

The Rising of Green Society: Low-Carbon Consumption as a Result of Environmental Education in China

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ABSTRACT

This article analyzes the factors that influence low-carbon consumption of college students, with the purpose of guiding environmental education in Chinese universities. To that end, a theoretical framework is proposed on the basis of interviews with several groups in combination with literature analysis using grounded theory and empirical verification methods. The study finds that external environment changes, individual psychological awareness, individual living habit, product technology development and low-carbon consumption intention are positively related to low-carbon consumption patterns. Finally, this paper points out that cultivating environmental education concepts of college students should make full use of different policy tools and adhere to the following principles: the combination of various policies and measures, the participation of multiple stakeholders, the popularization of low-carbon concepts, the demonstration of governments, the effectiveness of mass media, clearly defined laws and regulations and informal system construction.

Keywords: low-carbon consumption, environmental education, grounded theory

INTRODUCTION

Reducing carbon emissions, coping with climate change, and educating the public about desirable environmental behaviors are the focus of international community. Faced with increasingly serious environmental problems around the world, the Stockholm Conference on Human Environment was held in 1972. It was the starting point of global environmental education campaigns. In 1977, United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations (UN) Environment Program initiated a conference on environmental education in Tbilisi, the former Soviet Union. In 1987, the World Commission on Environment and Development released the report of *Our Common Future*. In 1992, the Earth Summit put forward the Agenda 21. Recently, environmental education has become necessary general knowledge for citizens, as well as common international responsibilities. In 2007, the UN Climate Change Conference held in Bali, Indonesia is a milestone that formulated the "Bali Roadmap" concerning how to combat climate change and played a positive role in moving the world towards a low-carbon economy. In 2008, there was a discussion about accelerating the low-carbon society development at the Forum of Ministers of Environment in Monaco. In the same year, United Nations Environment Programme (UNEP) set the theme of World Environment Day as "changing traditional concepts and promoting a low-carbon economy."

Since 2013, Beijing Environmental Monitoring Center has repeatedly reported the smog index of "Out of range". As the smog and haze weather aggravate, residents are gradually realizing that carbon emissions have adverse effects on human health. As an international topic, the Energy White Paper came up with the concept of low-carbon economy in 2003. In particular, it calls for actions to control greenhouse gas emissions, promote a low-carbon transition in economic development and develop energy conservation technologies at a Copenhagen conference in the next few years. Furthermore, the 18th National Congress of the Communist Party of China described the ecological protection issue as a single section for the first time. It proposed a basket of long-term strategies for low-

Contribution of this paper to the literature

- Explaining low-carbon consumption behavior through grounded theory, exploring specific causes of low-carbon consumption behaviors of college students, clarifying factors between subject and object, establishing a theoretical framework, and then using questionnaire as the basis for quantitative analysis to verify the previous theoretical framework.
- Analyzing the stability and validity of factor loading, factor covariance and path coefficient in terms of theoretical framework model and empirical framework. It contributes to cross-cultural research on related topics. The study comprehensively applies multiple questionnaire designs, and innovatively combines with institutional analysis and the framework of model analysis.
- Through identifying factors of low-carbon consumption, the study builds a low-carbon consumption model and put forward feasible suggestions and policies for public sectors to guide low-carbon intentions and environmental education of college students.

carbon economic development, developing emerging industries and new technologies. In addition, it is necessary to improve fiscal and taxation policy support for low-carbon development, formulate low-carbon development laws and regulations, establish low-carbon consumption concepts, encourage green-travelling modes, and launch the “Five Provinces and Eight Cities” project for low-carbon development pilots. China’s 13th Five-Year Plan also stressed the unprecedented opportunities and challenges of environmental protection. We must strengthen environmental regulation and assessment, formulate carbon emission standards for key industries, achieve environmental quality improvement and reduce emissions of pollutants, which in turn has led to a transition in the mode of economic development to low-carbon economy. The chairman of Xi Jinping believes that “Environmental development results in prosperity of civilization”. Therefore, the economic and social development evaluation system should reflect the ecological protection and construction indicators. The country should promote green development, low-carbon development and recycling development to form a good economic development model and establish a resource-saving and environment-friendly society. Constructing low-carbon countries and developing low-carbon cities are the requirements of sustainable development and represent the human well-being and responsibilities. There are more than 200 cities adopting low-carbon policies as the goal of economic development in China, such as Shanghai where the World Expo2010 reflecting the concept of low-carbon development from site selection to the operation. Hangzhou also introduced 50 “Low-carbon Deals” to promote the six in one Construction. Under the globally background of actively exploring low-carbon development mode and improving environmental quality, policy supports from home and abroad, contributions from consumers of low-carbon consumption to create sustainable and healthy environmental education, are all the requirements for developing a low-carbon economy. In response to global warming, energy conservation and emission reduction have become important parts of the global social, economic and environmental sustainability discourse. The construction of low-carbon consumption mode is an important means to promote environmental education.

Beijing is an important economic and political city in China, but one of the cities suffering from pollution seriously. The media has paid significant attention to this subject. Studying low-carbon consumption behaviors of Beijing will contribute to providing references for low-carbon development mode in other cities, thereby promote the overall performance of low-carbon society. In addition, as a special group of consumers, college students have incredible demand for consumption. Their consumption behaviors have radioactive and demonstrative effects on the community, family and society. This study has great benefits in guiding low-carbon consumption behaviors of college students. Simultaneously, we could revisit the many problems associated with environmental education concerning the economic, social and political structure, social justice, natural processes, natural systems, and other factors, while cultivating future citizens who have the awareness of environmental civilization. It also provides an effective and complete educational model for school education, and promotes the innovation of modern educational tools.

LITERATURE REVIEW

The Subjective Value of Environmental Education via Behavioral Intentions in Low-Carbon Consumption

Environmental education aims to promote multiple and complex educational goals – knowledge, meaningful understanding of self and environment, pro-environmental attitudes and values, and readiness for environmental action (Granit-Dgani, Kaplan, & Flum, 2017). The importance of knowledge of behavior and level of skill notwithstanding, people’s actual behavior is undergirded, most proximally, by their behavioral intentions. Nevertheless, extensive research suggests that behavioral intentions are fundamental for the behavior to be enacted and constitute ‘the best single predictor of behavior’ (Granit-Dgani et al., 2017). Thus, rather than a primary focus

on the goals of behavioral change, current environmental education programs should aspire to achieve goals that combine environmental knowledge and readiness for environmentally-oriented behaviors with self-reflection and identity exploration about environmental issues, thus promoting students' identities around environmental values, goals, self-perceptions and their associated actions (Stevenson, Dillon, Wals, & Brody, 2013).

