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Ecologically Conscious Consumer Behavior and the Adoption of Green Electricity: from the Perspective of Innovativeness Characteristics

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Abstract

The intensity of public concern about global warming emissions has spiked. One practical solution is to implement “green electricity” such that the power is generated by more environmentally sustainable means. Past literature in the area of ecologically conscious consumer behavior (ECCB) provides the greatest insights on how the consumers can adopt the environmental friendly products and who would pay for high premium prices; but very few have studied the high-ticket product such as the solar power generator from the new product adoption perspective. The purpose of this research is to investigate innovativeness characteristics that would influence consumer’s buying intentions of “green electricity,” and to develop a workable platform for the government and enterprises to bring innovative green products onto the market. Our result indicates that ECCB is a significant factor in affecting the green electricity adoption. In addition, innovativeness characteristics are found to have a moderating effect on the relationship between ECCB and the adoption intent. Individuals who possess independent judgment making have higher tendency in adapting this high-ticket green electricity product.

Keywords: Ecologically conscious consumer behavior; Consumer innovativeness

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1. Introduction

Since the industrial revolution, people have used large amounts of coal, fuel, and other fossil fuels to pursue technology advancement and economic growth. The immeasurable cost is the increase of emissions of carbon dioxide and pollution. Nowadays, scientists and environmentalists have taken up the issue at a worldwide scale in dealing with global warming and protecting natural ecosystem.

With the intensity of public concern about global warming emissions, one practical solution is to implement “green electricity” such that the power is generated by more environmentally sustainable means.

Green electricity is defined as electricity generated from renewable sources of energy; it is distinguished from conventionally generated electricity by its relatively low pollution emissions, and is typically marketed at prices ranging from 10% to 30% above the price of conventional electricity (Kotchena and Mooreb, 2007). Wind, solar, hydrogen, geothermal, biomass, landfill gas, and waste incineration, all refer to renewable and non-polluting energy sources.

Green electricity is becoming increasingly available now, many countries dedicated to promote it to protect the environment. For example, China, the second largest electricity industry in the world, its 10th Five Year Plan species goals including producing a

Renewable Energy Development Plan. The Renewable Energy Promotion Law came into effect on January 2006 as government policy for promoting the development and utilization of renewable energy, improving the energy structure, diversifying energy supplies, and so on. Yet, this law does not specify the suggestion of tariff reductions which could provide a further incentive for R&D investment in technological innovation amongst market participants (Cherni and Kentish, 2007).

Several EU countries follow feed-in tariff strategy for promoting renewable energy sources (RES), such as Austria, Belgium, Denmark, Finland, France, Germany, Greece, Luxembourg, Portugal, Spain, and Sweden; other countries use quota obligation, tenders, exemption from energy taxes, parts of the revenue of energy taxes finance RES (Reiche and Bechberger, 2004).

As increased attention to the need for a sustainable hydrogen energy system, competition has emerged between nations; Iceland, China, Germany, Japan and the US in the race to commercialize hydrogen energy vehicles in the 21st Century (Solomon and Banerjee, 2006). Financial commitment was announced in most of these countries to support their energy R&D program.

The governmental commitments to the employment of policy instruments have raised issues concerning evaluation. However, Taiwan lacks self-produced

energy – 98% of energy is relied on imports. Moreover, 76.3% of Taiwan's electricity is generated by burning coal and natural gas in power plants which release millions of tons of carbon dioxide every year that damages human bodies.

To protect the environment and to release the heavy burden of electricity supply from Taiwan Power Company (TPC), exploring green power is an urgent concern for the Taiwanese people. However, research issues on who the potential purchasers of green electricity are and what makes people purchase more expensive green power instead of conventional power system remain open questions.

Previous studies have mostly been undertaken to factors influencing cost reductions in green power such as photovoltaic from cost perspectives (Albrecht, 2007; Nemet, 2006; Zwaan and Rabl, 2004); and ascertain how much of a premium for green electricity people would be willing to pay from economic perspectives. But for marketers, another important task is to identify which consumers are willing to pay more.

Only limited attention has been paid to profile the potential purchaser of green electricity or environmentally friendly products (e.g. Laroche et al., 2001; Rowlands et al, 2003), proposed that those who would pay higher premiums for green electricity possess particular characteristics.

In those characteristics (including demographic, attitudinal, psychological, behavioral, and socialization), ecological concern can best identify the potential purchasers. This research focuses on ecologically conscious consumer behavior to discuss the adoption of green electricity.

