

GENDER PREFERENCES FOR ALTERNATIVE ENERGY TRANSPORT WITH FOCUS ON ELECTRIC VEHICLE

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ABSTRACT

Transportation has become an important part of our day to day life. Due to changing lifestyle, frequent travels whether related to work or leisure has become a common phenomenon. Such lifestyle also demands comfortable transport medium and reasonable availability of fuels. As need of vehicle for transportation is rising, it has put pressure of fuel supply, fuel prices and environment as well. The rising prices of fuel, increasing pressure on resources and threatening environment pollution is driving the need for alternative and clean sources of energy. Increasing competition among nations to own the resources is becoming a serious threat for many developing countries. This paper empirically examines the gender preference for alternative energy sources and related technologies for vehicles. In total, 1168 questionnaires were received from respondents (male-711, female-442, not disclosed-15) from eleven cities in India viz. Bengaluru, Chennai, Cochin, Coimbatore, Hyderabad, Pune, Imphal, Rohtak, Sagar and Tiruvanathpuram in India and one city from Bhutan-Thimpu. Respondents who did not disclose their gender were excluded from the study. The study was conducted from October 2013 to June 2014. The objective of the study was to understand the social dimensions and gender preferences of the respondents regarding their preference for electric vehicle as an alternative energy transport for personal and public use. The primary data was collected through a structured questionnaire. The data was analyzed through the Statistical Package for Social Science (SPSS®). Findings indicate that in general fueled vehicles are still preferred over electric vehicles. However there is a strong interest in electric vehicles. It was observed that more than 66% of the respondents in the age group of 18-30 can become prospective customers in the near future, if the electric vehicles meet their expectations. In this age group, 59% of the respondents were male and 41% were female. Most of the respondents indicated that they would purchase the electric vehicle as it would save operating costs, it is environment friendly and less dependent on fossil fuel. It was observed that as compared to female, male respondents were more inclined towards the influential factors like fuel efficiency, safety, vehicle power and reliability and early availability of vehicle in the market. In all 93% of respondents confirm that they are willing to pay the premium price and among them, 61% were male and 39% were female.

Keywords: Gender Preferences, Electric Vehicles, Attitudes and Perceptions, Environment, Alternative Fuel Vehicles, Education, Age Group, Income Group

1. INTRODUCTION

Conventional transportation technologies use fossil fuels as the main source of energy for vehicle propulsion.

However in the recent times, the rising prices of oil and petroleum products, along with environmental awareness, are forcing nations to look for alternative transportation technologies. Over the past few years,

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high oil prices, fossil fuel depletion and climate change have accelerated the need for Alternative Energy Transports (AETs). Competition is also rising among automobile companies; and they are on a continuous quest for developing more sustainable vehicles in order to combat fuel costs and the harmful environmental effect of petroleum products.

In India also, a new generation of quality conscious, price conscious and environment conscious consumer has evolved. The younger generation, especially in the age group of 18-30, is on one hand technology savvy and on the other hand conscious about making investment. A customer today has become conscious and believes in intelligent purchasing. The decision is dependent on thorough research and market responses.

A study was conducted by involving 1168 respondents belonging to different age groups. Persons from various companies, colleges and universities were asked about their views on a range of transportation-related issues and their level of acceptance of new technologies. It was found that the most promising target group for the adoption of Alternative Energy Transports (AETs) is that of young, well-educated and environmentally aware people, who have the option of charging their car at home, who do not travel long distance in the city and need a small car. Out of these 1168 respondents, 15 respondents did not disclose their gender and were excluded from the study.

Dependence on the vehicle alternatives, environmental awareness and budget constraints for purchasing the second vehicle, reputation and reliability of vehicle, joint decision in buying, willingness to pay substantial amounts for the cost of environmental friendly fuel, driving range, pollution, vehicle-tax exemptions are also important factors influencing the purchase of an Alternative Energy Transportation (AETs).

A conclusion was drawn based on the data and preference of people. It is clear that there is an awareness gap regarding the effect on health and global climate change as only a few people are aware of the rising pressure on depleting natural resources due to an increase in consumption. There is a need of creating awareness amongst the middle-aged segment. The Alternative Energy Transportation (AETs) vehicle will be accepted in the society only if it is fuel efficient, cost saving and pollution free.

1.1. Objective

The main objective of the study was to determine the consumer's preference for Alternative Energy

Transportation (AETs), buying decision and the greater difference in their use of vehicles.

