



ICGSEE-2013[14th – 16th March 2013]

International Conference on Global Scenario in Environment and Energy

The Study Of Low-Carbon Policy Influence On Consumers' Energy Efficiency Household Appliance Purchase Behavior

Qianyu DONG*, Tohru Futawatari

Graduate School of Environmental Engineering, Faculty of Environmental Engineering, University of Kitakyushu.

***Corres.author: sabrina111dqy@gmail.com, Tel: +81-080-4317-8386**

Abstract: Sequences of low carbon policies are aimed at reducing greenhouse gases and increasing energy efficiency—also in the household sector in China. However, not all the policies are useful to guide consumers' purchase behavior. Consumer's environmental friendly purchase behavior is affected not only by personal influence but also by external environmental forces. While information provision policies may be effective in encouraging certain consumers to understand the energy efficiency household appliance, but not promote purchases; fiscal incentive may be more attractive during pre-purchase period (information collection); regulation instrument regards as the most effectively instrument to influence consumers' energy efficiency household appliance purchase behavior, but useless to advance citizen's environmental awareness. Analysis of a survey dataset of Chinese households observes considerable heterogeneity in terms of influence of three policy instruments, in line with our conjectures.

Keywords: low-carbon, policy instrument, regulation instrument, fiscal incentive, information provision, consumer behavior, energy efficiency.

1. Introduction

Over the past decade, climate change has been described as one of the greatest environmental challenge for human beings. Since China has become the biggest CO₂ emitter from the year of 2007, the Chinese government announced a national strategic CO₂ mitigation goal to reduce CO₂ emissions per unit GDP by 40-45% by 2020 compared with the 2005 level in 2009.

Household consumption has grown rapidly in China over the past two decades, averaging around 8 per cent a year and rising to around 10 per cent in the past few years¹. Yet, there are already a number of energy efficiency appliances and several types of policy measures that have been implemented to reduce the emission of CO₂. However, the continued progress on low-carbon initiatives raises a number of questions. In the following sections, this study will address these questions.

Our approach is based on an established categorization of policy instrument developed by Salamon² and Van der Doelen³: information-provision policies, fiscal incentives and regulatory instruments). With policies of

information provision, consumers are given information on the state of the environment, and on ways how to make their lifestyles less harmful for the environment⁴. Regulatory instrument is legal, enforceable, 'command and control' type instrument aimed at reaching desired, prescribed environmental quality targets or performance standards by regulating the behavior of individuals and/or firms⁵. The purpose of Fiscal incentives is to motivate individual through the promise of reward or penalty to behave in a certain way without the level of government coercion inherent in regulations^{6,7}.

Its specific contributions lie, firstly, to address the affecting framework of consumer energy efficiency appliance purchase behavior : personal influence and external environmental forces; secondly, to determine the relationship between environmental awareness and energy efficiency appliance purchase behavior, a citizen classification model are built; thirdly, to consider explicitly the influence of the three policy instruments on consumers' daily lives and household appliance purchase decision; fourthly, to explore the particularities of policy instruments on consumers' energy efficiency appliance purchase behavior. This is extremely necessary inasmuch as this type of case studies in China is relatively few. Hence this study would fill in this gap.

2. Theory innovation

Whist each of scholarly writings about policy instruments, or consumer behavior are rich and mature, not much work combines these strands of research in order to explore the particularities of policy instruments for consumers' energy efficiency appliance purchase behavior, particularly based on a real case in China is few.

2.1 Mechanism of citizens' energy efficiency appliance purchase behavior

In order to answer the questions above, we develop consumer behavior model, (as illustrated in Fig.1 below), which contains two parts. Firstly, we frame the personal influence and external environmental forces that affect the consumers' energy efficiency appliance purchase behavior. Meanwhile, the policy instrument will play different role in consumers' environmental awareness and purchase decision making period.