Moreover, we probe into consumer innovativeness characteristics. The concept of innovativeness is related to the new product adoption process, so as to help marketers be able to accurately identify 'early adopters' of green electricity, develop strategies targeted at these consumers, and then to capture a significant share of this new market.

To synthesize, the purpose of this paper is to provide some insight into Taiwanese consumers' demand for green energy services that promise more favorable environmental characteristics. The results from a designated survey in eliciting the effect of consumer innovativeness on green power adoption and ecologically conscious consumer behavior are presented.

The main contribution lies in the combination of ecologically conscious consumer behavior with consumer innovativeness characteristics applied to the adoption of green electricity. This can contribute to the growing body of literature on the adoption and diffusion of innovations. The more comprehensive framework is conducive for the government and enterprises to bring and promote innovative green products onto

the market.

2. Literature Review

2.1 Ecologically Conscious Consumer Behavior (ECCB)

The concerns over the ecosystem and living environment have become a dominant social topic. From the early 1960s that focused on environmental pollution and energy conservation to the very recent issue of global warming, individuals and the public alike have demonstrated great concerns on environmental policy and compliance.

Ecologically conscious behavior is defined as an evaluation or an attitude toward one's own behavior or others' behavior in consequences of the environment (Fransson and Gärling, 1999). Recent studies have applied another term, environmental concerns, to refer to the whole alignment of environmentally related emotional arousals, attitudes, perceptions, values and behaviors (Bamberg, 2003).

The degree of environmental concerns has a direct and positive impact on people's behavior in specific environmentally related domains, such as recycling, energy saving, and buying environmentally friendly products. It has been suggested that individuals with higher levels of environmental concerns should be more likely to engage in ecologically conscious consumer behavior (Shetzer et al., 1991).

Therefore, we can posit that *ecologically conscious consumer* will

scores higher on the measure of *environmental concerns*, while the progress toward solving environmental problems is likely to depend on *ecologically conscious consumer behavior (ECCB)* that resolving the environmental concerns.

2.2 Consumer Innovativeness

Rogers (1995) defines *innovation* as an idea, practice or object that is perceived as new by an individual or an adoption unit. The definition implies that an innovation can take various forms or appearances, either a tangible product or an intangible service or pattern.

Individuals who adopt these innovations relatively earlier than others are thought to have *innovativeness* in their characteristics. Innovativeness is frequently used as a measure of the degree of 'newness' of an innovation adopted by those "innovators" (Garcia and Calantone, 2002). Related issues are investigated in areas of behavioral and social sciences and have received great attention by consumer researchers.

Consumer innovativeness is a concept studied in consumer psychology as a linkage to the adoption of new products. It is based on the belief that communicated experiences from others may affect a person's decision-making (Midgley and Dowling, 1978). Consumer innovativeness refers to the tendency to willingly embrace change and try new things (Cotte and Wood,

2004), and to buy new products more often and more quickly than others (Roehrich, 2004).

Hirschman (1980) argued that innovativeness is more likely to be socially influenced than a personality trait. She proposed the idea of inherent novelty seeking which is ‘the desire of the individual to seek out novel stimuli’. Manning et al. (1995) adopted Hirschman’s “consumer novelty seeking” and proposed two constructs of consumer innovativeness related to new product adoption: *consumer independent judgment making* (i.e., the degree to which individuals make innovative decision independently of the communicated experiences from others) and *consumer novelty seeking* (i.e., the desire to seek out new product information).

Consumer independent judgment making is ‘the degree to which an individual makes innovation decisions independently of the communicated experience of others.’ In other words, individuals with high independent judgment making do not rely on interpersonal communications in making the purchase decisions.

2.3 Global Innovativeness

Global innovativeness is an abstract of personality traits. Kirton (1989) provided a theoretical measure of global innovativeness as a cognitive style and personality-like construct. Goldsmith et al. (1995) regarded global

innovativeness does not tie to any specific object, compared with *domain-specific innovativeness* and *concrete innovativeness*.

Personality researchers contend that all generalized personality traits fall within five dimensions, known as the five-factor models (Buss, 1996). The five factors are Openness (to experience), Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Emotional Stability) (OCEAN). Global innovativeness can be subsumed within the *openness-to-experience* dimension, since the propensity to be innovativeness would require a predisposition to be open to new experience (Vishwanath, 2005). This includes a series of behaviors, such as meeting new people and seeking out new information about innovations. Hence, innovators tend to have more social participation and have greater exposure to mass media than late adopters.

