MECHANICAL ENGINEERING | RESEARCH ARTICLE

Barriers to widespread adoption of plug-in electric vehicles in emerging Asian markets: An analysis of consumer behavioral attitudes and perceptions

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Abstract: Electric vehicles (EVs) are one of the near-term practical solutions in vehicle technology, which can reduce emissions leading to the greenhouse effect and dependence on fossil fuels that are correlated with conventional vehicle-conventional vehicles (CVs). Several interferences are yet to be overcome for widespread adoption of EVs, despite many benefits provided to the consumers. The tendencies of customers to resist new technology is one of the major barriers in EV adoption. Hence, the policy-related decisions that showing grim concerns of EV have a greater level of success. This research aims to identify potential environmental and socio-technical barriers to purchase of EVs and it determines if governmental policies and awareness of individuals affect the customer decisions purchasing an EV. This research tries to convey valuable insights into perceptions and preferences of technology enthusiasts, individuals who are greatly connected to latest technology developments, and those who are well equipped to sort out the numerous differences between CVs and EVs. These

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PUBLIC INTEREST STATEMENT

Electric vehicles (EVs) are one of the near-term practical solution in vehicle technology, which has the capability to reduce emissions leading to greenhouse effect and dependence on fossil fuels are correlated with conventional vehicles (CVs). Several interferences and constraints are yet to be addressed for widespread adoption of EVs. The tendencies of customers to resist new technology, is one of the major barriers in EV adoption. Hence, the policy-related decisions that showing grim concerns of EV have a greater level of success. The project develops an insight on preferences of technology enthusiasts considered the EVs. The knowledge and consumer behavior attitudes and perceptions differ across gender, age, and education groups. EVs are affected by sustainability and environmental benefits, their expenses and efficiencies remain behind them. Uncertainty of EV battery system is a major possible obstacle to widespread EV acceptance. Media and social networks can influence public view of EV acceptance.
results can provide direction to EV engineer’s decision in including customer preference into EV engineering design. It can also help policymakers in developing transportation and energy policies. A survey-based study was conducted with a sample of 1230 people from urban cities of emerging Asian markets, i.e. India and Sri Lanka. The data collected were analyzed, which found perception of economic benefits, functional characteristics of EVs, awareness, knowledge, and familiarity of EVs as significant parameters, which directly have an impact on the purchase behavior of fully EVs.

Subjects: Transport & Vehicle Engineering; Automotive Technology & Engineering; Sustainable Transport Engineering

Keywords: plug-in electric vehicles; consumer attitudes; adoption behavior; socio-technical barriers; environmental concern; energy policy

1. Introduction

A total transformation in the transportation industry is required globally, to reduce the dependence on fossil fuels, greenhouse gas emissions and air pollution. According to the International Energy Agency (IEA), around 14% of worldwide greenhouse gas emissions are accountable for the transport industry alone, which is forecast to rise by 2030 to about 50%. This prediction demonstrates that the current transport system cannot sustain in future.

Due to the growing concerns environmental sustainability, electric vehicles (EVs) are considered as an option for reducing or preventing the cause of these issues. However, such a transformation will not be easy to achieve in an emerging or developing country, as it demands the rise in knowledge, awareness and change in attitude EVs (Ajzen, 1991; Larson et al., 2014). The major car manufacturers in the world today are demonstrating interest manufacturing an EV and is developing a new version of commercial and EVs (Ajzen, 1991; Gyimesi & Viswanathan, 2011; Larson et al., 2014).

India launched “National Electric Mobility Mission Plan (NEMMP) 2020” in 2013, which aims promotion of hybrid and EVs in the country to achieve national energy security. It also addresses issues such as pollution and growth of production capabilities. Restating its commitment to the Paris agreement, the Government of India has been planning to take drastic steps to move EVs by the year 2030 (Gyimesi & Viswanathan, 2011). After a long stream of subsidies and incentives, The Government of India has finally directed its focus building EV infrastructure in the country (Krause et al., 2013).