As the advanced stage of ecological awareness, low-carbon intention emphasizes on maintaining environment bases for social development. It pays attention to overall optimization of social economic development and ecological environment to comprehend and pursue human development. It stresses that examining the relationship between human and nature from the perspective of low-carbon value, the relationship between human and human as well as the development of human beings themselves is the reflection of human's conception from low-carbon dominant rules and low-carbon restrictive conditions. The connection of low-carbon intention and environmental education are homologous, inherited and innovative. 1) Low-carbon intention and environmental education have somethings in common. Environmental problems are caused by the rapid growth of population, modern science-technology and productivity. Concerns about the deterioration of living environment have led to the emergence of environmental education. The original motivation comes from caring and cherishing of human lives. To some extent, the low-carbon intention is an innovative achievement of environmental education. Both are concentrated on the relationships between human beings and the environment, and aimed to solve environmental problems and achieve sustainable development. Their tasks are to improve human environmental awareness and effective participation, to popularize the knowledge and skills of environmental protection, and to cultivate environmental protection talents. They are social practice activities through specific means. 2) The low-carbon intention provides an innovative environment for environmental education. Nowadays, developing low-carbon economy has become a great issue at all levels of government, enterprises and the public. The inputs from policies, technologies and resources have increased unprecedentedly. Aimed to protect the ecological environment and improve environmental quality, environmental education requires policy supports from governments, technical supports from enterprises. It also requires general public to put into practice through daily behaviors. The appeal of low-carbon economy intention in communities provides an innovative environment for environmental education at a deeper level. 3) Environmental education provides a platform for low-carbon intention. Through imparting environmental knowledge, demonstration of environmental protection skills and training of environmental protection attitudes, from the three levels of knowledge, awareness and behavior, people are guided to protect the environment and preserve environment in line with the philosophy of "3L" (low energy consumption, low emission and low pollution). Environmental education provides a psychologically platform for low-carbon intention.

The Factors of Low-Carbon Consumption Behavior and Low-Carbon Intention

The previous fragmented research identifies some factors of low-carbon consumption. The findings are that personal statistic variables (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Henion, 1972; Muetzelfeldt, Robertson, Bundy, & Uschold, 1989), psychological awareness (Chen, 2007; Fraj & Martinez, 2007; Poortinga, Steg, Vlek, & Wiersma, 2003) and other factors may be positively related to on low-carbon consumption.

Among demographic variables, most studies focus on the notion that younger, more educated and wider environmental knowledge groups prefer low-carbon consumption. But there is still no agreement. Henion (1972) argues that there is a positive correlation between education and consumption behavior, and that the higher the education level and the higher the sensitivity to environment, the more consumers tend to buy low-carbon and other green products. Muetzelfeldt et al. (1989), however, points out that there is no correlation between educational attainment and the impact of consuming intention. Bohlen, Schlegelmilch, and Diamantopoulos (1993) argues that environmental knowledge (general knowledge and specific knowledge) has a significant correlation with low-carbon consumption. Conversely, an empirical analysis by Pickett et al, shows that environmental knowledge has no effect on the consumption behavior of consumers. Abrahamse et al. (2005) identifies demographic variables such as the age, education, and profession of the population, which impact on energy using behavior and willingness, and that impacts of different demographic indicators are different. According to Steg (2008), the accumulation of personal knowledge influences on low-carbon consumption.

Concerning factors of personal life attitude and psychological awareness, individual living habits and psychological awareness have impacts on low-carbon consumption intention and affect low-carbon consumption behavior in further. Through the survey of social status quo, Poortinga et al. (2003) finds that the lifestyle and attitude of residents are not significantly related to consumption behavior. Chen (2007) considers that personal motivation influences attitudes and therefore can be regarded as the function of policy value, environmental perception, personal willingness and other factors. Fraj and Martinez (2007) divides the cognitive, affective and intentional components into three dimensions of environmental attitudes and uses the Structural Equation Modeling (SEM) model to demonstrate that environmental attitudes are directly related to actual environmental behavior. Steg (2008) also identifies the impacts of consumer motivation on consumption intention, and divides

energy behavior into two aspects: psychological strategy and structural strategy. Psychological strategy (access to information, etc.) affects individual willingness and motivation. The effective change of structural strategy (laws and regulations, etc.) will affect personal consumption behavior to a large extent. Abrahamse (2005) concludes that reward approaches will stimulate individual consumption behavior, which has a short duration. Additionally, Michaelidou and Hassan (2010) uses models to prove that consumer behaviors impacted by price, environmental perception and living habit, which lead consumers to choose between organic and stocked products differently.

From the perspective of external influence and product technology, most studies find that the maturity of product evolution and the attitudes of surrounding consumer behaviors will have different degrees of impact on their own low-carbon consumption behavior. In other words, if setting series of promotional measures or improving product quality, it will be likely to stimulate low-carbon consumption behavior. As reported by Winett et al. (1985), the publicity of mass media has a significant effect on shaping the consumption behavior of consumers, and the high strength of publicity will facilitate public consumption and thus increase consumer benefits. Bohlen et al. (1993) also proves that there is a significant correlation between behavior and environmental attitudes in the dimensions of purchasing behavior and recycling behavior. Lane and Potter (2007) emphasizes the factor of the technology of product evolution. If the performance and technical conditions of the product tend to mature, consumers would tend to make positive comments on the product, thus forming purchasing behaviors. Steg (2008) considers that the model power in energy behavioral strategies, the infrastructure in structural strategies, and the level of service delivery potentially impact on consuming behavior. Wang and He (2011) applies the grounded theory to build a model of Consciousness-Situation-Behavior from the perspective of qualitative analysis, then concludes that the attitude of individual behavior and social factors together lead to low-carbon consumption behavior of residents.

To sum up, (1) from the perspective of research methods, most literatures mainly focus on the test of single hypothesis design and series of models for testing empirical hypothesis, which lacks theoretical summary; (2) from the research results concerning factors of low-carbon consumption of college students, there is no consensus, and even some studies have direct conflicts; and (3) most research proves the direct influence of independent explanatory variables on low-carbon consumption, ignoring the indirect effect of pre-variables.