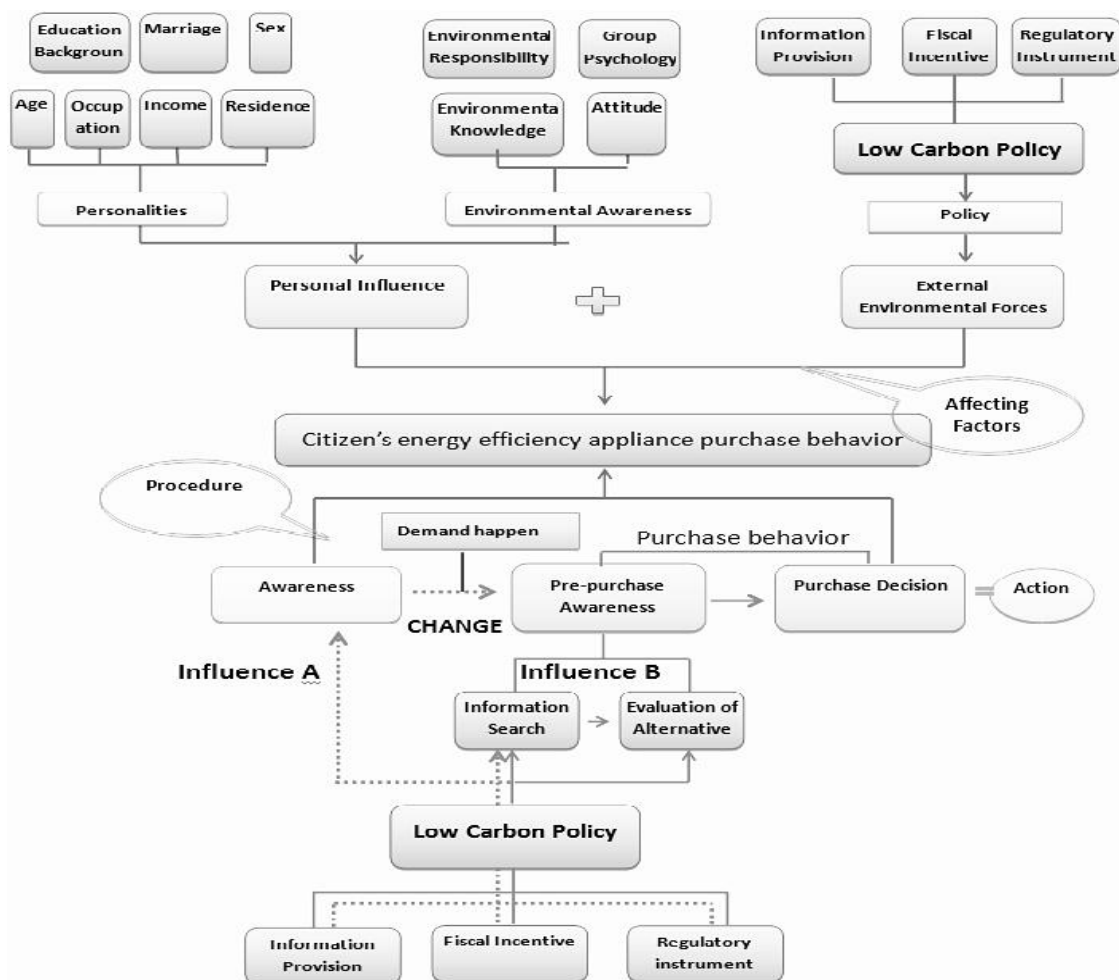


Fig.1 Mechanism of citizens' energy efficiency appliance purchase behavior

In terms of affecting factors, with Lewin's Equation⁸ : $B=f(P, E)$, it states that behavior B is a function of the personalities- P and his or her environment- E [9]. In our research, personal influence contains two big factors: personalities and environmental awareness. Environmental awareness can be measured by three factors: environmental knowledge, environmental responsibility, and attitude to the environment¹⁰.

In terms of the procedure of policy instruments influence on household appliance purchase behavior, because of the demand happening, the effect of the three policy instruments on consumers' environmental awareness and purchase decision making should be different.

2.2 Classification model of citizen

In order to understand the reasons why and how citizens' pro-environment attitude and response for policy are different, we classified citizens into six groups under two dimensions: environmental awareness and energy efficiency appliance purchase behavior. In Fig.2, letters A, B, C, D, E and F represented different kinds of citizens', respectively. A group stands for citizens who have high environmental awareness and bought energy efficient appliances.