The automotive manufacturers are facing difficulties in understanding the needs and wants of the customer. This research aims at helping the automobile manufacturers to understand the customer better. This research investigates the barriers the adoption of EVs by trying to understand the attitudes, perception, behavior, awareness, familiarity, knowledge, and the wants of individuals in urban areas (Ajzen, 1991). The influence of governmental policies in the purchasing behavior of the individual is taken into consideration (Krause et al., 2013). The insights gained from this research will help policymakers around the world in crafting transportation and energy policies in the EV transportation system. The EV design engineers will be benefitted to develop an innovative product by considering consumer preferences (Ajzen, 1991). Lack of study on this topic in India is the reason for a gap in consumer adoption and scientific research EVs. Filling that gap is the motive of this research.

Elias (2010) in his study says, “The path EVs may be unsure and steep”. While Brown (2013) forecasted a rise in EVs by 200% over the decade. According to Steinhilber et al. (2013), the true potential of EVs has not been harnessed. Sales growth has undeniably been much short of industry expectancy, about a third of forecast sales.
This work aims to provide useful insights into the views and expectations of technology enthusiasts, people who are closely linked to new advances in technology and people who are well prepared to deal with the various variations in CVs and EVs.

2. Background

2.1. Awareness, familiarity, and knowledge
Theory of planned behavior proposed by Ajzen says, “Knowledge and experience are the key factors determining the buyer behavior”. A study shows that buyers need more trustworthy and objective information, including word of mouth, in order to make better-versus buying decisions. Currently, the buyers are being educated mainly through media coverage and advertisements. Additionally, except for experienced users, buyers have taken little interest to look for information about EVs (P. Larson et al., 2014). The buyers are more willing to pay a higher price for the vehicles as their knowledge about EVs increases (Gyimesi & Viswanathan, 2011). According to P. Larson et al., 2014, “Awareness is greater than familiarity which is greater than knowledge. On the basis of the purchasing funnel—knowledge implies familiarity, which implies awareness; but not vice versa”. The interest in purchasing an EV is much higher among HEV owners. This interest among HEV owners seems to be based on experience and knowledge (Neenan et al., 2010). Krause et al. (2013) suggest that updating the buyers about the benefits of EV technologies and available incentives is promising steps toward commercialization of EVs.

2.2. Psychological factors

2.2.1. Perception of economic benefit
Individual perception of economic benefit often affects the adoption of a product (Lai et al., 2015). Berensteau and Li’s, study showed that the EVs sales increases in comparison with gasoline vehicles due to the effect of high gasoline prices because the maintenance and running expenses of full EVs are low. The outcomes of Wang and Gonzalez’s research showed that energy costs of gasoline, natural gas, and diesel automobiles are approximately eight times more than those of EVs. Cheap electricity and expensive gasoline are good encouragements to purchase an EV instead of conventional fossil-fueled vehicles (Ing, 2011). Buyers might consider these benefits when taking a judgement concerning the purchase of a new vehicle (Hardman, 2019).

2.2.2. Electric vehicle attitudes
A broad range of concerns have been recognized by the existing literature which has the potential to affect in what way customers form preferences of and opinions EVs (Morton et al., 2016). The previous studied carried, identify the prominent issues that act as a barrier hindering the demand of EVs, including functional deliverables of EVs such as limited range and price (Bunch et al., 1993; Eggers & Eggers, 2011; Krupa et al., 2014). Psychometric factors were broadly assessed which could differentiate mainstream car buyers from EV adopters. The functional barriers are one of the central concerns in EV adoption, the attitudes concerning the functional characteristics proved to be most effective (Nayum et al., 2016). Hence, these barriers can be considered as intervening variables during the assessment of the buying behavior of individuals to a particular innovation.

2.3. Environmental factors
Environmental factors are significantly connected to buyer behaviors such as buying ecologically safe products and recycle those products after use (Kang & Park, 2011). Kahn’s research indicated that non-environmentalists are less likely to buy EVs than environmentalists. A study by Jensen et al. claimed environmental factors to have a constructive effect on buyers while choosing an EV before and after they have experienced an EV. Environmental concern is a primary influence that finally leads to consumer’s behavior intention purchasing a full EV (Lai et al., 2015). Though individuals believe EVs to be environmentally friendly, which can improve the overall quality of life, and would lower air pollution, they are also worried about the negative environmental impact of the emissions caused by the production of electricity and battery waste (Delang & Cheng, 2012). Environmental benefits act as motivators while making a purchase decision regarding EVs (Peters & Düschke, 2014). Additionally, studies state that
environmental factors are of less importance to buyers in comparison to vehicle cost and performance (Lane & Potter, 2007a), (Egbue & Long, 2012). Consumers are more encouraged to accept EVs when they expect EVs would reduce environmental risks (Bockarjova & Steg, 2014). Though sustainability influences consumer’s purchase decision, the majority are indefinite about the sustainability of EVs paralleled to conventional vehicles (CVs) and alternative-fueled vehicles. Environmental factors must affect consumer behavior the acceptance of EVs (Wu et al., 2019).