In brief, we can summarize that global innovativeness is a personality trait that measures consumers’ need for uniqueness and the predisposition to purchase new products rather than to remain with previous consumption patterns.

3. Conceptual Framework

The purposes of this study are to integrate relevant literature and to develop a comprehensive research framework for the government and enterprises for bringing innovative green

products onto the market. Figure 1 shows our conceptual framework.

From the previous section, it has demonstrated that people's environmental attitude and behavior correlate with the involvement of ecologically conscious consumer behaviors (ECCB). It can be assumed that ECCB would influence their intention to adopt green products. Also, it can assume other psychographic characteristics, such as innovativeness characteristics, have moderating effects on this relationship. Few articles had addressed innovativeness characteristics into discussion, and this becomes the major contribution of our research.

In order to present different innovativeness characteristics, we take *consumer innovativeness* as the behavior aspect and *global innovativeness* as the psychological aspect. Furthermore, we use clustering analysis to classify all respondents by investigating their innovativeness characteristics.

To sum up, this research introduces *innovation adoption* as the dependent variable, *ECCB* as the independent variable, and *innovativeness*

characteristics as the moderator.

4. Research Hypotheses

4.1 The Role of ECCB

According to the conceptual framework above, two hypotheses are needed to be examined. The first one is that ecologically conscious consumer behavior (ECCB) has a direct effect on the intention of green electricity adoption, and the second is that innovative characteristics will moderate this relationship between ECCB and the adoption intention.

From the literature review, we know that people engage in ECCB will be more conscious of the environment (Shetzer et al., 1991); the perception about the ecological problems might influence their willingness to pay more for ecologically compatible products (Laroche et al., 2001).

In other words, a positive attitude toward improving the environment can be a significant predictor of purchasing environmentally safe products (Minton and Rose, 1997). People considering the adoption of green power may be influenced by their feelings of moral

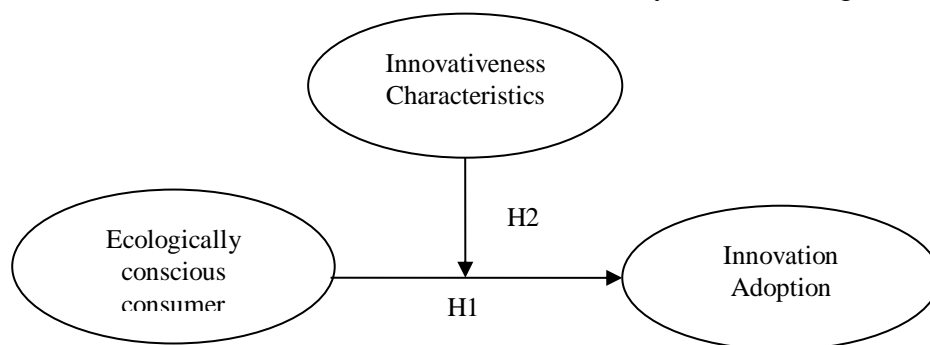


Figure 1 Conceptual Framework

responsibility; the more they feel responsible for the environment, the higher the probability of adoption of green power will be (Arkesteijna and Oerlemans, 2005).

With regard to study about green electricity, Rowlands et al (2003) addressed that those who would pay higher premiums for green electricity are more likely to possess particular demographic, attitudinal, and socialization characteristics. In which attitudinal characteristics specifically ecological concern, liberalism and altruism best identify the potential purchasers of green electricity.

Ecological concern is an individual's general environmental attitude and perception of the necessity for societal change corresponding to the concept of sustainable development (Blaikie, 1992; Scott, 1999). It can be inferred that people with higher level of ECCB implies the ecological concern so that to do their green energy choices that have consequences for the environment.

This study does not direct survey consumers' actually purchase of green electricity because this product is just heading for introduction stage. In view of Fishbein and Ajzen (1975) theory of reasoned action, an individual's performance of a specified behavior is determined by his or her behavioral intention to perform the behavior. This behavioral intention is decided by one's attitude and subjective norm concerning the behavior.

Although linkages between environmental attitudes and behaviors have been concluded that such relationships are tenuous, behaviors consistent with high concern over the environment may be lacking (Roberts and Bacon, 1997; Scott 1999). Respondents willing to spend more for green products may not actually do so in reality (Laroche et al., 2001). However, the subjects for this study are adopters that have set up solar heating system in their houses, who actually and consciously paid higher prices for green products.

