

Assessing consumers' behavioral intentions to adopt green technologies: A combined research framework

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Abstract

The adoption of green technologies, i.e., technologies affecting energy usage in residential buildings is a highly debated research issue among researchers in environmental behavior. During last decades, environmental management literature focused on how governments or companies could develop strategies aimed at fostering the adoption of these measures in order to effectively reduce the overall energy consumption. This paper develops and applies a framework that combines the Ajzen's Theory of Planned Behavior and the analysis of perceived image' to examine consumers' intention to adopt green technologies. First, we identified the impact of Ajzen's determinants (i.e., attitudes, subjective norms, and perceived behavioral control) on consumers' intention to adopt these technologies. Then, we determined the perceived image of green technologies by identifying their attributes and, in turn, their latent dimensions. Finally, we measured the impact of green technologies' latent dimensions on Ajzen's determinants and behavioral intentions. Results showed that the advantages/disadvantages related to green technologies were the psychological determinants that influenced to a greater extent the intention to use them. Moreover, the perception of such technologies as innovative, healthy and energy-independent was the main determinants of the intention to adopt them in residential buildings. Theoretical and managerial implications for marketers and policymakers were also discussed.

Keywords: Green technologies, Sustainability, Communication, Ajzen, Perceived Image.

1. Introduction and Research Objective

The diffusion of green technologies, i.e., technologies impacting energy usage (Wurlod & Noailly, 2018) in residential buildings has grown rapidly in the past few decades, as it has been intensively promoted by public and private organizations through different initiatives. As a result, the adoption of practices and green technologies in residential buildings has been investigated across a number of studies. Several authors (e.g., Prete et al., 2017) examined households' intention to adopt a broad variety of technologies (e.g., solar photovoltaic, micro-wind, solar thermal, heat pumps, biomass boilers and pellet stoves) applying the Theory of Planned Behavior (Ajzen, 1991), according to which the possible determinants of consumers' final intention are attitudes (i.e., behavioral beliefs), subjective norms (i.e., normative beliefs) and perceived behavioral control (i.e., control beliefs). Despite these efforts,

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little attention has been devoted, instead, to the analysis of the perceived image of green technologies (cf. Rizzo et al., 2018).

In this study we propose a research framework that combines the Ajzen's (1991) Theory of Planned Behavior and the analysis of the perceived image of green technologies. By studying the effect of these personality attributes on the determinants of the Ajzen's model, and in turn, on the behavioral intentions to adopt green technologies, this study could provide an instrument of paramount importance for companies to calibrate in an effectual manner their communication strategies.

2. Methodology

Ajzen's (1991) model postulates that three main factors affect individuals' final intention, that is: (1) attitude, a positive or negative evaluation of a given behavior based on the subjective advantages or disadvantages that could derive from performing such behavior; (2) social norms, the perceived social pressure due to the decision to enact (or do not) the behavior based on other's judgments; and (3) the perceived behavioral control, the subjective evaluation about the factors that may facilitate or hinder such behavior.

The analysis of the perceived image, instead, allows examining the personality of specific products. The brand or product personality has been observed across a wide range of studies that attempted to associate human personality to brand or products. For instance, Caprara, Barbaranelli and Guido (2000) assume that the unlimited set of attributes that describe the human personality may be reduced, through a linguistic sedimentation process, to a more approachable range of attributes (so-called markers) that best elicit the different personality traits in perceivers. In the marketing field, this procedure allows to measure, through regression analysis, the different impact of each product personality attribute on consumers' intention to enact a given behavior. By identifying a number of attributes which can best describe green technologies' perceived traits, this study points out their latent dimensions and their effect on the determinants to adopt these measures.

By combining these two theories in a unique research framework, it is possible to identify the main determinants of the intention to adopt green technologies, as well as which are the attributes of their perceived image most affecting each determinants, and in turn, the decision to enact that behavior.

In this way, marketers and practitioners may identify the critical factors affecting the decision to adopt green technologies and how to promote effectively such behavior.

