

## Identifying and ranking the factors affecting the adoption of biofuels

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### CHRONICLE

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### ABSTRACT

This paper presents an empirical investigation to determine the important factors influencing on adoption of biofuels from consumer's perspective. The study designs a questionnaire in Likert scale and distributes it among 211 randomly selected people who use green products in city of Tehran, Iran. Cronbach alpha is calculated as 0.812, which is well above the acceptable level. Using principle component with Varimax rotation, the study has determined five important factors including social commitment, product usefulness, infrastructure, management approach and customer oriented, which influence the most on adaptation of biofuels.

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## 1. Introduction

One of the most essential questions in today's day-to-day activities is to learn more on how to take care of the environment. Every day, more news appear about the effects of global warming on people's lives. These days, we hear more from media on unpleasant incidents such as shortage of water supply, starvation, air pollution, etc. Fossil fuels are blamed as the most important causes of air pollution and Biofuel is an alternative solution to reduce the burden of fossil fuels. During the past several decades, many have argued as to whether or not it is possible to reach a replacement of environment friendly fuels, which would be also cost effective. In other words, many have tried to answer a simple question "Does it pay to be green?" (Hart & Ahuja, 1996). Bhat (1999) investigated the relationships between the environmental performances and financial performances of some U.S. firms. The environmental performance in this survey was measured in pollution in pounds per sales revenue while the financial performance was computed in terms of profit margins and stock market performance. Bhat performed an indebt investigation into more than 230 firms and found that lower pollution per sales revenue had a positive effect on the profit margins and stock performance. Pollution in their survey was also determined to maintain a direct effect on environmental compliance, spills and different other legal infractions. Stefan and Paul (2008) investigated the relationship between emissions reduction and

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company performance on data from S&P 500 firms. They reported that “efforts to prevent pollution and reduce emissions drop to the ‘bottom line’ within one to two years of initiation and that those firms with the highest emission levels stand the most to gain”. Orsato (2006) presented a model for categorizing generic kinds of competitive environmental strategies to help managers determine and rank areas of organizational action, and to optimize the overall economic return on environmental investments and making them into sources of competitive advantage. King and Lenox (2001) performed a survey and reported that despite the fact that there are some evidences on relationship between lower pollution and higher financial valuation, a firm's fixed characteristics and strategic position may create some barriers on this association. Biofuels extracted from low-input high-diversity mixtures of native grassland perennials may give more usable energy, bigger greenhouse gas reductions, and less agrichemical pollution per hectare than alternative ones such as corn grain ethanol or soybean biodiesel (Tilman et al., 2006) and the primary objective of the present survey is to learn how to cope with this type of fuels.

## 2. The proposed study

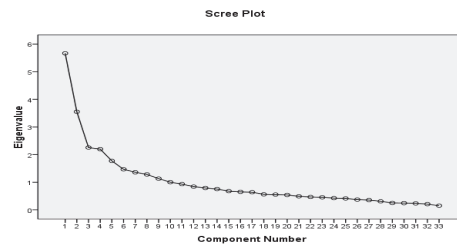
This paper presents an empirical investigation to determine important factors influencing on adoption of biofuels in consumer's perspective. The study designs a questionnaire in Likert scale and distributes it among 211 randomly selected people who use green products in city of Tehran, Iran. Cronbach alpha is calculated as 0.812, which is well above the acceptable level. Table 1 presents the results of KMO and Bartlett's tests. Table 2 demonstrates the results of the summary of communalities. Table 3 presents the implementation of principal component analysis after rotation. Fig. 1 demonstrates Scree plot of the factors in our survey.

**Table 1**  
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.756
	Approx. Chi-Square	2596.94
Bartlett's Test of Sphericity	df	595
	Sig.	.000

**Table 2**  
The summary of communalities

Question	Variable	Initial communalitie	Extracted communalitie	Question	Variable	Initial communalities	Extracted communalities
q1	Distribution channels	1	0.567	q19	Public awareness	1	0.788
q2	Attention to environment	1	0.798	q20	Technical feasibility	1	0.614
q3	Organization's social responsibility	1	0.733	q21	Financial feasibility	1	0.778
q4	Customers' knowledge	1	0.628	q22	Fast commercialization	1	0.56
q5	Attention to green social programs	1	0.669	q23	Supply of raw material	1	0.681
q6	Customization	1	0.688	q25	Quality life	1	0.671
q7	Business strategy	1	0.647	q26	Logistics	1	0.695
q8	Green distribution	1	0.691	q27	Government support	1	0.74
q9	Public transportation	1	0.719	q28	High cost of R & D	1	0.515
q10	Fair prices	1	0.669	q29	Product life cycle	1	0.556
q11	Profitability for customers	1	0.705	q30	Customer expectation	1	0.669
q12	Subjective norms	1	0.726	q31	Perceived usefulness	1	0.678
q13	Green purchase behavior	1	0.551	q32	Social marketing	1	0.6
q14	Technical equipment	1	0.642	q34	Fossil fuel resources	1	0.606
q15	Market analysis	1	0.529	q35	Fossil fuel prices	1	0.596
q16	Customer information	1	0.625				
q17	Green development	1	0.698				
q18	Globalization	1	0.654				



**Fig. 1.** The results of Scree plot

As we can observe from the results of Fig. 1, after eight components, the figure becomes flat. Therefore we initially extract eight factors.

**Table 3**

The results of principle component analysis after Varimax rotation

	Component							
	1	2	3	4	5	6	7	8
VAR00002	.388					.616		
VAR00003						.667		
VAR00004						.675		
VAR00007		.485		.389		.553		
VAR00008		.943						
VAR00009				.959				
VAR00010			.914					
VAR00011	.593		.465					
VAR00012								.969
VAR00013	.858							
VAR00014							.956	
VAR00015	-.383				.543			
VAR00016	-.523				.509			
VAR00018					.669			
VAR00019					.733			
VAR00020					.680			
VAR00021		.485		.389		.553		
VAR00022		.943						
VAR00023				.959				
VAR00024			.914					
VAR00025	.593		.465					
VAR00026								.969
VAR00027	.858							
VAR00028							.956	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

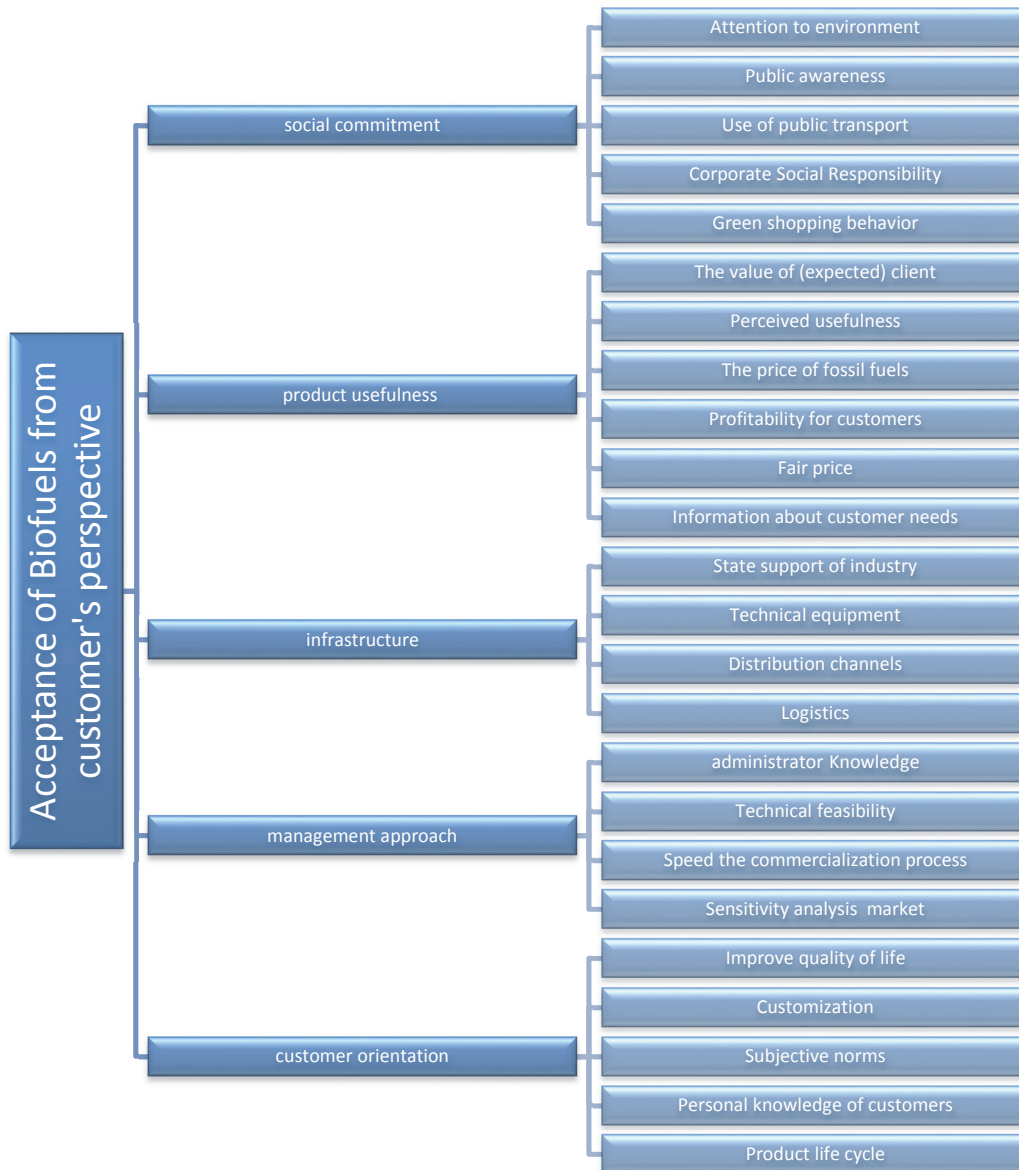
a. Rotation converged in 7 iterations.

As we can observe from the results of Fig 2, the survey has detected five important factors as the most important factors influencing on Biofuels adoption the study including social commitment, product usefulness, infrastructure, management approach and customer oriented, which influence the most on adaptation of biofuels. Table 4 demonstrates the results of examining different factors and as we can observe the effects of all factors have been confirmed.

**Table 4**

The results of the effects of different influential factors

Alternative	Estimate	P	Accept the	Alternative	Estimate	P	Accept the
q2	0.904	P<0.001	Accept	q14	0.738	P<0.001	Accept
q19	0.868	P<0.001	Accept	q1	0.422	P<0.001	Accept
q9	0.736	P<0.001	Accept	q26	0.38	P<0.001	Accept
q3	0.835	P<0.001	Accept	q35	0.496	P<0.001	Accept
q13	0.395	P<0.001	Accept	q20	0.733	P<0.001	Accept
q30	0.762	P<0.001	Accept	q22	0.61	P<0.001	Accept
q31	0.666	P<0.001	Accept	q15	0.429	P<0.001	Accept
q34	0.755	P<0.001	Accept	q25	0.48	P<0.001	Accept
q11	0.6	P<0.001	Accept	q6	0.636	P<0.001	Accept
q10	0.63	P<0.001	Accept	q12	0.686	P<0.001	Accept
q16	0.536	P<0.001	Accept	q4	0.519	P<0.001	Accept
q27	0.698	P<0.001	Accept	q29	0.459	P<0.001	Accept



**Fig. 2.** The results of PCA method

### 3. Discussion and conclusion

In this paper, we have presented an empirical investigation to study the effects of various factors influencing on the adaptation of biofuels in Iran. The survey has detected five factors. The first factor, social commitment, consists of five sub-factors. Attention to environment appears to be one of the most important items, which must be considered in both governmental as well as public sector (D'Souza et al., 2008). To reach this objective, it is essential to raise public awareness, which is also the second factor detected in our survey. There is no doubt that public transportation plays essential role for reaching better environment system. Of course, this should be accompanied with a good corporate social responsibility and green shopping behavior, which are other important factors and it must be considered as social commitment. The findings of this part of the survey are consistent with findings reported by Gan et al. (2008).

Product usefulness is the second factor in our survey, which consists of six factors. The value created by client is the most important factor followed by the perceived usefulness. In order to reach this

objective, it is necessary to see cheaper prices of biofuel products and increase consumer's profitability. Government may intervene in pricing alternative fuel products and provide necessary information for customer. Infrastructure is the third most important factor influencing on biofuel adaptation with four sub-factors. Any fuel change must be supported by industry and technical equipment must be available. In addition, it is necessary to have appropriate channels with effective logistics (Gurau & Ranchhod, 2005).

Management approach is another factor in our survey, which consists of four sub-factor. The first step for management team to adopt biofuel is to setup an appropriate administrative knowledge. It is also necessary to determine whether or not the new fueling system is technically feasible (Hu et al., 2008; Brennan & Owende, 2010). On the other hand, technology now changes rapidly and it is important to cope with the changes and perform an analysis on how to cope with market change.

Customer orientation is the last component of our survey with five sub-factors. Improving the quality of life would be first objective of the survey followed by appropriate customization of the product and subjective norms. Moreover, any customer orientation must be accompanied with sufficient personal knowledge of customers. Finally, product life cycle is the last important factor influencing the most on customer orientation. In fact, a short life cycle for a particular fuel product may discourage customer for green fuel usage. Development of biofuel may offer other advantages such as reduction on poverty in agriculture (Peskest et al., 2007). However, others argue such claims. According to Car (2011), in the forest products marketing literature, many people study the environmental perspectives of business strategy as the nexus between economic growth and sustainable development. Car (2011) presented a three-stage evolutionary framework driven by the government regulations, environmental standards, private initiatives, environmental NGOs and consumers. The study suggested that an environmental marketing strategy may create competitive opportunities for companies, but some environmental practices, such as forest certification, might not improve competitive performance unless they are located with the firm's resources and the external environment as part of the strategy. This part of Car's findings are consistent with findings of this study in terms of management approach.

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