RESEARCH QUESTION

By studying key factors of low-carbon consumption behavior, this study explores low-carbon environmental education, strengthens the role of low-carbon environmental education, and promotes social responsibility for environmental protection. Exploring factors of low-carbon consumption of college students is the main task of this study, which uses a combination of research methods, such as the field survey and questionnaire survey. The extensive and effective surveys cover humanities colleges, scientific engineering universities, key universities and ordinary colleges, thereby choosing Beihang University, Renmin University of China, Capital Medical University, Beijing City University as examples. First of all, carrying out qualitative research on the factors of low-carbon consumption, the study sets open questions for investigation and multi-level codes to establish a theoretical framework based on the grounded theory. Then, we quantify previous qualitative research on the low-carbon consumption of college students through survey with large samples from four universities. After removing irrelevant elements and explaining relevant elements, this study proposes feasible advices for low-carbon education. The purpose of this research is to explain the following questions:

Research Question 1: What factors influence the formation of environmental sustainability education in the process of low-carbon consumption behavior?

Research Question 2: In the process of influencing low-carbon consumption behaviors, what is the nexus of these factors?

MATERIALS AND METHODS

The Research of Grounded Theory

As an inductive research paradigm, the grounded theory is mostly used in qualitative analysis. It emphasizes a natural process from proposing problems to theory constructions, which advocates a number of raw materials processing and induction system without any assumption, thus, to obtain the "social reality" theory. By multiple coding structure, this theory often requires objective and comprehensive accesses to information, so that the collected information will have characteristics of authenticity, representative and extensive. It breaks through the "procedural" style of empirical paradigms and prevents the influence of experiences and notions on actual investigations (Glaser, 2017). Grounded theory emphasizes conceptualization and theorizing original realistic materials and preventing preconceived thinking, aiming to form an objective and accurate understanding of social

issues by social process analysis. It attaches the utmost importance to the procedures of organizing materials and recording notes after an interview. The classic grounded theory includes substantial coding and theoretical coding, which correspond to two levels of data processing and theoretical structure. The program grounded theory includes open coding, spindle coding, and selective coding designed to understand the true thoughts of their hearts by communicating with the interviewee (Glaser, 2017).

This article applies the method of programmatic grounded theory coding. Firstly, the open coding is based on the central issue of "affecting the low-carbon consumption of college students." By designing less than 10 open questions for respondents, after the interview, researchers obtain no less than 600 original sentences according to the arrangement of notes and recordings, and then refine research concepts. Due to the existence of a certain degree of cross-meaning between the meanings of sentences, they need to be categorized. The concepts of similarities, existing relationships, and causal relationships should be merged into one category. The inconsistency and less frequent conceptions should be excluded. The original initial concept would be transferred into fewer categories (generally less than 50). The second is the spindle encoding. Due to a large number of categories, the relationship between categories is not clear. Under the full understanding of the research objects and research contexts, researchers should explore primary categories in the initial categories based on the logical order and the relationships between the primary categories. The third is selective coding. Selective coding is to further select the core category in the spindle coding, analyze the relationships between the core categories and the main categories and sub-categories, finally describe and analyze the phenomenon.

After previous three rounds of coding processes, the core category is assumed as "factors for low-carbon consumption of college students". If the main category has covered essential elements of the core category and there are no other constituent factors between the main categories, then researchers are not necessary to collect more information. Therefore, the study could construct a theoretical model consisting of several dimensions for explanation and elaboration.

Empirical Verification-SEM Model Analysis

In contrast to qualitative research, quantitative research quantifies multiple dimensions of the theoretical framework according to the grounded theory. With questionnaire survey, this study adopts a combination of empirical investigations, literature research, comprehensive induction and other methods to conduct the empirical quantitative research. The questionnaire method is on the basis of literature reading, mainly introducing the scientific sampling questionnaire method, exploring factors of low-carbon consumption of four universities in Beijing as case studies. The questionnaire includes information on the basic status (gender, grade, educational level, place of birth and monthly consumption) of the respondents and psychological awareness of the college students, living habits, external influence factors and product performance, etc.

Firstly, SPSS is adopted for statistical analysis. We use descriptive statistics to do basic frequency analysis on the demographic variables of respondents in five aspects, including gender, grade, educational background, birthplace and monthly consumption status. Accordingly, we can make basic descriptions and grasp of the factors that affect the low-carbon consumption of college students.

Secondly, factor analysis method is introduced to summarize and integrate independent variables to simplify the data. The original sequence variables are converted into fixed variables by factor scores, and logistic regression analysis and multiple regression analysis are conducted. Factor-Payload variables are transcoded into dummy variables, along with the factor scores obtained previously as independent variables, select "If there is a product of the same function, will you give priority to buy low-carbon products?" as a dependent variable for logistic regression analysis. Then we choose low-carbon consumption behavior which is convenient for regression analysis to establish the multiple regression model. Following these steps, we can compare and analyze the results.

Finally, the AMOS software is applied for SEM model analysis. Through P value observation of the structural path, we conduct the verification of relationship between the P value and path coefficient, and track the overall effect and indirect effects of standardized estimates of the two-tailed test results to examine factors of low-carbon consumption by the dependent variables under the influence of mediating variables.

Research Hypotheses

On the basis of related elements detected by the grounded theory, the hypotheses are built upon quantitative analysis. From the scope of low-carbon products, this article explores the main factors of purchasing behavior regarding psychological awareness of consumers, as well as the effect path of low-carbon products consumption behavior affecting by external influence, the degree of product development, individual living habit and other factors.

Psychological awareness and low-carbon consumption

With the energy conservation and low-carbon economy, individual psychological awareness will form the demand preference and individual evaluation when choosing low-carbon products. According to previous studies, individual psychological awareness can be further decomposed into multiple levels of individual awareness of environmental responsibility, individual environmental concerns, individual perception of behavioral effect and the low-carbon knowledge. This is can be proved and illustrated by Michaelidou and Hassan (2010), who discuss the factors of psychological awareness. Based on previous researches, we put forward the following hypothesis:

H₁: The positive low-carbon psychological awareness has positive impacts on the consumption of low-carbon products.

Individual living habit and low-carbon consumption

Individual living habit is defined as the daily performance beyond the consuming purchase, which can be measured as turning off lights, using low-power appliances, etc. Individual living habit potentially affects the consumption behavior of college students. This view has been described and explained by Poortinga, Steg, Vlek, and Wiersma (2003), Wang and He (2011). When individuals living habits tend to environmental care and energy conservation, they are more likely to generate green consumption and low-carbon consumption. Therefore, the following hypothesis is formed:

H₂: A Good individual living habit has positive impacts on low-carbon consumption.