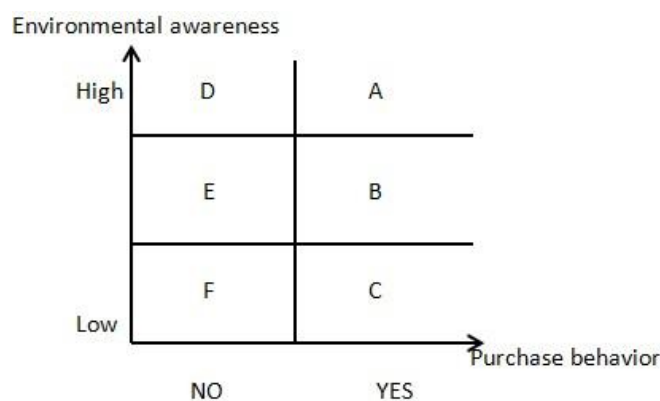


Fig.2 Classification model of citizen

Compared with other groups, A group people have higher environmental responsibility, reasonable environmental knowledge, as well as active and objective attitude towards environment and; B group citizens have general understanding of environmental problem and purchased environmentally friendly household appliance; C group's member actually do not know too much about environmental protection, but unnaturally, they have purchased energy efficiency household appliance; group D, although has a great environmental awareness, unfortunately they did not chose energy efficiency household appliance; group E's people has a fair environmental awareness and do not have high enthusiasm about environment. They also did not buy environmentally friendly appliance; and lastly, group F is the most negative one, since this type of people's environmental awareness is almost nil, and as a result, they did not purchase energy efficiency household appliance.

In the following sections, we take two approaches: a descriptive study of the survey results, as well as correlation analysis. We put forth the following conjectures: First, individuals have different preferences for different policy instrument. Second, the effect of policy instrument on consumers would change because of purchase behavior and, third, we expect a lot more heterogeneity in the reasons behind the response to policy instruments.

3. Database

The survey was conducted in October 2012 at the capital city of Sichuan province, China. The target of the survey was to obtain a sample representative for energy efficiency household appliance buyers. All the samples were selected randomly from the top three shopping malls in Chengdu. All items from the questionnaire quoted in this paper have been translated in English by the authors. From 500 questionnaires sent out, 375 were retrieved (response rate 75%). There was no incentive for participation in the survey other than a bottle of water. The 4-page survey consisted of 10 parts. They are personal characteristics, low-carbon basic knowledge testing, attitude for the environment of China, environmental responsibility testing, reaction for 3 policy tools, low-

carbon information policy’s influence testing, financial subsidy influential for citizen’s purchase decision, legal incentive influential for citizen’s purchase decision and reason analysispart respectively.

4.Results and Analysis

The total of effective respondents amounts to 295 (effective rate 78.7%) of which 50.5% are female, 49.5% are male. About 63.7% of respondents are married. And 43.1% of respondents are aged 19-29 years old, 34.3% of consumers are between 30 and 49 years old, 22.7% of respondents are older than 50 years old. Applying a USD/RMB exchange rate of 6, majority of the respondents, about 35.9% (n=106), earns USD 400 to USD 660 a month, 12.2% of respondents monthly income is more than 900 dollar. 34.9% of respondents are enterprises’ employees, and 24.1% of them are teachers and students. 70.5% of people are living in cities;while 62.7% of the respondents graduated from university.

4.1 Classification model of citizen

1). Descriptive statistics

In accordance with the environmental awareness and final purchase behavior, citizens are divided into six types. In order to get a comprehensiveassessment of individuals’ environmental awareness level, respondents have been asked thirteen questions from three aspects: basic environmental knowledge, evaluation for the environment and environmental responsibility.

Based on five-rank ordinal scale, every answer was graded from 1 to 5 point. The criteriaused are: better understanding of basic knowledge, high environmental responsibility and more objective recognition of environment. And the average score of all the thirteen questions is the final environmental awareness level of respondents. If a person’s average score 4, he/she is deemed to have a higher environmental awareness level; if 3 average score < 4, the respondent is regarded to havemedium environmental awareness; if the final score < 3, the person is supposed to have a poor environmental awareness.

Furthermore, consumers have been asked on whether they bought an energy efficient household appliance. This question is essentially an inquiry into whether they have energy efficiency household appliance purchase behavior. Majorityof the respondents (about 75.3%), have the experience of buying energy efficient household appliance, while 24.7% of the respondents did not purchase any energy efficiency household appliance.