2.1. Method

First, a pilot study on 20 Italian consumers aimed at determining the Ajzen's determinants and the attributes related to the perceived image of green technologies was conducted. According to respondents, the principal advantages related to the implementation of green technologies were: 1) an increase of real estate value; 2) the possibility to become energy-independent from traditional energy providers; 3) an improvement of environmental sustainability; 4) a reduction of energy consumption; and 5) a better quality of life. Instead, the principal perceived disadvantages were: 1) high installation costs; 2) difficulties in the disposal of installation; 3) high maintenance

costs; 4) bureaucratic barriers; and 5) the uncertainty in service assistance. Regarding normative beliefs, consumers' choice to adopt green technologies resulted to be mostly influenced by partners, family members, young people, environmental associations, neighbors, elderly people and friends. Last, the events or situations that can facilitate the implementation of green technologies were: 1) subsidies or tax reduction/exemptions; 2) access to banking and financing mechanisms; 3) the possibility to sell excess energy to the grid; 4) a public forced action to support the diffusion of green technologies; and 5) the use of more aesthetically pleasing installations. Conversely, the events that could obstacle the implementation of green technologies were: 1) lack of support for the maintenance of installation; 2) the unexpected increase of installation costs, 3) bureaucratic inertia; 4) long payback times; and 5) the lack of information.

In order to assess the perceived image of such technologies respondents were asked to indicate 15 adjectives that, according to their knowledge, could effectively describe green technologies. Each adjective has been associated to its opposite to obtain a couple of bipolar attributes: traditional-innovative, obsolete-modern, polluting-ecological, useless-useful, inefficient-efficient, disadvantageous-advantageous, boring-interesting, dirty-clean, ineffective-effective, unsustainable-sustainable, inappropriate-appropriate, expensive-cheap, dependent-independent, dangerous-healthy, not indispensable-indispensable.

A main study was then conducted on a sample of 88 people (50% F). In order to assess behavioral, normative, and control beliefs, respondents were asked to indicate on a 7-point Likert scale the probability and the importance for each belief identified in the pilot study. In order to assess the perceived image of green technologies, respondents were asked to evaluate on 7-point Likert scales how much the attributes, identified in the pilot study, were able to describe such technologies. Finally, respondents were asked to report their socio-demographic characteristics (i.e., gender and age).

2.2. Results

2.2.1. Application of Ajzen' model

Respondents were mainly middle-aged ($M_{age} = 41$; $SD = 13.10$) and married people (66%) with an income less than 30,000 € (53.9%). Ajzen's determinants (i.e., attitudes, subjective norms, and perceived behavioral control), as well as the intention to adopt green technologies were computed as the sum of products of the importance attributed to each determinant and the probability that they may occur. A linear regression model showed that attitude towards green technologies ($\beta = .48, p < .05$) was the only variable capable to exert a positive influence on the intention to use these technologies, confirming that consumers' decision to adopt energy-efficient technologies mainly depends on the perceived advantages.

2.2.2. Analysis of the perceived image of green technologies

Once identified the attributes (so-called marker) that best describe green technologies, their influence on consumer choice to adopt them was assessed. To this aim, the couples of bipolar adjectives that describe green technologies were first

evaluated by looking at the mean values. The analysis showed that the attributes “traditional-innovative” and “obsolete-modern” reported the highest values. Both couples of attributes have a mean value close to 7, confirming that the adjectives “innovative” and “modern” were those that better described the image of green technologies.

Afterwards, through a factor analysis, the couples of bipolar attributes were collapsed into three interpretable latent variables, capable to explain the 72.06% of the variance. Specifically, the first latent variable, denominated “Value” (57.36% of variance), was mainly characterized by the bipolar adjectives “inefficacy-efficacy”, “dangerous-healthy” and “disadvantageous-advantageous” (see table 1 for a full description of the attributes). The second component, called “Convenience” (7.65% of variance), was related to only one couple of attribute (i.e., “expensive-cheap”), as well as the third latent variable, denominated “Independency” (7.04% of the variance), that featured the couple “dependent-independent”.

