iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** III **Month of publication:** March 2022

DOI: https://doi.org/10.22214/ijraset.2022.40606

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

Transition in Automotive Sector from Fuel-Based Engines to Electric Vehicles: A Study on Consumer Attitude towards Electric Vehicles

Dr. Raghu G. A[1], Dr. Mala K. M.[2]
[1, 2]*Jain University-Bangalore*

Abstract: ***Electric Vehicles have advanced significantly in quite your time, owing partially to decreasing battery costs. Yet EVs remain more costly than gasoline fueled vehicles over their useful life .This research paper analyzes the additional advances which can be needed ,if electric vehicles are to significantly penetrate the passenger vehicle fleet during this low pricing market. This has further been divided into 3sub parts:***

1) ***Battery Prices***
2) ***Will Declining Battery Costs Make EVs competitive?***
3) ***EV's Charging Infrastructure challenges***

Battery Prices- Cell costs have fell down drastically to $100 kwh or 7500RS approximately or lower and are even expected to continue falling with technological improvements and returns to large-scale production. While cells are just one component of the value of an installed battery, the price of installed battery, the value of installed batteries has declined from around $1000 per kwh in 2010 to an estimated $250 -350 per kwh in 2018.Total Battery costs are falling more slowly as consumers demand EVs with longer ranges and thus larger batteries. Meanwhile, governments are finding it difficult to fiscally justify large subsidies to draw in buyers.

Keywords: Costs, Gasoline, Battery costs, Consumer Attitude, Automotive industry

I. INTRODUCTION

EVs operate at a fundamentally lower cost, and within the previous number of years, the trends suggest that there has been a fragile interest among the Indian masses for electric cars still as two-wheelers. electric cars Electric vehicles will incite crucial changes within the Indian automobile market, and their growing adoption will end in additional futuristic business models. the worldwide environment seems to favour electric vehicles, and with time the world seems to be getting serious about them. an outsized number of EVs are selling across the earth, and although China, the US, and Europe are contributing to a limiteless chunk of the sales, industry leaders consider India to be a promising player with a receptive market. EVs operate at a fundamentally lower cost, and within the previous number of years, the trends suggest that there has been a gradual interest among the Indian masses for electric cars moreover as two-wheelers. Understanding Consumer Behaviour Buying a vehicle could even be a time-consuming process with various internal and external factors influencing the choice. Particularly in India, the decision-making process is incredibly complicated because the buyers often face an information overload. research indicates that female automobile buyers consider features like safety, affordability, and efficiency, whereas male buyers target performance, features, and aesthetics like interiors and elegance. Also, male audiences express more interest in electric vehicles. the mandatory Shift Viability in an exceedingly consumer-based market, the viability of the E.V. industry is sick with factors like incentives on scrapping used vehicles, favorable government policies, and reducing GST. Consumers also believe that E.V. manufacturers need a more proactive marketing approach instead of playing safe. Fuel Efficiency Because petrol and diesel prices are always on the increase, consumers are keenly interested in what proportion would they save by switching to an electrical vehicle from an ICE vehicle. Marketing an estimated long-term fuel savings are the key to a consumer's heart. Technology Most electric vehicle buyers are early adopters of innovation, green technology, and skill in being an environmental ambassador. Consumers applaud EVs as an environment-friendly technology and are captivated with switching to vehicles which is prepared to possess zero emissions. Most electric vehicle buyers are early adopters of innovation, green technology, and knowledge in being an environmental ambassador. Consumers applaud EVs as an environment-friendly technology and are passionate to switching to vehicles which might have zero emissions. Some people say that the world environment appears to possess permanently shifted in favour of electrical vehicles (EVs). But is that the world truly getting serious about EVs? In 2018, about five million electric vehicles were sold, a staggering 63% increase over 2017, as per an

IEA report. However, an unlimited majority of EVs were sold in China, followed by Europe and also the US. the remainder of the globe only accounts for a little portion of EV sales. How does this play get into emerging markets? India, one amongst the world's largest marketplace for automobiles, continues to be a largely insignificant player within the EV space. Nigeria and African nation, Africa's two largest economies don't fare far better and neither is that the UAE, a rustic that doesn't retreat from experimenting with revolutionary transportation technology, a giant marketplace for EVs. Lack of consumer interest could be a common reason why a replacement consumer product/category doesn't kick off. However, the lagging or non-existent EV market in these countries isn't a mirrored image of lack-lustre consumer interest, in line with a recent survey conducted by a digital research company, Borderless Access. As with any consumer-centric product, understanding consumer sentiments is an efficient means to grasp ground-realities and the way to shape the car industry that's making a shift towards EVs. And per the report, an unlimited majority of consumers in these four markets are highly optimistic about the appearance of EVs. Consumer perception about viability Universally, favourable government policies have fast-tracked the expansion of the EV industry. And consumers acknowledge this. At the identical time, consumers also believe that the onus also falls to a specific degree on automobile manufacturers, who should be more proactive in pushing forward EVs instead of playing safe. Source: Borderless Access Range anxiety? There is a belief that the limited range of EVs makes them not viable as a sort of transportation. 'Range anxiety', the term accustomed discuss with this aspect, is commonly cited because the main reason why EVs cannot succeed, especially by the proponents of ICE (internal combustion engine) vehicles. However, on the contrary, range anxiety doesn't seem to be as big an issues because it is formed resolute be. As per the survey, an EV's range isn't at the highest of consumers' list of concerns . this can be likely because the range offered by EVs today is nice enough to satisfy the transportation requirements of most consumers, especially urban consumers. Instead, consumers willing to contemplate EVs are more concerned about the provision of charging stations and also the cost of purchase, which continues to be high even when the value of lithium-ion batteries still fall. Is enough being done? Source: Borderless Access Not surprisingly, more and more people across the world, are charging their EVs at private charging points rather than public charging points. We could conjecture that the pace at which charging infrastructure is being developed must accelerate to drive greater adoption of EVs. And, that currently, most EV adopters still mostly restrict trip a radius that might allow them to return home to recharge their vehicle's battery. Battery operated EVs V/S hydrogen-powered EVs? We have today come to just accept that vehicles powered by renewable sources of energy are the longer term and are important to counter heating. during this regard, EVs or more specifically BEVs (battery-operated EVs) are still not ideal as long because the source of electricity doesn't come from a renewable source. On the opposite hand, fuel-cell electric vehicles (FCEVs) or hydrogen-powered vehicles offer a promising alternative. The current growth of BEVs comes with a caveat. As demand for batteries go up, so will the requirement for scarce materials like lithium and cobalt. While the price of batteries will still fall as a result of the economy of scale, it'll only be a matter of your time before we feel the pinch as we run out of those key materials, unless a more sustainable source of energy is developed. While governments and most auto manufacturers are firmly invested within the development of BEVs, consumers feel that widespread BEV adoption will lead to new problems within the future. and that they strongly believe that FCEVs are a far better bet for the longer term . Source: Borderless Access Electric vehicles are definitely the longer term The sentiment amongst consumers towards EVs, by and huge, is optimistic. This survey brings to light certain aspects of consumer mindset that are important for the healthy growth of EVs including the factors influencing consumer purchase decision for EVs, one in every of which matches against the commonly perceived notion. additionally, the actual fact that almost all consumers in India and UAE believe EVs will become mainstream in roughly a decade, may be taken as an indication of those markets being plenty more ready for more aggressive marketing and products introduction by automobile companies, which might have to take a more measured approach in African countries. Source: Borderless Access We are at a critical juncture where decisions taken by key institutions will shape the longer term of transportation for better or worse. it's important that these decisions are soft on forethought and by involving everyone invested. Raising the proper questions and understanding the buyer sentiments and market insights should be the correct way forward.

A. Will Declining Battery Costs Make EVs Competitive?

This paper compares the lifetime costs of battery -only cars(BEVs), plug in hybrid(PHEV) and gasoline fueled internal combustion engine vehicles(ICE) using a range of gasoline prices, discount rates, and battery costs. The PHEV is more expensive than the ICE in almost all scenarios while the BEV is robustly cost- competitive, once installed battery prices reach $200-$250per kWh .Hence further reductions in battery costs will still be needed for BEVs to be a viable alternative to ICEs.

This paper compares the lifetime costs of The TATA NEXON EV to the costs of an equivalent PHEV and ICE using a range of gasoline prices discount rates and battery costs .

B. EVs Charging Infrastructure Challenges

Commercial success for EVs will require installing charging infrastructure that is accessible, easy to use, and relatively inexpensive -whether at home or in public locations.

The form this infrastructure will take is still uncertain, with a range of charging technologies currently available and more expected to emerge over the next few years .The current range of equipment spans slower alternating current (AC) chargers best suited to home or office locations and short trips and much faster direct current fast chargers for rapid refueling in public locations ,best suited for recharging on longer journeys.

The time taken to add 100miles of range varies from 26hours for the slowest AC charger ,to six minutes for the fastest DCFC charger -still far slower than the 300 miles per minute enjoyed by a 30mile per gallon.

The cost of charging infrastructure are both fixed (installation, utility service, transformers and equipment) and variable (electricity charges).For chargers on commercial electricity tariffs, demand charges can dominate operating costs. As a result, the total cost of power from fast charging stations is higher than slower residential chargers unless the former can achieve sufficiently high utilization rates.

Modeling different types of charging infrastructure and comparing them with the operating with the operating costs of an ICE suggests that simple home charging is competitive with today's more efficient gasoline cars and could be significantly cheaper if a time of use electricity tariff with lower prices in off-peak periods ,is in place. More powerful home charging is sensitive to capital costs ,but is competitive with moderately efficient ICEs and substantially cheaper under a time of use tariff .For commercial chargers ,the price of electricity required for investment in the system to break even falls sharply at progressively higher utilization rates . At 30% utilization ,all variants are cheaper than fueling an average ICE, and at 40% utilization they are competitive with an efficient ICE.

At current levels of utilization (optimistically ,10%) , commercial chargers are almost universally not economically profitable, suggesting a significant , sustained increase in demand will be needed for commercial charging infrastructure to deliver financial returns and compete with both ICEs and cheaper residential charging.

Managing additional power demand from EVs is both a challenge and an opportunity for distribution utilities. High concentration of EV home charging during peak periods can overload local transformers. Utilities may have to procure additional peak capacity, unless they are able to shift demand to off-peak periods.

Time of use electricity pricing along with smart metering have already been deployed in some states to incentivize off peak charging and manage peak loads respectively.

It is unclear whether they will be sufficient to offset demand increases. Vehicles to grid technology allowing EVs to serve as mobile storage units could complement these efforts but will need adequate incentives which are not presently available. Overall electricity tariff reforms will be essential, if today's power systems will be able to serve the additional demand from the significant deployment of electric vehicles.