2.4. Government policies
Government plays a critical role in the adoption of new technology by sponsoring research, educating consumers, spreading objective information and developing policies to increase adoption with the help of financial incentives and subsidies. Lane, B., and Potter, S., 2007, stated that government policies concerning the environment, fuel prices and monetary incentives for purchasers of automobiles, furthermore with the progress of charging infrastructure will impact the acceptance of EVs. Moreover, these policies will fail to influence the consumers and affect adoption, unless they have a good understanding of governmental policies. Since the EVs of today cannot compete with CVs, financial incentives and subsidies may be needed on a temporary basis to increase the sales of EVs. Financial incentives and subsidies today may play an important role in stimulating widespread electric vehicle adoption in the future (Sierzchula et al., 2014). A study (Egbue & Long, 2012) stated that if buyers have low confidence on electric then incentives like fuel taxes and tax credits may have less influence on market penetration. Some studies have shown that there is a positive influence on the buying behavior of EVs due to financial incentives provided by manufacturers or governments (X. Zhang et al., 2013). Environmental policies such as sales tax waivers and financial incentives can influence EV purchases (Loi et al., 2015). Flynn, R, 2007, claim that the political state of affairs influences the acceptance of technology and products.

2.5. Car characteristics
Car characteristics play a major role in influencing buyers to purchase a new vehicle. A report by JD Power and Associates recognizes eight potential barriers that influence purchase of EVs: (1) high purchase price; (2) range limitations; (3) uncertain replacement costs and battery life; (4) uncertain fuel cost savings; (5) uncertain power and performance; (6) uncertain total cost of ownership over vehicle life; (7) extensive time required for vehicle recharging; and (8) uncertain infrastructure, for vehicle support and recharging (Green, 2010). Several studies and surveys earlier conducted show that high buying price of EVs is claimed to be a large barrier (Carley et al., 2013; Curtin et al., 2009; Green, 2010). A study found the major concerns about car characteristics of EVs are purchase price, battery range, vehicle reliability and availability of charging infrastructure (Egbue & Long, 2012). Axsen, J., and Kurani, K. S., 2013, claimed that the recurrent concerns of buyers EVs are charger availability, limited range and higher purchase prices. Some of the concerns noted by Graham-Rowe et al., 2012 about EVs are possible vehicle obsolescence, driving range, price premiums, battery charging time, power, and performance driving range, and impressions people form about EV drivers. One of the studies also suggests that nonexistence of vehicle model alternatives in the market is the main drawback on customer choice (Bowermaster et al., 2017).

3. Research objectives
The study aims to find various influencing factors that affect the consumer buying behavior of EVs and to understand the barriers to the adoption of EVs. The current study designed, evaluated and tried to understand the barriers in the emerging Asian markets. The study also tries to identify the factors influencing purchase behavior of EVs, develop a conceptual model that links the various factors in relation to the adoption of EVs and derive implications that provide implementable suggestions to the policymakers and EV design engineers.

4. Research model
Several researchers have emphasized the importance of awareness, familiarity, and knowledge of EVs in electrical vehicle adoption (Ajzen, 1991; Gyimesi & Viswanathan, 2011; P. Larson et al., 2014). Some authors have found psychological factors like perception of economic benefit and EV attitude
functional characteristics of electric as playing role during the decision-making process of buying an EV (Beresteanu, A. and Li, S., 2011; Ing, 2011; Lai et al., 2015; Wang & González, 2013) (Cheng et al., 2019). Recent studies have indicated governmental policies to stimulate buyers alternative fueled vehicles (Bockarjova & Steg, 2014; Egbue & Long, 2012; Sierzchula et al., 2014; X. Zhang et al., 2013). Many studies have been done to understand the importance of car characteristics in purchase intention and have found concern compared to conventional fueled vehicles which resist buyers from purchasing EVs (Bowermaster et al., 2017; Carley et al., 2013; Curtin et al., 2009; Green, 2010). The importance of environmental factors affecting the acceptance of EVs has not been well studied. The intentions and actual behavior may be divided, as the market is too new to collect data to measure the actual buying behavior of EVs (Daziano & Chiew, 2013). Thus, this research focuses on studying personal intents concerning the acceptance of EVs. In this research awareness, familiarity, knowledge of EVs along with environmental factors, psychological factors, government policies and

Figure 1. Conceptual model.
car characteristics were taken as variables to understand with purchase behavior of EVs. The conceptual model representing the factors considered in the present study is shown in Figure 1.

4.1. Dependent variable
The dependent variable identified is buyer behavior of EVs.

4.2. Independent variables
The independent variables identified are environmental factors, which is determined by three variables: environmental benefits, environmental sensitivity and sustainability. Then under psychological factors: perception of economic benefit and EV attitudes are considered. Awareness, familiarity & Knowledge of EVs along with government policies and car characteristics are also identified in the research model.

Hypothesis 1 (H1): A buyer’s attitude towards functional characteristics of EVs has a positive impact on the buying behavior.

Hypothesis 2 (H2): A buyer’s perception of economic benefit towards EVs has a positive impact on the buying behavior of EVs.

Hypothesis 3 (H3): Environmental benefits of EVs has a positive influence on the buying behavior of EVs.

Hypothesis 4 (H4): A buyer’s environmental sensitivity towards EVs has a positive influence on the buying behavior of EVs.

Hypothesis 5 (H5): A buyer’s perception of Sustainability has a positive influence on the buying behavior of EVs.

Hypothesis 6 (H6): A buyer's awareness, knowledge and familiarity of EVs has a positive influence on the buying behavior of EVs.

Hypothesis 7 (H7): Car characteristics like reliability, Battery range, safety and Purchase costs of EVs have a positive influence on the buying behavior of EVs.

Hypothesis 8 (H8): Governmental Policies have a positive influence on the buying behavior of EVs.

5. Research method

5.1. Development of the questionnaire
The questionnaire was created by examining accessible scales and metrics linked to the literature. Two sections are included in the questionnaire. Section 1 contained all private data concerning participants including the name, age, family earnings, and other data. Section 2 includes 44 questions for the 8 research model constructs. A scale of 5-point Likert, 1 with a “strongly agree” and 5 with a “strongly disagree,” was used.

5.2. Method of data collection
A personal request mailer was sent to acquaintances. A completed questionnaire, 1230 in numbers, was collected back after the repeated pursuit. A survey-based study was conducted with a sample of 1230 people from urban cities of emerging Asian markets, i.e., India and Srilanka. Table 1 shows the reliability and validity of the attributes considered in the study.
5.3. Pilot study and analysis
A 35-sample size pilot test for content, construct, and reliability of criteria was carried out for the questionnaire created. The initial 44 items in the questionnaire were decreased to 28 items following the confirmatory factor analysis. For the main information set of 1230 specimens, this decreased questionnaire was used with 28 objects. IBM SPSS 19, LISREL package and SMS Package Smart PLS 2.0 were used for analysis. Figures 2 and 3 show the path modeling and structural model of the study.

6. Results

6.1. Demographic details of respondents
The demographic distribution shown below gives an understanding of the characteristics and distinctive features of respondents. As the demographic distribution shown below provides an idea about the respondent’s background and details which provides strength to the conclusions, which are drawn through the data.

