



Empirical study of the willingness of consumers to purchase low-carbon products by considering carbon labels: A case study



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ABSTRACT

Due to the severe environmental problems caused by the rapid development of the global economy and high consumption rates, many countries and organizations are trying to identify methods such as carbon labeling for guiding low-carbon consumption by residents in order to actively respond to global climate change. As a method for identifying the greenhouse gas emissions produced during the full life cycle of a product, the effects of carbon labels on low-carbon consumption behavior by different types of consumers is worthy of investigation. First, this study reviews the relevant theories and research into carbon labels and the willingness of consumers to buy low-carbon products. By combining grounded theory with classical theory, the carbon label is subdivided into the degree of carbon label understanding, acceptability of carbon labels, and credibility of carbon labels, which are then employed to construct a theoretical model of the factors that affect the willingness of consumers to purchase low-carbon products. Next, using data collected with a questionnaire, Pearson's correlation coefficient and logistic regression analysis were used to identify the main factors that influence the willingness of consumers to buy low-carbon products. Finally, the variance and mean analysis were calculated to test the differences among demographic variables and situational factors that determine the willingness of consumers to buy low-carbon products, which allowed us to modify the theoretical model accordingly. The results indicate the following. (1) The degree of carbon label understanding, acceptability of carbon labels, credibility of carbon labels, attitudes toward purchasing low-carbon products, perceived effectiveness of low-carbon consumption, social norms, reference groups, the price of low-carbon products, and economic incentives were all important factors that influenced the willingness of consumers to buy low-carbon products. (2) Among the carbon label-related factors, the degree of understanding, acceptability of carbon labels, and credibility of carbon labels had positive relationships with the willingness to purchase low-carbon products, where the higher acceptability and credibility of carbon labels, as well as a better understanding of carbon labels or low-carbon knowledge were associated with a greater willingness to purchase low-carbon products. (3) The willingness to purchase low-carbon products differed significantly with respect to values, age, income, and education. Based on these conclusions, some policy implications are suggested.

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1. Introduction

China's economy has grown rapidly since the reform and opening up, and it is now the second largest economy in the world. However, China has the world's highest carbon emissions because high-speed economic growth is accompanied by high-carbon

emissions, and thus there is a huge pressure to reduce emissions (IEA, 2011; Yu et al., 2014). The problem of high energy consumption has severely restricted the sustainable development of China's economy and society. Therefore, how to achieve low-carbon development in the future is now a major challenge for China (Song et al., 2016a,b). In other countries, emissions have been reduced mainly by addressing the energy supply and energy consumption (Long et al., 2015; Liu et al., 2016). China committed to reducing the intensity of carbon emissions by 40%–45% by 2020 at the United Nations Climate Change Conference (Yu et al., 2012; Xiang et al., 2013). However, it is difficult to change the high-

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carbon characteristics of the energy structure in the short term in China because the supply of energy is constrained by the energy structure and socio-economic development. Furthermore, low-carbon technology and product development are still long-term objectives. Thus, changing consumption patterns is the main way of reducing emissions at present in China.

According to a report by the World Bank, the annual per capita carbon emissions in China are about 4.1 t, which account for about 29.27% of total carbon emissions, i.e., the second major source of energy consumption after industry (Yang et al., 2010). The per capita energy consumption of urban residents is 1.5 times that of rural residents, and thus urban residents have great potential for making energy savings and reducing emissions (Zheng, 2015). Therefore, guiding urban residents toward a low-carbon consumption life style has become a significant focus of global research.

In 2000, the European Union first proposed the concept of a carbon footprint, which represents the amount of greenhouse gases emitted by an activity or organization (Low et al., 2015). In order to guide consumers toward better consumption patterns and to reduce carbon consumption, the carbon footprint is a very important measure that can be communicated in the form of labels to deliver carbon information to consumers.

In 2007, the UK began to promote and encourage the use of carbon labels by domestic enterprises, including Tesco, Coca-Cola, Boots, and 20 other manufacturers of 75 types of goods. Since 2008, Japan has encouraged companies to label products with their carbon footprints on the packaging, so consumers can understand which have the most severe impacts on the environment and to prefer low-carbon products. The French government also encourages retailers to consider their carbon footprints, where the French supermarket giant Casino uses the concept of food mileage to measure carbon emissions, as well as using two labels to denote environment-friendly products and the related CO₂ emissions. In addition, the USA, Germany, Sweden, Canada, Korea, and other countries promote the use of carbon labels. At present, increasing numbers of countries are adopting “carbon labels” and developing institutions to deal with carbon emissions measurements and monitoring, as well as other issues, such as the Carbon Trust in the UK and World Resources Institute in the USA (Hu et al., 2010).