II. INTRODUCTION TO ATTITUDES

"It is difficult to imagine a psychological world without attitudes. […] Our environment would make little sense to us; the world would be a cacophony of meaningless blessings and curses. Existence would be truly chaotic and probably quite short"

A. Relationship of Attitude and Behavior

Attitudes are of interest to researchers mainly because it creates a connection to behavior. (Schlenker, 1978) Needed to be mentioned is that, while connected, the 2 variables are distinctly different as attitudes are held and behavior is performed. (Ajzen & Fishbein, 1977)

"Attitudes are expected to predict and explain human behavior" (p. 12), because positive attitudes will have stronger chances of elicitation as compared to negative attitudes. Research has placed increased stress on evaluation because the primary element of attitude (Ajzen, 2008). For that reason, attitudes predict behavior in a very more consistent manner when both attitude and behavior visit the identical „evaluative dispositions". (Ajzen & Fishbein, 2000)

In 1975, Fishbein & Ajzen wrote a comprehensive study on understanding the complex process that someone goes through from his/her initial beliefs until he/she reaches a specific behavior toward an object. In their first chapters, the authors develop a awfully clear and simple to know framework (See Figure 4) that takes the reader on a journey from beliefs, through attitudes, then intentions, and eventually to behaviors.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

III. CONSUMER ATTITUDE INFLUENCING FACTORS

Consumer attitudes are and still are a key factor for companies. jointly of the key concepts in psychology, it provides an understanding of the „pre-stage‟ of one‟s behavior. From a business perspective, consumer attitudes are accountable for an evaluation of a product or service and consequently the acquisition or not of this product or service. (Fishbein, Ajzen; 1975) The purpose of this chapter is to explain, discuss and analyze consumer attitudes within the automotive industry. Factors and dimensions that influence attitudes within the automotive industry are analyzed.

IV. CAR ATTRIBUTES

In order to know consumer attitudes within the automotive industry, it's necessary to define the thing to which the patron addresses his/her attitude. within the case of this thesis, the item may be a car. The car, as a product, consists of various attributes which affect consumers‟ attitudes. These different attributes cannot all be known by each consumer, so consumer knowledge about car attributes is proscribed or varies. Because car attributes can affect consumer attitudes, they have to be analyzed by marketers, as this might raise consumers‟ attraction toward a particular car. Attributes will be classified into two categories: tangible and intangible. Tangible are those which consumers have contact with (e.g. the fabric the wheel is formed of, what number gadgets this particular car has and what's their usefulness), while the intangible attributes are those which provoke consumer senses and build a sway supported abstract observations (e.g. design or stylishness of interior). (Olson & Peter; 1999) Therefore consumers are judging a car for both its physical and abstract characteristics. Even though attributes have a bearing on attitudes, not all attributes of a product are important to consumers. that's why defining the important attributes should be considered from perspective of consumers. It will be hardly proven that, as an example, the connection between the car‟s horse power and its weight is very important knowledge for the overwhelming majority of consumers. Gupta and Lord (1995) addressed the difficulty of defining decisive attributes of a car for consumers. Their study revealed that customers are evaluating cars regarding their „price, reliability, ratio, rear leg room, ride, front seating, acceleration, routine handling, and luggage capacity.‟ (Gupta and Lord; 1995) Car attributes are thus defined and evaluated supported the subjectivity of the individual consumer which is consequently shaping his/her attitude. These subjective evaluations may be obsessed on more factors, and because the following section discusses, these factors significantly affect individuals‟ attitudes and their actions.

V. FACTORS AFFECTING CONSUMER ATTITUDES WITHIN THE AUTOMOTIVE INDUSTRY

A. Consumer Experience

Attitudes of consumers are built round the specifics of a specific product. within the case of a car, these specifics may well be car attributes like fuel economy, safety, reliability, acceleration, styling, and workmanship. These attributes are perceived by consumers differently. one among the ways to perceive car attributes is by regarding the country of origin where certain car manufacturers are operating. Brown et al. (2007) analyzed consumer attitudes within the U.S. towards foreign importers from Japan and Europe. Already mentioned attributes were matched to the car manufacturers in relevancy the country they came from, and consequently these manufacturers (countries) were ranked. in step with this study, the very best overall ranking, while taking into consideration all mentioned attributes, was received by Japanese and German (West Germany at that time) car manufacturers. They were considered as manufacturers producing the foremost reliable, stylish cars with solid fuel economy and workmanship. (Brown et al., 2007). The study of Brown et al. (2007) will be questioned because it may well be viewed out-of-date. the alternative is true because consumer attitudes are rarely being changed. As Blythe (1997) argues, the attitudes can hardly be changed with new circumstances, objects, or during this case, cars. Consumers will simply consider and like one product from another because they need „first‟ or „second-hand‟ experience. (Blythe; 1997) In other words, consumers within the U.S. would buy rather Japanese or German cars, or a minimum of have a better inclination towards them than to the others thanks to their own experience or from other people‟s experience. Therefore experience from the past is one amongst the determinants of consumer attitudes.

B. Age

Consumer attitudes can vary counting on the age of the buyer. They express different attitudes towards products during their lives. Consumer attitudes at a selected age also reflect the life-style consumers prefer. Thus, their attitudes are changing with relevance their age. Consumers are usually divided into several age groups. most ordinarily used are youth (under 18), „generation X‟ (ages 18-29), „baby boomers‟ (ages 30-mid 50s), and seniors (age 50+).10 (Hoyer & MacInnis; 2007) For the aim of this thesis, the „generation X‟ is that the most vital. However, there's also a desire to clarify the subsequent two because „generation X‟ are there in an exceedingly few years.„

Generation X‟ consumers are characterized a highly potential group of consumers for marketers within the long-term perspective. These consumers are creating their own attitudes towards particular products during this stage of life. Consumers during this age category usually have a freewheeler and are open-minded. Usually they are doing not have a materialistic attitude and don't reply to brand names. They respond positively if marketers communicate in a very language understandable for them, usually reflecting their lifestyle. These consumers treat products within the same way, too. (Schiffman & Kanuk; 2000) „Baby boomers,‟ on the opposite hand, are a bunch of individuals who are the foremost attractive to marketers since they hold high purchasing power and are setting out to spend money on costlier products like cars, as an example. They even have a positive attitude towards consumerism since they sometimes have families. This obliges them also to worry more about the longer term, and life stability. They also tend to be involved and identify themselves with their favorite products. (Schiffman & Kanuk; 2000)

The seniors group is that the most overlooked group of consumers. in step with Bartos (1980), 76% of all seniors are promising consumers.

They even have variable attitudes, and what can not be forgotten is that the incontrovertible fact that they need fewer expenses than the previous two groups. Seniors tend to enjoy their lives since their children are already self-supporting. a remarkable fact is that for many of the seniors, their age isn't so important, and that they don't like being marked as old. This group of individuals usually has enough wealth and is a smaller amount concerned about spending it. Seniors have already developed attitudes toward some products and might have problems modifying these attitudes. (Bartos, 1980)11 The research by Bartos is supported by Myers and Lumbers (2008), who also discussed complexity of senior group of consumers. In their study, senior consumers are marked as group stricken by different historical events which shaped their attitudes. Myers and Lumbers (2008) argued that senior consumers‟ behavior express certain chronological variability, while they're being analyzed within the identical age bracket. the most finding during this study was that current seniors express „younger‟ attitudes than their parents, which is in line with Bartos‟ finding regarding seniors‟ resistance of being marked as old.

If a car is taken as an example of a product, for car companies, „baby boomers‟ and seniors are the foremost attractive groups. In those stages, consumers are having a form of selfidentification with a selected model of car.

C. Changes Within the Automotive Industry

Due to the complexity of consumer characteristics and therefore the fast changes in consumer demands, automotive industry is facing various challenges with same intensity of change. Schwarz (2008) developed a framework with global trends that the automotive industry goes through. consistent with Schwarz‟s framework, the automotive industry will face and is already facing challenges from fast growing automobile companies, especially from China. More important, consumer attitudes toward cars, as a product, are shifting. the most reason behind this can be the expansion of oil prices and environmental pressure. These factors caused dramatic shift in consumers‟ demand and compelled car manufacturers to become more adaptable, flexible and invest more in development.

VI. EV CONCEPT

The EV concept is receiving increasing interest, and plenty of stakeholders are shedding light on this subject. within the context of long-term emission targets, Electric Vehicles are getting a topical concept. (European Parliament, 2010)

In March 2011, the International Geneva Motor Show has organized an automobile event that presented what was new and what the longer term will hold for this industry.

The event had a “Green Vision” section that promoted the segment of eco-cars and also the section had 12 brands that displayed a complete of 13 different Electric Vehicles.12 The event stressed the importance of the EV concept and therefore the proven fact that it's a phenomena happening right away.

As some investigations (Green Car Institute, 2010; Anderson & Anderson, 2010) show, the interest for the electrical Vehicle has been present for quite a century now and there's a true consumer market and car fleet.

Because of the large benefits that Electric Vehicles (EVs) herald terms of environmental protection and energy consumption, they're undoubtedly the motorized road vehicles of the longer term.13 This statement belongs to the Association of electrical Vehicles in Europe, and shows why the concept is gaining acceptance. To add, the considerable interest in Electric Vehicle is thanks to global climate change concerns and environment, tougher efficiency standards and increasing oil dependency.

Strengths & Weaknesses of the electrical Vehicle

A. Strengths

The Association of electrical Vehicles in Europe (AEVE) has devised variety of things which will be translated into the 000 benefits if the concept are going to be more globally accepted:

1) Positive effects on environment and pollution it's been persistently stated and it's become a indisputable fact that EVs are having a positive impact on the environment as they produce no exhaust emissions (Larminie & Lowry, 2003) and thus substantial air quality benefits. (Ewing & Sarigollu, 2000) they're cleaner and more fuel efficient compared to combustion vehicles. (Association of electrical Vehicles Europe) Other significant advantages, listed by the AEVE (2010):

a) "Electric vehicles consume less energy than fuel vehicles; • Electric vehicles generate significantly less CO2 than fuel vehicles

b) The electrical cars in production or within the pipeline consume less energy and generate significantly less CO2 emissions than the cleanest fuel cars;

c) Electric vehicles will have a positive impact overall on electricity production."

2) They're extremely quiet, and it's expected that they're going to eliminate the majority traffic noize (Larminie & Lowry, 2003 & AEVE)

3) The Association of electrical Vehicles in Europe found that if Electric Vehicles would be use on a world scale, the advantages are going to be that they would: (p. 1) • "To save around 20% of production and thus reduce oil dependency; • To significantly reduce urban pollution; • To eliminate most traffic noise; • to cut back traffic and parking congestion."

