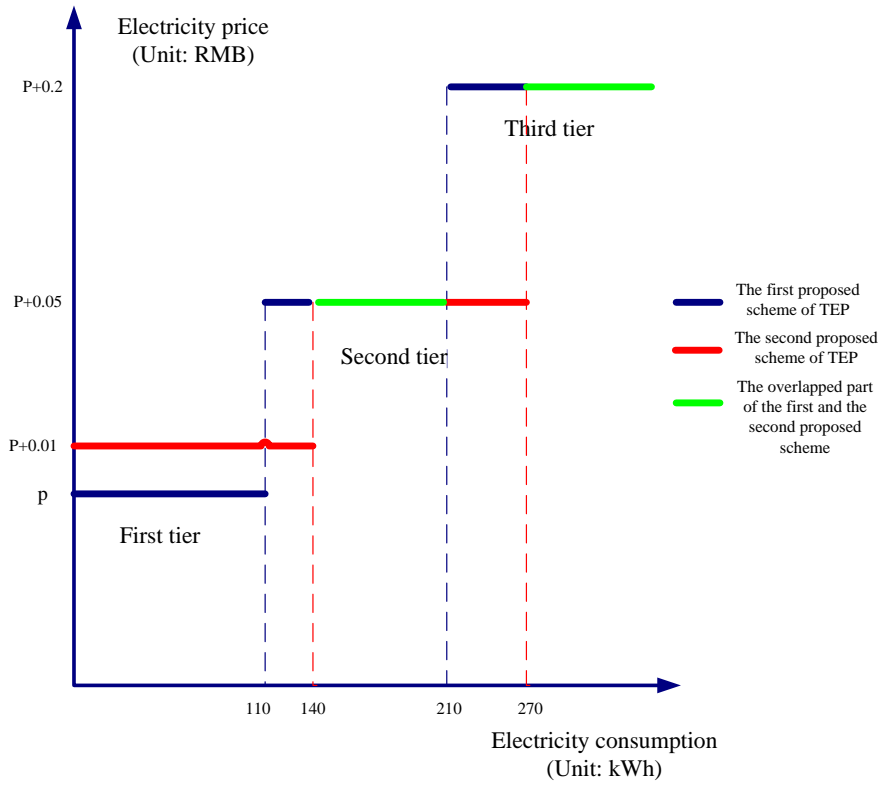


Fig.2. Two proposed schemes of TEP reform by NDRC of China

Note: p is the present electricity price of household sector

Generally speaking, the first tier is set to satisfy low-income residents' electricity demand for subsistence [16]. The price of this tier, as a result, should be designed as the acceptable price of the

low-income residents, which could be calculated as follows [17]: $\bar{p} = \frac{I \times R}{q}$ (\bar{p} : the acceptable

electricity price of low-income residents; I : subsistence security standards; R : the proportion of acceptable electricity expenditure in total expenditure of low-income residents; q : the upper bound electricity consumption of the first tier). The price of the first tier is the minimum of the present price and the acceptable price of low-income residents.

The quota of electricity consumption in the second tier is designed for the normal electricity demand of household [18]. However, the design of tariff rate in this tier is more complicated than the first tier. It should be designed to cover the power cost (including the cost of power generation, transmission, distribution, retail etc.) or gaining reasonable benefits and considering the psychological acceptability of vast majority [17]. As a result, it is necessary to identify the public acceptable tariff rate of the second tier before the implementation of TEP.

The electricity consumption in the third tier is much higher than that of the other two tiers. It is reasonable for the much higher price in this tier aiming at inducing the residents to reduce the unnecessary electricity consumption.

There are some typical differences between China's TEP and TEP in some other countries around the world. Firstly, the disparity of tariff rate between the highest tier and the lowest tier is much smaller than that in other counties. According to consulting draft of TEP reform, the electricity price in the third tier is about 1.2 times of the first tier. However, the corresponding proportion between the highest tier and the lowest tier in Korean and California is 11.7 and 1.8 respectively [10-11]. This shows that the marginal prices between high electricity consumption and sustainable electricity consumption are small at present in

China. This design can mitigate residents' boycott mood (especially the high-income residents). Therefore, it is important to take income into account when research public acceptance of TEP in China. Secondly, the increasing block rates are often designed to be revenue neutral in most of the world. This means that the first price tier falls below the average household electricity price. However, the proposed tariff rate of the first tier in China maintains the same as or even a bit higher (the second scheme) than the present electricity price. It seems disaccord with revenue neutral. As a result, residents (especially the low-income ones) may have economic burden from the increased price caused by TEP reform. It is necessary to identify their attitudes towards TEP reform and find out measures to raise their acceptance.

2.3 Research hypotheses

Residents' acceptance plays a significant role in the successful implementation of TEP reform. Therefore, it is important to identify the drivers and barriers for the residents to accept TEP reform. The theory of planned behavior (TPB) provides a framework for systematically investigating the factors that influence behavioral choices [19]. And many studies on pro-environmental behavior or household energy conservation behavior are based on framework of TPB [20]. TPB assumes that behavioral intention is determined by attitude, perceived behavioral control and subjective norm [19]. It plays a reference role in our research since residents' acceptance of TEP reform is also the result of a reasoned process of weighing various factors about external environment and internal attitudes. Therefore, this paper tries to construct the hypothesis framework mainly based on TPB. Meanwhile, some additional variables are incorporated as well to enrich the content of hypotheses.

Attitudes, according to TPB, refer to the degree to which a person has a favorable or unfavorable evaluation of a behavior [21]. Residents' attitudes towards environmental protection (pro-environment) and energy-saving would play a significant role in their preferences of TEP reform. This is attributed to the fact that residents who concern more about energy crisis and environmental consequences would be more in favor of electricity conservation [22-23]. TEP reform aims to promote household electricity conservation. It obliges residents to give up their personal economic benefits for the sake of collective interests (e.g. energy saving and environmental protection). Residents concerning more about environmental protection or energy-saving, therefore, would be more likely to accept TEP reform. These analyses lead to our first hypothesis:

H1. Residents' awareness of pro-environment and energy-saving would be positively related to their level of acceptance of TEP reform.