Table 1: Attributes and latent components of green technologies

	<i>Components</i>		
	<i>Value</i>	<i>Convenience</i>	<i>Independency</i>
Inefficacy – Efficacy	.854		
Dangerous – Healthy	.849		
Disadvantageous – Advantageous	.842		
Useless – Useful	.841		
Inappropriate – Appropriate	.831		
Polluting – Ecological	.830		
Inefficient – Efficient	.829		
Boring – Interesting	.829		
Unsustainable – Sustainable	.806		
Dirty – Clean	.802		
Obsolete – Modern	.798		
Not indispensable - Indispensable	.798		
Traditional – Innovative	.628		
Expensive – Cheap		.968	
Dependent – Independent			.973
% of variance explained	57.36	7.65	7.04
cumulated %	57.36	65.02	72.06

Then, we evaluated the way in which the latent components obtained by the factor analysis, as well as the markers of green perceived image, affect both the attitudes towards such technologies and the intention to adopt them. To this end, a multiple linear regression approach was used. In particular, the latent components (i.e., Value, Convenience, Independency) were used as predictors, while the attitudes towards green technologies and the intention to use them as the dependent variables. Hence, two

different regression model were estimated. A first model showed that the latent components “Value” and “Independency” exerted a significant influence on the intention to adopt green technologies in residential buildings. Such an effect proved to be greater for “Value” ($\beta = .49, p < .05$) rather than “Independency” ($\beta = .21, p < .05$). This result implies that the intention to use green technologies is first determined by the advantages deriving from the adoption of such technologies (e.g., more efficiency and environmental sustainability) and, secondly, by the possibility to become energy-independent from traditional energy providers. A second regression model showed instead that the component “Value” is the only one capable of influencing the attitudes towards green technologies ($\beta = .38, p < .05$).

2.2.3. Main analysis

Finally, we tried to combine the results obtained by the Ajzen’s Model and the analysis of the perceived image. In order to evaluate if the perception of green technologies as “Value” can favorably affect the attitudes towards them and thus individuals’ intention to adopt green technologies, a mediation analysis was performed. Specifically, the SPSS Process macro was used to test whether the attitude towards green technologies mediates the effect of the latent component “Value” – previously extracted through a factor analysis – on the intention to adopt such technologies. The total effect was statistically significant ($b = 6.73, SE = 2.05, t(82) = 3.29, p < .01$). The latent component “Value” significantly predicted the attitudes towards green technologies ($b = .28, SE = 0.1063, t(82) = 2.63, p < .05$). Furthermore, the attitudes towards green technologies significantly predicted the intention to use such technologies ($b = .06, SE = .02, t(81) = 3.53, p < .01$). The direct effect of the latent component “Value” on the intention to use these technologies was also significant ($b = 6.72, SE = 2.05, t(82) = 3.29, p < .01$), as well as the indirect effect of “Value” on the intention to use ($b = 1.77, SE = 1.86, 95\% \text{ BCI } .72-3.56$).

3. Discussion

The development of strategies for enhancing the adoption of green technologies is a highly debated topic among researchers and policy-makers. The research adopted a different approach compared to prior research by providing a research framework that combines the Ajzen’s Theory and the analysis of the perceived image (Caprara, Barbaranelli & Guido, 2000).

The application of the Ajzen’s model allowed shedding light on consumers’ beliefs regarding the adoption of green technologies. It revealed that the advantages/disadvantages related to green technologies were the psychological determinants that influenced to a greater extent the intention to use such technologies.

The analysis of the perceived image allowed to determine those attributes that effectively describe the image of these technologies. The couples of adjectives (i.e., personality markers) that most affect the intention to use these technologies resulted to be “traditional-innovative”, “dependent-independent”, and “dangerous-healthy”. Therefore, these findings revealed that the perception of such technologies as innovative, healthy and energy-independent were the main determinants of the intention to adopt green technologies in residential buildings.

Then, through a mediation analysis the research showed that attitude towards green technologies mediates the effect of the latent component “Value” on consumers’ intention. Such a result extends the Theory of Planned Behavior and the analysis of the perceived image, provided a framework that researchers could apply to study people’s pro-environmental behavior in general, as well as the adoption of specific green technologies. Results of this study provide companies and policymakers with useful suggestions for strategies aimed at promoting the adoption of green technologies. As an example, marketers could highlight the advantages deriving from the use of these technologies by using in their communication strategies the attributes related to the innovativeness and efficacy of these measures.

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