External influence and low-carbon consumption

External factors, such as surrounding people, media, policies, governmental demonstration and social ethos, positively affect college students in society. College students can use the Internet and mobile phones to comprehend the systemic protection and preferential policies of low-carbon products. Additionally, promotional patterns of advertisements will also influence the consumer psychology of college students, resulting in low-carbon products consumption behavior. Steg (2008) and Winett et al. (1985) hold different attitudes towards this issue. For purpose of exploring external influence factors, the following hypothesis is formed:

H₃: Positive word-of-mouth publicities have positive impacts on low-carbon consumption.

The degree of product evolution and low-carbon consumption

The technical conditions as the evolution of low-carbon products, related facilities, product diversity etc., have affected the consumption of college students to a certain extent. College students would produce the purchase behavior of products or not, through the low-carbon products and other products in the economic benefits, recycling convenience comparisons. When the functions and benefits of low-carbon products exceed ordinary products, concerns and purchases of low-carbon products will be generated. These relevant factors can be found in Winett et al. (1985) and Wang and He (2011). Therefore, this article proposes the following hypothesis:

H₄: The better the low-carbon product evolution, the more positive effect it has on low-carbon consumption of college students.

Population and Sample Selection

The respondents of the questionnaire encompass a wide range of college students with different ages, educational backgrounds, and occupations. The survey adopts on-site and online forms to ensure reliable and scientific samples. The locations of the survey include Beihang University, Renmin University of China, Capital Medical University and Beijing City University. Renmin University and Beihang University are national key universities.

Data Collection

In the qualitative research, based on literature research, we collect first-hand information through opening questions and panel discussions. The first is purpose sampling. Selecting seven students of Beihang University as separate interview samples, begin theoretical sampling

The next step is to take Renmin University of China, Capital Medical University, and Beijing City University as examples to meet the basic requirements from the sample of the grounded theory. In the process of quantitative research, a complete random sampling method is introduced to collect a large number of samples for data analysis and verification of relevant elements of the interview. A total of 500 questionnaires are sent to collect 420 valid questionnaires, the recycling rate of 84.0%. The data collection is shown in the [Table 1](#). In addition, the

Table 1. Sample Features

Features	Classification	Number	Percentage (%)	Features	Classification	Number	Percentage (%)
Grade	1	108	25.71	Major	Humanities	188	44.76
	2	178	42.38		Science and Engineering	218	51.9
	3/4	109	25.96	Origins	Arts	14	3.33
	Postgraduates	25	5.95		City	315	75
Gender	Male	198	48.33	Countryside		105	25
	Female	206	51.67				

questionnaire recycling excludes the questionnaires with obvious wrong answers and high similarity of answers to ensure the accuracy and validity of the data. From the qualitative research and in-depth understanding of small samples, to quantitative studies and data interpretation of large samples, this study achieves scientific and rigid problem research.

RESULTS

Grounded Theory of the Framework of Construction

Deviations may easily occur in the encoding process due to personal preferences and result bias. Hence, this encoding involves three people. Results are compared during the encoding process. If similarity is above 75%, then the process will continue. If similarity is below 75%, then recoding will be conducted to ensure the scientificity and comprehensiveness of samples.

Table 2. Open coding

Category	Initial concepts
Consumption concepts	<ul style="list-style-type: none"> • Firstly, personal consciousness and concept of responsibility are not clear. They contend that low carbon is mainly the concern of the government. • They haven't formed the belief or habit in not choosing low-carbon products. • Correct concept of consumption plays an important role in guiding people's behaviors.
Government initiative	<ul style="list-style-type: none"> • The government itself failed in low-carbon consumption. As university students, if they follow the good example set by the government, it will be of great assistance. • The government plays quite a significant role. If government takes the initiative, other people will pay more attention to this matter at least. • If government officials take part in the practice themselves, university students will be very touched.
Understanding on severity of environmental issues	<ul style="list-style-type: none"> • Carbon dioxide has become a serious issue. So university students should focus on low-carbon consumption. • If the current amount of CO₂ is controlled, green GDP growth is quite difficult to be achieved.
Knowledge of low-carbon consumption	<ul style="list-style-type: none"> • University students can understand the benefits of low-carbon consumption, so it is necessary to publicize some knowledge of low-carbon consumption. • Due to the lack of knowledge on what low carbon is, people don't have the standards of selection. • In fact, everyone is aware of low-carbon lifestyle, but the knowledge on low-carbon consumption is not quite popular yet.
Social atmosphere	<ul style="list-style-type: none"> • Although university students know the necessity of doing this, they don't have the favorable atmosphere of guidance. • The social context of low-carbon consumption and energy conservation should be developed.
Influence of people around	<ul style="list-style-type: none"> • Current publicity about low carbon merely stays on paper. If schools implement some practice, it will play an important role. • Parents don't pay much attention to low-carbon consumption, so I don't care much about it either.
Media publicity	<ul style="list-style-type: none"> • Now that media are so developed, repeated publicity and propagation can make people aware of serious issues and change their own behaviors. • Mass media don't conduct adequate publicity, so people tend to ignore this problem in purchasing. • There is shortage of publicity and effectiveness.
University students' sense of responsibility	<ul style="list-style-type: none"> • University students don't have the awareness to protect the society and assume social obligations. • For them, changing the thinking pattern is rather important. It should pose unconsciously impacts and influence on students' faith. • University students' values haven't completely developed. It is necessary to start with their sense of responsibility.
Personal effects	<ul style="list-style-type: none"> • Even a drop of water is still use. University students, as individuals of the nation, should become aware their own roles in the society. • Due to shortage of current resources, individuals play significant and important roles in cherishing every little bit of resources. • The general public doesn't realize the severity and operability of low-carbon consumption.