B. Weaknesses

1) Limited range because of their battery capacity, and thus their use are restricted to commuting. (EABV, 2010)

2) tasking to refuel – as compared to burning (IC) cars. (Larminie & Lowry, 2003, Ewing & Sarigollu, 2000) a serious drawback for the EV is that the time it takes to recharge. Because it takes an excessive amount of time, it becomes a good inconvenience for the buyer.

3) Price of car Electric Vehicles are referred to as being expensive in comparison to IC cars. within the last years, the worth gap between the 2 different car classes has been strongly diminishing, but still, today consumers should pay a premium price for an electrical Vehicle. the most reason for the worth is relaetd to the very fact that batteries are very expensive, as Larminie & Lowry (2003) state.

4) Poor acceleration and speed a substantial disadvantage that seems to follow the EV concept ever since its birth in 1900 is that they lack the speed of normal cars. Thus in 1910, Victor Appleton wrote that "while they were very nice cars, [they] didn‟t seem to travel in no time or very far." (Anderson & Anderson, 2010, p. 166) Unfortunately not much has changed since then, this still remaining today a difficulty of consideration for potential buyers. another excuse tied to hurry is additionally the poor acceleration of the electrical Vehicle.

C. EV – Past, Present and Future

The history of the EV is of importance to the thesis because one can see the developments and the way this car has managed to continue its existence until today. Anderson & Anderson (2010) divide the history of the electrical Vehicle into three parts:

1) The first Years (1890–1929) While the initial Electric vehicle is dated back to 1830‟s, it's only within the 1890‟s that the concept became commercialized, and also the first automobile to be put into production is believed to be a German Benz in 1885. oddly enough, "in the 1900 in France there have been 5,600 automobiles in France and 265 electric charging stations", which may be seen as an incredible fact dating back in history. Another extremely fact is that in 1905 some researchers made a car that ran 130 miles on one battery charge. (Anderson & Anderson, 2010) Then, the EV was a true success because it had most more benefits than an enclosed combustion (IC) car. "It was clean, silent, freed from vibrations, thoroughly reliable, easy to begin and control (no shifting required) and produced no dirt or odor. The disadvantages were short range and high initial cost. curiously enough, Electric vehicles outsold all other varieties of cars in America within the years 1899 and 1900." (Anderson & Anderson, 2010, p. 22) Nevertheless, with the advances of the IC engine and with the low price on oil, things were at risk of dramatically change then they did. (Larminie & Lowry, 2003)

2) The center Years (1930–1989) the center years saw a quick peak of interest in EVs brought on by the gasoline shortages during war II, the environmental concerns of the 1960s and oil shortages of the 1970s.

3) The present years (1990–present). the present years brought renewed interest in air quality and also the impact on the environment of pollution from the inner combustion engine. Since 2002, statutes have encouraged research in EVs and re-energized the event of environmentally friendly vehicles through tax incentives, grants and government-industry collaborative projects. From 2008, when the quantity of EVs was somewhat limited and little - 13 models and over the subsequent years the EV will get to achieve in 2012 a complete of 119 models. (Deutsche Bank, 2009) Other studies confirm that EV will experience ascent within the years to come back

VII. REVIEW OF LITERATURE

According to the author F Liao said in an article published by Taylor and Francis that studies concerning about EV adoption is roughly divided into two categories: economic and psychological. The foremost widely applied methodology among economic studies is discrete choice analysis during which EV adoption is described as a choice among a gaggle of car alternatives described by their characteristics or "attributes". Consumers make decisions by making trade-offs between attributes. Economic studies specialise in estimating the taste parameters for attributes which denote their weights within the decision. Psychological studies specialize in the motivation and process of decision-making by examining the influence of a large range of individual-specific psychological constructs (attitudes, emotion, etc.) and perceptions of EV on intentions for EV adoption. Their strength lies in uncovering both the direct and indirect relationships between these constructs and also the intention. In contrast to economic studies, these studies generally ignore other vehicle options (conventional vehicles (CVs) like gasoline and diesel vehicles) and don't specify or systematically vary the EV attributes. Consequently, psychological studies only provide limited (if any) insight into how changes within the attributes of EV can result in a shift in preferences for EV. Moreover, discrete choice analysis also allows the incorporation of psychological constructs, which enables a more comprehensive conceptual framework than that of psychological studies. This review utilises the framework applied in economic studies for 2 reasons: first, many governments or car manufacturers aim to extend EV adoption by improving EV attributes or the supporting service system (e.g. charging infrastructure etc.), and discrete choice analysis – employed by economic studies – is more suitable for evaluating the potential effectiveness of those policies or strategies. The second reason is that it can relatively easily incorporate factors and theories from psychological studies.

A. A review of Preferences For

1) EV Attributes

According to the author E Molin, EV preference studies generally include the financial, technical, infrastructure and policy attributes for vehicle alternatives. In addition they include ASC within the utility function, capturing the joint effect of all the attributes of an alternate which aren't included within the choice experiment. The ASC for EV is typically interpreted as a basic preference for EV compared to standard cars when everything else is equal. Since different studies usually include different attributes, by definition the ASCs in these models cover various factors and can't be directly compared.

This section presents a summary of the findings on the preferences for various attributes of EV. The summary of attributes (without policy attributes) for every attribute, we first discuss its operationalization to work out how it's defined and measured within the choice experiments, so present its parameter significance. We also elaborate whether preferences vary among samples and supply some explanation for preference heterogeneity if applicable. Because there are many sporadic findings regarding the link between individual-related variables and therefore the taste parameters of attributes, we only discuss those which are either reasonable/counter-intuitive/inspiring or repeatedly confirmed.

2) Infrastructure Attributes

Infrastructure attributes specialize in the provision of the charging infrastructure. there's not yet consensus regarding its operationalization: some studies show the density of charging stations relative to filling station.

In most studies it's a significantly positive effect, possibly because more charging facilities save time and search cost for users in addition as relieving their range anxiety in addition. Charging posts in several activity locations are preferred by certain groups, the long distance commuters value chargers in work places significantly more and like the next density of charging stations.

The reviewed studies don't differentiate slow charging posts from fast charging stations, while– as explained above – these two serve different purposes. Public slow charging posts are mainly situated in workplaces or shopping malls where parking is for extended periods, while fast charging stations are mostly located on highways (also in cities but just for emergency) to support longer EV trips. most significantly, unlike CV which needs regular visits to gas stations for refuelling,

EV allows users to depend upon home charging as long as one's daily distance is within the EV's range, which applies to the general public. Users prefers recharging reception to refuelling at petrol stations thanks to convenience. In contrast, since EVs mostly depend on slow charging, it's almost impossible to use an EV regularly if there's no charging facility reception or work. Whether respondents were fully awake to this wasn't clear.

3) Policy Attributes

Policy attributes include different policy instruments for promoting EV adoption. If the preference parameter for a certain policy attribute in the final choice model is significant, then the policy can be regarded as potentially effective. Five policies were tested in the reviewed studies.

Regarding one-time price reducing policies, reducing purchase tax is important all told cases while reducing damage is merely significant 2 out of 4 times. The difference may be most clearly seen in contrast. A 1,00,000rs tax reduction is significantly positive while a 1,00,000rs step-down isn't significant. This will possibly flow from to the upper symbolic value attached to a better priced car. The kind of tax incentive offered is as important because the generosity of the inducement.

As for usage cost reduction policies, annual tax reduction seems to be the sole significant policy, while free parking and toll reduction aren't significant in any of the studies that explored their effects. The effectiveness of various styles of tax reduction reflects the difference in perceptions people have towards taxes versus other expenses.

As for the sole non-financial policy tested, the effectiveness of giving EV access to HOV lanes remains ambiguous. There could also be several reasons for the contradictory findings and lack of significance of potential non-financial policy instruments. First, the placement of the information collection may play a job, people living in cities or regions without serious hold up don't value access to high occupancy vehicle (HOV) lanes much if at all; additionally, good availability of parking zones and cheap or free parking are likely to guide to indifference towards dedicated and free parking space. Second, people living in places where there are not any HOV lanes may have difficulty perceiving its benefits. Third, the polarised preferences of various groups could lead on to an insignificant parameter when considering the complete sample. EV policy incentives which aim to encourage the substitution of CV by EV could have the unintended rebound effect that households increase the quantity of cars.

4) Technical Attributes

Technical attributes describe the technical characteristics of the vehicle itself:

A relatively short golf range is taken into account to be one among the most important barriers to the widespread adoption of EV. the foremost common operationalization is practice range with a full battery. An exception including both range under normal and unfavorable circumstances. Range is found to own a positive and statistically significant effect on EV adoption decisions within the overwhelming majority of studies. However the effect to be insignificant, which can be the limited range is 30–60 miles. The utility for practice range is way higher for an EV than for a CV, which is maybe because of the massive difference in range between these two car types.

Recharging time is found to be significant altogether the studies that included it. However none of the studies distinguished between slow and fast charging. Recharging time depends on the facility of the charging post and therefore the battery capacity. For everyday purpose, EV uses slow charging reception or at work which takes around 6–8 hours for a full charge. As for recharging during long trips, fast chargers can fill the battery up to 80% within 15–30 minutes. In other words, "charging time" varies greatly counting on the conditions.

Performance is sometimes represented by engine power, acceleration time or maximum speed. Consumers are generally found to prefer better performance. However, acceleration time is found to be insignificant since heterogeneous preferences among the population may cancel one another out: males have a big preference for faster acceleration while females prefer slower acceleration

B. Factors accounting for heterogeneous EV preferences

In this section, we focus on individual-related variables which are found to have an impact on the general preference for BEV and PHEV and attempt to explain part of the taste heterogeneity. An overview of the main factors explored in previous studies and related findings. One point worth noticing is that almost all individual-related variables are found to be insignificant in at least some studies and excluded in the final model; therefore, we only list cases in which they are found to be significant.

There are many studies done globally to grasp consumer adoption of EVs. Factors studied are the price of the EV, driving distance per charge, time to recharge the battery, availability of charging points and battery cost. Range anxiety and incentives offered—both financial and non-financial—are the opposite attributes researched in previous studies.

Technology refers to the technical characteristics of a vehicle. Previous studies indicate range anxiety, that is, the short distance travelled per full charge of the battery, because the major hurdle to the adoption of EVs. Infrastructure attributes target the available charging infrastructure. Research reports the positive influence of this factor. Adequate charging facilities will save time and search cost, hence, address the consumers' range anxiety. The higher price of EVs could restrain EV adoption. Some policies associated with financial attributes like tax reduction or rebate are strongly supported by evidence while non-financial incentives like free parking and toll reduction don't have enough supporting evidence. Other barriers for adoption of EVs found were the non-availability of EVs and lack of EV models. Literature shows that the dearth of data and unqualified car dealership may discourage EV adoption. North American and European countries account for many of the research. The effect of individual-specific variables on EV adoption requires further research. Studies have shown that psychological factors have a proven and stable effect. Studies in India are few, and also the focus of this text is on an electrical car, which is nothing but a subset of the EV.