1.2. Literature Review

Vehicle pollution has been a serious concern for the past few decades all over the world. The combination of a short supply of fossil fuel reserves, environmental pollution and volatility in crude oil prices has generated interest for using alternative fuels. In his book "Alternative Fuels for Transportation", (Arumugam and Ramadhas, 2011) discusses the case of zero emission vehicles in three chapters, electric vehicles, fuel cells and hybrid vehicles. He discusses that based on the available energy sources, the battery electric vehicle and fuel cell electric vehicle cannot compete with the internal combustion engine vehicles in terms of driving range or initial cost. In the future according to his research, the hybrid electric vehicle (commonly called the hybrid vehicle) is not only a major class of alternative fuel vehicles, but also a practical solution for commercialization of super ultra-low emission vehicles.

The continued growth in the amount of imported oil required to meet demand for petroleum products threatens national and economic security and is not sustainable in the long term. Accordingly, the U.S. government has been adopting a wide range of policies to reduce energy consumption in the transportation sector since the energy crisis of 1973, such as reducing individuals' dependence on personal vehicles and promoting higher average vehicle fuel economies. For the past forty years, United States Presidents have repeatedly called for a reduction in the country's dependence on fossil fuels in general and foreign oil specifically. Stronger efficiency standards and higher taxes on motor fuels are a step in this direction, but achieving even greater reductions in oil consumption will require changing the way Americans power their transportation system. The Obama administration has, for example, embraced a goal of having one million electric-powered vehicles on U.S. roads by 2015, while others proposed a medium-term goal where electric vehicles would consist of 20% of the passenger vehicle fleet by 2030-approximately 30 million electric vehicles (Lee and Lovellette, 2011).

This will include a multi-billion dollar investment in automotive battery manufacturing, tax credits and loans for plug-in vehicle manufacturing and purchase and research initiatives. Some states have adopted their own initiatives as well (Hidrué *et al.*, 2011).

Alternate Fuel Vehicles (AFVs) have been appealing transportation technologies in the U.S. since 1990. The

public and private sectors have invested billions of dollars into the development of AFVs. At this time, a few types of AFVs are on the roads in the U.S and some demonstration plans for AFVs are in process. These vehicles are potential substitutes for current gasoline vehicles and may account for a considerable share of the automobile market in the future. Conversely, it is also possible that some types of AFVs will die out since they fail to meet the requirements of potential consumers and hence do not achieve sufficient market share to be viable. However, how AFVs behave in the market depends on a variety of endogenous and exogenous factors, such as their performance, their limitations, consumer preferences, the regulatory environment, the price and availability of gasoline and so on. Therefore, it is difficult to forecast the market penetration of various AFVs. Yet, the forecasts of AFVs' market are essential to evaluating their potential contributions to the reduction of energy consumption and emissions in the transportation sector.

It is widely accepted that electrification of the transport sector is one of several technological trajectories that could redress some of the environmental issues associated with the growth in travel demand including climate change and oil demand at a global scale and air quality and noise pollution at the urban scale. Electric vehicles have been considered a promising technology at repeated intervals over the last century, but this promise has not been realized (Steinhilber *et al.*, 2013). More importantly, the EV's ability to expand its niche market to a mass market would depend on dramatic advances in technology aimed at lowering the cost of battery production while maintaining high vehicle performance (Tsang *et al.*, 2012). In most countries, however, lack of renewable electric energy is one of two important arguments making electric charging of batteries into a disputable global warming reduction action (Hjorthol, 2013). EV is a significant new technology; this makes it pertinent to explore EV adoption as "new technology" adoption (Jabeen *et al.*, 2012).

Electric Vehicle (EV) is considered as an alternative which can potentially reduce the environmental impact substantially in contrast to cars powered by fossil fuel (Liao, 2014). Electric vehicles historically predate gasoline vehicles, but only received mainstream interest in the last decade (Avci *et al.*, 2012). EVs have the potential to deliver significant GHG emission savings in road transport in a cost-effective way, particularly after 2030 (Contestabile *et al.*, 2012). It is expected that electric vehicles will be

available especially for driving short distance for individual transport due to the limited range of the batteries and drive systems (Hanke *et al.*, 2014).

For any product or service, information is one of the most important resources that one must collect. When it comes to consumer preferences, it becomes difficult concept to grasp. It was realized that consumer preferences can be effectively measured and their research may provide a deeper understanding of the choices that consumers make when deciding to select an offer against another and when deciding to continue in time the relationship with one supplier (Voicu, 2013). Concerns have been expressed by manufacturers and customers about the environmental impact of products during recent decades. Various studies support the assertion that consumers today prefer environmentally safe products and have a positive disposition towards companies following such practices (Bhatia and Jain, 2013).

2. MATERIALS AND METHODS

Our approach towards gaining an understanding of consumer preferences entailed developing a survey instrument for collecting individual data on the important variables. The primary research instrument used was a detailed questionnaire. This was used for data collection because it provides the most efficient means of collecting quantitative data on the major variables for a large cross section of population. The questionnaire was administered by the research team in various schools, colleges and corporates to get diversified views on the various variables. Information available on internet was also referred to, for better understanding of the subject.

The development of the questionnaire was a complex and lengthy process. It was designed after conducting various focus group discussions and interviews with professors, community members and transport industry representatives. On the basis of the focus group discussions and literature review, scales measuring attributes of transportation were developed and evaluated. After completion of various versions, the final version was designed and used in the metros or tier-1 and tier -2 cities in the southern part of India and Thimpu-Bhutan.

The survey includes demographic characteristics of people, vehicle attributes, environmental impacts, technological issues and detailed information on daily travel. Demographic variables like gender, age, household income and education level were taken for understanding the consumer preferable attributes. The data reveals that male respondents drive 30 km on an

average 19% more than their female counterparts (male 44% and female 25%). Overall, the km driven daily decrease as the age group increases. In our survey we observed that 68% of respondents were from the age group of 18-30, whereas 29% belonged to the age group of 31-60.

Along with the demographic information such as gender, age, education and income, respondents were also asked to share their views on transportation issues faced by them. Questions were asked about the environment, technology used and environmental impact of motor vehicles. Vehicle related questions included their vehicle ownership and factors that might influence their purchase decision.

3. DATA ANALYSIS

The descriptive responses were collected and the questionnaires were analyzed by using frequency distribution and descriptive statistics in *Statistical Package for the Social Science* (SPSS version 20)

software. All incomplete surveys were discarded from the analysis. Frequency tables and descriptive statistics were constructed to display results with respect to each of the research question.

4. RESULTS

4.1. Transportation Issues

To understand the transport related issues, the respondents were asked questions related to problems faced by them. This included questions on congestion, noise level, pollution, safety, fuel import etc. This helped to develop a better understanding of respondents' attitude toward transportation. "Figure 1" presents the response of gender on various transport related issues. In terms of percentage male and female were almost similar with just a variation of 4-5% which means that male and female both are sensitive about transport issues as explained in **Table 1**". Importing of fuel is a problem or major problem for male and female equally in terms of percentage.

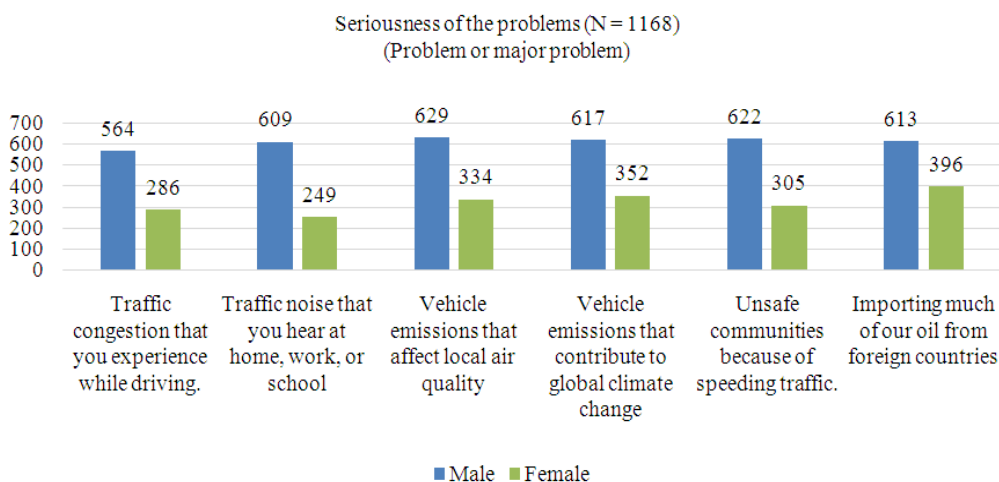


Fig. 1. Break-up of major transport issues based on gender. Respondents included 711 males and 442 females

Table 1. Break-up of major transport issues based on gender

Seriousness of the problem (problem or major problem)	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Traffic congestion that you experience while driving.	564	81	361	83
Traffic noise that you hear at home, work, or school	609	87	399	92
Vehicle emissions that affect local air quality	629	90	403	93
Vehicle emissions that contribute to global climate change	617	89	402	92
Unsafe communities because of speeding traffic.	622	90	402	93
Importing much of our oil from foreign countries	613	88	381	88

4.2. Impact on Environment

It was observed in “Table 2” that male and female both are sensitive about the transport issues which has an impact on environment with just a variation of 1-2%. It was observed that there is no difference between the thoughts of gender when the question was asked related to greenhouse gases. Male and female equally (in terms of total percentage) consider that cars, minivans, vans, pickups and SUVs are an important source of the greenhouse gases that many scientists believe are responsible for global warming. It was also observed that almost 15-20% of the respondents are not concerned about environmental impact which is caused by various transport vehicles. Almost 30-40% of respondents think that small cars are not the reason behind air pollution. “Figure 2” presents gender-wise view related to impact on environment by various transport modes.

4.3. Reasons in Support of Electric Vehicles in Future (Part 1)

“Table 3” presents that out of total respondents, 79% of male agreed that saving money on the cost of operation is very important or important while 84% female said that it is important or very important. 89% said that electric vehicles are very important or important for reducing the harmful impact (pollution) on the environment, while 93%

female said that they are very important or important. 90% of male said that it is important to reduce the dependence on gasoline, 92% female said that it is important. 89% of male and female were interested to drive a vehicle with more advanced or innovative technology and said that it is an important factor which they will consider in the future for buying the electric vehicle.

It was observed in “Fig. 3” that female respondent were marginally more sensitive about the purchasing factors in-comparison to male respondent.

4.4. Reasons in Support of Electric Vehicle in Future (Part 2)

When asked to list some of the important factors which would restrict a customer from buying the Alternative Energy Transportation (AETs), the common issues were concern about recharge stations, higher price, availability of desirable vehicle size, reliability, ongoing maintenance, operating costs and the ability to carry occasionally heavy loads as explained in “Fig. 4”. In each case it was found that these above mentioned factors are important or very important for more than 80% of the respondents. It was observed that females were marginally more selective than the male respondents while selecting important factors in terms of percentage as explained in “Table 4”.

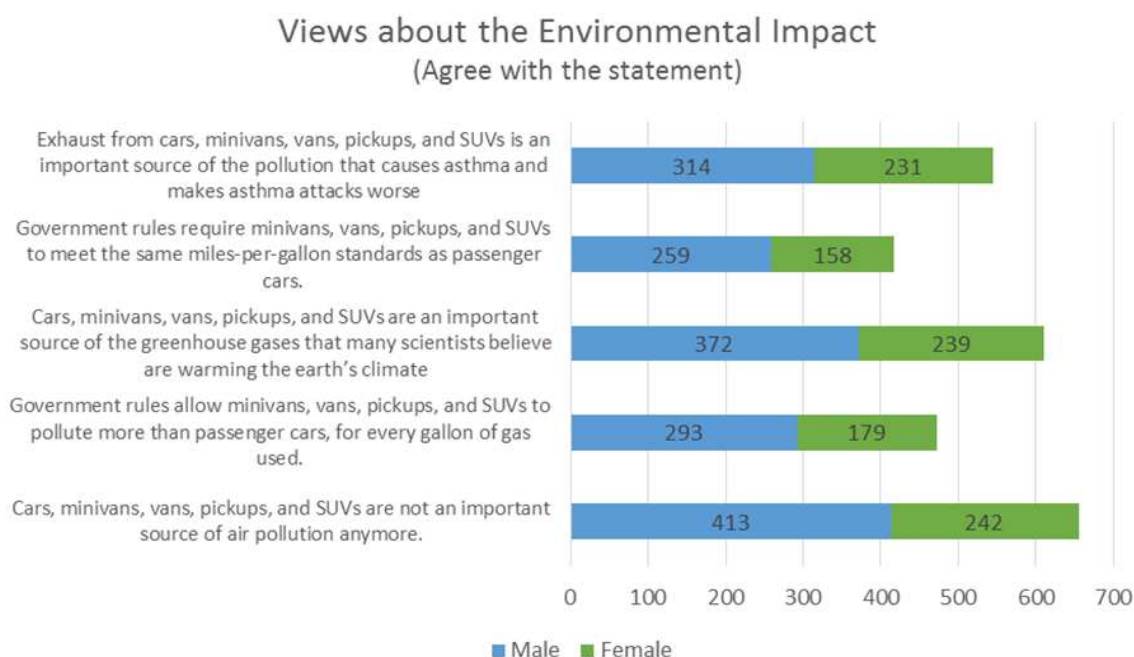


Fig. 2. Gender-wise view-impact on environment of various transport modes. Respondents included 711 males and 442 females

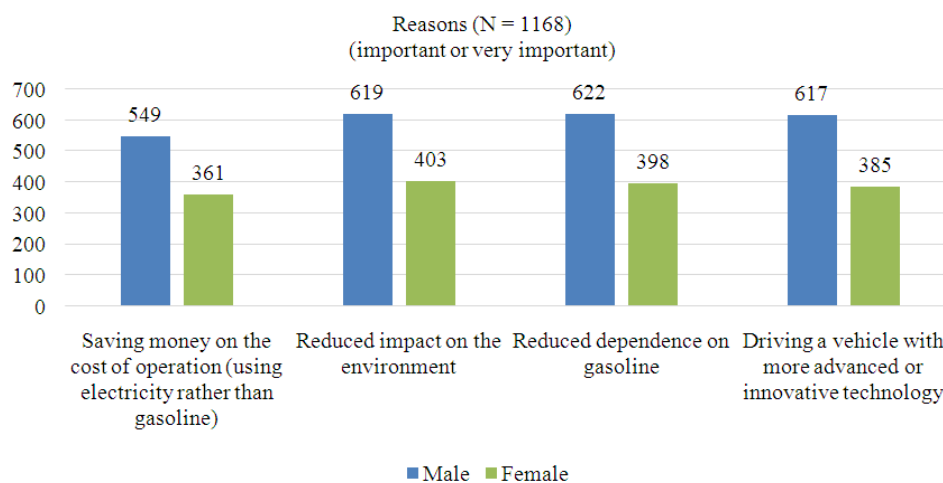


Fig. 3. Responses in support of electric vehicles in future-gender preference. Respondents included 711 males and 442 females

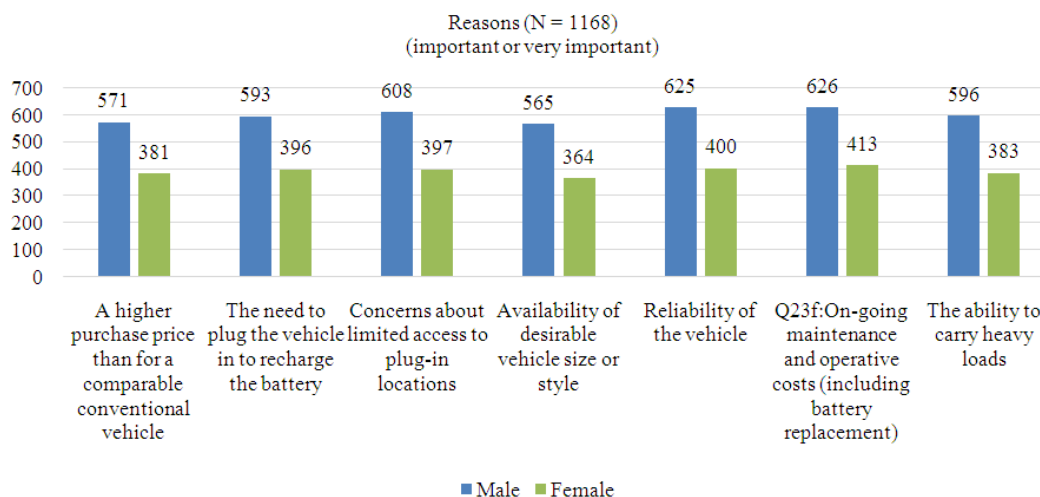


Fig. 4. Factors supporting purchase of electric vehicles-gender preferences. Respondents included 711 males and 442 females

Table 2. Gender-wise view-impact on environment of various transport modes

Factors	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Cars, minivans, vans, pickups and SUVs are not an important source of air pollution anymore.	413	60.8	242	56.0
Government rules allow minivans, vans, pickups and SUVs to pollute more than passenger cars, for every gallon of gas used.	293	43.3	179	41.7
Cars, minivans, vans, pickups and SUVs are an important source of the greenhouse gases that many scientists believe are warming the earth's climate	372	55.1	239	55.2
Government rules require minivans, vans, pickups and SUVs to meet the same miles-per-gallon standards as passenger cars.	259	38.4	158	36.7
Exhaust from cars, minivans, vans, pickups and SUVs is an important source of the pollution that causes asthma and makes asthma attacks worse	314	46.2	231	53.3

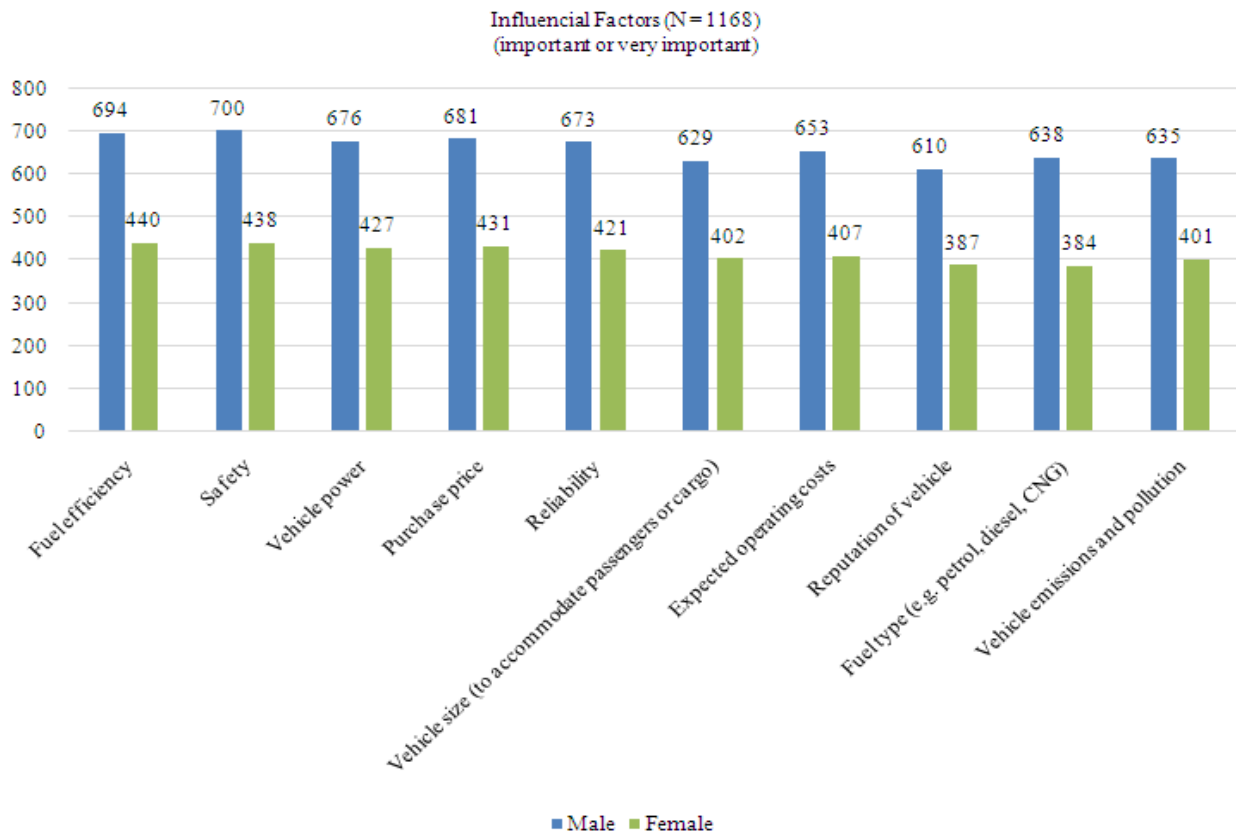


Fig. 5. Factors important for purchase of personal vehicles. Respondents included 711 males and 442 females

Table 3. Responses in support of electric vehicles in future-gender preference

Factors	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Saving money on the cost of operation (using electricity rather than gasoline)	549	79	361	84
Reduced impact on the environment	619	89	403	93
Reduced dependence on gasoline	622	90	398	92
Driving a vehicle with more advanced or innovative technology	617	89	385	89

Table 4. Factors supporting purchase of electric vehicles-gender preferences

Factors	Male		Female	
	Frequency	Percentage	Frequency	Percentage
A higher purchase price than for a comparable conventional vehicle	571	83	381	89
The need to plug the vehicle in to recharge the battery	593	86	396	92
Concerns about limited access to plug-in locations	608	89	397	93
Availability of desirable vehicle size or style	565	82	364	84
Reliability of the vehicle	625	91	400	93
On-going maintenance and operative costs (including battery replacement)	626	92	413	96
The ability to carry heavy loads	596	87	383	88

Table 5. Factors important for purchase of personal vehicles

Factors	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Fuel efficiency	694	98.58	440	100
Safety	700	99.29	438	100
Vehicle power	676	96.16	427	98
Purchase price	681	96.87	431	98
Reliability	673	95.73	421	97
Vehicle size (to accommodate passengers or cargo)	629	89.99	402	92
Expected operating costs	653	93.02	407	93
Reputation of vehicle	610	88.15	387	91
Fuel type (e.g., petrol, diesel, CNG)	638	91.14	384	88
Vehicle emissions and pollution	635	90.46	401	92

4.5. Factors Important for Purchase of Personal Vehicles

The respondents showed their concerns for fuel efficiency, safety, vehicle power, vehicle reliability, size of the vehicle, expected operating costs (for maintenance and repair), reputation of a particular vehicle make or model, fuel type (e.g. petrol, diesel, CNG), vehicle emission and pollution as explained in “**Fig. 5**”. Most of the respondents shared that they would consider all the above mentioned points to a large extent while deciding which new vehicle to purchase and consider them important in terms of percentage as explained in “**Table 5**”.

5. CONCLUSION

The views of all the respondents who participated in the survey were analyzed and hence conclusions based on the responses were derived. This section summarizes the key findings and presents some recommendations based on the responses.

The survey was conducted in universities and hence more than 65% of the respondents were in the young age group of 18-30. It was observed that only 4% of male and 1% of female respondents have electric vehicle at their home. Out of the respondents who do not have electric vehicle at their home, 58% were male and 37% were female. More than 66% of respondents were interested in buying the new electric vehicle once it is available in the market, of which male % was 40 and female % was 26. If this group is targeted properly and made aware of the usefulness of electric vehicles, this group can easily become prospective buyers of electric vehicles. They can be potential customers in future.

Television, newspaper, internet and magazine were the main source of information about new technologies

for majority of the respondents. Very few respondents get information from radio and other sources. Around 91% of the respondents shared that they purchase a vehicle after discussing it with their family members, relatives and friends. Such respondents prefer to take a joint decision for the purchase of a new vehicle.

Most of the respondents expressed desire to purchase electric vehicle as it will save on operating cost, it is environment friendly and less dependent on fuel. It was also observed that female is marginally more sensitive than the male respondents towards environmental factors. The survey also revealed that almost 93% of the customers are even willing to pay a premium for a hybrid vehicle. This clearly shows that demand of fuel efficient hybrid vehicle exists in the market.

After a detailed analysis of the survey result, it was concluded that people are willing to purchase an electric vehicle which is powerful, reliable, fuel efficient and safe.

It was further observed that there is lack of awareness among people on important issues such as link between using a vehicle causing pollution and its hazardous effects on health and global climate change. Due to this lack of awareness, environmental issues play a limited role in the decision making process while buying a new vehicle.

6. RECOMMENDATION

After analyzing customer response and preference through survey, it was strongly felt that Alternative Energy Transports (AETs) could be made more acceptable by focusing on consumer preferences and vehicle characteristics i.e. good power, reliability, fuel efficiency and safety. It is necessary to educate and sensitize the public on AETs especially electric vehicles to increase its acceptance and usage, so that a positive transition can take place which will help in bringing energy security, air quality, public health and economic benefits to India.

Therefore, significant investment in research and development is required to improve the perception and popularity of Alternative Energy Transportation (AETs) such as Electric Vehicles. Government subsidies, procurement programs and development of niche markets, all will have a role to play in encouraging the uptake of the new technology.

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