Table 2 (continued). Open coding

Category	Initial concepts
Infrastructure	<ul style="list-style-type: none"> • Parents tend to drive cars more often, as they don't think the public transportation is comprehensively developed yet. • Now, it is necessary to build up some basic infrastructure and facilities to make people think that low-carbon products are well-developed. • There seems no useful ways to recycle things like used batteries.
Product Evolution	<ul style="list-style-type: none"> • Although companies are also doing this thing, it is still not enough to develop low carbon products. • Currently, low carbon products haven't developed that many categories, it is not convenient to buy them. • Development and popularization of low-carbon products are quite important to the consumption of university students.
Living habit	<ul style="list-style-type: none"> • Go out with a stack of paper. The Japanese have a sense of conservation when talking about these details. • Living habit play an important role in personal behavior.
Economic development	<ul style="list-style-type: none"> • Now that economic development and conditions have become much better, people are also more boastful. • Rich students seldom care about the low carbon products.
Comfort level	<ul style="list-style-type: none"> • Low-carbon lifestyle involves a lot of trouble. We also need to know what low carbon is. Life won't be easy that way. • As for computers, we don't shut them down often quite, we can still use them on the next day. • It is not quite convenient to recycle and reuse.
Pressure from people around	<ul style="list-style-type: none"> • Other people may despise me if I pick up a waste bottle in the campus. • Most people tend to give gifts with nice packaging. If gifts are poorly packaged, it won't be good for the friendship.
Constraint conditions	<ul style="list-style-type: none"> • There is no specific punishment for not using low carbon products, so there is no restriction. • A limit should be set for extra charges or usage restriction of high-carbon products.
Laws and regulations	<ul style="list-style-type: none"> • The current laws and regulations are not comprehensive and targeted for low-carbon consumption. • The government lacks adequate executive ability. It is also related to people's lack of focus on low-carbon consumption. • If the government can enact some policies and laws about low-carbon consumption, they will at least establish authority and effects of deterrent forces.
Exaggerated effects	<ul style="list-style-type: none"> • When I bought something at the duty-free airport in Taiwan, I saw black lungs on the packages of cigarette. It is quite good for the current environmental protection. • Proper intimidation is a good thing. At least it is beneficial to everyone.
Emotional resonance	<ul style="list-style-type: none"> • Current patterns of publicity only focus on benefits of products rather than true implementation of national policies. • Propagation of environmental protection doesn't cause resonance. It needs to focus more on aspects and things in close relations with people's daily life.
Association publicity	<ul style="list-style-type: none"> • Association plays an important in universities today. Associations like Green Wing can conduct some activities on a regular basis.
Students' organization	<ul style="list-style-type: none"> • Nowadays, associations rarely pay attention to low-carbon consumption. I live in Shahe. To a large extent, students' environmental organization in the school seldom implement activities in this regard. They only conduct activities about singing and dancing. • Students' association union once conducted an activity about low-carbon consumption, and it produced positive effects.
Form innovation	<ul style="list-style-type: none"> • Now, people aren't willing to take part mainly because the activities are not quite interesting. • If activities are conducted in interesting ways, many people are expected to participate.
Face factors	<ul style="list-style-type: none"> • Many people tend to buy things with nice packages as they want to keep up appearances. • Ostentation and extravagance do exist in universities and colleges.

Table 3. Axial Coding

Main category	Corresponding Scope	Gist of scope
External influence	Influence of other people	Families and friends' points of views on low carbon
	Social influence	Social assessments and pressure on low-carbon consumption behaviors
	Policy influence	Influence of policy changes on low-carbon consumption of university students
	Media influence	Propagation forms, intensity and resonance, effects of spreading terrors by the media
Product Evolution	Product innovation capability	Corporate competence in developing low-carbon products
	Development of basic infrastructure	Defective recycling system. Impacts of backward designs
	Product and hardware development	Bad product quality and less categories impact people's concept of low-carbon consumption
Consumption intention	Consumption possibility	University students' viewpoints on low-carbon product consumption
	Intention in participating in low-carbon consumption activities	University students' consumption intention on low-carbon activities and sense of participation in products
Living habit	Taking public transport	University students' viewpoints on green transportation impact consumption
	Usage of low-carbon products	University students' habits of using low-carbon products impact low-carbon consumption
	The awareness of reusing products	Costs of product recycling impact costs of low-carbon consumption
Psychological awareness	Understanding of environment subjects	Necessity and feasibility of low carbon implementation
	Individual consciousness of responsibility	University students' sense of responsibility of low-carbon consumption and environment
	Knowledge system	Personal knowledge on what low carbon involves
	Individual effects	University students' cognition on giving play to personal effects

Table 4. Relationship structure of open coding

Relationship structure	Structural gist
External influence—Consumption intention—Consumption behavior	External influence can pose influence on consumption intention, and low-carbon consumption behaviors of university students.
Product Evolution—Consumption intention—Consumption behavior	Development of product infrastructure and capability of recycling are external factors to low-carbon consumption behaviors. But interactions of different factors may pose impact consumption behaviors on consumption intention.
Consumption intention—Consumption behavior	Consumption possibility is the intervening variable. It can direct impact consumption behaviors
Living habit—Consumption intention—Consumption behavior	Living habit is the internal condition to cause consumption behavior. It poses impacts on consumption intention through the level of consumption behaviors
Psychological awareness—Consumption intention—Consumption behavior	Individual sense of liability and knowledge on low carbon pose direct influence on low-carbon consumption intention. They also become important conditions to influence consumption behavior.