EVs have shallow adoption in India, and the general public lack the experience of handling EVs. Although the initial price to shop for an EV is also higher; the price of running and maintenance is comparatively low. this can be as compared to the interior combustion engine propelled vehicles that have the next running cost. Perceived economic benefit (PEB) impact on adoption is one in all the variables. As there's a growing awareness of EC, this variable is additionally postulated to be influencing the adoption of EVs. Self-image and social influence can influence high involvement products' adoption. Attitude is that the mediating variable with behavioural intention because the variable quantity.

C. What other authors said about Electric Vehicles

1) Avdhoot Dixit specifies the data about various factors affecting EV adoption in several states of India. Prominent factors that he specified are Price, KM range of EVs, Availability of charging infrastructure, Tax on EVs, Subsidy provided by the govt., Reliability and safety and various other functional and operational parameter of EVs.

2) Till Gnann specifies the knowledge on need of Fast charging station for EVs. In his research paper he tried to analyse the gap between current charging behaviour from the massive data collected from Sweden and Norway. the perfect charging time should be same as conventional refuelling in IC engine vehicles. thanks to which more focus is provided analysing the fast charging station for public demand of EVs.

3) Chethan Kn specifies the knowledge on commercial viability of electrical vehicles in India. India along with china and USA entered into Paris Agreement and prescribed helping to scale back Earth's average temperature by 2 degree Celsius. The further analysis is finished to analyse the effectiveness of EVs as compared to IC engine vehicles. EVs working method is analysed in these research paper.

4) Mohammed M specifies the data on challenges and opportunities in adoption of EVs. Some of the challenges that he mentioned is Efficiency, Demand, Vehicles Quality etc. a number of the opportunities that he mentioned is Government Initiatives, Battery, environmental etc.

5) K.W.E Cheng specifies the knowledge about recent development in electric vehicles. Various developed operational parameters are Breaking and power generation, ABS (Antilock Braking Systems), Skid Steering etc.

6) Potential Need for Electric Vehicles, Charging Station Infrastructure and its Challenges for the Indian Market: by Praveen Kumar and Kalyan Dash, India should invest in small scale reinforcements to manage the load issues locally instead of going for an infinite change. Home charging should be encouraged. Proper planning of place, population, traffic density and safety should be considered before implementing the huge scale charging infrastructure. the mixing of activities within the energy and transport fields is vital. Development goals through different innovative policies and programs, for example, drivers of electrical cars are offered a financial consumer incentive, like tax credits, purchase subsidies, discounted tolls, free parking, and access to restricted highway lanes will help the market to grow.

7) Conventional, Hybrid, or Electric Vehicles: Which Technology for an Urban Distribution Centre?: by Philippe Lebeau, Cedric De Cauwer, Joeri Van Mierlo, Cathy Macharis. Freight transport contains a major impact on urban movement. Researcher explored the possible integration of electrical vehicles in urban logistics operations. A fleet with different technologies has the chance of reducing the prices of the walk. Researcher presented a fleet size and blend vehicle routing problem with time windows for EVs. The most contribution of the authors was considering the variability of the range of EVs. In the segments of small vans, EVs are often the foremost competitive technology. within the segment of enormous vans, diesel has seen the foremost interesting solution from a financial point of consider electric vehicles would wish to cover a extended distance to be cost-competitive. Hybrid vehicles are chosen within the segment of trucks as its running costs and stuck costs are not up to the diesel truck.

8) Consumer preferences for electric vehicles: by Fanchao Liao, Eric Molin & Bert van Wee.

Widespread adoption of EVs may contribute to lessening of problems like environmental pollution, global warming and oil dependency.

However, this penetration of EV is relatively low in spite of governments implementing strong promotion policies. They presented a comprehensive review of studies on consumer preferences for EV about to convey policy-makers and provides direction to further research.

They compared the economic and psychological approach towards consumer preference for Electric vehicle. The impact of monetary and technical attributes of EV on its utility is mostly found to be significant, including its purchase and disbursal, golf range, charging duration, vehicle performance and brand diversity on the market. The density of charging stations also positively affects the utility and promotion of EV. The impact of incentive policies, tax reduction is sort of effective.

- International Council on Clean Transportation: Lingzhi Jin, Peter Slowik,

The first market growth for electric vehicles continues, but variety of barriers prevent their widespread uptake. These barriers include the extra cost of the new technology, relative inconvenience of technology considering range and charge times, and consumer understanding about the supply and viability of the technology. This last point, typically said as “consumer awareness,” is crucial.

- Study on Electric Vehicles in India Opportunities and Challenges: by Mohamed M, G Tamil Arasan, and G Sivakumar.

The replacement of ICE with electric engines will reduce pollution to an excellent extent and be profitable to consumers. Many countries have implemented this technology and are contributing to the development of the environment. The researcher saw the opportunities and challenges faced in India over implementing EVs. Opportunities like Government Initiatives, Batteries, Industries, and Environment are considered. With these challenges like cost of EVs, efficiency of EVs in India and demand for EVs were taken into consideration. The implementation of EVs in India aims primarily to scale back greenhouse emissions and cut oil expenses. The govt. should make the foremost out of the opportunities available and find suitable ways to tackle the challenges.

- Electric Vehicles in India: marketing research with Consumer Perspective, Policies and Issues: Pritam K. Gujarathi, Varsha A. Shah, Makarand M. Lokhande,

Indian Scenario is different because the current market share of EV/PHEV is around 0.1%. Presently most vehicles consider fossil fuel-based transportation. These pollute the atmosphere by the emission of greenhouse gases & causes global warming. The gap between domestic petroleum production and consumption is widening. India import around 70% of oil required each year. Hence there's an urgent have to investigate factors and challenges for sustainable and cleaner alternatives.

- Perception and Awareness Level of Potential Customers towards Electric Cars: Masurali.A, Surya P.

India contributes around 18% in transport sector alone in terms of carbon emission. the electrical Vehicle (EV) is one amongst the foremost feasible alternative solutions to beat the crises. Several automotive companies are introducing EVs and are expanding their portfolio. Promoting EVs can help reduce fuel dependence and pollution and beneficial for both consumers and also the nation. The education of individuals has

significantly higher influence over their awareness level on EVs. aside from manufacturers, Government should strive hard to spread awareness and influence positive perception among potential customers.

- A Study of Consumer Perception and buy Intention of electrical Vehicles: Pretty Bhalla, Inass Salamah Ali, Afroze Nazneen,

Choice of cars depends upon environmental concern, cost, comfort, trust, technology, social acceptance, infrastructure availability. These arguments are tested for both conventional cars and EVs. They assume that these factors have direct influence on individual choice of vehicle.

They found that EV manufacturers and Government should invest more in social acceptance of the vehicle by creating more infrastructural facilities, putting more thrust on technology to make trust. The analysis depicts that the population is cognizant of the environmental benefits. The responsibility lies on the shoulders of the govt. and makers to investing within the manufacturing of vehicles.

- Electric Vehicles for India: Overview and Challenges: by Mr. A. Rakesh Kumar, Dr Sanjeevi kumar Padmanaban, Global pollution is on the increase and every effort made, is to chop back the CO2 emissions and save the world. One such effort is that the introduction of EVs. The transport sector is one in all the biggest emitter of CO2 and hence it is important to scale back it. the govt. has come up with ambitious plans of introducing EVs to the Indian market and confine pace with the event of EVs globally. The National Electric Mobility Mission Plan 2020 has included an in-depth report on the EVs. India encompasses an enormous challenge in shifting the transportation sector from ICE engines to EVs. This needs lots of planning together with R&D. Charging infrastructure must be adequately build to pander to range anxiety. It's vital to create demand generation by making all government buses electric and offering tax exemptions for private EV owners.
- Opportunities and Scope for Electric Vehicles in India: by Janardan Prasad Kesari, Yash Sharma, Chahat Goel. Developing an aggressive strategy for the adoption of EVs in India and ensuring a well executed implementation may be a challenge but vital for state. The geography and variety of India will present problems that need thoughtful solutions. Public procurement is anticipated to be a very important driver of growth of EVs, with the acquisition of four-wheeled vehicles for state offices, three wheeled vehicles and buses for transport. Investments by fleet operators like Ola and Uber, and operators of food distribution services, also are expected to spice up the initial growth of two- and four wheeled electric vehicles. However, the private EVs may take 5-6 years to realize popularity and acceptance.
- Indian Electric Vehicles Storm in an exceedingly teacup: Yogesh Aggarwal, Vivek Gedda and Kushan Parikh. Users of scooters, who need only to travel short distances, may consider an EV, but those, who have to travel longer distances and already own bikes sort of a Hero Splendor, may find it difficult to maneuver to an e2W. For cars, it's relatively simple to boost the range with increased battery size. For electric 2Ws though, every increase in kWh may provide an additional 30km in range, but the rise in weight is around 10kg, approximately a tenth increase within the total weight of the bike. This weight issue is even more pronounced in smaller bikes (less than 150cc).

VIII. RESEARCH METHODOLOGY

A. Research Methodology

In India, EVs are not common on the road and are not available readily in the market. Potential buyers of EVs may have never even seen, driven or charged such vehicles. People have limited familiarity with the characteristics of these vehicles.
Descriptive research methodology is used. Primary data of a sample population of is collected using google forms.

B. Purpose of Study

The purpose of study is to point out how electric vehicles which is accessible in a different set of ways creates its on the current automobile sector.

C. Objectives of This Research

1) To identify customer needs and expectations
2) To find target market and new oppurtunities
3) To recognise defeciencies in the product
4) Product positioning in the market
5) To know customer acceptance

D. Research Type

The study was conducted online through google forms.

E. Respondents

The respondents in this study were between the ages of 18-25. This age group spend ample amounts of time on social media and are specifically targeted when it comes to Electric vehicles . There was a total of 41 participants in the study. Participants were chosen through random sampling.
All participants agreed to participate and answer each question truthfully.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

IX. SAMPLING PLAN

Participants were chosen through random sampling. In order to determine the impact electric vehicles in individuals' attitudes and perceptions, a descriptive correlational survey method was used. This method was conducted to know the opinions of the respondents on the topic – Consumer attitude towards electric vehicles. Additionally, each respondent was asked to fill in a survey questionnaire in order to determine the factors that may affect their attitudes and perceptions when using social media to connect with businesses.