Bolwig and Gibbon (2009) noted that after the introduction of international standards for carbon footprint certification, products entering the EU market in the next 10–15 years will require carbon label certification, which means that carbon labels will become barriers to future international market access. Many researchers consider that carbon labeling will have a major impact on export trade because if the exporters of products from developing countries do not perform carbon labeling certification, it will be difficult to gain a foothold in the international market (Wirth, 2009; Garcia and Freire, 2014).

China is also aware of the importance and urgency of establishing a carbon labeling system, and it has taken measures to actively promote the establishment of a suitable system. The China National Institute of Standardization and British Standards Institution cosponsored the Publicly Available Specification 2050 (PAS 2050) conference in 2009 to promote the establishment of a pilot carbon labeling system in China (Liu et al., 2016). The Certification and Accreditation Administration of the People's Republic of China issued the first batch of low-carbon product certification implementation rules, as well as establishing a low-carbon product certification system, and technical preparation is almost complete in China. In September 2015, the General Administration of Quality Supervision, Inspection, and Quarantine of the People's Republic of China released the *Measures for the Administration of Certification of Energy-saving and Low-carbon Products*, which provides important

guidance and guarantees to facilitate the standardization of an energy-saving and low-carbon product certification system, thereby providing foundations for implementation of China's carbon label system.

Therefore, in order to cope with the effects of future carbon tariffs and carbon trading on the Chinese economy, it will be necessary to develop a Chinese carbon label system as soon as possible. In addition, by studying the relationships between carbon labels and consumers, China can establish and promote a carbon label system more effectively, which is another reason for studying carbon labels. The manner in which carbon labels are presented on commodities can promote the transparency of related carbon emissions, stimulate companies to reduce negative environmental effects by using relevant measures, and guide consumers to choose low carbon commodities. Thus, China can meet the aim of reducing carbon emissions and slow the progress of climate change. However, three major problems remain unresolved in the carbon labeling system implementation process. (1) Among the relevant carbon label factors, it is not known whether the degree of carbon label understanding, acceptability of carbon labels, or credibility of carbon labels might positively affect the intentions of consumers to purchase low carbon products. (2) Previous research mainly comprised comparative studies of carbon labeling systems in different countries from a macro-scale perspective, but few have employed a micro-scale perspective in empirical research. Therefore, it is important to study whether products with carbon labels affect whether people actively choose low carbon products. (3) Due to the differences in carbon certification costs and production processes, commodities with carbon labels are more expensive and their retail prices are relatively high. Thus, the intention to purchase low carbon products may vary according to the demographic characteristic of consumers to some extent. It is not clear how to guide consumers toward purchasing commodities with carbon labels according to these differences, and this issue has been mentioned rarely in previous studies. In summary, it would be useful to study carbon labeling in greater depth because the development of carbon labeling is still in the primary stage in the UK, where the concept was first proposed, as well as throughout the rest of world, and there is a lack of relevant research in China.

- (1) Thus, the theoretical significance of adding carbon labels needs to be investigated starting with the three dimensions of the degree of carbon label understanding, acceptability of carbon labels, and credibility of carbon labels in order to determine the factors that influence consumer purchasing behavior, thereby obtaining insights into the willingness of consumers to buy in a low-carbon consumption context as well as enriching our theoretical understanding of low-carbon consumption. (2) There is a practical and significant need to understand the influence of promoting carbon labeling on the willingness of consumers to buy low-carbon products in order to determine their potential effects on low-carbon consumption by urban residents in China, as well as providing theoretical and empirical support for the implementation of a carbon labeling system in China.

The remainder of this paper is organized as follows. Section 2 describes related research. The construction of the model and the data acquisition process are explained in Section 3. An empirical study of the factors that affect the willingness of consumers to buy low-carbon products is presented in Section 4, where this section focuses on the relationship between carbon label-related factors and consumer willingness to buy low-carbon products. The results of this study are discussed further in Section 5. We give our conclusions in Section 6 and suggest the policy implications of the

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