Fig.3 illustrates the distribution of the six groups. Obviously, group A occupies the largest share among the six groups; Group F only accounts for11% of respondents.Fig.4 indicates the distribution of environmental awareness level, in which the people who hold higher environmental awareness take up 53% of all the citizens, and medium awareness accounts for 40%, the low awareness only has 7%.

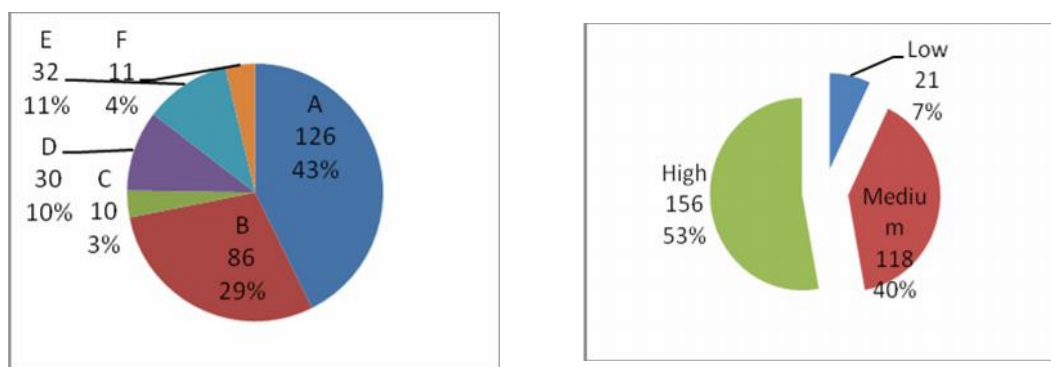


Fig.3 Distribution of six groups Fig.4 Distribution of environmental awareness

Table1. ANOVA of energy efficiency household appliance purchase behavior environmental awareness.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.866	1	1.866	6.516	.011
Within Groups	83.915	293	.286		
Total	85.781	294			

Connecting with Fig.3 and Fig4, and according with the analysis of variance (ANOVA) in Table1. The Sig. is 0.011 which is smaller than 0.05 (corrected p-value). This implies that the energy efficiency household appliance purchase behavior is proportional to environmental awareness.

2). Correlations

Table 2. The main result of ANOVA based on group C (significance probability)

Group	External Environment			Information policy			Fiscal incentive	Regulation	
	Family concern	Purchase behavior	Government	Frequency	Understanding	Purchase Behavior			
C	F	0.72	0.028	1.000	1.000	1.000	1.000	0.288	1.000
	E	0.003	1.000	1.000	0.069	1.000	0.002	0.079	1.000
	B	0.000	1.000	0.057	0.001	1.000	0.000	0.000	0.402
	D	0.270	0.196	1.000	0.000	1.000	0.000	0.004	1.000
	A	0.000	1.000	0.008	0.000	0.014	0.000	0.000	0.020

On the basis of our developed theory, the citizens can be divided into six groups. In order to prove the six groups are different from each other in reaction to the policy instruments, we used ANOVA. Because of length limitations, we just take the main result of ANOVA based on group C as an example. The result of analysis of variance (ANOVA) (Table 2) indicates that group C differs from the other five groups in eight items. Due to some limitations, however the complete analysis of variance cannot be presented in this paper. Other five groups gave the same analysis of variance, and the result proves that all the six groups are significantly different from each other. Therefore, our hypothesis on the classification model of citizen is proven.

4.2 The affecting factors of consumers’ energy efficiency household appliance purchase behavior

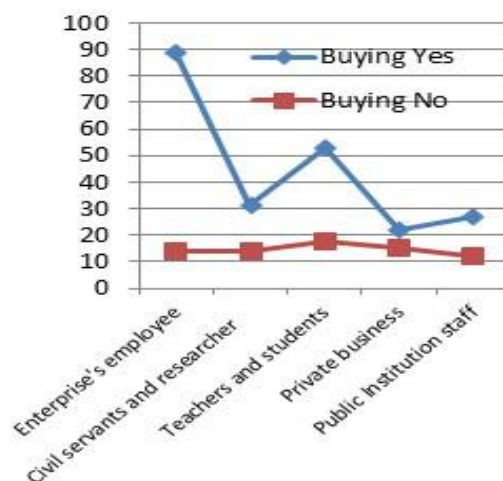
1). Internal influence

Regarding the analysis of variance (ANOVA), the ‘age’ and ‘occupation’ have important significant difference.

