

# Factors affecting customer acceptance of hydrogen fuel cell vehicles in Korea

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**Abstract.** Despite government efforts to promote green transportation, hydrogen fuel cell vehicles (hereinafter HFCVs) need to gain public acceptance before they enter the market successfully. The results of this empirical study imply that a customer's awareness of HFCVs can lead the customer to consider HFCVs when they are confronted with the situation in which the purchasing decision is made. Thus, hydrogen fuel cell vehicle-manufacturers and government agencies striving to promote green transportation need to scale up their efforts to enhance customer awareness of HFCVs in order to stimulate diffusion in the hydrogen fuel cell vehicle market

**Keywords:** Hydrogen fuel cell vehicles; Customer's intention to accept; Awareness of hydrogen fuel cell vehicles

## 1. Introduction

The Korean government strategy for green growth focuses on investments in environmental sectors to create new engines of economic growth, such as green technologies, resource and material efficiency, renewable types of energy, sustainable transport, green buildings, and ecosystem restoration [1]. The ensuing "Five-Year Plan for Green Growth" also addressed green transportation as a high-priority issue [1,2]. Despite this progress, it is not uncommon for new products made through advanced technologies, such as hydrogen fuel cell vehicles, to face public skepticism preventing market penetration. Therefore, the factors impacting customer acceptance of hydrogen fuel cell vehicles have to be estimated and the relationships among these factors have to be empirically tested. Through this study, both manufacturers of hydrogen fuel cell vehicles and government bodies will be provided with useful information that can be used to stimulate diffusion in the hydrogen fuel cell vehicle market.

## 2. Literature Review

On developing a research model and hypotheses, there are a number of indications from earlier studies to be reviewed which provide logical foundations for a model and related hypotheses.

### 2.1. Hydrogen Fuel Cell Vehicles in Korea

The Korean government was early in declaring a national vision for a hydrogen economy in 2005 designed to stimulate the development and commercialization of hydrogen energy and fuel cells for vehicles and portable devices [3]. Although hydrogen fuel cell vehicles may not be the cleanest alternative, there are acceptable reasons why the government has focused on hydrogen fuel cell vehicles rather than on battery-powered vehicles or bio-fuel cars. HFCVs are not only clean and environmentally friendly means of transportation, but they are also important to strengthen Korean energy security. Battery vehicles or bio-fuel cars are also clean alternatives, but in the context of energy security, they are less practical than HFCVs. This is supported by the Korean circumstance of having to import most of the feedstock of bio-fuel and fossil fuels for electricity.

While the public is becoming familiar with hydrogen energy and HFCVs, most people do not have many opportunities to experience them in a practical manner [4]. New products made through advanced technologies, such as HFCVs, often do not penetrate the market when they face public doubt regarding them that is stimulated by a lack of knowledge and experience. This explains the necessity of cost–benefit analyses and scientific risk assessments as well as public acceptance studies toward HFCVs and their technologies [5].

## **2.2. Customer Acceptance of Technological Innovations**

Consumers are asked to approve the use and implementation of technological innovations in their daily life, after which they should decide whether or not they will accept and purchase the products regularly. According to ideas of Wolfe et al. (2002), customer acceptance can be identified as a formal decision to implement or deploy products derived from technological innovations [6]. A product produced by new technologies will be accepted when consumers perceive the benefits it offers more than the potential risks it has. While scientists and economists perform risk–benefit analysis in order to compare usefulness of different products and technologies, the acceptance of a product is not always identical to the scientific observations and expectations. The acceptance of a product is often affected by personal perceptions encompassing both benefit perception and risk perception. Thus, it is important to conduct research of the acceptance which is related to personal perceptions as well as scientific risk assessment [5].

## **2.3. Factors Affecting Customer Acceptance**

There are factors that affect whether or not consumers accept technological innovations that produce new products and services, such as trust in information and advice from experts or scientists, recommendations by government agencies [7,8,9,10] mass media reporting and advertising [11], and family and peer group pressure. With regard to the level of knowledge, it is controversial as to whether more knowledgeable consumers are more likely to accept those products and services [12,13]. Also, acceptance of new technologies can vary significantly according to socio-economic groups, age, gender, and the cultural context in which the technologies and risks are being considered [14]. According to a qualitative study conducted by Schulte et al. (2004) on the acceptance of hydrogen fuel for road vehicles, three components directly influence the acceptance of any product, such as perception of product, values of person in question, and needs of person in question. These three factors also affected from personal experience and social background [5].

## **3. Research Model**

The research model and hypotheses of this study were based on the former study of Schulte et al. (2004) [5], and some features were considered in the model to reflect the purpose of this study.

### **3.1. Research Hypotheses**

H1: A customer's awareness of HFCVs has a positive impact on the customer's perception of HFCVs.

H2: A customer's environmental concern has a positive impact on the customer's perception of HFCVs.

H3: A customer's perception of HFCVs has a positive impact on the customer's intention to accept HFCVs.

H4: A customer's environmental concern has a positive impact on the customer's intention to accept HFCVs.

H5: A customer's need to feel worth has a positive impact on the customer's intention to accept HFCVs.

H6: A customer's environmental concern has a positive impact on the customer's need to feel self-worth.

## **4. Research Methodology and Results**

The method of survey research was used to collect quantitative data for testing the hypotheses. In conducting a survey, samples of 430 people living in high density residential areas close to Seoul in Korea were randomly chosen and 305 valid responses were gathered through an Internet survey, as well as a PAPI (Paper-And-Pen-Interview).

The testing of hypotheses and examining the validity and reliability of their measurement scales are being conducted using the PLS analysis. The validation of the measurement scales confirms that each construct has sufficient reliability and discriminate validity. Table 1 and Fig. 1 provide the results of the PLS analysis and examination of the hypothesis.

Table 1. Tests of Hypotheses

Hypothesis	Path Coefficient (Direct Effect)	Indirect Effect	Total Effect	t-Value for Path	Supported?
Awareness of HFCV → Perception of HFCV	0.29		0.29	3.46***	Yes
Environmental Concern → Perception of HFCV	0.22		0.22	2.52**	Yes
Perception of HFCV → Intention to Accept HFCV	0.25		0.25	2.22**	Yes
Environmental Concern → Intention to Accept HFCV	0.17	0.19	0.36	1.77*	Yes
Need to Feel Self-Worth → Intention to Accept HFCV	0.33		0.33	3.32***	Yes
Environmental Concern → Need to Feel Self-Worth	0.39		0.39	4.23***	Yes

\*\*\*p<0.01, \*\*p<0.05, \*p<0.1

Note 1: Total effect = Direct effect + Indirect effect

Note 2: R<sup>2</sup> for Intention to Accept HFCV = 0.32, R<sup>2</sup> for Perception of HFCV = 0.14, R<sup>2</sup> for Need to Feel Self-Worth = 0.15

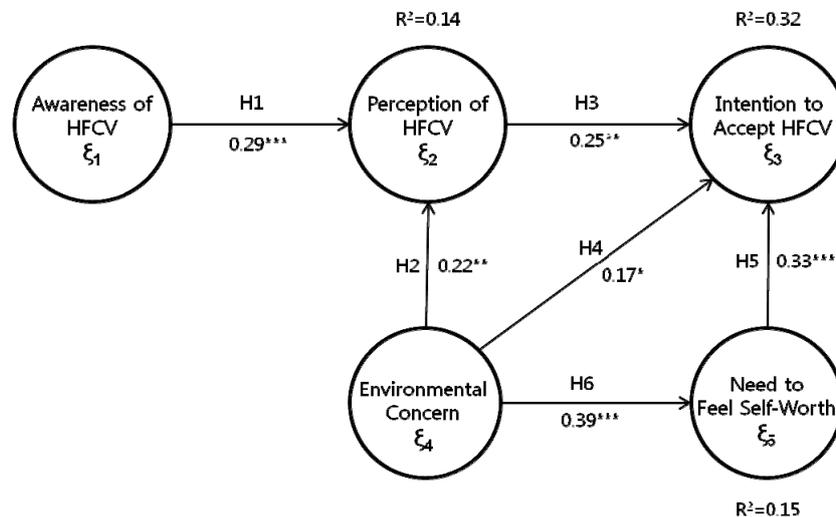


Fig. 1. Results from PLS analysis

The results of the PLS analysis reveal that all paths are not only statistically significant, but also support hypothesized relationships. The PLS analysis was used to calculate the total effects, which consist of direct effects and indirect effects of antecedent constructs on consequent constructs; by these calculations, it can be supposed that Environmental Concern (0.36) is the strongest predictor of the Intention to Accept HFCV, followed by Need to Feel Self-Worth (0.33) and Perception of HFCV (0.25). Each direct path between the endogenous variable of Intention to Accept HFCV and the corresponding exogenous variables, in this case Perception of HFCV, Environmental Concern, and Need to Feel Self-Worth, is statistically significant. The t-values for these are 2.22 (p<0.05), 1.77 (p<0.1) and 3.32 (p<0.01), respectively. Also, the path between the Awareness of HFCV and the Perception of HFCV is statistically significant. The t-value for this is 3.46 (p<0.01).

## 5. Discussion

The hypothesized path from a customer's awareness of hydrogen fuel cell vehicles (HFCVs) to the customer's intention to accept HFCVs, which is mediated by the customer's perception of them, was tested and proved by this empirical study. The results of this study imply that a customer's awareness of HFCVs can lead the customer to consider HFCVs when they are confronted with the situation in which the purchasing decision is made. Regarding these empirical results in detail, the more customers become aware of HFCVs, the more customers have a positive image of HFCVs stemming from their optimistic evaluation

of HFCVs' levels of driving performance and riding comfort. These types of feelings related to HFCVs would strengthen customers' intention to implement HFCVs. Thus, HFCV-manufacturers and government agencies striving to promote green transportation need to scale up their efforts to enhance customer awareness of HFCVs. In that regard it seems necessary to provide and enhance communication channels by which manufactures or sellers and potential customers share the information related to HFCVs, such as mass media, interpersonal communication channels, and interactive communication channels, i.e., Internet [15]. In addition, stimulating a customer's desire to be respected as a person acting for environmental conservation can be a good means of accelerating the diffusion of HFCVs into future market.

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## 7. References

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