The complete sample size in this study was 1230 in number. Males with 65.6% and 34.4% females in this research dominated gender distribution. Majority of the respondents belonged to the age group of 20–30 years (67.2%) followed by the age group of 30–45 years (12.8%), 45–60 years (10.3%). Looking at the Educational qualification of the respondents most of them were graduates (59.5%) followed by post-graduates (25.6%). This represents the respondents were well qualified and knowledgeable. In the income point of view, the majority of the respondents have a family income of 8500 US dollars to 21,000 US dollars per annum (39%) followed by family income greater than 21,000 US dollars. Thus, the majority are from a group called the millennials who are the future buyers of EVs and are

| Attributes                  | Percentage |
|-----------------------------|------------|
| Gender                      |            |
| Male                        | 65.6       |
| Female                      | 34.4       |
| Age                         |            |
| Less than 20 years          | 6.2        |
| 20–30 years                 | 67.2       |
| 30–45 years                 | 12.8       |
| 45–60 years                 | 10.3       |
| More than 60 years          | 3.6        |
| Educational Qualification   |            |
| 10 + 2                      | 11.3       |
| Graduate                    | 59.5       |
| Post—Graduate               | 25.6       |
| Diploma                     | 1.5        |
| Doctoral Degree             | 1          |
| Others                      | 1          |
| Family income (yearly)      |            |
| Less than 2800 USD          | 8.7        |
| 2800–8500 USD               | 25.6       |
| 8500–21,000 USD             | 39         |
| Greater than 21,000 USD     | 26.7       |
competent enough to deliver the necessary information both in quantitative and qualitative forms. In addition, the respondents are mature enough with adequate qualifications.

### 6.2. Factor analysis

Factor analysis is a technique that was used for evaluating a whole matrix of all the correlations between a number of different variables to expose the latent causes of variation which could account for the correlations between many otherwise dissimilar variables. Table 2 shows the factor loading as per the analysis performed. The pilot study data of 35 respondents were used in factor analysis out of the 44 items used in pilot study the items with lower values (lower than X) of factor loading were removed and a questionnaire of 28 items was used for further analysis. The results of the validity assessed based on factor loading have positive values indicate a strong effect of the factor on the variable of the study. Table 3 shows the statistical comparison of hypothesis of EV in current study.

### 7. Discussions

The use of several theoretical frameworks was explored for the adoption of EV, to understand the impact of attitudes and the changes in them over time. The studies based on representative samples focuses on its purposes and enforced adoption. As the market for EVs develops, focusing on the consumer adoption behavior regarding EV's become much more viable and important in comparison to intensions. Moreover, in the EV framework, it is essential to know the gap between purpose and actual behavior. To reduce the attitude-behavior gap (Stern, 2000), examining interferences and discussions, that can offer additional insight into the behavior/intentions of consumer EV acceptance.

Another significant constraint of present studies is the understanding and abilities of consumers calculating and comparing the economic advantages and expenses of CVs and EVs (Lane and Potter, 2007a). The economic advantages and expenses of EVs versus CVs, future study on how to...
educate customers on this issue needs to be discussed and communicated by policymakers and marketing experts. Customer perceptions towards present environmental, vehicles, fuels, and especially EV policies can have an impact on their conduct towards EVs (Eccarius & Lu, 2010; Lane and Potter, 2007a; Sovacool, 2009). This research helps to further understand the prospective implications for policymakers and people’s opinions of policy. One important aspect is to understand if consumers strongly accept or support a strategy.

Additionally, the promotion vs prevention focus (Lee et al., 2010), education, and framing of policies, and their influence on consumer environment concern can be examined. Social norms and the neighboring impact have obtained found to affect customer EV adoption conduct as detailed in the evaluation (Egbue & Long, 2012; Y. Zhang et al., 2011). The way green neighborhoods are created (Kahn, 2007) can be a topic for future studies. The results can assist policymakers design policies that empower not only people but also environmentally friendly neighborhoods.

A basic issue regarding attitudes and actions is whether customers see a link between EVs and environmental protection. This is essential to investigate since today’s marketing of several EVs, as well as advertising strategies, use environmental arguments and imaging (Higueras-Castillo et al., 2019). There are, however, also instances of vehicle producers who do not mainly use environmental concern to market their EVs and instead concentrate on their EVs superior quality (e.g., Tesla Motors). In Graham-Rowe et al. (2012)’s exploratory study, while debating the environmental effects of battery manufacturing and generation of electricity, customers stated doubts about any beneficial environmental effects of EV adoption. In several countries, where electricity is produced from various mixes of renewable and non-renewable sources, little is known about the perception of the environmental effects of EV. Another attitude factor is the self-efficacy of consumers or perceived efficacy plays a significant role in the consumer’s intention to embrace EVs (Oliver & Rosen, 2010). It is suggested that policy and education affect the self-efficacy of customers.
### Table 2. Factor loading

| Factor | BEV | CC | ENB | ENS | EVA | GPL | PEB | SUS |
|--------|-----|----|-----|-----|-----|-----|-----|-----|
| AFK1   | 0.664 | 0 | 0   | 0   | 0   | 0   | 0   | 0   |
| AFK3   | 0.744 | 0 | 0   | 0   | 0   | 0   | 0   | 0   |
| AFK4   | 0.88 | 0 | 0   | 0   | 0   | 0   | 0   | 0   |
| BEV1   | 0   | 0.77 | 0   | 0   | 0   | 0   | 0   | 0   |
| BEV2   | 0   | 0.889 | 0   | 0   | 0   | 0   | 0   | 0   |
| BEV3   | 0   | 0.858 | 0   | 0   | 0   | 0   | 0   | 0   |
| CC1    | 0   | 0   | 0.767 | 0   | 0   | 0   | 0   | 0   |
| CC2    | 0   | 0   | 0.626 | 0   | 0   | 0   | 0   | 0   |
| CC4    | 0   | 0   | 0.455 | 0   | 0   | 0   | 0   | 0   |
| CC5    | 0   | 0   | 0.525 | 0   | 0   | 0   | 0   | 0   |
| ENB1   | 0   | 0   | 0   | 0.716 | 0   | 0   | 0   | 0   |
| ENB2   | 0   | 0   | 0   | 0.743 | 0   | 0   | 0   | 0   |
| ENB4   | 0   | 0   | 0   | 0.799 | 0   | 0   | 0   | 0   |
| ENS2   | 0   | 0   | 0   | 0   | 0.302 | 0   | 0   | 0   |
| ENS3   | 0   | 0   | 0   | 0   | 0.858 | 0   | 0   | 0   |
| ENS4   | 0   | 0   | 0   | 0   | 0.841 | 0   | 0   | 0   |
| EVA5   | 0   | 0   | 0   | 0   | 0   | 0.344 | 0   | 0   |
| EVA6   | 0   | 0   | 0   | 0   | 0   | 0.357 | 0   | 0   |
| EVA9   | 0   | 0   | 0   | 0   | 0   | 0.368 | 0   | 0   |
| GPL1   | 0   | 0   | 0   | 0   | 0   | 0   | 0.852 | 0   |
| GPL2   | 0   | 0   | 0   | 0   | 0   | 0   | 0.895 | 0   |
| GPL3   | 0   | 0   | 0   | 0   | 0   | 0   | 0.873 | 0   |
| PEB1   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.571 |
| PEB2   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.765 |
| PEB3   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.87 |
| SUS1   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.871 |
| SUS3   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.117 |
| SUS4   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0.649 |

### Table 3. Statistical comparison of hypothesis of EV in current study

| Hypothesis   | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | Standard Error (STERR) | T Statistics (O/STERR) | Hypothesis |
|--------------|---------------------|-----------------|-----------------------------|------------------------|------------------------|------------|
| AFK -> BEV   | 0.2149              | 0.2202          | 0.0813                      | 0.0813                 | 2.644                  | Supported  |
| CC -> BEV    | 0.0489              | 0.0535          | 0.0752                      | 0.0752                 | 0.6495                 | Not Supported |
| ENB -> BEV   | 0.0148              | 0.0078          | 0.1116                      | 0.1116                 | 0.1325                 | Not Supported |
| ENS -> BEV   | 0.11                | 0.1315          | 0.0968                      | 0.0968                 | 1.1363                 | Not Supported |
| EVA -> BEV   | 0.2536              | 0.2518          | 0.0919                      | 0.0919                 | 2.7593                 | Supported |
| GPL -> BEV   | 0.1433              | 0.1275          | 0.1031                      | 0.1031                 | 1.3894                 | Not Supported |
| PEB -> BEV   | 0.3035              | 0.301           | 0.1033                      | 0.1033                 | 2.9365                 | Supported |
| SUS -> BEV   | -0.0615             | -0.0611         | 0.1171                      | 0.1171                 | 0.5256                 | Not Supported |
Examining the impact of different structured strategies and instructional signals in the types of advancement versus avoidance focuses on the self-efficacy of customers and the motives of buying EVs can produce significant results and consequences.

A study presents and comments about the various justifications required to address and communicate the customer perception on EVs (Graham-Rowe et al., 2012). The justifications may relate to the economic or technical elements of EVs. CVS’ fuel effectiveness has risen quite dramatically over the past few years. Thus, the EV, viewed by customers as an asset, may become more competitive with novel trends of advanced motors and other techniques from CVS. This creates difficulties for EV producers to continually re-innovate EVs if the goal is to create customers view it over time as an enterprise. This also requires ongoing studies into the perceived variations between customers between CVS and EVs. Habits and routines, which according to Stern (2000) are important determinants of environmentally significant activities, are ignored areas in EV studies in regards to cognitive modifications. Habits, considered automated behaviours, may take a long time to alter, but once they are formed, they will allow customers less focused on their habits.

Future trials were called on to explore the layout and charging methods of EVs with less behavioral shifts and less resistance from consumers (Caprile & Kurani, 2012; Lane and Potter 2007a). Various symbolic significances are attached by EV adopters in the United States (Caprile & Kurani, 2012) and in the UK (Graham-Rowe et al., 2012; Skippon & Garwood, 2011). In a multitude of cultures, however, there is little knowledge about the symbolic meanings of EVs in other countries, since the symposium relies on the background.

Sierczhula (2014) acknowledges the fact that EVs from fleet executives from 14 organizations in the Netherlands have been accepted by various motivations. “The choice to embrace electrical vehicles by fleet executives (Sierczhula, 2014) is a common impact on the” testing of innovative technologies, reducing economic effects, granting government funding, and enhancing the public image. Future study in these areas may further investigate the implementation of EVs by fleet directors in distinct nations with various regulatory incentives to define the variables influencing the implementation choice of the fleet manager. In addition, future research will further examine whether driving and experiencing an EV in the workplace can potentially encourage drivers to adopt EVs as a private vehicle. Finally, we take customer feelings as an ignored component in consumer EV acceptance studies. The latest research has given the basis for an analysis of feelings and feelings within the framework of customer EV acceptance (Schuitema et al., 2013). We see a chance to further develop this area with theoretical emotional frameworks in the fields of psychology, PEB, morality, and consumer conduct to proceed with the study. Policies, communication messages, and education in customers can generate particular cognitive and emotional reactions and thus impact their choices and actions. Comprehension of cognitive and emotional reactions can assist marketers and policymakers.

Awareness, familiarity, and knowledge have emerged out to be a dimension, which has a significant influence on buying behavior of EVs. So, one of the most important implications to the policymakers and professionals in the automobile industry is to educate people about developments in vehicle industry and the characteristics of EVs. In addition, automobile manufacturers can organize workshops and events to make people familiarize and provide information on EVs. These actions may lead to widespread adoption of EVs. Both the psychological factors have been found to have a significant influence on the purchase behavior of EVs. This says the perception of economic benefit plays an important part in purchase behavior. This implies cheap electricity and expensive gasoline are great encouragements to purchase an EV instead of a gasoline car. Attitude towards functional characteristics of EVs is also found to be an important factor. This says that people compare the functional characteristics of EVs to CVS. The design engineers of automobile manufacturers must consider this. If there is no significant difference in the functional characteristics of EVs and CVS then people will not be ready by EVs in the future. Environmental factors were
found not to affect the purchase decisions of buyers towards EVs this may be due to people in our country are more concerned about economic benefit than environmental impact. This represents the insensitivity of people towards sustainability. However, this can also be due to a lack of knowledge of the benefits of EVs to CVs. Government policies have also not been considered as a significant characteristic. I would suggest in-depth research on these factors in the future.

8. Conclusions and implications for transportation policymakers

The study samples cannot be representative of the whole population because of differences in environmental awareness, education, and income among the majority of respondents. However, they offer a useful insight into the preferences and attitudes of technologically aware people. The results show that EV behavior, understanding, and views differ in sex, age, and education. Furthermore, our findings show that while EVs are affected by sustainability and environmental benefits, their expenses and efficiencies remain behind them. Overall conclusions derived from the study are that, despite various reservations expressed in relation to EVs, there is moderate to the strong interest in EVs. In general, EV-based attitudes were not entirely positive or very negative, but completely negative EV-based attitudes, though minimal, should not be overlooked. This research highlights the need to tackle socio-technical obstacles to EVs. As stated earlier, battery technology, battery expenses, and charge are some important difficulties that EVs face. Consumer adoption is however essential since it is essential to the business achievement of EVs (or failure), even if the additional criteria are fulfilled. In our technologically oriented target group, the insecurity connected with the EV battery system and a sustainable supply of gasoline is a major possible obstacle to widespread EV acceptance. If customers are not confident in EV technology, current incentives such as tax credits to settle EV and gas charges can have little effect on the penetration of their EV industry. Certain initiatives are therefore necessary to improve the market share of EVs. These initiatives, including awareness, knowledge, increased EV investments, infrastructure, battery swaps technology, high guarantees on EV batteries, and maybe increased tax credits to help support the cost of EVs, are among those already being examined. As media and social networks can influence public view, political decision-makers can use this medium in order to influence the government awareness of the non-financial benefits of EVs, such as power safety and economic footprint reduction.

9. Limitations

Based on the research of the variables affecting EV adoption, the intention of customers to adopt EVs is usually a combination of population, situational, and psychological variables. Moreover, current studies normally model distinct parallel variables and ignore their hierarchical relations. Further understanding of EV adoption will, therefore, depend not only on more extensive studies but also on the interactions between the various variables. Some data collection defects exist and further studies are required. Because the intention to assess is difficult to measure, these studies generally use survey methods. During the study, some individuals were never in contact with EVs, which could restrict the validity of their reaction. Although certain participants have received short-term practical experience and have chosen EV consumers in the study, the small sample of the research can cause distortions. More representative and more studies that are vibrant are therefore necessary for the future.

The technical characteristics of EVs are also changing with the constantly developing technology. For researchers, policymakers, and manufacturers, the ever-changing effects of EV’s technical features are therefore of great importance because this can help improve EV’s popularity and marketing strategies. Since environmental characteristics of EVs lead to adoption, an important area of research in this field is how consumer doubts can be mitigated. The understanding of the impact of specific policies in several countries and regions can contribute to improving future policies in terms of government policy (Whitehead et al., 2014), (Sierzchula, 2014). Consumers are the targets of policies linked to EV and can have an impact on their intention to adopt their views or perception of policies (Krupa et al., 2014). Studies that understand strategy assessments and consider the variables that fulfill or dissatisfy customers need to be carried out. Whilst surveys indicate that enhancing consumer practical knowledge through some operations would enhance the likelihood of EV adoption, it is not simple to organize and implement it. This is primarily because too many stakeholders such as
customers, producers, distributors, and governments are involved. The design and evaluation of well-organized actions could produce significant outcomes and consequences.

Future research should concentrate on methods to lead customers to EVs; this can be accomplished by promoting and creating a cultural culture that can encourage the application of appropriate governance policy. Emotions are also regarded as variables in other psychological factors (e.g., attitudes) at the same level and relations between them need to be further investigated. Although other researchers have been less worried about other psychological variables, future studies should not ignore them. These variables may be modified as society evolves and may be considered in future studies.

10. Future scope
Future studies can conduct research in emerging EV markets of developing countries to add value to the findings. In this research, a technological group of people concentrated on the perceptions and attitudes of EVs. For future research, the attitude of this sample will be compared with the attainments and perceptions of the public in other organizations in order to provide an insight into what distinct kinds of customers are perceived. The price of owning vehicles mentioned in this article also contributes to future research possibilities.

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Abbreviations
EV: electric vehicle; GHG: greenhouse gas; CV: conventional vehicle; NEMMP: National Electric Mobility Mission Plan; HEV: hybrid electric vehicle; PHEV: plug-in hybrid electric vehicles; EREV: extended-range electric vehicles; BEV: Battery Electric Vehicle; AFE: awareness, Familiarity and Knowledge; EVA: Electric Vehicle Attitudes; PEB: Perception of Economic Benefit; BI: Behavioral Intentions; GPL: Governmental Policies; ENB: Environmental Benefits; ENS: Environmental Sensitivity; SUS: Sustainability; CC: Car Characteristics; FAME: Faster Adoption and Manufacturing of Hybrid and Electric Vehicles; SEM: Standard Error of Mean

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