Table 3: Occupation and purchase behavior

Occupation	Buying		Total
	Yes	No	
Enterprise's employee	89 86.4%	14 13.6%	103 100%
Civil servant & researcher	31 68.9%	14 31.1%	45 100%
Teachers & students	53 74.6%	18 25.4%	71 100%
Private business	22 59.5%	15 40.5%	37 100%
Public Institution staff	27 69.2%	12 30.8%	39 100%

Fig.5 Occupation and purchase behavior



Combining with the descriptive statistics in Table3 and Figure5we can find that about 86.4%of enterprise's employees bought energy efficiency household appliance, which has the highest rate during the five occupations; followed by 74.6% of teacher and students who have the experience of buying energy efficiency appliance; while private business workers has the lowest buying rateamong the five occupation categories, with a percentage rating of 59.5%.

2). External environmental force

sBased on the analysis of variance (ANOVA) (Table4.), we found that there are three external environmental factors that have significant positive correlation to energy efficiency household appliance purchase behavior: environmental knowledge, environmental responsibility and conformity.

Table 4: Significance of external environmental factors

	Environmental knowledge	Environment Evaluation	Environmental responsibility	Conformity1 Families	Conformity2 behavior
Sig.	0.001	0.899	0.05	0.001	0.000

From the statistical perspective, an objective evaluation of environment does not have significant correlation with consumers' energy efficiency household appliance purchase behavior.However, it can be inferred from this result that evaluation of environment does not have statistical significant correlation, instead of no influence.

4.3 Influence of policy instrument

In the following empirical analysis, we focus in particular policy's influence on consumers' awareness and purchase behavior.

1).The effect of government appeals

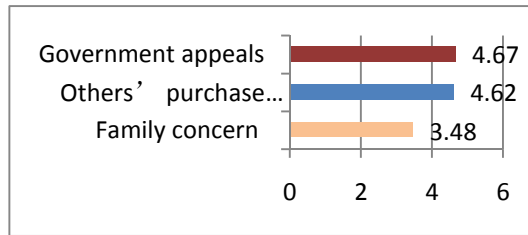
Respondents were asked to evaluate their external environment by answering three questions, which are aimed to compare the conformity and policy's potency. 45.1% of respondents agree with 'My family and friends are caring about environment protection', and 38.6% of respondents hold the neutral options about it, only 16.3% of consumers do not think so. Meanwhile, thefamily or friends' concern about environmental problem has significant correlation with consumers' energy efficiency household appliance purchase behavior as proven by ANOVA(Table5). When citizens were asked:'if the people around them would like to buy energy efficiency appliance, would they to follow'. Almost all the respondents (86.8%) thought they would like to do it. And its significance probability is smaller than criterion 0.05; majority of the respondents can be affected by others' purchase behavior. The consumers were also asked about their attitude towards the government appeals (which can be deemed to be a kind of representation of information provision), 84.4% of the respondents (249 people) said they would obey the policy. However, we found out those only 52 consumers who said they would abide by the policy bought energy efficiency household appliances. And the significance probability is 0.071 which is bigger than the criterion. Therefore, even if a lot of consumers provided positive response to theappealofthe government to buy energy efficiency appliance, results showed that not much people put it into practice.

Despite the significance probability, the results in Figure4 provide that the government has the biggest influence, 4.67, to consumers' awareness in the three external environmental factors. Followed by 'others purchase behavior's effect, even the family and friends' concern about environment may affect the final purchase behavior, its mean is still the lowest among the three factors.

Table 5: External Environmental influence

	Family concern	Others' purchase behavior	Government appeals
Sig.	0.001	0.000	0.071
Mean	3.48	4.62	4.67

Fig.6 External Environmental influence



2).Policy instruments: citizens' attention

How do consumers care about the three policy instruments in their daily lives? The fiscal incentive gets the highest average score, 3.31; followed by information provision which is 3.19; and regulation instrument owns the lowest attention 3.15. Anyhow, all the three policy tools do not receive too much attention from consumers. And on the basis of result of analysis of variance, there is no significant difference during the three policy tools attention.