X. DATA ANALYSIS

After retrieval of the completed questionnaires, responses were tabulated and the results were compiled. The results were analysed to uncover the attitude towards electric vehicles. The study used descriptive analysis to understand the mindset on participants' attitudes and perceptions towards electric vehicles. Observations were made using the compiled results from the survey.

A. Respondents

Below are the demographic information from the questionnaire that was circulated to people.

Fig 1 shows the respondents according to gender

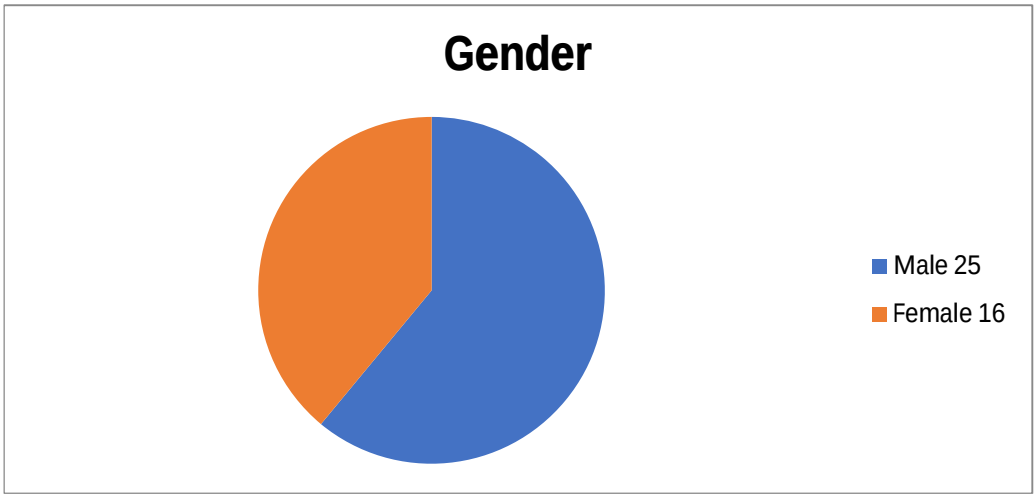
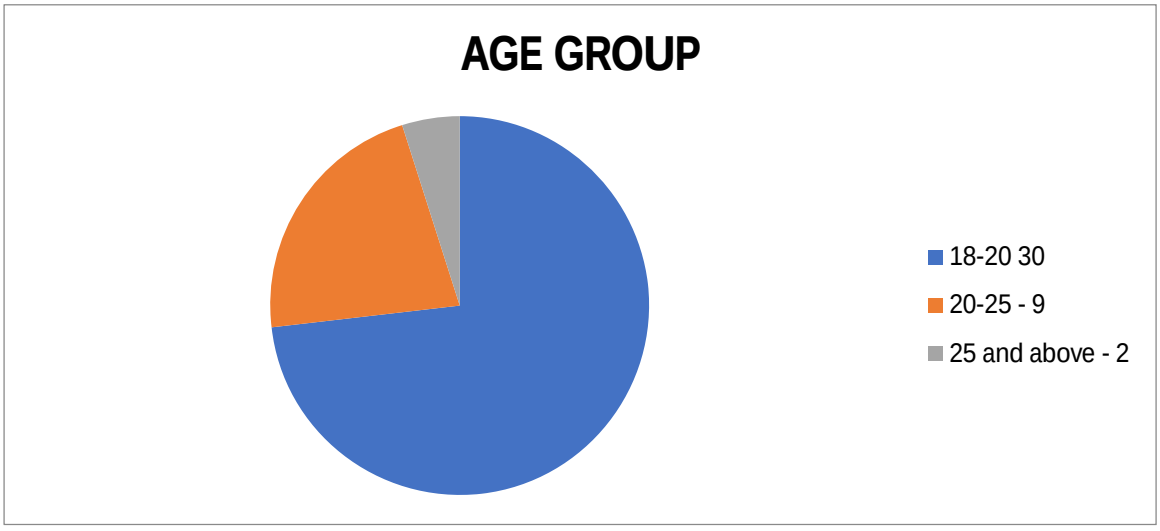


Fig 1

Fig 2 shows the respondents wrt their age group



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

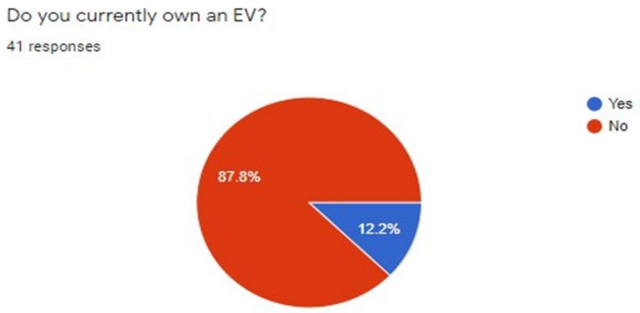
XI. DATA ANALYSIS AND INTERPRETATION

A. Gender and Age of Respondents

From the results of the questionnaire, most of the respondents were young males. From the total 41 respondents, 25 were males whereas 16 were females. Of those percentages, the survey revealed that 80% of the respondents were under the age of 20, predominately male. The other 20% of the respondents were above the age of 20.

1) Do you currently own an EV?

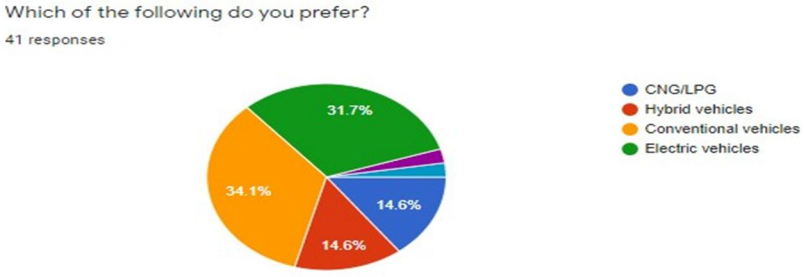
87.8 % of the responses said no and only 12.2% of the population said yes. Even though electric cars are receiving more positive attention and becoming more common, adoption is slow. This is typical of any new technology. It's due in part to the fact that people don't trust electric vehicle (EV) technology and have many doubts. In fact, there are still many people who simply don't think EVs can ever replace gas cars. While many automakers are making strides in electrification, it seems most aren't ready to transition just yet. One of the main reasons behind buyers not going for an electric car is the high ownership cost. For buyers of EVs, the total cost of ownership, which includes the cost for acquisition, running cost, and service, is the most important factor determining the viability of the vehicle, according to a white paper on electric mobility released by strategy consultant firm Kearney.



2) Which of the following do you prefer?

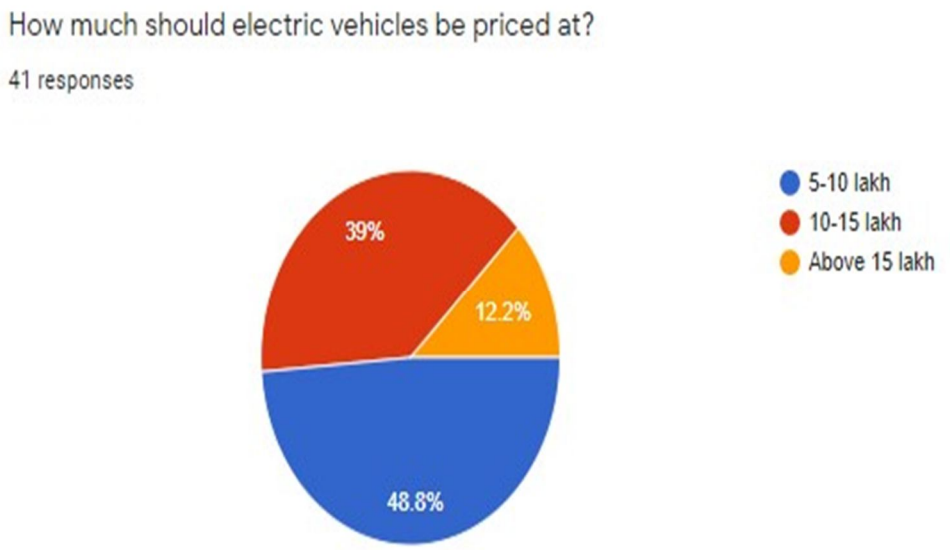
a) CNG/LPG
b) Conventional vehicles
c) Hybrid vehicles
d) Electric vehicles.

31% which is the majority of the population voted for conventional vehicles. One of the main reasons behind buyers not going for an electric car is the high ownership cost. For buyers of EVs, the total cost of ownership (TCO), which includes the cost for acquisition, running, and maintenance, is the most important factor determining the viability of the vehicle, according to a white paper on electric mobility released by strategy consultant firm Kearney.



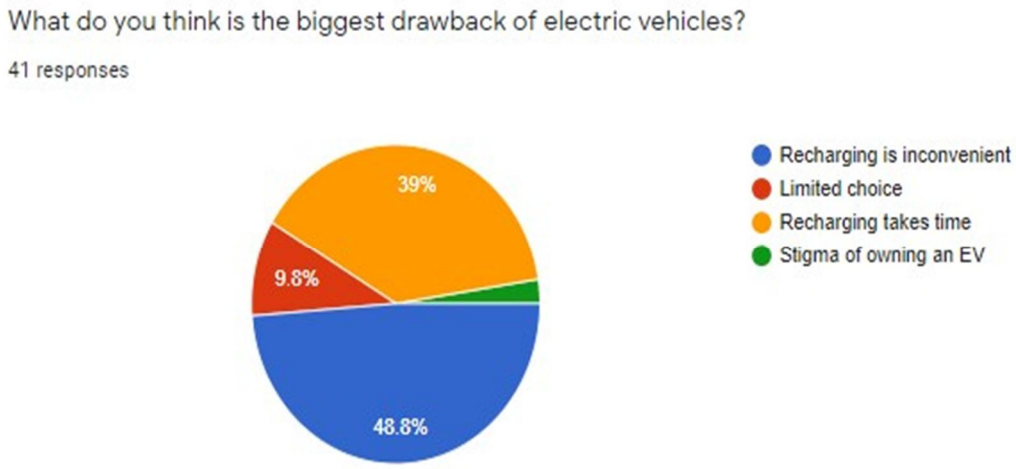
3) How Much Should Electric Vehicles be Priced at?

Our respondents voted for 5-10 lakh lakh bracket which is a reasonable price for both the manufacturer and the consumer. Electric cars available in India are in the price range of Rs. 4.50 Lakh - Rs. 1.12 Crore. The most popular electric cars include Hyundai Kona Electric (Rs. 23.75 Lakh), Jaguar I-Pace (Rs. 1.05 Crore) and Mercedes-Benz EQC (Rs. 1.04 Crore). Although consumers in India are seeking a lower price point than consumers in other countries, they are also willing to accept a slightly longer charge time and a slightly shorter range.