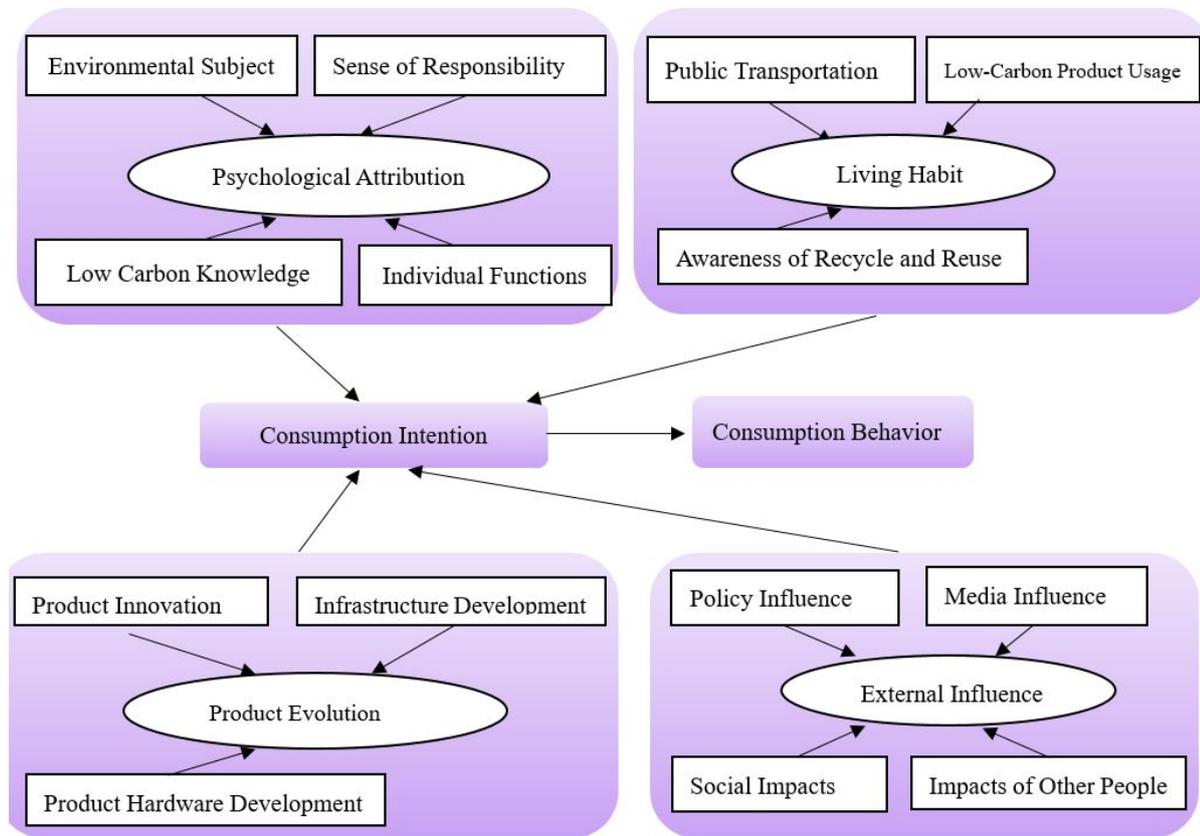


Figure 1. Theoretical Framework of Low-carbon Consumption

Empirical Validation Based on Questionnaire

Questionnaires consist of surveys and scoring scales of basic situation. Basic situation surveys include demographic variables, observation and utilization of daily consumption. Scales are developed on basis of scholars' research and studies, including psychological awareness, external influence, product evolution, living habit, usage intention and usage behaviors. Likert scale and 5 points scoring method are adopted mark scores of 1 to 5 based on "Don't quite agree", "Don't agree", "Agree", "Relatively agree", and "Quite agree". 500 copies of questionnaires are released. 420 copies of valid questionnaires are collected. The rate of collection is 84%.

Psychological awareness indexes setting consulted research and studies by Michaelidou and Hassan (2010), including sense of responsibility (x_1), knowledge on low carbon (x_2), focus on the environment (x_3), behavioral effects (x_4). External influence indexes setting consulted research and studies by Steg (2008) and Winett et al. (1985), including government example (x_5), policies (x_6), media (x_7), social atmosphere (x_8) and influence of other people (x_9). Product evolution designs consulted research and studies by Winett et al. (1985) and Wang and He (2011), including infrastructure (x_{10}), recycle outlets (x_{11}), product categories (x_{12}) and product quality (x_{13}). Besides, according to relevant life situation, the paper also discusses whether other indexes, such as product appearance and price tolerance, is related to consumption behaviors of university students. Living habit index setting consulted research and studies by Poortinga et al. (2003), Wang and He (2011), including traffic (x_{14}), usage of low carbon products (x_{15}), usage habits (x_{16}) and product reuse (x_{17}). Consumption behavior is set as the explanatory variable, which mainly consulted question designs by Lane and Potter (2007), Poortinga et al. (2003). The intervening variable of purchase intention consulted index designs by Lao and Wu (2013). Tests are conducted based on the following indexes: low-carbon product propagation intention (m_1), low carbon purchasing intention (m_2), intention of participating in low-carbon activities (m_3), intention of low-carbon transport (m_4).

The scale reliability is tested by Gronbach coefficient. Most scholars tend to accept that scientific scale reliability α is greater than 0.7. According to reliability analysis results, the reliability value of total scale is 0.921. Coefficient of other dimension is also greater than 0.7. Construct validity uses confirmatory factor analysis to set up PA-LV models. After using the AMOS21.0 software analysis, results are shown in Table 5. Null hypothesis includes many independent variables. The paper extracts the common factor through maximum variance method, and conducts

Table 5. Variable Measurement

Latent variable	Main theme	Problem description	Cronb-ach's α	No.
Consumption behavior	Time tolerance	Spend extra time to purchase low-carbon products	0.799	Y
	Price tolerance	Pay higher prices for some low-carbon products.		
	Product purchasing	Willing to purchase low-carbon products in nearby supermarkets and stores.		
	Product purchasing	Seldom purchase products with excessive packaging		
	Product purchasing	Seldom purchase disposable products		
Consumption intention	publicity intention	Become volunteers for low carbon consumption	0.851	m ₁
	purchase intention	Purchase low carbon products within financial and time limits		m ₂
	Participation intention	Take the bus to work to realize low-carbon society.		m ₃
	Activity intention	Participate in low-carbon and energy-conserving abilities.		m ₄
Psychological awareness	Sense of responsibility	Feel obligated to practice low-carbon consumption and save energy.	0.750	X ₁
	Knowledge on low-carbon	Know what products can be recycled.		X ₂
	Behavior effects.	Understand that low-carbon consumption behavior is consumption pattern with low energy consumption, low pollution and discharge.		X ₃
	Focus on environment	Carbon dioxide emissions exceed standard levels in the city.		X ₄
External influence	Government examples	If government officials take part in low-carbon consumption, other people will also engage in the practice.	0.739	X ₅
	Policy influence	In the case of policy subsidies, you will purchase low-carbon products.		X ₆
	Influence of other people	Families may impact your low-carbon consumption.		X ₇
	Social context	The social context of low carbon conservation is not developed yet		X ₈
Product Evolution	Infrastructure	Modern infrastructure is not comprehensive, so people throw garbage around. Newspaper and TV publicity influence low carbon consumption.	0.701	X ₉
	Recycling outlets	Can't find the outlets for recycling low carbon products		X ₁₀
	Product categories	Less categories of low carbon products can't meet demands of purchasing.		X ₁₁
	Product quality	Bad product quality also impacts purchasing intention		X ₁₂
living habit	Transport	You will choose public transport to go out, such as subway and buses	0.828	X ₁₄
	Article usage	You use household appliances with low electricity consumption.		X ₁₅
	Usage habits	You turn off lights, electric appliance and water taps when leaving.		X ₁₆
	Recycle and reuse	You may dispose things rather them throw them away after they break down.		X ₁₇

factor analysis with SPSS20.0 software. On condition that KMO value is 0.920 and Bartlett sphericity test results conform to standards, the paper conducts factor analysis on measurement indexes of the scale, and retains the items with factor loads greater than 0.5.