3).Policy instruments: purchase decision

How do consumers evaluate the influence of fiscal incentive, information provision, as well as regulation instrument on their energy efficiency household appliance purchase behavior?

In terms of information provision, a large part of consumers (53.2%) responded that they would not buy any energy efficiency appliance unless they learned it from the government information channels. Meanwhile, the mean of its effect is 3.22. When citizens were asked the question: 'Only fiscal subsidy available, I'm willing to buy energy efficiency appliance', 50.9% of respondents agree with it, while 33.2% consumers disagree with it. And the mean of fiscal subsidy is 3.17, which is smaller than information provision. When people were asked to evaluate the effect of regulation instrument, 81.4% of consumers think that if the appliance meets the standards and requests of government, they would buy it. Remarkably, the mean of regulation instrument influence is the highest in the three tools (4.23).

Compared with the attention of the three policy tools we have analyzed above, the influence of three policy tools on consumers' energy efficiency household appliance purchase behavior is different; the transformation is presented in Figure 5.

Fig.7 Influence of policy instruments on purchase behavior and attention

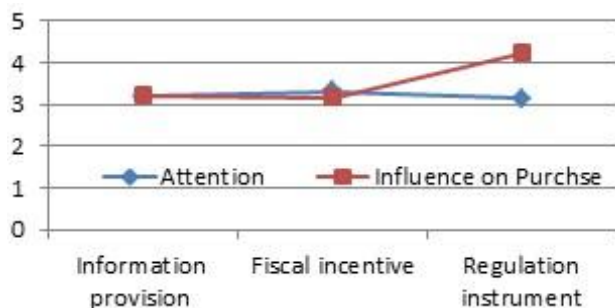


Table6: Result of analysis of variance

	Information provision	Fiscal incentive	Regulation instrument
Attention	0.802	0.321	0.937
Influence on Purchase	0.032	0.000	0.003

The different effects of information provision, fiscal incentive and regulation instruments are shown in Figure 5. The figure showed that the regulation instrument's role has the biggest transformation result. People are used to not paying too much attention on regulation instrument in their daily lives, in contrast, however regulation

proved the most influential factor among the three policy tools when people buy an energy efficiency household appliance. The other two policy instruments do not have significant changes with the effect and attention.

In spite of the attention attracting or influence on purchase consideration, do they have significant correlation to purchase behavior? Would the higher attention or influence lead to higher purchase rate? We used analysis of variance (ANOVA), and the result is shown in Table 6. Obviously, the three policy instruments' role is totally different. There is no significant positive correlation between attention to policy instrument and purchase behavior; by contrast, there is significant positive correlation between the influences of them on purchase behavior. This suggests that policy instruments' impact changes when people buy energy efficiency household appliance which is in line with our conjecture in model of citizens' energy efficiency appliance purchase behavior.

5. Conclusion

In this paper, we analyzed to what extent consumers are affected by the mechanism of public policy promoting energy-efficient household appliance the mechanism of it. In order to prove our hypothesis and new developed theory, we conducted a one month survey in China. Based on the results of this survey, we came up with the following conclusions:

Firstly, consumers' energy efficiency appliance purchase behavior can be affected not only by personal influence but also by external environmental forces. The most significant personal influence factors are 'age' and 'occupation'. The youth and enterprise employees as well as teachers and students have higher enthusiasm to purchase energy efficiency household appliances. Whilst, there are three external environmental factors that have significant positive correlation to energy efficiency household appliance purchase behavior: (1) environmental knowledge, (2) environmental responsibility, and (3) conformity. Secondly, as a kind of performance of policy instrument' influence, government appeal to buy energy efficiency household appliance has a major effect on consumers' purchase behavior, this influence is even bigger than the effects of the family's concern and others' purchase behavior. Thirdly, in the daily life, the environmental policy instruments do not receive too much attention from consumers. And the attention does not contribute to the purchase behavior of efficiency household appliances. Further, the influences of the three policy tools on consumers' energy efficiency household appliance purchase behavior are different with each other. Lastly, the regulation instruments have the most important influence on consumers purchase behavior.

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