4) What do you Think is The biggest Drawback of Electric Vehicles?

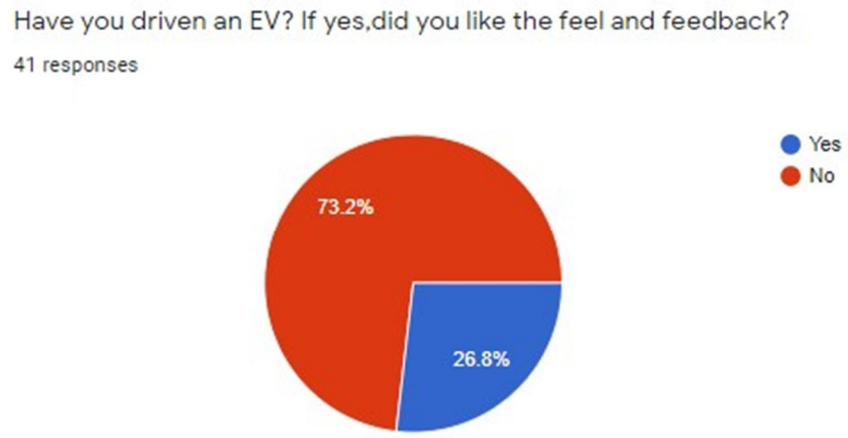
Majority of the respondents voted for the inconvenience of recharging as the biggest drawback in electric cars. A country like India has huge stretches of rural lands where you cannot find any charging stations for your car. In a situation like this, electric mobility would not be ideal for all spaces and circumstances. Travelling long distances through suburban areas would not be possible in an EV. Their price compared to a traditional car and charging infrastructure are the top reasons why consumers shun an EV. The time it takes to charge an electric car and an overall lack of knowledge rounded out the top five reasons why consumers aren't interested in an electric vehicle. Unlike refueling a gas car, which takes only a few minutes, recharging an EV can take 25 to 60 minutes (depending on the battery size and charging speed) using fast chargers in public places. Under normal circumstances, it takes about 10 hours to recharge an EV using (240-volt) chargers when the battery is near empty.



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

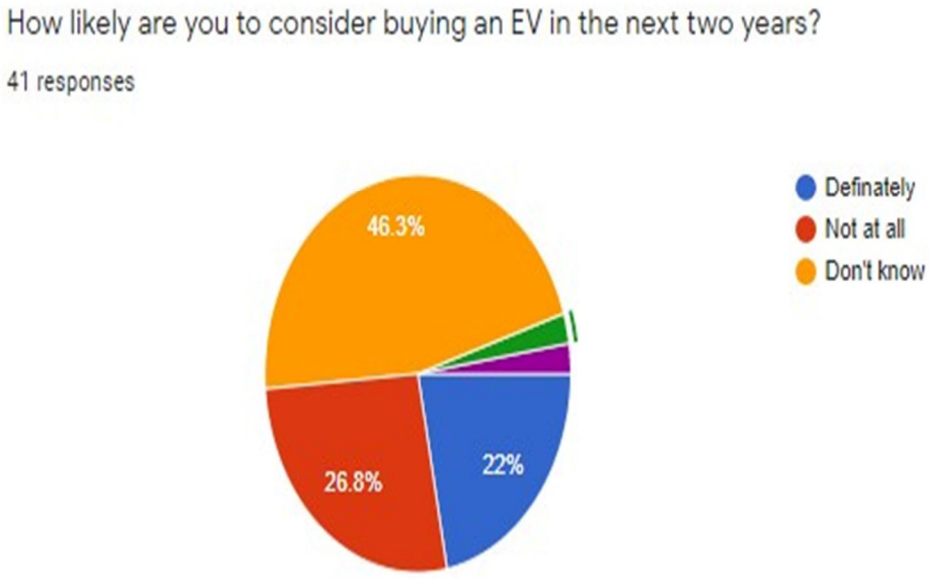
5) Have you Driven an EV? If yes,did you like the Feel and Feedback?

73% of the responses said no, this is mainly because the access to these vehicles is still limited and many have not got a chance to experience how an EV feels to drive or ride. One of our authors got a chance to ride an EV and Yes, they are very quiet. The main noise you will hear is the wheel to road friction noise. As to whether it's unnerving, I suppose when you first get behind the wheel, particularly when you're pulling off at initially quite slow speeds, it can feel very strange if you're used to the noise generated by a petrol or diesel engine, but it's amazing how quickly you get used to it. And then, once you're moving at a normal speed, say 40 kmph or more, you do start to hear those friction noises a bit more, which helps to give you the audio feedback you're used to having from your more conventional car.



6) How Likely are You to Consider Buying an EV in the Next two Years?

The responses said that 46.3% of the population is still sceptical about buying an EV as their next purchase and 26.8% said not at all which is shocking because it is a huge number and is mainly due to less confidence and the cons attached to EVs For drivers who are often stuck at home and dreaming about being on the open road, it comes down to a choice between an electric car, a hybrid, or buying or keeping their current conventional vehicle. Each option has its advantages and disadvantages that are easily overlooked in an emotionally charged debate about the value of electric vehicles (EVs).

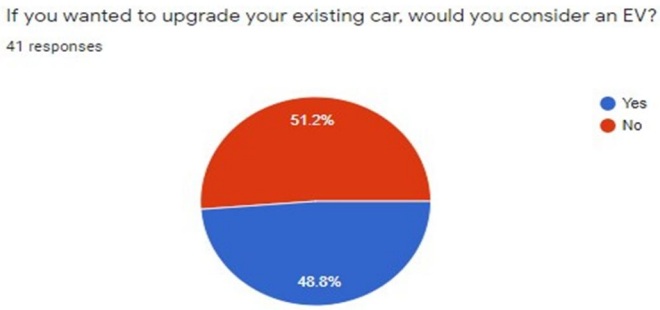


7) If you Wanted to Upgrade your Existing car, Would you Consider an EV?

51% of the population said yes which is a very good sign keeping in mind the current population levels.

The big challenge is of course charging infrastructure which will need to be combined with existing refuelling stations and at alternative locations closer to homes. Improving battery swapping stations will eliminate wait time for charging, make better use of land, reduce the size of batteries in vehicles and will give an increased available range.

Further, the country's charging infrastructure will need to be standardized. EV charging station vendors are perplexed at the moment, regarding the standard that should be adopted for fast charging.



XII. FINDINGS AND CONCLUSION

A. Main Findings

We conduct the literature review to spot which attributes of EV and its service system have a control on the utility of EV, including vehicle attributes, infrastructure system and EV promotion policies. We also aim to search out which individual-related variables affect one's preference for EV. Most research which investigated both of those two topics applied stated choice method since it provides a framework which may easily accommodate the impact of both vehicle attributes and individual characteristics on EV preference. The impact of monetary and technical attributes of EV on its utility is mostly found to be significant, including its purchase and budget items, practice range, charging duration, vehicle performance and brand diversity on the market. The density of charging stations also positively affects the utility of EV, which demonstrates the importance of charging infrastructure development in promoting EV. As for the impact of incentive policies, tax reduction (either purchase tax or road tax) is possibly effective, while there's not yet evidence supporting the effectiveness of other usage cost reduction like free parking and toll reduction. The findings regarding giving EV access to priority lane vary for studies conducted in regions. The preferences for the above attributes are mostly numerous heterogeneous and might partially be accounted for by various individual-specific characteristics.

We also synthesised findings regarding the direct effect of varied clusters of individual-related variables on one's general preference for EV. The effect of psychological factors is proven to be stable by most studies if included. The results regarding the effect of socio-economic and socio-demographic variables are contradictory thus their effect remains ambiguous. The impact of mobility and car-related conditions of spatial variables, experience with EV and social influence is explored by only some studies. Although these variables are usually found to be significant, it's still too early for a definitive conclusion. When applying these results, it's important to stay in mind that the way within which choice analysis approaches this subject generally lacks methodological rigour since many of them didn't control for correlation between these individual-related variables, which can result in self-selection bias and incorrect estimates for his or her direct effects.

B. Environmental Concern

It is defined as an individual's awareness of environmental problems and their willingness to deal with these problems. Studies report that environmental benefits do influence consumer adoption intentions. Kahn (2007) found that individuals who show concern towards the environment are more inclined to adopt EVs. Those who are inclined to environmental protection and energy conservation exhibit higher intention for adoption. Pro-environmental consumers are the probable EV adopters. Environmental benefits are essential motivators for the adoption of EVs as reported in a very consumer survey from Germany. The adoption of EVs will reduce environmental risk and positively influence the EV adoption. Besides, environmental protection, acted sort of a big motivator a key factor for consumer attraction. EVs mustn't only stress energy conservation; instead, they must also target environmental protection, which can enhance the adoption rate.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

C. Social Influence

As an idea, it covers peer pressure, subjective norms, neighbours and cultural influence. Individuals seek family members' and friends' approval of their actions. Families', relatives' or friend's opinions influence the consumer's decisions, and consumers seek social approval using products acceptable to people whose opinions. Effect of people's behaviour influences an individual's decisions in their social network; this influence acts as an important determinant in EV promotion as pointed. The impact of the social network is crucial to an individual's adoption as confirmed by Rasouli and Timmermans (2016) study.

D. Perception of Economic Benefits

The high cost of EVs may be a deterrent in adoption as compared with the same conventional vehicle. Studies suggest that the incentives offered support the acceptance of an EV. Lower running and maintenance costs encourage BEV adoption asserted. advantages of a hybrid vehicle within the USA, concluding that revenue enhancement incentives led to a rise in market share of HEV. The energy cost of other fuel vehicles was eight times more than that of EVs. Low energy consumption and power tariff lead to lower running cost. the overall cost of ownership hence is lower and compensates for the premium cost of an EV. Consumers with long driving ranges stand to realize quite small daily run consumers. Lower operating costs support the adoption of EVs. Researchers conclude that economic incentives influence EV adoption.

E. Limitations and Further Studies

This study focuses only on the citizens and their acceptance of full electric vehicles in India. India may be a country that's suitable for the adoption of full electric vehicles, and thus, the findings of this study might not be generalizable to other countries with different geographic and economic features. However, the market in India isn't developed enough to incorporate actual purchase decisions within the model; therefore, further studies are recommended to revise this model for studying the particular purchasing behaviour in a very more developed market, for instance, in Norway. As this research investigated only four positive psychological factors, it's suggested that other positive and negative factors like perceived drawbacks can be added in future studies to widen the scope of this research area. Additionally, there are differing types of advantages. This study considers only long-term, personal, direct, and measurable economic benefits that are printed within the catalogues of electrical vehicles. However, researchers can consider integrating other benefits like social and environment benefits in their research. This study is worried only with consumer acceptance of full electric vehicles. it's going to not be generalizable for other environmental transportation technologies. Future studies are suggested to research whether an analogous concept will be employed with relevancy installing other environmental transportation equipment.