Several researches reveal that people made conscious efforts in the past may be a predictor of early adoption behavior, if they showed actual environmental behavior in the past, the probability that they will adopt green power raised (Arkesteijna and Oerlemans, 2005; Derksen, 1990; Minton and Rose, 1997). Whereas subjects in this research are solar heating system adopters, their intentions had transformed into actual behavior. These users were expected to provide information on predicting actually green consumption behavior.

Since green electricity is produced from environmentally friendly sources, it is not surprised that people with higher level of ECCB will be more willing to adopt green electricity. Thus, the hypothesis we assumed is that:

H1: An individual's level of ECCB positively relates to the intentions of green electricity

adoption.

4.2 The Role of Innovativeness

Previous survey has shown that on average, as many as 90 percent of respondents in a given sample expressing high level of environmental concern (Minton and Rose, 1997). However, people who are ecologically conscious of the environment do not necessarily buy or adopt green products. Factors affecting their willingness are many, but we want to identify the driving factors that push people to adopt.

To rest on Cotte and Wood (2004) and Roehrich (2004), innovativeness is the tendency to willingly embrace change and try new things, and to purchase more quickly than others. The ‘innovators’ of any innovation are those members of society prepared to adopt the new product early in its diffusion (Midgley and Dowling, 1978), and transforms consumer actions from routinized purchasing of a static set of brands and products to dynamic behavior (Hirschman, 1980).

For this reason, we assume that individuals’ levels of innovativeness may influence both their intentions of green electricity adoption and high levels of ECCB. Therefore, we assume the hypothesis is:

H2: The relationship between ECCB and adoption will be moderated by innovativeness characteristics.

In the following section, we develop

our research methodology and design the questionnaire to examine these two hypotheses.

5. Methodology

5.1 Subjects

According to the choice experiment estimating consumer preferences and willingness-to-pay for voluntary participation in green energy electricity programs conducted by Borchers et al. (2007), individuals have a preference for solar over a generic green and wind.

To be aimed at solar power, there have been a small number of people who are using solar power to generate electricity in Taiwan, namely Photovoltaic Power Generating System (P.V. System). These adopters are mainly organizations come from government apparatus, schools, and enterprises. Few are individuals who set solar system on their house roofs. Most people start using environmental P.V. System from *solar heating system* to generate hot water in their houses. Why would they adopt solar system and how can we launch innovative green products or service are we want to know. Such an understanding is especially essential for predicting a success of launching energy generation sources by the government and enterprises.

Owing to Taiwan government endeavors to promote solar heating system installation, provide reimbursement to those who adopt, solar heating system is the only

commercialized solar energy application. Among all of the green energy application, it is the most widespread energy used, there have been 170 thousand solar heating users until 2007. Because of the well-development of solar heating system, we take solar heating users as our research subjects to conduct this study.

The research subjects for this study are *decision-makers and users* that have adopted solar heating system in their houses. As a result, we focused on the sampling unit as the household head. The sampling frame is generated from the panel study of the Solar Energy R&D Foundation in National Cheng Kung University (NCKU) in the amount of 500 solar heating system users.

A structured questionnaire was designed to gather the data required for this research and accordingly mailed to these subjects. Postage paid envelopes were also enclosed for replies. Aside from the paper-based mail, this research posted the questionnaire on an Internet questionnaire survey service; hope to let more people get the investigation message for enough sample size.

5.2 Questionnaire Design

The research questionnaire was made up of three parts that measure different hypothetical constructs. Part 1 is the behavior investigation in understanding the usage experience and satisfaction toward the solar heating system.

Part 2 investigates their attitude

toward ecological consciousness and innovativeness characteristics, including consumer innovativeness, global innovativeness, and ECCB. All the items are acquired from previous research studies (see Table 1) to ensure content validity. Each question was measured on a five-point Likert scale (strongly disagree to strongly agree).

Part 3 collects demographic characteristics of these respondents, such as age, education, family income, residential information, and so on.

A four-page questionnaire is used as the research instrument. Prior to sending the survey, a pre-tested was done on ten solar heating users. These respondents were asked to provide comments on the relevance and wording of the questionnaire items, length of the survey and time taken to finish it. Afterwards, the reliability and validity of items were examined. Based on the feedback, several items were modified to improve clarity.

The formal self-report survey was conducted after the pre-test. Data were gathered mainly through paper-based mail delivery survey, and partly through an Internet questionnaire survey service. Respondents were restricted to those who adopt and use solar heating system in their houses. This questionnaire survey lasted for about two weeks, from February 25th to March 7th, 2008.

Table 1 the Reference of Constructs and Number of Items

Construct	Reference Work	No. of Items
Consumer Innovativeness	Manning, K.C., Bearden, W.O. and Madden, T.J. (1995), "Consumer Innovativeness and the Adoption Process", <i>Journal of Consumer Psychology</i> , 4 (4), 329-45.	12
Global Innovativeness	Hurt, H.T., Joseph, K. and Cook, C.D. (1977), "Scales for the Measurement of Innovativeness," <i>Human Communication Research</i> , 4(1), 58-65.	6
ECCB	Roberts, J.A. and Bacon, D.R. (1997), "Exploring the Subtle Relationships between Environmental Concern and Ecologically Conscious Consumer Behavior", <i>Journal of Business Research</i> , 40, 79-89.	6

5.3 Measures and Validation

5.3.1 Ecologically conscious consumer behavior (ECCB)

Since individuals who engage in ECCB have a higher level of environmental concern than other people, this study defined ECCB as 'the level of respondents' concern and behavior toward environment-related issues'. People who engage in ECCB are assumed to buy environmentally friendly products, or products that can be recycled.

The items were selected from the standardized ecologically conscious consumer behavior (ECCB) scale developed by Roberts and Bacon (1997), which asked respondents to rate the veracity of various statements regarding their behavior regarding environmental product attributes. For example, "I have switched product for ecological and

environmental protection reason", "Whenever possible, I use my own shopping bag in superstore", "I have purchased light bulbs that were more expensive but saved energy", and so forth.

Reliability tests were conducted on each factor. The scale showed a standardized $\alpha=0.7835$, which is above the average of 0.70 recommended to establish a scale's reliability (Nunnally and Bernstein, 1994).

Factor analyses were applied to evaluate the ability of the items to measure each construct; performed using the maximum likelihood method to extract the factors. A factor analysis showed that all items loaded on 1 factor, and, all the loadings are greater than 0.6.

5.3.2 Consumer Innovativeness

The operational definition of consumer innovativeness was 'the degree of the respondents to accept

change and try new things and buy new products more actively and more quickly than others’.

The scale developed by Manning et al. (1995), including two dimensions, consumer independent judgment-making (CIJM) and consumer novelty seeking (CNS). Items are such as “I ask friend or neighbor about his or her experiences with a new product if the new product is expensive”, “I often seek out information about new products and brands”, etc.

This research use five-point Likert statements anchored strongly disagree to strongly agree to measure this construct; yet, the original scale of CIJM is assessed by a five-point, agree-disagree response format, we hence inversed code respondents’ answers for further analysis.

The scale yielded a standardized $\alpha=0.8436$ and 0.8533 . A factor analysis showed that items loaded on 2 factors, all the factor loadings are much greater than 0.6.

5.3.3 Global Innovativeness

From the literature reviewed, the construct of global innovativeness is an abstract personality trait related to openness to experience and measures consumers’ need for uniqueness. For this reason, this study defined global innovativeness as ‘the degree of the respondents’ need for uniqueness’.

To assess global innovativeness, it is referred to Goldsmith et al. (1995)’s

question items that are selected from HJC scale (1977). Items are such as “I am reluctant about adopting new ways of doing things until I see them working for people around me”, “I rarely trust new ideas until I can see whether the vast majority of people around me accept them”, etc.

The original scale is measured by agree-disagree response format, we also inversed recode respondents’ answers. The scale yielded a standardized $\alpha=0.8720$. A factor analysis showed that all items loaded on 1 factor, and, all the loadings are much higher than 0.7.

5.3.4 Adoption

The dependent variable, adoption of solar energy, was defined as ‘the level of respondents’ willingness to use green electricity’; measured by asking respondents to the willingness to recommend friends or neighbors to install solar heating system and the intention level to adopt other solar energy products, which are available but expensive five times than solar heating system. Some information about solar energy generator was provided in the end of the questionnaire for respondents to refer to.

6. Result

6.1 Preliminary Analysis

In order to test the proposed model, we included the main effect ECCB, the moderating effect innovative characteristics, and the dependent

variable adoption. We have collected 205 respondents. There are 23 invalid questionnaires, this yields 182 completed forms retained for further analysis.

Among all valid data, 132 were retrieved from paper-based while 50 were acquired from internet; a test for homogeneity was required as the responses came from two different sampling methods. This research used location as the operating variable (design variable); p -value is 0.1009, which means the survey from paper-based and from Internet do not differ significantly; therefore, can be regarded as a single homogeneous sample.

Table 2 shows a brief profile of respondents. Our sample is composed of a majority of male respondents (64 percent), live in townhouse (90 percent), married (76 percent), and ageing above 51 years old (37 percent). Nearly half are university graduates (52 percent), have a household income of at least 50 thousand NT dollars (66 percent), and live in southern Taiwan (46 percent).

This preliminary analysis reveals that male predominate most of the decisions in their family, and people who have taken high education tend to adopt innovatively environmental products. Age more than 50 years old has the most solar heating users, but also many users below it; expresses that young people may have environmental consciousness as elder people. Most respondents live in

central and southern Taiwan, and house type belong to townhouse, for the reason that solar heating system are easier to install and use for one family.

This research also investigated the reasons why respondents adopt solar heating system. Most people want to save energy (80 percent), and solar energy is the easiest to leadoff. Safety (67 percent) and environmental protection (63 percent) are also what they concern. 24 percent of respondents are encouraged by government reimbursement, indicates that promoting green energy still needs the boost and reward from the authorities.

As consumers' usage behaviors, almost 70 percent have used this system for four years or longer; 86 percent of the respondents spend less than 80 thousand NT dollars after deducting the government reimbursement. Respond to what we mentioned that many people adopt the solar heating system for the reason that it can save energy, 78 percent think this system really help them save monthly electricity and gas fee.

Another issue that deserves to be mentioned; about 70 percent of users are satisfied with the solar heating system, only 4 percent users are not satisfied with it. This displays that the solar heating system functions well, and can really achieve consumers' expectations.

6.2 Clustering Analysis

Cluster analysis is a class of techniques used to classify objects into

Table 3 Factor Results of Innovativeness Variables

Factor	Items (Factor loading)	<i>Eigenvalues</i>	Cumulative variance (%)
Factor 1 Uniqueness -oriented	Trust new ideas until majority accept (0.8474)	4.6763	25.98
	Others must use then I would consider (0.8324)		
	I feel old way is the best way (0.8268)		
	Usually one of the last to accept new (0.8120)		
	Reluctant adopting ways until working (0.7689)		
	I am cautious about accepting new (0.5530)		
Factor 2 Novelty -seeking	Like to go to exhibitions (0.8033)	3.8518	47.38
	Look for new things improve quality (0.7867)		
	Often seek out new information (0.7325)		
	Seek new thing improve environment (0.7297)		
	Like magazines introducing new brands (0.7275)		
	Spending time checking out new brands (0.6860)		
Factor 3 Independent -judging	Rely on friends to give detailed info (0.8675)	2.1355	59.24
	Rely on positive and negative opinions (0.8554)		
	Rely on experienced friends to decide (0.7608)		
	Ask experienced friends about valued (0.6700)		
	Confer experienced or new service (0.6439)		
	Confer experienced to new product (0.6162)		

relatively homogeneous groups, namely clusters. To better capture the green power consumption behavioral patterns, we cluster the respondents based on the factor scores (see Table 3) of the (consumer and global) innovativeness variables into two groups: *independent-judging adopters* and *futuristic adopters* (see Table 4).

The number of factors extracted is decided by Kaiser's rule, taking principal components with eigenvalues greater than 1. Totally three factors explain 59.24% of the total variance; this research named these factors

according to their principal items. Factor 1 is labeled as "Uniqueness-oriented", factor 2 is "Novelty-seeking", and factor 3 is "Independent-judging".

K-means clustering was applied to conduct non-hierarchical clustering. Based on the CCC (Cubic Clustering Criterion) and the relatively sizes of the clusters is meaningful, cluster number equals two is the best results. Consequently, we use the innovativeness variables to classify the respondents into two groups and check whether the two clusters differ from each other. Since the *p*-value of Wilk's Lambda is

significantly smaller than 0.001, and the eigenvalue is greater than 1, we conclude that the cluster 1 significantly distinguishes from the cluster 2. Two clusters were named respectively. As cluster 1 has relatively high values on variable factor 3; hence be labeled as “*Independent-judging adopters*”. In the same way, cluster 2 has relatively high values on variables factor 1 and factor 2, be labeled as “*Futuristic adopters*”.

Table 4 Cluster Summaries

Cluster	Frequency
1. Independent-judging adopters	N=50 (27.5%)
2. Futuristic adopters	N=132 (72.5%)

6.3 Hypothesis Testing

Regression analysis is applied to examine the hypothesized causal relations between constructs. In this section, the relationship between the dimensions is explored by using regression analysis to investigate the

following causal paths: (1) ECCB has impact on the intention of green electricity adoption. (2) The relationship between ECCB and adoption will be moderated by innovative characteristics.

With respect to the effect of ECCB, H1 posits that an individual’s level of ECCB positively relates to the intentions of green electricity adoption. This hypothesis was supported ($R^2=0.073$, $F=14.17$ and $p<0.001$), which indicates that ECCB is significantly associated with green electricity adoption (see Table 5).

Our framework also posits innovativeness characteristics as a moderator, which has an influence on the relationship between ECCB and the intention of green electricity adoption. The two clusters of innovativeness characteristics analyzed above are transformed as dummy variables. The interactive effect of innovativeness characteristics and ECCB on green electricity adoption is denoted as “*ECCB* Innovative Characteristics*”.

Table 5 Simple Regression Analysis: ECCB

Dependent variable=	Standard Coefficient Beta	t-value	Significance
Adoption	(β)		(p-value)
(constant)	2.0795	5.35	<0.0001***
ECCB	0.3693	3.76	0.0002***
R-square (R^2)		0.073	
F		14.17	
P		0.0002***	

Note: “***” represents that the coefficients are significant at 0.001 or above, “**” represents that the coefficients are significant at 0.01 or above, “+” represents that the coefficients are significant at 0.1 or above.

Under the significance level of 0.1, the p-value of *ECCB * Innovativeness Characteristics* is 0.0760, which illustrating that innovativeness characteristics has a moderating effect – that is, the relationship between ECCB and the green electricity adoption will be affected by people’s innovativeness characteristics. The statistics $R^2=0.0937$, $F=6.14$ and $p<0.001$ indicate that the framework in Figure 1 is supported, and the moderator interacts with the relationship between ECCB and the adoption (see Table 6).

We further conduct a regression analysis to clarify the moderating influence. To discuss the interactive influence of a continuous and categorical variable on the dependent variable, this research applies the ATI (Attribute-Treatment Interaction)

regression analysis, which is common in psychological and educational research.

For the two different clusters classified above, this yields two different regression models where $X = \text{Innovativeness Characteristics}$.

For cluster 1 (independent-judging adopters, $N=50$), the result is $t=3.45$ and $p=0.0012$, the p-value reaches the level of significance. We can present their relationship by a regression model:

$$Y_{\text{independent-judging adopters}} = 0.8807 + 0.6582X$$

For cluster 2 (futuristic adopters, $N=132$), the result is $t=3.45$ and $p=0.0221$, the p-value reaches the level of significance. In the same way, we present the relationship by a regression model:

$$Y_{\text{futuristic adopters}} = 2.5249 + 0.2633X$$

Table 6 Multiple Regression Analysis: Innovative Characteristics as Moderator

Dependent variable=	Standard Coefficient Beta	t-value	Significance
Adoption	(β)		(p-value)
(constant)	2.5283	5.61	<0.0001***
ECCB	0.2642	2.32	0.0217*
Innovative Characteristics	-1.6576	-1.88	0.0612 ⁺
ECCB* Innovative Characteristics	0.3984	1.79	0.0760 ⁺
R-square (R^2)		0.0937	
F		6.14	
P		0.0005***	

Note: “***” represents that the coefficients are significant at 0.001 or above, “**” represents that the coefficients are significant at 0.01 or above, “+” represents that the coefficients are significant at 0.1 or above.

We can see that if individuals are independent-judging adopters, the influence of innovativeness characteristics has a higher positive influence on the relationship between ECCB and the innovation adoption than that of futuristic adopters, as shown in see Figure 2. This reflects the complexion of moderating effects.

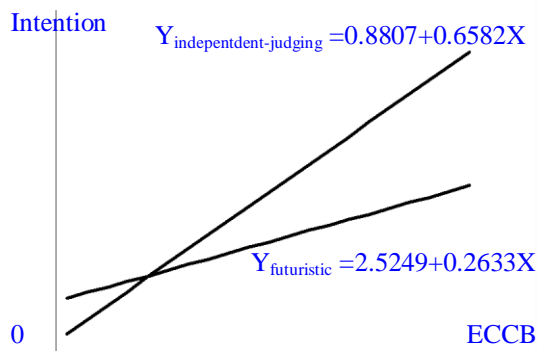


Figure 2 Regression of Two Innovative Clusters

7. Discussion

This study focuses on individuals' ecologically conscious consumer behavior (ECCB) and innovativeness characteristics construct and its moderating effect on the relationship between ECCB and the intention of green electricity adoption.

Both our hypotheses are supported. ECCB is found to be a significant factor in affecting the adoption of green electricity. Innovativeness characteristics are found to have moderating effect on the relationship between ECCB and adoption. Besides, two innovativeness characteristics, independent-judging and futuristic, have different moderating

effects. Individuals who are independent judging, the influence of innovativeness characteristics has a higher positive effect on the relationship between ECCB and the intention of green electricity adoption.

7.1 Theoretical Contributions

Our first contribution is to bring innovativeness into consideration. From the literature review, we know that many factors would have impacts on individuals' ecologically conscious consumer behavior (ECCB), but very few have studied the relationship between ECCB and their intention of innovative green energy adoption. Some researchers have discussed the importance of ECCB on environmental concerns, but most of them did not take further studies. In this research, we investigate the innovativeness as a moderating role in green energy adoption.

Second, the sampling plan is hard to choose and implement for innovation adopters. Though we know that natural resource shortage has made a lot of people aware of the problem, this awareness does not necessarily push every one of them to adopt green products. Therefore, identifying those "innovator" to match our study objectives is difficult. Our *solar heating system users* have provided plenty of information on green consumption behavior.

Third, green energy consumption is a

very critical research topic. As we mentioned that since Taiwan lacks self-produced energy, 98% of energy is relied on import, and about 76.3% of the electricity is generated by burning coal and gas in power stations, that releases millions of tones of carbon dioxide every year. To develop and promote green electricity is a critical and urgent issue. We hope that our research can provide an insight for the government and enterprises to understand Taiwanese ECCB for environmental products.

Last, this is a very first study on green energy consumption conducted in Taiwan. Since the respondent is hard to identify. This illustrates our contribution for further research.

7.2 Managerial Implications

First, enterprises can start from market segmentation to push and promote green electricity. We can encourage people with different characteristics by different ways. From the research results, we know one distinct segment; the independent judging adopters tend to have higher intention of green electricity adoption. We think these people are environmentalists alike, so they are less concerned about the cost or inconvenience, contrarily, they would definitely adopt green energy if these green electricity is friendlier for the environment.

Second, ECCB plays a key factor in the adoption process. Most people who

are willing to use solar heating system have a higher concern about environmental issues. Most adopters are innovators who do not care about the cost of green products, even when using such products or service would bring them some inconvenience in their life.

However, the critical obstacle towards the path of solar innovation might be the consumer behavior. Homeowners are slow to adopt the expensive water heaters for new solar solutions. Reliability is also an issue: while current solar technologies have proved relatively durable, it is unknown how resilient the next generation would be. Fortunately, entrepreneurs in the land who ignored in the past now embraced as one of the next big things, solar energy may gain traction in the near future.

From a practitioner's perspective, the findings of this study suggest several indicators for identifying consumer innovative characteristics and their ecologically conscious behavior. These can help the government and enterprises in better allocating their marketing resources and improving the chance of innovative green product success.

7.3 Limitations and Directions for Future Research

Our study intends to provide new insights for the government and enterprises to promote innovative environmentally friendly products. However, there are several limitations

that become barriers for further research expansion.

First, the sample frame is considered as a limitation. Solar energy is a new and unfamiliar topic to many people in Taiwan, and that becomes a big problem for us to find an environmental product to conduct our study. Although the results from the solar heating system are significant, it is questionable whether the results from such specific group can be generalized to the general public on green electricity promotion.

Second, there are many factors influencing individuals' decision-making. The solar power module technology is not mature and is still under development. Relevant green products usually have a higher price than conservative ones. Except for the price, there are other factors may influence individuals' intentions of the adoption. This certainly limits follow-up discussions.

Finally, we did not discuss perceived risk which many people take it seriously when they buy new products or use new service. Perceived risks that might become salient in different aspects of consumer innovativeness are another interesting avenue for future researches.

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