Considering the correlation between consumption intention and low-carbon consumption behavior, this paper firstly analyzes the correlation between variables and consumption intention as well as consumption behavior, laying the foundation for regression analysis and structural equation modeling. Results indicate that variables like psychological awareness, external influence, living habit, product evolution have significant correlation with consumption intention and consumption behavior, and sig. = 0.000. Therefore, it can be found a strong association between independent variables measured in four dimensions and dependence variables and intervening variables.

Table 6. Correlation Analysis

	Psychological awareness	External influence	Living habit	Product Evolution	consumption intention
Consumption intention	0.545***	0.609***	0.599***	0.457***	1***
Consumption behavior	0.474***	0.507***	0.498***	0.417***	0.679***

Note 1 : * signify $p < 0.05$, ** signify $p < 0.01$, *** signify $p < 0.001$

Table 7. Multiple Regression Analysis

Variable sequence	R	R ²	ΔR^2	F Value	B	Sig
1. Consumption intention	0.679	0.460	0.458	356.604***	0.630	0.000
2. Psychological awareness	0.690	0.476	0.473	189.235***	0.132	0.002
3. Product Evolution	0.697	0.486	0.483	131.370***	0.153	0.003

Table 8. Main Effect and Interaction Analysis of Psychological Awareness, External Influence and Living Habit

Variable	df	MS	Sig.
Psychological awareness	17	18.848	0.000
External influence	12	3.182	0.000
Living habit	12	18.329	0.000
Psychological awareness * External influence	71	12.250	0.000
Psychological awareness * Living habit	61	8.035	0.107
External influence * Living habit	48	6.433	0.416
Psychological awareness * External influence * Living habit	36	11.923	0.000

In order to understand different influences exerted by low-carbon consumption factors, this paper adopts multiple stepwise regression method to explore the impact of predictors, such as consumption intention and psychological awareness on dependent variables. As the multivariate regression model should be constructed when there are no multiple collinearity and autocorrelation among variables, correlation tests and statistical tables are adopted to examine the overall conditions. Results show that the overall residual of model satisfies normal assumption and the model can be build. In order to examine whether this model has autocorrelation, this paper conducts Durbin-Watson testing with DW coefficient 1.905, and it can be concluded that random error term has no autocorrelation. Furthermore, through the measurement of tolerance and Variance Inflation Factor (VIF), the influence of multiple collinearity is also excluded as results indicate that VIF value (< 2) and tolerance (> 0.6) all meet the requirements of modeling. Therefore, those selected indicators are reasonable and multivariate regression model can be constructed. In addition, this paper uses Wald stepwise regression method to prevent multiple lineal model problem caused by all highly correlated variables entering a general lineal model. Then, apart from population statistics, putting living habit, consumption intention, psychological awareness, product evolution, external influence into the equation, it can be concluded that the multiple correlation coefficient between three predictors and the dependence variable is 0.697, the determination coefficient 0.486 and F test significant. The regression coefficient of consumption intentions is the highest, reaching 0.630.

According to the predicated explanatory power, production evolution has the best forecasting performance towards consumption behavior and the explanatory power is 48.6%. According to regression coefficient, consumption intention has a positive β , thus it can be seen that the explanations consumption intention, psychological awareness and product evolution towards consumption behavior are all positive and the constant is 2.56. Therefore, we can build a model as $Y = 2.560 + 0.630X_1 + 0.132X_2 + 0.153X_3$.

When it comes to the contributory factors of low-carbon consumption, considering that interaction may occur among psychological awareness, external influence and living habit, thus we conduct multivariate analysis of variance by taking these three variables as fixed factors and consumption behavior as a dependent variable to examine this assumption. According to the result, psychological awareness, external influence and living habit have significant main effects and there is an interaction among psychological awareness and external influence ($p < 0.01$), psychological awareness as well as external influence and living habit ($p < 0.05$). Therefore, undergraduates' perception for external environment and living habit is still influenced by living habit (Table 8).

We build a low-carbon consumption behavior SEM by taking items in low-carbon consumption quantity table as observed variables and low-carbon consumption behavior, consumption, external environmental influence, psychological awareness, production evolution, living habit as latent variables. The normality test of every single indicator is the absolute value of the value of kurtosis and skewness, all meeting criteria. Therefore, it is reasonable for this paper to analyze consumption behavior by using maximum likelihood method. SEM is constructed as:

Table 9. Consumption Behavior SEM Equation PNFI

Index	CMIN/DF	GFI	CFI	IFI	PGFI	PNFI	RMSEA
First model	5.785	0.823	0.756	0.896	0.632	0.617	0.107
Revised model	2.437	0.933	0.950	0.951	0.613	0.628	0.059

Table 10. Research Hypothesis Testing

Research Hypothesis	Standardized Path Coefficient	P-value	Conclusion
Psychological awareness->Consumption intention	0.10	0.04	Support
Product evolution ->Consumption behavior	0.16	0.04	Support
External influence->Consumption intention	0.63	< 0.001	Support
Living habit-> consumption intention	0.12	0.03	Support
Psychological awareness-> External influence	0.72	< 0.001	Support
Psychological awareness->Living habit	0.79	< 0.001	Support
Psychological awareness-> Product Evolution	0.50	< 0.001	Support
Living habit-> External influence	0.76	< 0.001	Support
Product Evolution -> External influence	0.61	< 0.001	Support
Living habit-> Product Evolution	0.60	< 0.001	Support