Some big challenges are:

1) Charging infrastructure
2) Lack of technology
3) Lack of skilled workforce
4) Import of EV components and materials

XIII. CONCLUSION

In general, the effect of individual-specific variables on EV preference remains an open question. Psychological variables are the exception and have a proven stable effect, shown by several studies. For socio-economic and demographic variables, the impact is unclear and sensitive to small changes in model specification. The direction of the effect is additionally ambiguous since existing evidence is contradictory. Other variables are only included during a few studies therefore their effects are until now inconclusive. In most cases, the correlation between of these variables has not been controlled for to avoid self-selection bias. More research is unquestionably necessary to clarify these currently fuzzy relationships and other methods are needed to feature more rigour and confidence to the results. Considering development, historic government policies implementation, Indian people buying concerns, response to new technologies and economics, the growth of IC engine technology will remain in demand with automatic transmission vehicle demand will rise in future. Hybrid fuel technology growth will be limited due to cost. Conversion of the conventional vehicle into the plug-in hybrid electric vehicle by retrofitting may have a tremendous market in India. EV and PHEV will have promising future in India, however, its current growth will be limited and the limit is decided by policies and awareness creation. A way towards sustainable transportation will go in slow space for some more time due to lack of EPT manufacturer, clear policy and its implementation.

XIV. QUESTIONNAIRE

1) Do you currently own an EV?
- YES
- NO

2) Which of the following do you prefer?
- CNG/LPG
- Hybrid vehicles
- Conventional vehicles
- Electric vehicles

3) How much should electric vehicles be priced at?
- 5-10lakh
- 10-15lakh
- above15lakh

4) What do you think is the biggest drawback of electric vehicles?
- Recharging is inconvenient
- Limited choice
- Recharging takes time
- Stigma of owning an EV

5) Have you driven an EV? If yes, did you like the feel and feedback?
- Yes
- No

6) How likely are you to consider buying an EV in the next two years?
- Definitely
- Not at all
- Not sure

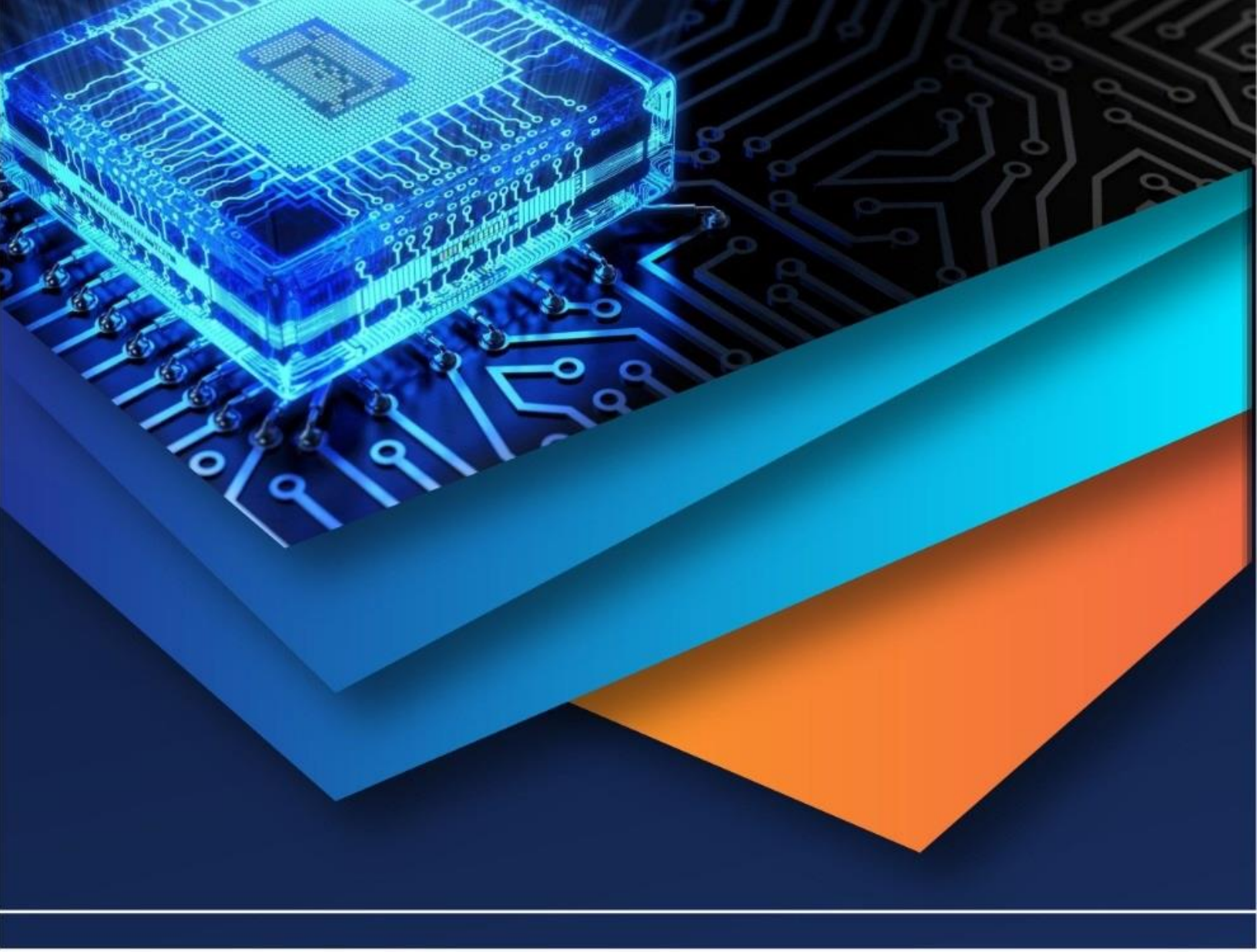
7) If you wanted to upgrade your existing car, would you consider an EV?
- Yes
- No

REFERENCES

[1] Statista, D. R. (2020, April 8). Statista. https://www.statista.com/statistics/664729/total-number-ofvehicles-india/
[2] Wikipedia. (n.d.). https://en.wikipedia.org/wiki/Electric_vehicle_industry_in_India
[3] Dash, P. K. (2013). Potential Need for Electric Vehicles, Charging Station Infrastructure and its Challenges for the Indian Market. Advance in Electronic and Electric Engineering, 471- 476.
[4] EEA, (2018, November 22). https://www.eea.europa.eu/highlights/eea-report-confirms-electric-cars
[5] Fanchao Liao, E. M. (2017). Consumer preferences for electric vehicles: a literature review. Transport review, 275.
[6] Gulati, V. (2013). NEMMP2020. Department of heavy industry, Gov of India.
[7] IEA. (2018). https://www.iea.org/reports/tracking-transport-2019 8. Janardan Prasad Kesari, Y. S. (2019). Opportunities and Scope for Electric Vehicles in India. IJME Journal,
[8] Jose, T. (2018, Aug 30). https://www.indianeconomy.net/splclassroom/fame-india-scheme/
[9] Lingzhi Jin, P. S. (2017). Literature review of electric vehicle. International Council on Clean Transportation.
[10] Marcello Contestabile, D. G. (2012). Electric Vehicles: A Synthesis of the Current Literature with a Focus on Economic and Environmental Viability.
[11] Masurali.A, S. P. (2018). Perception and Awareness Level of Potential Customers towards Electric Cars. International Journal for Research in Applied Science & Engineering Technology.
[12] Mohamed M, G. T. (2018). Study on Electric Vehicles in India Opportunities and challenges. International Journal of Scientific Research in Environmental Science and Toxicology.
[13] Mr. A. Rakesh Kumar, D. S. (2019). Electric Vehicles for India: Overview and Challenges. IEEE India