Perceived behavioral control provides another theoretical lens to account for factors that can influence residents' acceptance of TEP reform. It reflects the perceived ease or difficulty of engaging in TEP reform. Cost would be one of the obvious behavioral controls that residents could perceive when they participate in TEP reform. Various costs are brought from TEP reform, such as financial costs, effort or time. These costs can be classified as two kinds: economic cost and life quality loss. Residents often concern much about the financial cost when engaging in energy consumption [24-26]. It is clearly shown that the premiums in the second and third tiers would increase the expenditure of electricity consumption. Moreover, the implementation of TEP reform may disturb the lifestyle of electricity use. Less use of air-condition or washing machine, for instance, has to be considered if residents would like to reduce their average cost of electricity consumption. The resulting uncomfortable feeling would negatively influence residents' acceptance of TEP reform, because comfort benefits are highly preferred by them [24]. Based on above discussion, the following hypothesis is posited:

H2. The economic cost and life quality loss would be negatively related to the level of residents' acceptance of TEP reform.

Based on TPB, subjective norm refers to the perceived social pressures to perform or refrain from a

behavior. Accordingly, individual's acceptance of TEP reform might be influenced by social environmental factors. It is indicated that other people's attitudes and behavior in electricity saving may influence individual's electricity saving activities [23]. Moreover, social atmosphere for environmental protection or energy conservation is helpful for individual's electricity saving behavior. In recent few years, for instance, there are many educational activities for disseminating the importance and skills of electricity conservation in China. Such activities would also activate residents' enthusiasm in accepting TEP reform. Besides, corresponding policies might have shaped a potential pressure on individual's acceptance of TEP reform. Therefore, we have the following hypothesis:

H3. The pressure from social environment would be positively related to the level of residents' acceptance of TEP reform.

Beyond the framework of TPB, several studies indicate that previous experience has a direct effect on intention and/or behavior [27-28]. Macey and Brown [29] reported that experience is the best predictor of conservation behavior. Typically, it can affect electricity conservation behavior in two ways. For one thing, residents who are customary to electricity saving are more easily to accept new policies for electricity conservation. For another, it is also indicated that residents who had the experience of brownouts of electricity use would concern more about electricity saving [3].

Information is often introduced as an important determinant in the analysis of residents' energy-saving behavior [23, 27 and 30]. Holding more information about electricity conservation skills and energy efficiency technology would be helpful for residents to engage in electricity saving [27]. It facilitates residents' electricity-saving behavior, which helps to mitigate the negative impacts of increased electricity charge caused by TEP reform. Then we posit the following two hypotheses:

H4. The experience of electricity saving or shortfall would be positively related with the level of residents' acceptance of TEP reform.

H5. The holding information about electricity conservation skills or energy efficiency technology would be positively related to the level of residents' acceptance of TEP reform.

There are debates on whether the income level would be related to household electricity saving. Many surveys indicate that income level is a determinant of energy saving, with poor people participating more in energy saving activities than rich people [21, 26 and 31]; while others indicate no significant relationship between income level and energy saving [32]. However, there should be relationship between income level and public acceptance of TEP reform, as the rich people might pay little attention to the additional electricity expense. Therefore, we introduce income level as a control variable in our research model (see Figure 3).

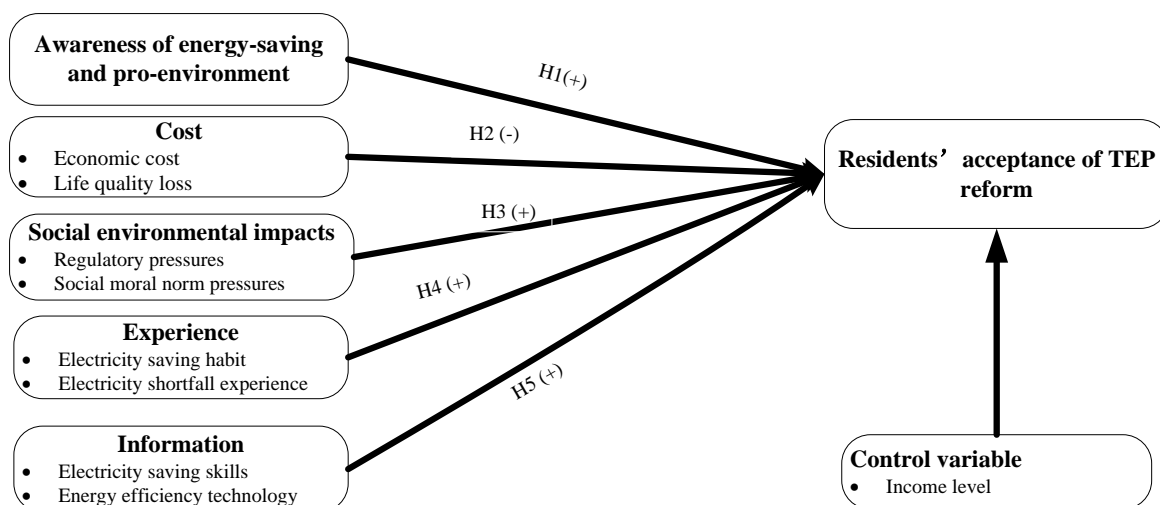


Fig. 3 Research hypotheses

3. Methodology

In this section, we describe the methodology for questionnaire development, and deduce the process of data collection. Then the orbit regression methodology is used to test the various research hypotheses.

3.1 Questionnaire development and data collection

Survey data were collected from four urban cities (namely Beijing, Shanghai, Tianjin and Chongqing) in China to test the research hypotheses presented in section 2.2. The four cities are all municipalities directly under the central government control, and would be in the forefront of TEP reform in China. The residents in these four cities could be representative of residents in the urban cities of China. Concretely, data collection occurred in two phases including a pilot test and a random survey, whose results are eventually aggregated.

- Pilot test: To customize the questionnaire to the context in China, we initially conducted a pilot test to validate and refine the measurement instrument. The pilot test was conducted in two residential quarters, namely Tian Tongyuan and Fang Zhuang that are the largest and second largest residential quarters in Beijing according to the resident population. Based on the suggestions from 50 respondents in the two residential quarters, we made minor modifications to the wording of the questionnaire.
- Random survey: We conducted a random survey in some residential quarters of Beijing, Shanghai, Tianjin and Chongqing from October 2009 to May 2010. An onsite survey was carried out in Beijing, with 238 usable questionnaires received. The questionnaire survey in other three cities was carried out using postal survey. The questionnaires were sent to the neighborhood committees¹ in some large residential quarters of these cities by mail. Then the neighborhood committees were in charge of the questionnaire delivery and collection. 1200 questionnaires were sent out, and 649 responses were received. Then we eliminated those responses with missing values on any measurement items of independent variables or attitudes towards TEP reform. After taking out the responses with incomplete data, 531 usable responses remained for our subsequent data analysis. We performed an independent-samples T test to compare the data characteristics between the onsite survey and postal survey. The results show that there is no difference (at 5% level of significance) between the two groups in questionnaire responses on demographic items and the items measuring attitudes towards TEP². The sample description is shown in Table 1.

Table 1

Distribution of samples

City	Quantities of issued questionnaires	Quantities of responded questionnaires	Incomplete questionnaires	Effective rate
Beijing	400	238	12	56.50%
Tianjin	400	204	26	44.50%
Shanghai	400	217	48	42.25%
Chongqing	400	228	52	44.00%
Total	1600	887	138	41.8125%

- Sample aggregation: Overall, 749 usable responses were collected. In order to identify whether there are some differences in sample characteristics among these four cities, we performed a one-way

¹ Neighborhood committees are the community management organizations of residential quarters in China, and are often very familiar with residents living in their residential quarters. Collecting the questionnaires on the spot with their help can improve the credibility and raise response rate of the survey.

² The results of independent-samples T test on each items are as follows: Residents' attitudes toward TEPR (t-value = -1.275, sig.= 0.203); Gender (t-value = -1.446, sig.= 0.149); Education (t-value = 0.332, sig.= 0.740); Age (t-value = -1.250, sig.= 0.212).

analysis of variance (ANOVA). The results are shown in Table 2. It is indicated that respondents' acceptance of TEP as a whole is not significantly different in these four cities ($F=0.756$, $Sig. =0.519$). And other sample characteristics show no statistical discrepancy at 5% significant level, except for the income level³. It is therefore reasonable to combine the samples collected from the four cities for data analysis.

Table 2

One-way analysis of variance for sample

	Mean squares		F-value	Significance
	Between groups	Within groups		
ALTP ^a	0.442	0.585	0.756	0.519
Gender	0.314	0.365	0.862	0.461
Education	0.411	0.683	0.602	0.614
Age	1.877	1.075	1.746	0.156
Income level	17.755	1.616	10.990	0.000

^aALTP refers to respondents' attitudes towards TEP reform

The demographic information of respondents has good distribution and is representative based on gender, age, and income level, although there are some sample biases. 51.23% of the respondents were man, and 48.77% were woman. The sex ratio of respondents is similar with the actual condition in China (1.06:1). Figure 4 and Figure 5 show that no single age group or income group dominated the respondents. However, there are a few biases compared with the actual situation of overall population in China. Survey participants aged from 20 to 50 accounts for 86.52%. The respondents aged below 20 and above 70 only account for 3.47% and 2.27% respectively. This would not influence the representative of the sample apparently. Because the young people below 20 often do not own a house themselves and they live with their parents. People aged above 70 are often cared by their youngsters. The income level is divided into 5 tiers. Since all the respondents are from four urban cities in China, the income level is a bit higher than the average level of China. The respondents with income between 4000 and 6000 account for 34.45%; and the respondents with income below 2000 and above 8000 account for 17.09% and 11.48% respectively.

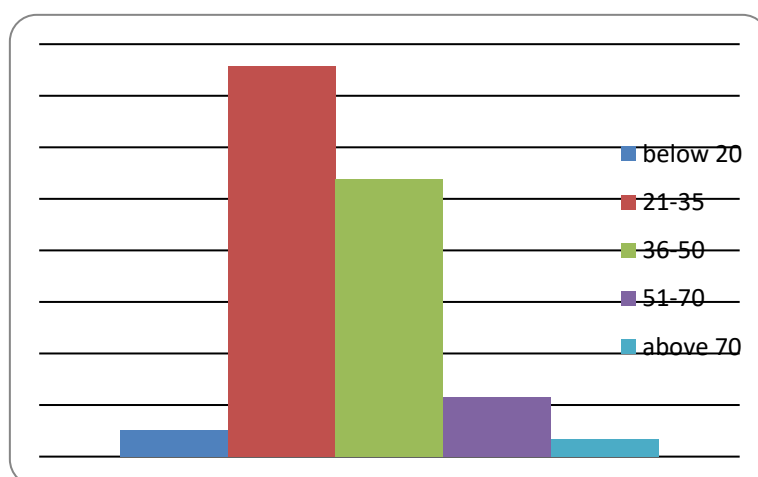


Fig. 4 Age profile of respondents

³ Residents' income levels in the four cities of China indeed have obvious discrepancy. Our results are in accord with the reality. And this discrepancy does not influence the reliability and validity of our sample, since we make a further analysis of income level in the following regression model.

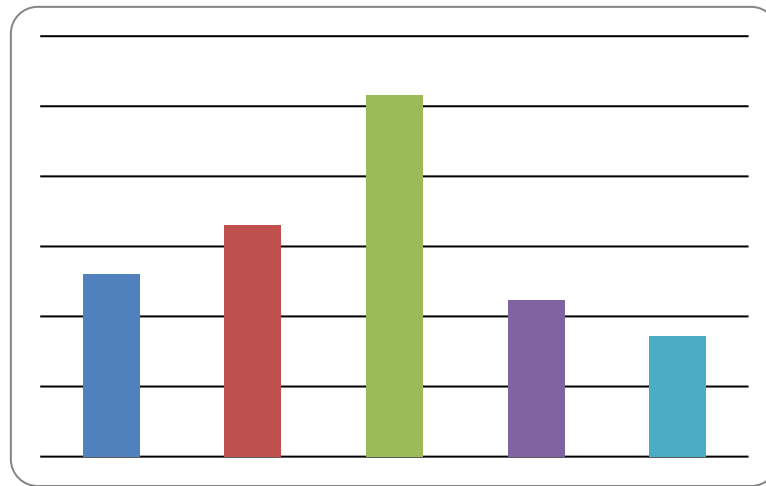


Fig. 5 Income profile of respondents (Unit: RMB/ month)

The formulation of questions included in the questionnaire was based on the framework in Figure 2, with content covered by three main sections: individual demographic information, dependent item and determinants of residents' acceptance of TEP reform. The five dimensions of determinants of residents' acceptance of TEP reform in this study are evaluated by 15 measurement items. As seen in Table 3, each construct is measured by three items. The measurement items of *Awareness of energy-saving and pro-environment* were developed based on a previous study [33]. Three measurement items of *experience* were adopted from one study [26]. The items for evaluating *Information* and *Cost* were developed based on previous studies [23, 24 and 30]. Three measurement items of *Social environmental impacts* referred to the following studies [21, 34 and 35]. The survey results of pilot test also provided reference for the formation of measurement items.

The target respondents answered the questions using a five-point Likert-type scale (e.g. 1= not at all important, 2= not important, 3= not thinking about it, 4= important, 5= extremely important). And the designed question for the household willingness to accept TEP reform is "How much additional payment do you think is reasonable to put on the present electricity price in the second tier of TEP?" Here respondents selected their willingness in four increasing ranks of choices.

Before testing the hypotheses, we testified whether our framework of determinants would adequately fit the data collected. A confirmatory factor analysis (CFA) was performed to validate the measurement properties. All the measurement items were forced to load on their corresponding factor, with no correlation with other factors. Table 2 presents the results of CFA. It is shown that all the measurement items had a reasonably high and significant loading with t-value greater than 2.0 towards their respective factors. And the completely standard loadings range from 0.58 to 0.83. These results support the convergent validity of the latent constructs, and substantiate the measurement properties.

Moreover, data reliability was checked. Table 3 provides the Cronbach's alpha values for the five determinants. The high values of Cronbach's alpha (>0.70) suggest that all five latent factors fit the data reasonably well.

Table 3

Descriptive statistics and CFA results for factors

Items	Mean	S.dev	Completely standardized loading	t-values
Independent structure ($\chi^2=210.21$; NFI=0.95; NNFI=0.96; GFI=0.97; RESEM=0.045)				
Awareness of energy-saving and pro-environment (Cronbach's Alpha= 0.706)				
<i>Awareness of energy crisis</i>	2.85	.966	0.71	18.29

<i>Realization of global climate change</i>	2.84	.904	0.75	19.34
<i>Awareness of environmental protection</i>	2.72	.824	0.60	15.57
Cost (Cronbach's Alpha= 0.743)				
<i>Additional payment caused by TEP reform</i>	2.13	.872	0.79	19.90
<i>Discomfort from electricity conservation caused by TEP reform</i>	2.10	.745	0.75	19.05
<i>Cost or time-wasted for changing energy efficiency appliances because of TEP reform</i>	1.88	.825	0.58	15.23
Information (Cronbach's Alpha= 0.724)				
<i>Knowledge of methods for electricity saving</i>	2.55	.747	0.67	17.50
<i>Realization of policy or regulation in electricity using</i>	2.48	.857	0.66	17.24
<i>Improvement of technology for electricity conservation</i>	2.32	.774	0.72	18.98
Social environmental impacts (Cronbach's Alpha= 0.726)				
<i>Supportive policy</i>	2.29	.863	0.62	15.33
<i>Regulatory pressures</i>	2.77	.831	0.70	17.17
<i>Influence from friends' electricity saving behavior</i>	2.66	.894	0.69	17.01
Experience (Cronbach's Alpha= 0.712)				
<i>Experience of electricity shortfall</i>	2.17	1.006	0.64	16.89
<i>Habits of electricity saving in daily lives</i>	1.99	.966	0.83	22.04
<i>Experience of participating in pro-environmental activities</i>	2.62	1.092	0.58	15.06

3.2 Modeling public acceptance of TEP reform

Respondents selected their willingness to accept TEP reform from four alternatives: 1-would not like the implementation of TEP; 2-would accept TEP reform if the premium added on electricity price below 0.05 RMB; 3- would accept TEP reform if the premium added on electricity price below 0.1 RMB; 4-would accept TEP reform even if the premium added on electricity price above 0.1 RMB. Since the response variable is ordinal and has more than two levels, the ordered regression model with maximum likelihood estimation is suitable to testify our hypotheses. Yet there is a choice between ordered logistic regression and ordered probit models. It is indicated that the logistic model is a better choice if the response decision is made based on maximization of utility [36]. Considering that residents' willingness to accept TEP reform mainly depends on the expected utility from the saving behavior, the logistic model was selected. The following specification was used:

$$y_i^* = \beta x_i + \varepsilon_i$$

Where y_i^* : Latent and continuous measure of willingness to accept TEP reform

x_i : The vector of observations for the five dimensions of determinants presented in Table 3

β : The vector of parameters to be estimated

ε_i : The random error term

The observed and coded discrete willingness variable y_i is determined from the model as follows:

$$y_i = \begin{cases} 1 & \text{if } -\infty < y_i^* \leq \mu_1 & (\text{Would not like to accept TEP reform}) \\ 2 & \text{if } \mu_1 < y_i^* \leq \mu_2 & (\text{Would accept TEP reform with the premium } \leq 0.05) \\ 3 & \text{if } \mu_2 < y_i^* \leq \mu_3 & (\text{Would accept TEP reform with } 0.05 < \text{premium} \leq 0.1) \\ 4 & \text{if } \mu_3 < y_i^* \leq \infty & (\text{Would accept TEP reform with the premium } > 0.1) \end{cases}$$

Where μ_i represents the thresholds to be estimated along with the parameter vector β

The probabilities of y_i in different coded value are defined as follows in our ordered logit model:

$$\begin{aligned} P(y_i = 1) &= F(\mu_1 - \beta x_i) \\ P(y_i = 2) &= F(\mu_2 - \beta x_i) - F(\mu_1 - \beta x_i) \\ P(y_i = 3) &= F(\mu_3 - \beta x_i) - F(\mu_2 - \beta x_i) \\ P(y_i = 4) &= 1 - F(\mu_3 - \beta x_i) \end{aligned}$$

Where $P(y_i = k)$ refers to the probability that individual i responds his/her attitude towards TEP reform

at the level of k ; $F(\bullet)$ refers to the probability-distribution function of ε_i .

4. Results and discussion

4.1 Drivers and barriers to respondents' acceptance of TEP reform

The ordered regression results are displayed in Table 4. To identify the modeling fitting information of the regression model, a chi-square test was conducted on the -2log-Likelihood between the intercept only model and pre-hypothesized model, as it is usually considered as a critical statistic to detect incorrect model specification such as non-linearity in the predictors or missing predictors. The results (Chi-Square=100.490, sig. =.000) indicate that it is reasonable to reject the null hypotheses that the independent variables are not associated with the dependent variable. The Pearson Chi-Square and Deviance Chi-Square are 2524.528 and 1535.507 respectively, which present sound goodness of fit in our model. Pseudo R-square is also estimated in our analysis. The results (Cox and Snell = 0.126; Nagelkerke = 0.141; McFadden = 0.060) support the explanatory power of integral estimate. Besides, multi-collinearity was further checked among independent variables. Variance inflation factor (VIF) for all independent variables range from 1.024 to 1.401, well bellowing the maximum level of 10.0 suggested by Mason and Perreault [37]. This means multi-collinearity should not be a serious concern in our regression.

Table 4

Model estimation results

	Estimate	S.D	Wald	df	Sig.	VIF
Threshold						
[y _i =1]	1.496	.496	9.086	1	.003	
[y _i =2]	4.372	.522	70.147	1	.000	
[y _i =3]	6.173	.550	126.033	1	.000	
Dependent variables						
Awareness of energy-saving and pro-environment	.529	.109	23.359	1	.000	1.088
Cost	-.064	.109	0.100	1	.554	1.103
Information	.270	.125	4.609	1	.031	1.230
Social environmental impacts	.554	.111	24.804	1	.000	1.287

Experience	.064	.100	0.409	1	.523	1.170
Income level						1.010
[INC ^a =1]	-.315	.259	1.477	1	.244	
[INC=2]	-.943	.310	9.221	1	.002	
[INC=3]	-.793	.251	9.940	1	.002	
[INC=4]	-.293	.281	1.090	1	.297	
[INC=5] ^b	0			0		

^aINC refers to respondents' income level.

^bINC=5 is set to be the reference item with the parameter being set to zero.

Wald statistic in the outcome shows that the coefficients are significantly different from zero, and then we can assume that the predictors are making a significant contribution to the prediction of the outcome. H1 posits that residents' awareness of pro-environment and energy-saving influences their acceptance of TEP reform positively. From Table 4, we can see that the coefficient is 0.529 ($p < 0.01$), thus supporting H1. H3, which states that the pressure from social environment could promote residents' acceptance of TEP reform, is also confirmed ($\beta = 0.554$, $p < 0.01$). The support for H5, which posits the positive effect of information on residents' acceptance of TEP reform, is weak but still significant at the level of 0.05. However, the driving effect of experience, mentioned in H4, is not significant in our estimation. And we can observe the negative effect of *Cost*, but the effect is not significant at the level of 0.05. This provides limited support for H2. Some statistic significances in income level indicate that the respondents with different incomes present discrepant acceptance levels of TEP reform.

Concretely, social environmental impacts have largest influence on public acceptance of TEP reform ($\beta = 0.554$, sig. = .000). For one thing, policy regulation is an important aspect of external pressures.

China is a country with more centralized power systems, and the household electricity price is under tight governmental regulation. Chinese government has attached great importance to household electricity price reform and has done many preparatory works for the implementation of TEP. These processes could exert an influence on residents' understanding about TEP, and gradually eliminate their intrapsychical collisions to TEP. For another thing, several national strategies for responding to climate change and constructing conservation-minded society in China begin to form a social atmosphere for environmental protection and energy conservation. Such atmosphere is helpful for the implementation of TEP. Typically, this result is also in accordance with Ek and Soderholm (2010), who believe that individuals' energy-saving behavioral intentions are influenced by other residents' behavior surrounding them. Therefore, some respondents' positive attitudes towards TEP reform would promote other respondents living around to accept TEP reform.

Awareness of energy-saving and pro-environment also plays a significant role in public acceptance of TEP reform. This is in accordance with previous studies [38-40]. Along with the increasingly deteriorative environment in China, more residents are aware of the environment status of their living areas. And many residents begin to concern about the climate change due to more frequent extreme weather (e.g. disastrous weather of frozen rain and snow in southeast of China in February 2008, and continuous high-temperature climate in the summer of 2010) in recent years. All these environmental awarenesses bring potential pressure for energy conservation. As a result, respondents who concern more about energy crisis or climate change problem would prefer the implementation of TEP. However, the overall level of pro-environmental

awareness in China still lags behind the more developed countries. The mean value of awareness of energy-saving and pro-environment reported in Table 3 is only 2.80, fallen short of average value 2.50. It is indicated that there is a great potential to improve the environmental awareness in China. Some educational campaigns about serious global concerns like climate change or energy crisis may raise public environmental awareness and motivate respondents' acceptance of TEP reform.

Furthermore, respondents holding more information about electricity conservation skills are more likely to accept the implementation of TEP. This is because this specific knowledge could efficiently reduce their electricity consumption and offset the negative impacts caused by increased cost due to the implementation of TEP. Technology improvement for electricity efficiency in household appliances is an important channel for household electricity saving. Respondents who master corresponding information may control their household electricity consumption under the upper bound of second tier in TEP. These indicate that high information level for electricity saving is a powerful factor for residents to accept TEP reform.

Contrary to our hypothesis, the negative effect of cost is not significant. This may due to the fact that there has been a low level of electricity price in China for a long time. The financial cost resulting from the TEP reform brings limited pressure on residents' normal lives. In addition, the increased price that the respondents were asked was too small (e.g. 0.05-0.1 yuan/ kWh) to make respondents realize the real bill impacts caused by TEP reform. It is difficult to form cost pressure. This is in accordance with the argument of Ito (2010) [41]. For the cost of life quality, few negative impacts would be brought about as well. Electricity efficient appliances have been pervasive around China. It is easily to offset the discomfort or inconvenience by adopting these advanced and electricity efficient technologies.

Because of the obvious contradiction between high electricity demand and insufficient supply ability in China, many residents have the experiences of electricity shortage and power brownout. However, the results show that these experiences did not efficiently drive respondents' acceptance of TEP reform. Possible reason is that electricity policy in China is inclined to satisfy the demand of household electricity use firstly. This principle guarantees that the electricity shortfall in household sectors would not last too long to disturb respondents' daily lives, which as a result could not form enough pressures on the acceptance of TEP reform. The habits of electricity-saving also seem to play no special role in the acceptance of TEP reform. This might be attributed to fact that daily energy-saving habits are often driven by cost saving [24]. While the proposed TEP in China raises a bit cost for electricity consumption. Cost's effect on the acceptance of TEP reform is not significant in our results. Therefore, there are no significant differences in the acceptance of TEP between the respondents with and without the electricity-saving habits.

Compared with respondents whose incomes are above 8000 RMB/month, there are statistically significant negative impacts on the endorsement of TEP for two groups of respondents (INC2, INC3). It is indicated that respondents opposed to the implementation of TEP are primary the middle-income group with income between 2000 and 8000 RMB/month. Especially, respondents with income between 2000 and 4000 RMB are more against TEP reform because $|\beta_{INC2}| > |\beta_{INC3}|$. However, respondents with income above 8000 RMB per month shows much interest in the implementation of TEP. Besides, it is an unimagined finding that the respondents with the lowest income also present little resistance to TEP reform.

4.2 Estimation for the acceptable premium in the second tier of TEP

The electricity price in the second tier of TEP covers the electricity demand in residents' normal life. As a result, respondents care more about the price mechanism in this tier, and show different attitudes towards the premium. It is necessary to identify the general acceptable ratio for the premium before the implementation of TEP. The statistical results of the question "How much additional payment do you think is reasonable to put on the present electricity price in the second tier of TEP?", reveal that about 56.55% of respondents think it would be reasonable for an increase within 0.05 RMB of the electricity price in the second tier. There are still 19.25% respondents would not like to adopt TEP. Only 5.35% respondents would accept the ratio of additional payment above 0.1 RMB/kWh.

Considering the pressure of financial cost brought by TEP reform on residents, the acceptable additional payment in the second tier would also be discrepant for the respondents with different income. We made a further estimation on this using our estimated ordinal regression model in section 4.1. The sample was divided into 5 groups according to the income level. The average values of independent variables in each group were brought into the estimated ordinal regression model. The corresponding results were shown in Table 5.

Table 5

Estimation of the acceptable premium for respondents with different incomes

	ALTP ^a =1	ALTP=2	ALTP=3	ALTP=4
INC ^b =1	11.24%	57.96%	23.95%	6.85%
INC=2	43.98%	49.32%	5.53%	1.17%
INC=3	58.62%	37.55%	3.17%	0.65%
INC=4	10.78%	57.41%	24.66%	7.15%
INC=5	11.28%	58.00%	23.90%	6.82%

^aALTP refers to respondents' attitudes towards TEP reform.

^bINC refers to respondents' income level.

According to our estimation, respondents with income between 2000RMB/month and 8000 RMB/month are more unwilling to accept TEP, compared with other respondents. 43.98% of respondents with income of 2000-4000 RMB/month and 58.62% of respondents with income of 4000-8000 RMB/month would like to accept the present electricity price with no additional payment. Few respondents in these two groups (1.17% and 0.65% respectively) would like to accept the level of additional payment above 0.1 RMB/kWh. The respondents in the rest three groups showed more support of TEP. 57.96% of respondents with the income below 2000RMB/month would like to accept the additional payment level within 0.05 RMB/kWh. And most respondents with income above 8000 RMB/month also prefer the level within 0.05 RMB/kWh. The level of additional payment above 0.1 RMB/kWh also does not get wide acceptance by the respondents in these three groups, but there are much more supporters compared with the two groups with income between 2000 RMB/month and 8000 RMB/month.

5. Conclusion

This paper focuses on residents' acceptance of TEP reform and corresponding determinants of the acceptance. Results show that the majority of respondents prefer to accept the premium in the second tier of TEP below 0.05 RMB/kWh. And residents with different income levels show significantly different attitudes towards TEP reform. Most respondents who are against TEP reform belong to the mid-income group with the income between 2000RMB/month and 8000 RMB/month. The low income respondents and high income group seem more willing to accept higher premium. For one thing, this might be attributed to the fact that the electricity consumption of the residents with lowest income are small, which often does not reach the upper bound of the first tier. The implementation of TEP, as a result, has little impact on their

normal lives. And high income residents are rich enough to afford the high electricity consumption; the premium resulting from TEP would be trivial for them. While for mid-income residents, the electricity expenditure would increase significantly since large amount of their daily consumption are in the second tier. They would not like to pay for the increased expenditure. For another thing, mid-income residents may feel unfair of the proposed TEP. The rates tiers are too few, and the range of second tier is a bit large. The disparity of tariff rates between the second tier and the third tier are a bit small as well. Consequently, mid-income residents may feel that their increased burden has fewer differences with that of high income residents, and is much more than that of low income residents. So they would be reluctant to accept the TEP. The results indicate that tariff rates in each tier could be better designed by considering income level. For instance, the tariff rate in the third tier could be a bit higher to raise the average cost of high electricity consumption of high income residents. And it may be better to design a bit more rates tiers to mitigate the unfair feeling of mid-income residents.

The factor of cost caused by TEP is not statistically significant in our analysis. This result implies that enhancing residents' acceptance of TEP should not just focus on economic aspect. For example, direct allowance for low and middle income residents would play limited role since the increased cost of proposed TEP seems not to be the main barrier for the majority of residents to accept TEP. It is necessary to provide subsidy for the electricity consumption in different tier considering the distributional fairness. The electricity consumption within the first tier should get more subsidies than that in the second tier. Subsidy should not be provided for the electricity consumption in the third tier. Besides, subsidies should be designed to inspire energy conservation as well. For instance, bonus or discount could be provided to the residents whose electricity consumption is at a low level (e.g, within the first tier), when they buy the energy-efficient appliances.

Raising public awareness in energy crisis and environment degradation is also important. According to our survey, respondents concerning global warming and environmental deterioration or preferring to use energy-saving products are more willing to accept TEP. It indicates that sound social environment need to be constructed for inspiring residents' willingness to engage in energy saving and environmental protection. Typically, educational campaigns for energy scarcity and environmental degradation could be conducted to raise public consciousness of the necessity of TEP reform. Relevant knowledge about the benefits and mechanism of TEP could be disseminated more with various social mediums. Besides, other people's attitudes towards TEP play a positive role as well. It is necessary to provide convenient conditions for spontaneous activities of energy saving among residents. Residents, as a result, can exchange their electricity-saving experience and influence each other's positive attitudes towards TEP reform.

Our initial findings also leave space for future investigation. The sample in this study only included a convenient sample of residents in four urban cities of China. The residents' attitudes towards TEP reform in rural area have not been identified. Further research comparing urban residents and rural inhabitants is needed. In addition, we did not consider the bill impacts through the price elasticity analysis. Further research can assess price elasticity based on investigating the household's actual electricity consumption of each month and the demand variations in response to the electricity price increase. Besides, other key problems of TEP reform (e.g. the reasonable boundaries for each tier of TEP and the potential impacts of TEP reform after implementation) are not discussed in this study, as they are not the focus of this research. Additional investigation should be conducted to solve these problems.

Appendix A. Major Questionnaire Items

● Individual Information

- Your gender is (a) male; (b) female
- Your age is (a) below 20; (b) 21-35; (c) 36-50; (d) 51-70; (e) above 70

- Your monthly income is (a) below 2000 RMB; (b) 2000-4000 RMB; (c) 4000-6000 RMB; (d) 6000-8000 RMB; (e) above 8000 RMB
- How many years have you been educated in school? (a) below 6 years; (b) 6-9 years; (c) 10-13 years; (d) 14-18 years; (e) above 18 years
- **Dependent Item**
 - How much additional payment do you think is reasonable to put on the present electricity price in the second tier of TEP? (a) None; (b) within 0.05 RMB/kWh; (c) 0.05-0.1RMB/kWh; (d) above 0.1 RMB/kWh.
- **Independent Items**
 - **Awareness of energy-saving and pro-environment**
 - ◇ How often do you use energy efficient products?
 - ◇ How do you concern about climate change/ global warming?
 - ◇ How do you support any effort to curb the rate of environmental deterioration?
 - **Cost**
 - ◇ What do you think the economic burden brought from TEP?
 - ◇ Do you feel any discomfort of electricity conservation caused by TEP?
 - ◇ How do you feel about the cost or time-wasted for changing energy efficiency appliances because of TEP reform?
 - **Information**
 - ◇ What do you think about your knowledge or methods about electricity-saving?
 - ◇ Do you know any policies or regulations in electricity using?
 - ◇ Do you know any technologies about electricity conservation?
 - **Social environmental impacts**
 - ◇ What do you think about present policies' effect on TEP reform?
 - ◇ Do you feel any regulatory pressures of TEP reform?
 - ◇ What do you think about your friends and relatives' attitude on TEP?
 - **Experience**
 - ◇ How often do you ever experience electricity shortfall?
 - ◇ What do you think about your habits of daily electricity use?
 - ◇ How often do you participate in energy-saving activities?

Reference

- [1] Z.Y. Zhang. To deepen reform and push a development mode change: from extensive to economical. *Jing Ji Yan Jiu* 2005; 40: 4-9. (In Chinese)
- [2] A. Murata, Y. Kondou, M.Hailin, W. Zhou. Electricity demand in the Chinese urban household-sector. *Applied Energy* 2008; 85(12): 1113-1125.
- [3] D.S. Feng, B. Sovacool, et al. The barriers to energy efficiency in China: Assessing household electricity savings and consumer behavior in Liaoning Province. *Energy Policy* 2010; 38(2): 1202-1209.
- [4] S.J. Liu, J. Yang. Research on tiered electricity price. *Price: Theory and Practice* 2010; 3: 12-14. (In Chinese)
- [5] National Development and Reform Commission. Guidance for tiered electricity price reform in household sector (draft of consultation). Available on line at http://www.ndrc.gov.cn/jtdjyj/qwll/t20101008_374091.htm; 2010. (In Chinese)
- [6] C.V. Fiorio and M. Florio. Would you say that the price you pay for electricity is fair? Consumers' satisfaction and utility reforms in the EU15." *Energy Economics* 2010; 33 (2): 178-187.
- [7] K. Herter, P. McAuliffe, et al. An exploratory analysis of California residential customer response to critical peak pricing of electricity. *Energy* 2007; 32(1): 25-34.
- [8] N.Y. Zhang. Energy efficiency management and price policy in USA. *China Price* 2008; 4: 43-46.

- [9] K. Herter, P. McAuliffe, et al. An exploratory analysis of California residential customer response to critical peak pricing of electricity. *Energy* 2007; 32(1): 25-34.
- [10] S. Borenstein. Equity (and some efficiency) effects of increasing-block electricity pricing. Available online at: <http://www.econ.as.nyu.edu/docs/IO/8821/Borensteinpaper.pdf>; 2008.
- [11] C.R. Li, J.M. Yu. Experiences of household step tariff in Japan and Korea and revelations to China. *Energy Technology and Economics* 2010; 22 (7): 56-60. (In Chinese)
- [12] J. Reneses, T. Gomez, et al. Electricity tariff design for transition economies: Application to the Libyan power system. *Energy Economics* 2011; 33: 33-43.
- [13] Ito, K. How do consumers respond to nonlinear pricing? Evidence from household electricity demand. University of California, Berkeley 2010.
- [14] H. Chen. Exploration for the implementation of tiered electricity price in household sector. *Journal of Petroleum Educational Institute of Xinjiang* 2009; 10(6): 274-276. (in Chinese)
- [15] IEA. *Energy prices & taxes*. Paris 2009.
- [16] D.N. Wang. The problems of the proposed tiered electricity price in China and corresponding measures. *Price: Theory and Practice* 2010; 4: 42-43. (In Chinese)
- [17] L.Z. Zhang, H.T. Huang, S.R. Gui. Research on methodology of design of household tiered electricity price in China. *Price: Theory and Practice* 2010; 4: 44-45. (In Chinese)
- [18] L.Z. Zhang. Discuss in the increasing block rate of household electricity in China. *Price: Theory and Practice* 2010; 2: 9-10. (In Chinese)
- [19] I. Ajzen. The theory of planned behavior. *Organizational Behavior and human Decision Processes* 1991; 50: 179-211.
- [20] M. Bonne and M. Bonaiuto. Environmental psychology: From spatial-physical environment to sustainable development. In R. G. Bechtel & A. Churchman (Eds.), *Handbook of Environmental psychology* 2002; 28-54.
- [21] W. Abrahamse, L. Steg. How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? *Journal of Economic Psychology* 2009; 30: 711-720
- [22] C.D. Samuelson. Energy conservation: A social dilemma approach. *Social Behaviour* 1990; 5: 207-230.
- [23] E. Kristina, P.Söderholm. The devil is in the details: Household electricity saving behavior and the role of information. *Energy Policy* 2010; 38: 1578-1587.
- [24] S. Banfi, M. Farsi. Willingness to pay for energy-saving measures in residential buildings. *Energy Economics* 2008; 30: 503-516.
- [25] R. Scarpa, K. Willis. Willingness-to-pay for renewable energy: Primary and discretionary choice of British households' for micro-generation technologies. *Energy Economics* 2010; 32: 129-136
- [26] N. Zografakis, E. Sifaki, M. Pagalou, G. Nikitaki, V. Psarakis, K. P. Tsarakakis. Assessment of public acceptance and willingness to pay for renewable energy sources in Crete. *Renewable and Sustainable Energy Reviews* 2010; 14(3): 1088-1095.
- [27] P.M.Bentler, G. Speckart. Models of attitude-behaviour relations. *Psychological Review* 1979; 86(5):452-64.
- [28] A.J. Fredericks, D.L. Dossett. Attitude-behaviour relations: a comparison of the Fishbein-Ajzen and Bentler-Speckart models. *J Personal Social Psychology* 1983; 45(3):501-12.
- [29] S.M. Macey, M.A. Brown. Residential energy conservation: the role of past experience in repetitive household behaviour. *Environ Behav* 1983; 15(2):123-41.
- [30] K. Tsarakakis, F. Bounialetou, et al. Tourists' attitudes for selecting accommodation with investments in renewable energy and energy saving systems. *Renewable and Sustainable Energy Reviews* 2011; 15(2): 1335-1342.
- [31] T.A. Cameron. A nested logit model for energy conservation activity by owners of existing single family dwellings. *The Review of Economics and Statistics* 1985; 67(2): 205-211.
- [32] G. Brandon and A. Lewis. Reducing household energy consumption: A qualitative and quantitative field study. *Journal of Environmental Psychology* 1999; 19(1): 75-85.
- [33] I. Nnorom, J. Ohakwe, et al. Survey of willingness of residents to participate in electronic waste recycling in Nigeria-A

case study of mobile phone recycling. *Journal of Cleaner Production* 2009; 17(18): 1629-1637.

- [34] Q. Zhu and Y. Geng. Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers. *Journal of Cleaner Production*. In Press, Corrected Proof, Available online 8 October 2010.
- [35] J. Thøgersen and A. Gronhoj. Electricity saving in households: A social cognitive approach. *Energy Policy* 2010; 38: 7732-7743.
- [36] B. Supan. On the compatibility of nested logit models with utility maximization. *Journal of Econometrics* 1990; 43(3): 373-388.
- [37] C. Mason, W. D. Perreault. Collinearity, power, and interpretation of multiple regression analysis. *Journal of Marketing Research* 1991; 28(3): 268-80.
- [38] E. Sardianou. Estimating energy conservation patterns of Greek households. *Energy Policy* 2007; 25: 3778-3791.
- [39] S. Lindenberg, L. Steg. Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues* 2007; 63: 117-137.
- [40] M. Viklund . Energy policy options-From the perspective of public attitudes and risk perceptions. *Energy Policy* 2004; 32: 1159-1171.
- [41] K. Ito. Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing. Available online at http://ei.haas.berkeley.edu/pdf/working_papers/WP210.pdf; 2010.
- [42] The profit of national grid company grew 1828%, while the power plant deficit a lot. Available online at: http://www.china.com.cn/economic/txt/2011-05/23/content_22618034.htm. (In Chinese)