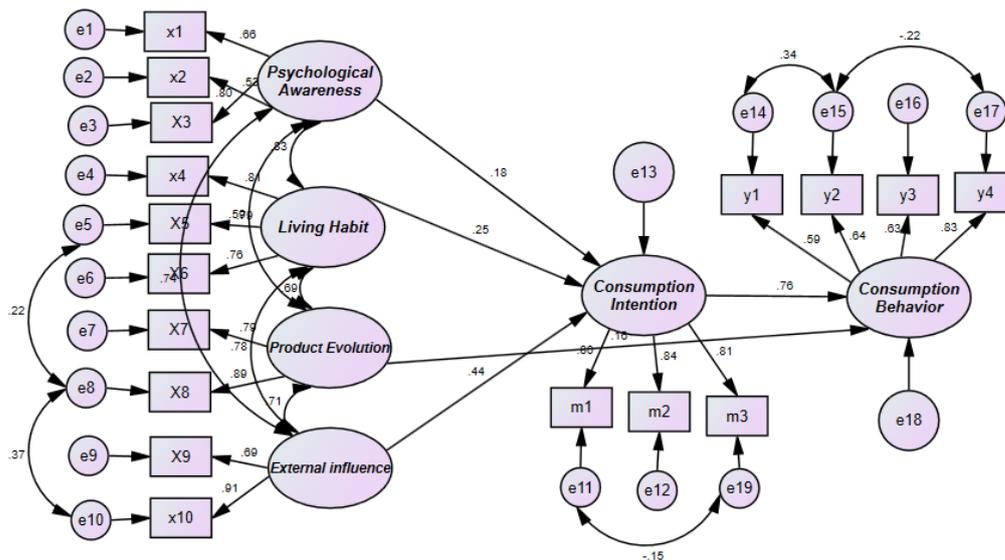


Figure 2. Low-carbon Consumption Behavior SEM Model

$$\eta = \beta\eta + \Gamma\xi + \zeta \tag{1}$$

$$x = \lambda x\xi + \delta \tag{2}$$

$$y = \lambda y\eta + \varepsilon \tag{3}$$

where x represents the observed explanatory variable; y the observed explained variable; λx and λy contrasted coefficient matrix; ξ the structural independent variable; η the structural dependent variable; δ and ε are corresponding error terms.

According to the statistics in the **Table 9**, most indicators in the first model are not ideal and far from fit criteria. Then we revise this model in accordance with correlation and it can be seen that product evolution can exert direct influence on consumption behavior without the help of consumption intention, thus both variables are directly related. What’s more, considering that there may be a correlation among independent variables, we associate them with each other and confirm the validity of this assumption.

SEM is revised in accordance with the M.I value, CR value and LR value, and correlates residual errors in related terms with each other. After revised, the model fits well and coefficients of its paths are significant: e5 is correlated with e8, e8 with e10, e11 with e19, e14 with e14 and e15 with e19. The path graph can be seen in **Figure 2**, and fit index of SEM is shown in **Table 9**.

According to the path graph, for use intention, external influence has the largest standardized coefficient, reaching 0.44, and the second is living habit, stands at 0.35 while psychological awareness has the smallest standardized coefficient, which is only 0.18. It can be conclude that the influence degree of contributory factors on low-carbon consumption behavior is external influence > living habit > psychological awareness.

DISCUSSIONS AND CONCLUSIONS

First, the changing external environment and sustainable environmental education are primary drivers for undergraduates to perform low-carbon consumption. The university is a kind of small society, and the attitude and behavior of individuals are prone to be influenced by each other. What's more, the freedom to dispose of time makes it possible for the public to have access to the mass media, an important way to disseminate information. By perceiving behaviors of reference group, people may change their own behaviors unconsciously, thus the external environment is of great significance for people to adapt to low-carbon consumption. According to the Attribution Theory proposed by Heider, reasons of individual behavior can be classified into two parts: Internal Attribution (Individual Attributes) and External Attribution (Environmental Attributes). The former includes individual personality, motivation, emotion, attitude and effort while the latter includes surrounding environment and luck (Heider, 2013). In in-depth interviews, some interviewees tend to attribute their inappropriate behaviors (such as not adopt low-carbon consumption pattern) to contextual factors (external attribution). The study in this paper indicates that the influence of external factors, such as surrounding people and the government's leadership, are the most important stimulator of low-carbon consumption. It is noted that most televisions and online media that people are exposed to be advocating luxurious lifestyle and consumption patterns. Under such circumstances, the public tend to pursue conformity. Therefore, relevant government authorities should restrict properly the spread of information concerning materialism and make efforts to promote civilized, frugal, environmental friendly and low-carbon consumption pattern. In the process of environmental education, the government should correctly publicize the idea about environmental protection and the government officials should take the leading role and guide the public to maintain a positive attitude towards low-carbon consumption, so as to foster a sustainable development idea that is consistent with the development of our times.

Second, internal factors, which include psychological awareness and living habit, provide reference for undergraduates' environmental education concept. An individual's living habit and psychological awareness, including environmental possibility awareness and personal knowledge, will exert varying influence on low-carbon consumption. As the independent individual, the public have their awareness of tendentiousness and their choices of behaviors are made through their psychological awareness. When this awareness comes more from personal experiences and practices, the foresting performance (includes short-term performance and long-term performance) of low-carbon psychological awareness towards low-carbon consumption pattern will be enhanced dramatically. In contrast, when this awareness comes more from boring textbooks, this kind of foresting performance will decrease and the effects of environmental education concept will be compromised, thus having an adverse effect on guiding undergraduates to a healthy and environmentally friendly lifestyle. However, many people are now still lacking understanding of environmental crises, such as climate change. Some people, though realizing these issues, take a negative attitude and even choose to "ignore" it. We call this kind of phenomenon as "ostrich mentality". It is only when low-carbon psychological awareness reaches a "tipping point" that it can help establish the low-carbon consumption pattern. When awareness is consistent with behavior, the low-carbon consumption education concept will be built naturally. Therefore, policymakers should work to enable the public to realize their individual responsibility for mitigating climate change, so as to encourage preferable transitions in consumption patterns and raise consciousness of environmental sustainability.

Finally, the development of low-carbon products and technologies, including innovative capability, degree of product recall, variety and quantity of products, provides guarantee for undergraduates to establish sustainable environmental education concept. Policymakers should make changes in situational and structural factors, such as infrastructure, product and technology conditions as well as policies and regulations. According to our in-depth interviews and empirical studies in this paper, infrastructure (public transportation, recall network and charging station etc.), product and technology conditions (accessibility of low-carbon products and maturity of technologies), policies and regulations (government policies and their enforcement) and other situational and structural factors have differing influences on the cost and benefit of low-carbon consumption pattern. In the process of environment education, we should improve infrastructure and multi-dimensionally reduce the individual cost of practicing low-carbon consumption, so as to encourage the public to establish the environmentally friendly ideology. Consumers often rank products in accordance with their criteria, thus those products which are simple and convenient can meet the public's needs. Reduced opportunity cost means that, driven by satisficing, the public can exchange for the maximum income with the minimum cost, leading to low-carbon consumption behavior. Therefore, the development of low-carbon products plays an important role in support of low-carbon products.

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