[14] Philippe Lebeau, C. D. (2015). Conventional, Hybrid, or Electric Vehicles; Which Technology for an Urban Distribution Centre? The Scientific World Journal, 11.
[15] Pretty Bhalla, I. S. (2018). A Study of Consumer Perception and Purchase Intention of Electric Vehicles. European Journal of Scientific Research, 362-368.
[16] Pritam K. Gujarati, V. A. (2018). Electric Vehicles in India: Market Analysis with Consumer Perspective, Policies and Issues. Journal of Green Engineering.
[17] Shanthi. (2019, December 19). https://inc42.com/features/paving-the-way-for-emobility-state-andcentral-government-ev-policies-in-india/
[18] Symbo (n.d.). www.symboinsurance.com/blogs/car-insurance/evolution-automobile-industry-india/
[19] Transport policy. (n.d.). https://www.transportpolicy.net/standard/india-regulatory-background/
[20] Wikipedia. (n.d.). https://en.wikipedia.org/wiki/Car#Etymology
[21] www.dpti.sa.gov.au.(n.d.).https://www.dpti.sa.gov.au/lowemissionvehicles/knowledge_bank/vehicle_technologies/conventional _vehicles
[22] Yogesh Aggarwal, V. G. (2019, September). Indian Electric Vehicles Storm in a teacup. HSBC Global Research, p. 13
[23] Achtnicht, M., Bühler, G., & Hermeling, C. (2012). The impact of fuel availability on demand for alternative-fuel vehicles. Transportation Research Part D: Transport and Environment, 17(3), 262–269. doi: 10.1016/j.trd.2011.12.005 [Crossref], [Web of Science ®], [Google Scholar]
[24] Ajzen, I. (1991). The theory of Planned behavior, Organizational Behavior and Human Decision Processes, 50(2), 179–211. doi: 10.1016/0749-5978(91)90020-T [Crossref], [Web of Science ®], [Google Scholar]
[25] Araghi, Y., Kroesen, M., Molin, E., & van Wee, B. (2014). Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment. Transportation Research Part D: Transport andEnvironment, 26, 42–46. doi: 10.1016/j.trd.2013.10.008 [Crossref], [Web of Science ®], [Google Scholar]
[26] Axsen, J., & Kurani, K. S. (2011). Interpersonal influence in the early plug-in hybrid market: Observing social interactions with an exploratory multi-method approach. Transportation Research Part D: Transport and Environment, 16(2), 150–159. doi: 10.1016/j.trd.2010.10.006 [Crossref], [Web of Science ®], [Google Scholar]
[27] Axsen, J., Kurani, K. S., McCarthy, R., & Yang, C. (2011). Plug-in hybrid vehicle GHG impacts in California: Integrating consumer-informed recharge profiles with an electricity-dispatch model. Energy Policy, 39(3), 1617–1629. doi: 10.1016/j.enpol.2010.12.038 [Crossref], [Web of Science ®], [Google Scholar]
[28] Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. Journal of Environmental Psychology, 27(1), 14–25. doi: 10.1016/j.jenvp.2006.12.002 [Crossref], [Web of Science ®], [Google Scholar]
[29] Beck, M. J., Fifer, S., & Rose, J. M. (2016). Can you ever be certain? Reducing hypothetical bias in stated choice experiments via respondent reported choice certainty. Transportation Research Part B: Methodological, 89, 149–167. doi: 10.1016/j.trb.2016.04.004 [Crossref], [Web of Science ®], [Google Scholar]
[30] Ben-Akiva, M., Bradley, M., Morikawa, T., Benjamin, J., Novak, T., Oppewal, H., & Rao, V. (1994). Combining revealed and stated preferences data. Marketing Letters, 5(4), 335–349. doi: 10.1007/BF00999209 [Crossref], [Google Scholar]
[31] Bockarjova, M., Knockaert, J., Rietveld, P., & Steg, L. (2014). Dynamic consumer heterogeneity in electric vehicle adoption. Transportation Research Board Annual Meeting 2014 Paper. [Google Scholar]
[32] Boxall, P. C., & Adamowicz, W. L. (2002). Understanding heterogeneous preferences in random utility models: A latent class approach. Environmental and Resource Economics, 23, 421–446. doi: 10.1023/A:1021351721619 [Crossref], [Web of Science ®], [Google Scholar]
[33] Bunce, L., Harris, M., & Burgess, M. (2014). Charge up then charge out? Drivers' perceptions and experiences of electric vehicles in the UK. Transportation Research Part A: Policy and Practice, 59, 278–287. [Crossref], [Web of Science ®], [Google Scholar]
[34] Burgess, M., King, N., Harris, M., & Lewis, E. (2013). Electric vehicle drivers' reported interactions with the public: Driving stereotype change? Transportation Research Part F: Traffic Psychology and Behaviour, 17, 33–44. doi: 10.1016/j.trf.2012.09.003 [Crossref], [Web of Science ®], [Google Scholar]
[35] Bühler, F., Cocron, P., Neumann, I., Franke, T., & Krems, J. F. (2014). Is EV experience related to EV acceptance? Results from a German field study. Transportation Research Part F: Traffic Psychology and Behaviour, 25, 34–49. doi: 10.1016/j.trf.2014.05.002 [Crossref], [Web of Science ®], [Google Scholar]
[36] Caperello, N. D., & Kurani, K. S. (2011). Households' stories of their encounters with a plug-in hybrid electric vehicle. Environment and Behavior, 44(4), 493–508. doi: 10.1177/0013916511402057 [Crossref], [Web of Science ®], [Google Scholar]
[37] Chorus, C. G. (2010). A new model of random regret minimization. European Journal of Transport, Infrastructures and Logistics, 10(2), 181–196. [Web of Science ®], [Google Scholar]
[38] Daziano, R. A. (2012). Taking account of the role of safety on vehicle choice using a new generation of discrete choice models. Safety Science, 50(1), 103–112. doi: 10.1016/j.ssci.2011.07.007 [Crossref], [Web of Science ®], [Google Scholar]
[39] De Haan, P., Peters, A., & Scholz, R. W. (2007). Reducing energy consumption in road transport through hybrid vehicles: Investigation of rebound effects, and possible effects of tax rebates. Journal of Cleaner Production, 15(11–12), 1076–1084. doi: 10.1016/j.jclepro.2006.05.025 [Crossref], [Web of Science ®], [Google Scholar]
[40] Dimitropoulos, A., Rietveld, P., & Van Ommeren, J. N. (2013). Consumer valuation of changes in driving range: A meta-analysis. Transportation Research Part A: Policy and Practice, 55, 27–45. [Crossref], [Web of Science ®], [Google Scholar]
[41] Dittmar, H. (1992). The social psychology of material possessions: To have is To Be. New York, NY: St Martin's Press. [Google Scholar]
[42] Doran, R., & Larsen, S. (2016). The relative importance of social and personal norms in explaining intentions to choose eco-friendly travel options. International Journal of Tourism Research, 18, 159–166. doi: 10.1002/jtr.2042 [Crossref], [Web of Science ®], [Google Scholar]
[43] Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. Energy Policy, 48(2012), 717–729. doi: 10.1016/j.enpol.2012.06.009 [Crossref], [Web of Science ®], [Google Scholar]
[44] Farber, S., Neutens, T., Miller, H. J., & Li, X. (2013). The social interaction potential of metropolitan regions: A time-geographic measurement approach using joint accessibility. Annals of the Association of American Geographers, 103(3), 483–504. doi: 10.1080/00045608.2012.689238 [Taylor & Francis Online], [Web of Science ®], [Google Scholar]
[45] Franke, T., & Krems, J. F. (2013). What drives range preferences in electric vehicle users? Transport Policy, 30, 56–62. doi: 10.1016/j.tranpol.2013.07.005 [Crossref], [Web of Science ®], [Google Scholar]
[46] Gallagher, K. S., & Muehlegger, E. (2011). Giving Green to get Green? Incentives and consumer adoption of hybrid vehicle technology. Journal of Environmental Economics and Management, 61(1), 1–15. doi: 10.1016/j.jeem.2010.05.004 [Crossref], [Web of Science ®], [Google Scholar]

[47] Glerum, A., Stankovikj, L., & Bierlaire, M. (2014). Forecasting the demand for electric vehicles: Accounting for attitudes and perceptions. Transportation Science, 48(4), 483–499. doi: 10.1287/trsc.2013.0487 [Crossref], [Web of Science ®], [Google Scholar]
[48] Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R., & Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. Transportation Research Part A: Policy and Practice, 46(1), 140–153. [Crossref], [Web of Science ®], [Google Scholar
[49] Hackbarth, A., & Madlener, R. (2013). Consumer preferences for alternative fuel vehicles: A discrete choice analysis. Transportation Research Part D: Transport and Environment, 25, 5–17. doi: 10.1016/j.trd.2013.07.002 [Crossref], [Web of Science ®], [Google Scholar]
[50] He, L., Wang, M., Chen, W., & Conzelmann, G. (2014). Incorporating social impact on new product adoption in choice modeling: A case study in green vehicles. Transportation Research Part D: Transport and Environment, 32, 421–434. doi: 10.1016/j.trd.2014.08.007 [Crossref], [Web of Science ®], [Google Scholar]
[51] Helveston, J. P., Liu, Y., Feit, E. M., Fuchs, E., Klampfl, E., & Michalek, J. J. (2015). Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the U.S. and China. Transportation Research Part A: Policy and Practice, 73, 96–112. doi: 10.1016/j.tre.2014.11.004 [Crossref], [Web of Science ®], [Google Scholar
[52] Hess, S., Fowler, M., & Adler, T. (2012). A joint model for vehicle type and fuel type choice: Evidence from a cross-nested logit study. Transportation, 39(3), 593–625. doi: 10.1007/s11116-011-9366-5 [Crossref], [Web of Science ®], [Google Scholar]
[53] Hidrue, M. K., Parsons, G. R., Kempton, W., & Gardner, M. P. (2011). Willingness to pay for electric vehicles and their attributes. Resource and Energy Economics, 33(3), 686–705. doi: 10.1016/j.reseneeco.2011.02.002 [Crossref], [Web of Science ®], [Google Scholar]
[54] Hoen, A., & Koetse, M. J. (2014). A choice experiment on alternative fuel vehicle preferences of private car owners in the Netherlands. Transportation Research Part A: Policy and Practice, 61, 199–215. [Crossref], [Web of Science ®], [Google Scholar]
[55] Holtsmark, B., & Skonhoft, A. (2014). The Norwegian support and subsidy policy of electric cars. Should it be adopted by other countries? Environmental Science & Policy, 42, 160–168. doi: 10.1016/j.envsci.2014.06.006 [Crossref], [Web of Science ®], [Google Scholar]
[56] Horne, M., Jaccard, M., & Tiedemann, K. (2005). Improving behavioral realism in hybrid energy-economy models using discrete choice studies of personal transportation decisions. Energy Economics, 27(1), 59–77. doi: 10.1016/j.eneco.2004.11.003 [Crossref], [Web of Science ®], [Google Scholar]
[57] Hsu, C.-I., Li, H.-C., & Lu, S.-M. (2013). A dynamic marketing model for hybrid electric vehicles: A case study of Taiwan. Transportation Research Part D: Transport and Environment, 20, 21–29. doi: 10.1016/j.trd.2013.01.001 [Crossref], [Web of Science ®], [Google Scholar]
[58] Huijts, N. M. A., Molin, E. J. E., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. Renewable and Sustainable Energy Reviews, 16(1), 525–531. doi: 10.1016/j.rser.2011.08.018 [Crossref], [Web of Science ®], [Google Scholar]
[59] Jensen, A. F., Cherchi, E., & Mabit, S. L. (2013). On the stability of preferences and attitudes before and after experiencing an electric vehicle. Transportation Research Part D: Transport and Environment, 25, 24–32. doi: 10.1016/j.trd.2013.07.006 [Crossref], [Web of Science ®], [Google Scholar]
[60] Kahn, M. E. (2007). Do greens drive hummers or hybrids? Environmental ideology as a determinant of consumer choice. Journal of Environmental Economics and Management, 54(2), 129–145. doi: 10.1016/j.jeem.2007.05.001 [Crossref], [Web of Science ®], [Google Scholar]
[61] Kim, J., Rasouli, S., & Timmermans, H. (2014). Expanding scope of hybrid choice models allowing for mixture of social influences and latent attitudes: Application to intended purchase of electric cars. Transportation Research Part A: Policy and Practice, 69, 71–85. [Crossref], [Web of Science ®], [Google Scholar]
[62] Klöckner, C. A. (2014). The dynamics of purchasing an electric vehicle – a prospective longitudinal study of the decision-making process. Transportation Research Part F: Traffic Psychology and Behaviour, 24, 103–116. doi: 10.1016/j.trf.2014.04.015 [Crossref], [Web of Science ®], [Google Scholar]
[63] Lane, B., & Potter, S. (2007). The adoption of cleaner vehicles in the UK: Exploring the consumer attitude–action gap. Journal of Cleaner Production, 15(11–12), 1085–1092. doi: 10.1016/j.jclepro.2006.05.026 [Crossref], [Web of Science ®], [Google Scholar]
[64] Lee, J. Y., & Kwan, M.-P. (2011). Visualisation of socio-spatial isolation based on human activity patterns and social networks in space-time. Tijdschrift Voor Economische en Sociale Geografie, 102(4), 468–485. doi: 10.1111/j.1467-9663.2010.00649.x [Crossref], [Web of Science ®], [Google Scholar]



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY