

# Electric Vehicles Influence: Analysis on Consumers Attitude and Perception related to widespread adoption in India.

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## HIGHLIGHT:

- ❖ WE SAMPLE INDIAN CONSUMER TO DETERMINE ATTITUDE TOWARDS ELECTRIC VEHICLES.
- ❖ CHARGING INFRASTRUCTURE IS THE BIGGEST CONCERN FOLLOWED BY HIGH COST.
- ❖ HIGH DEGREE OF POSITIVE ENVIRONMENT IS ASSOCIATED WITH INDIAN CONSUMER.

**ABSTRACT** - Electric Vehicles (EVs) are promoted as viable near-term vehicles technology to reduce dependence on fossil fuel and green-house emission (GHG). The Indian government has adopted an ambitious policy of switching 100% of light-duty consumer vehicles by 2030. But despite an ambitious policy, consumers are going to play a most vital role in the adoption and penetration of EVs in India. There are several barriers in adoption of EVs by the mass consumer because consumers tend to resist new technologies that are not adopted by the mass population and also they don't have prior experience in it, thus, the Indian government should have a better knowledge of consumer attitude and perception for EV then they can make policies more effective and efficient. This study investigates how differences in consumer population can change attitude and perception about EVs and can be used to determine potential obstacles to EVs adoption in India. This study provides valuable insights in preference and perception of consumer's towards EV and the various steps taken by the government of India to penetrate EV's into the Indian market is adequate or a better roadmap is needed. Data has been collected through an internet-based survey and analysis thoroughly. The result shows that the consumer preference in selecting their next car will be Electric Vehicles or Internal Combustion Engine (ICE). This paper present a comprehensive review of studies on consumer preference for EV, and aiming to better information to policymaker and give direction to further research.

## KEYWORDS:

**ICE:** Internal combustion engine; **BEV:** Battery electric vehicles; **EVs:** Electric Vehicles; **HEV:** Hybrid Electric Vehicle; **PHEV:** Plug-in Hybrid Electric Vehicle; **GHG:** Greenhouse gases.

## I. INTRODUCTION

The transportation sector is responsible for 24% of direct Co<sub>2</sub> emission from fuel combustion. Road vehicles- cars, trucks, buses, two-wheeler, and three-wheelers account for nearly three-quarters of transportation Co<sub>2</sub> emission (IEA, 2019). This projection implies that we will need to quickly adopt dedicated policy and other measures to reduce greenhouse gases (GHG) emissions from the transportation sector and move towards more clean energy.

India is currently the third-largest emitter of carbon dioxide (CO<sub>2</sub>) in the world (ucsusa.org). The transport sector accounts for 13% of India's energy-related Co<sub>2</sub> emission (INCCA, 2010). So, there are many opportunities that exist to mitigate GHG emission and make India's transport

growth more sustainable and climate compatible by aligning development and climate change agenda. GHG emission from transport can be reduced by adopting a sustainable approach through a combination of measure, such as mass adoption of Electric Vehicles (EVs) by public and enhanced clean policy for higher penetration of EVs in transportation and it is also recognized by India's national action plan for climate change (NAPCC, 2010).

As battery technology has improved, EVs have been praised as a viable alternative to conventional Internal Combustion Engine Vehicles (ICEVs) with the benefit of environmentally friendly. A market that was almost non-existent a decade ago is now growing rapidly with the global market share of EVs expected to reach approximately 15% by 2030 up from just 1% in 2018

(International Energy Agency, 2019). Electric mobility is expanding at a rapid pace. In 2018, the global Electric car fleet exceeded 5.1 million, up 2 million from the previous year, and almost double the number of new Electric car sales. However Electric mobility uses a variety of measurements such as Fuel economic standards coupled with incentives for zero- and low emission vehicles. Increasingly, policy support is being extended to address the strategic importance of Electric Vehicles (Global EV outlook, 2019).

Electric vehicles are one such technology that the Indian government relying on to reduce vehicular emissions. The government of India recently announced its intension to sell only electric vehicles by 2030 and India's ministry of power and renewable energy believes that shifting from petrol and diesel to electric will reduce air pollution and address change (The Hindu, 2017) Multiply initiative has been taken by the government of India to manufacturing as well as the adoption of EVs and this had led to increased penetration of EVs in the Indian market (Financial express, 2020). For boosting the adoption of EVs various plans and schemes, such as the National electric mobility mission plan 2020 (NEMMP) and faster adoption and manufacturing of (hybrid) and Electric Vehicles in India (FAME India) and as well as EV@30 Campaign.

Despite these potential advantages and policy support from the government of India, there are significant barriers remain to the widespread adoption of EV technology and currently, they represent a small market share of vehicles in services. Government or car manufacturers aim to increase EV adoption by improving EV attribute or the supporting system (e.g. charging infrastructure and etc). A Government should have a better knowledge of consumer attitude and perception for EV then they can make policies more effective and efficient.

In this research, we do focus on psychological studies focus on the motivation factor and the process of decision-making of EV on intension for EV adoption. Indian consumers are very different from any other nation's consumers. Firstly, they are very price-sensitive and secondly, they do not try a new technology until and unless it's been tried by someone else in the society. Psychological factors such as motivation, socialization, attitude, and belief can be a major influence on the adoption of EVs by Indian consumers. And insights gained from this research will shed more light on the certain mentality of the Indian consumers, whether in the future they preferred to buy Electric Vehicles or not.

Another obstacle in front of them they haven't got any prior experience with Electric Vehicles. And it will be very difficult for the adoption of EVs by the collective society. As individual decisions are expected to be influenced by the behaviors of people in their social network and social norms this can be regarded as the behavior of the collective society. Several Qualitative studies found that social

influence plays an important positive role in E.V promotion (Aksen & Kurani, 2011; Aksen, orlebar, & skippon, 2013)

As with emerging technology, the introduction of the Electric Vehicles transport fleet requires certain mentality changes in Indian consumers because it is also new to many people. It is a fact that currently, EVs are 15-30% expensive than conventional vehicles. This is mainly due to the high price of the battery pack. Another is the driving range is limited to approximately 150-250km. In a future higher range is possible but again it will increase the price of EVs. When it comes to charging your EV again it will take many hours to charge at home as public charging infrastructure is still nascent. And finally, the maximum speed of EVs may not satisfy the requirement of Indian consumers.

In this study, we investigate how differences in consumer population can change attitude and perception about EVs and can be used to determine potential obstacles to EV adoption in India. And also will see how much influence sustainability has on the EV purchase decision. This research considers functional attributes of EVs, such as driving range, battery life, and EV cost. Furthermore, we examined symbolic attributes which have been determined to influence consumer decision in general vehicles use as well as in the use of Hybrid- Electric Vehicles (HEV) and Battery Electric Vehicles (BEV).

## II. RESEARCH PROBLEM

In order for EVs to become mainstream and commercially successful, consumer acceptance is of vital importance. Even though EVs have made remarkable improvements over the past decade they still face numerous barriers in widespread adoption, which will be discussed in this paper. Within India, the adoption of EVs has lagged behind other developing countries despite recent government efforts. This is a problem, as the adoption of EVs is an effective way of reducing GHG emissions as well as air pollution. Therefore, how the Indian consumer reacts or has an attitude towards Electric Vehicles. This going to the obvious question of how Indian consumer's attitudes and perceptions lead to increased sales of EVs.

## III. LITERATURE REVIEW

Much of the research to date has been focused on the technological aspects of EVs and less so on consumer perceptions and preferences (Larson et al, 2014). Some of the major situation concern with EVs from a consumer perspective is a range, cost, and charging constraints (Egbue & Long, 2012). Every individual consumer has a different perspective that an EV must satisfy their personal requirement and be considered a better alternative to an ICEVs to justify adoption. So, Intrinsic motivation plays a very vital role in adoption, meaning the degree to which they value different characteristics of the vehicles, and on the other hand, Extrinsic motivation, which is stimulating

by rewarding adoption and is therefore guided by government policies (Langbroek et al., 2016)

The theory of planned behavior (TBP) by Ajzen (1991) explains the factor influencing consumer behavior. According to this theory, the main determinant factor of behavioral intention is the attitude, which is influenced by knowledge and experience, subjective norms that the consumer believes is acceptable by society, and the perceived impact of the behavior. In this context, consumer acceptance of technology is considered an intention to adopt, use, or support its development (Ajzen, 1991).

Public attitudes and preferences for EVs must consider in developing market share in this area. Apart from the technological problem i.e. battery technology, there are also social issues related to consumers in order to achieve widespread adoption. Most crucial is consumer acceptance to the continuing success of a sustainable transportation sector (Ozaki and Sevastyanova, 2011). However, the consumer tends to be resistant to new technology that is considered unfamiliar or that not adopted by the mass population. Therefore, the government should identify the issues and should overcome issues that hamper the widespread adoption of EVs.

There are some common barriers to the adoption of any new technology include lack of knowledge by potential adopters, High initial cost, and low-risk tolerance, show by research (Diamond, 2009). Another study by (Oliver and Rosen, 2010) indicates that consumer acceptance of HEVs is limited partly due to perceived risk with new products and tradeoff between vehicles fuel efficiency, size and price. The general public's perception of risk is based on experience, emotion, the media, and other non-technical sources (Sjoberg, 1998). As a whole, media, and social networks often influence values that affect consumer alternatives (Rogers, 2003).

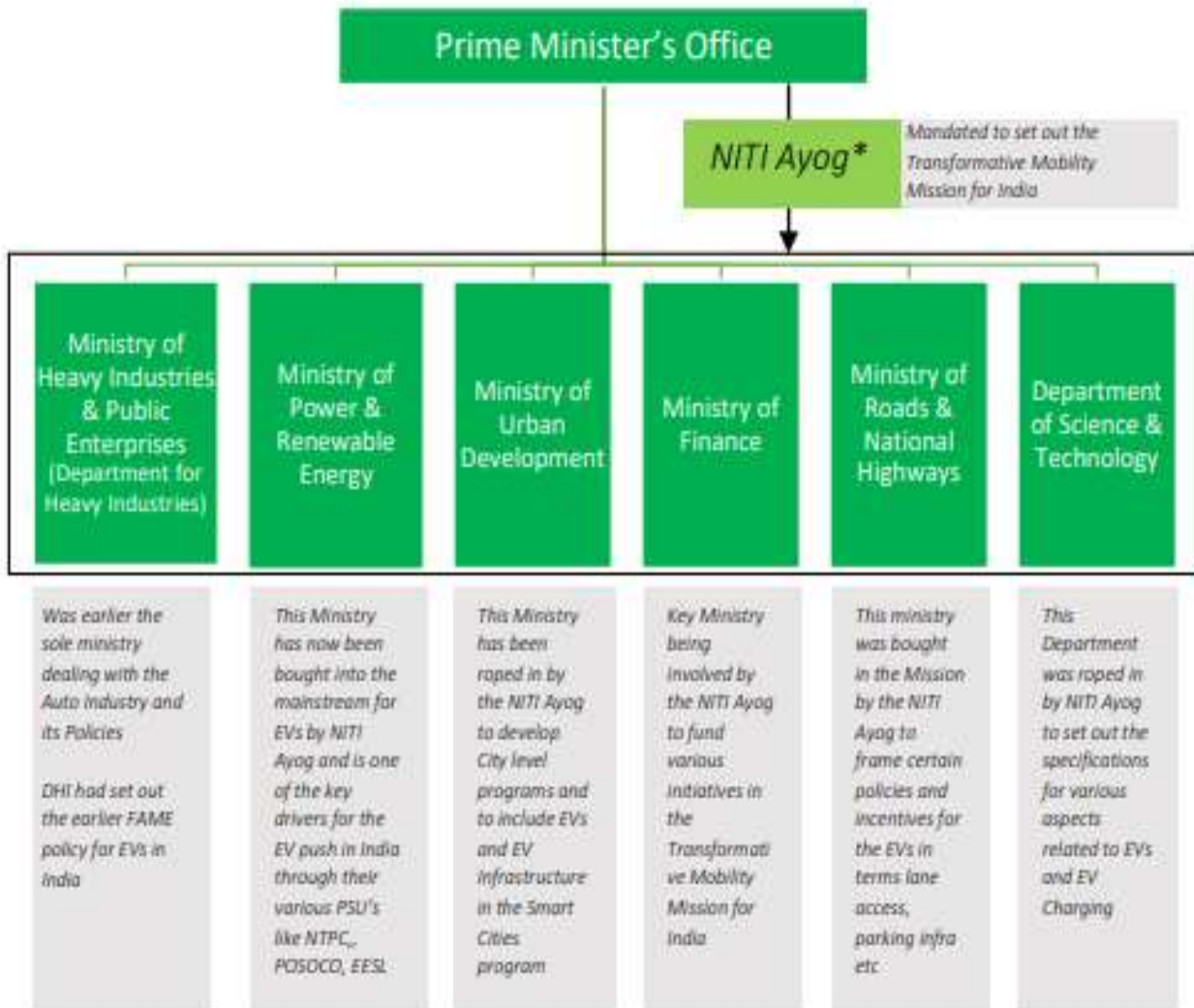
With regard to financial benefits, consumers are more likely to choose options that maximize utility based on their preferences, knowledge of alternatives and budget and at starting the cost of EVs is significantly higher when compared to an Internal Combustion Engine (ICE) and this cost increases linearly with the battery size or the range of the car and also they found out consumer adoption of HEVs increases in gas prices influence consumers behavior and also the consumers usually make the decision to buy HEV's

in response to increase in gas price and government incentives (Lebeau, Mierlo, Mairesse, Macharis, 2013).

GHG emissions have continued to increase ever since the pre-industrial era with economic and population growth being the two main drivers of CO<sub>2</sub> emission from fossil fuel combustion globally (Pachauri, 2014). Increasing GHG emissions has subsequently been a major contributing factor to climate change. Transportation is a major contributor to global GHG emissions accounting for 24% of direct CO<sub>2</sub> emission from fuel combustion globally (International Energy Agency, 2019). The effect of road transport is of particular concern. Within the EU alone, road transport accounts for 82% of total GHG emissions from the transport sector, despite technological advancement and policy measures to limit emission (European Environment Agency, 2018). Therefore, reducing emissions from road transport specifically can have a sizable effect on India's GHG emission. The non-financial reason, especially those associated with environment and energy can influence Indian consumer's decision to purchase EV (Shukla, Dhar, Pathak, Bhaskar, 2014). Consequently, the potential for EVs to create social benefits by reducing petroleum consumption and GHG emission can appeal to certain consumers. Environmental values are powerful predictors of certain consumer actions and positively influence willingness to engage in actions that protect that environment (Oliver and Rosen, 2010). Similarly, (Lebeau, Mierlo, Mairesse, Macharis, 2013) found that social preferences for environmental quality and energy security were a major determinant for consumer adoption of EVs. And also they concluded that social preference increases EVs sales more than rising gas prices or tax incentives.

Moreover, in the adoption of new technology, the trends show the new technology intrinsically attractive to a few early adopters, including visionaries and technology enthusiasts, the majority of consumers will remain close-minded about the new technology (Moore, 2002). On the other hand, few individuals are disagreeable with technological change and uncertainty, and therefore hesitant to accept innovation (Edison and Geissler, 2003). According to (Vidhi, Shrivastava, 2018) India have the potential to increase the penetration of EVs only if the proper policy is implemented all over India, also to encourage consumers and car manufacturer to widespread adoption of EVs in the Indian market.

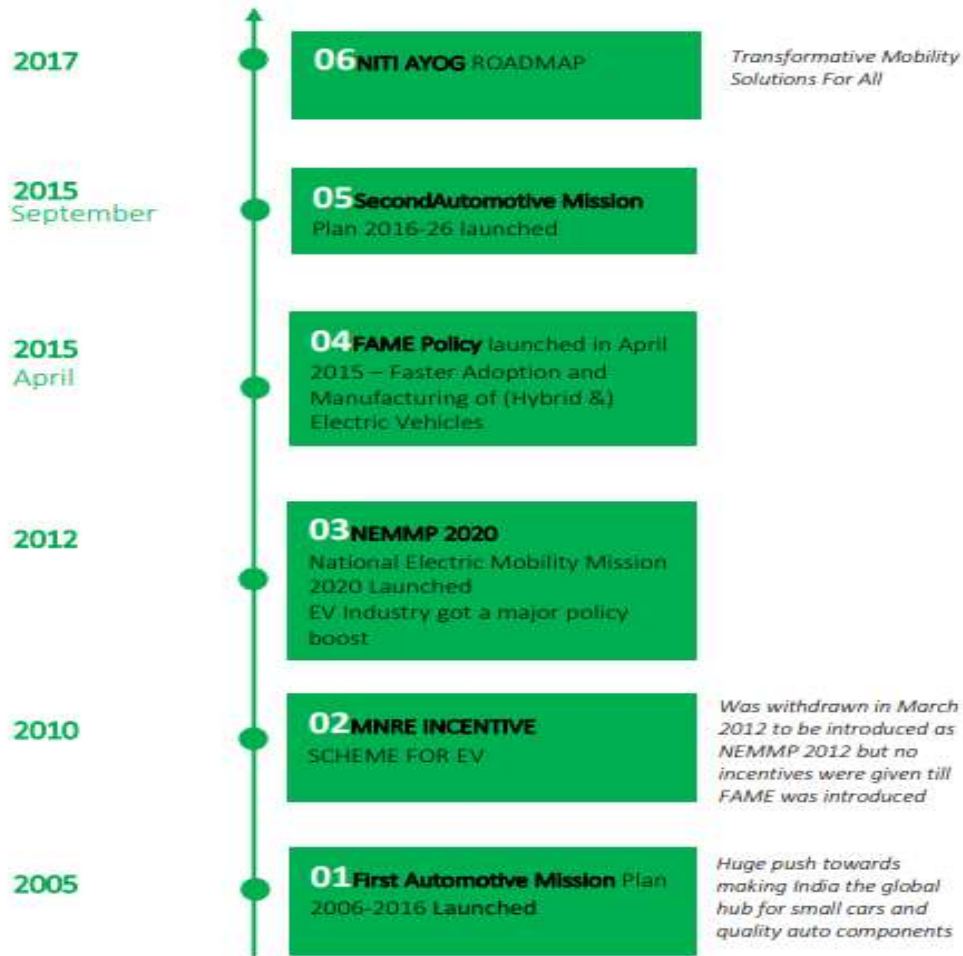
Table 1: Overview of Political Structure involved in EV Policy Planning



Source- NITI Ayog – National Institution for Transformative Initiatives



Table 2: Key Milestones in the EV Policies in India.



Source- NITI Ayog – National Institution for Transformative Initiatives



#### IV. CONCEPTUAL FRAMEWORK

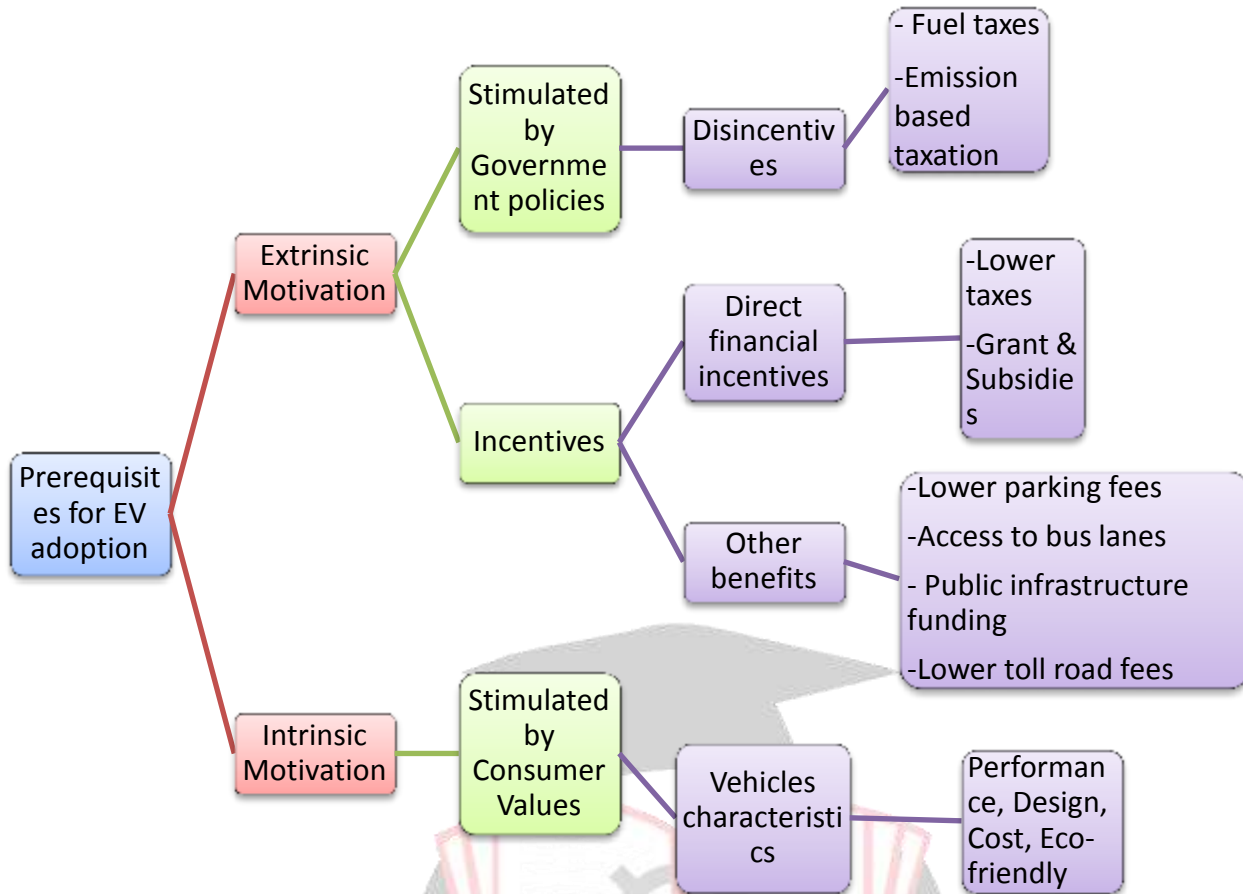


Figure 1- Conceptual framework

The conceptual framework (see figure 1) has been developed based on the literature on consumer opinion regarding EVs and barriers to EVs adoption. It is very important for governments to understand consumer behavior and implement sensible policies to promote EV adoption because adoption of EVs and other AFVs will be crucial in the decarbonization of the transport sector. So as to achieve for EVs to become widely accepted by the consumers, their need must satisfy. Currently, EVs face numerous barriers in adoption. The consumer tends to resist new technological innovation that is seen as unproven, and that is a major barrier in front of them, which means that willingness to accept is low. When purchasing an EVs a consumer personal level of intrinsic and extrinsic motivation needs to be sufficient and must be greater than that of Internal Combustion Engine Vehicles and then only a consumer going to adopt an EV. Intrinsic motivation is stimulated by the characteristics a consumer values in an EV, Specifically design attributes, eco-friendliness of a car, performance attributes, and potential cost saving. All of these attributes play a very vital role in adoption, some are related to functional performance or charging speed, whereas others appeal to social identities, such as eco-friendliness of the car, and other appeals to emotion, such as joy or pleasure that a consumer experience while driving a vehicle. Another one is the extrinsic motivation

that increased by offering a reward for adoption and is therefore stimulated by government policies in the form of incentives and disincentives. As like consumer differs, the level of intrinsic and extrinsic motivation also will differ with each consumer. Every consumer will react differently as to policies and various attributes. If there is an increase in fuel tax then it will discourage the use of ICEV's which in effect increases the competitiveness of cleaner alternatives. Incentives will encourage consumers and it will decrease the purchase price of the vehicles, whereas lower parking fees, public infrastructure development, and access to bus lanes would be an example of tax policies and subsidies towards purchasing an Electric Vehicle.

#### V. METHODOLOGY

##### 1.1 Rational Behind Methodology.

Firstly, a quantitative approach was chosen over the qualitative approach. A quantitative approach was chosen because it enabled the collection of numerical data that could be converted into statistics. Secondly, an online survey was chosen as it was the easiest and most convenient way of collecting a sufficient amount of data.

##### 5.2 Data Collection Process.

The survey was created using Google form. The survey was distributed using different electronic channels and shared in

different social groups. WhatsApp was the main distribution channel and data was collected from student, faculty, staff, and working professional. In terms of knowledge consideration, we consider the vast majority of the sample population as technological enthusiastic. And those people are better connected with global technological development, have a high level of quantitative skills. For this study, we consider the individuals to be likely early adopters only if they perceive EV's to be superior in performance compared to ICE vehicles.

### 5.3 Survey Design.

The survey was completely anonymous. And the main objective of this survey design is to characterize potential consumers who have better knowledge, interest, perception, attitude, and various barriers pertaining to EV's as well as views on sustainability. A secondary purpose of the survey was to relate certain socio-economic characteristics including age, education, gender, experience, and perception and attitudes towards EV's.

In total, the survey included 22 questions. At the starting of the survey, Respondents were asked what their age, gender, marital status, and their occupation and the last question asked related to global warming and whether there is any chance that your next car will be electric. Multiple different question designs namely, dichotomous question, multiple-choice question, Likert scale question as well as an open-ended question. The design of the question was to understand the following topic.

1. Experience and knowledge of EV's.
2. Their interest in EV's.
3. Willingness to pay for EV's.
4. Attitude and perception of EV.
5. Influential attributes.

The first question in the survey was on gender because gender plays a very vital role in the adoption of EV's and the preferences of financial and technical attributes differ from male to females.

Questions 2-5 were multiple choice that inquired age, marital status, occupation, and education. These questions are very much necessary to know the awareness of these states. Specifically marital status will let us know whether after marriage they willing to purchase electric vehicles soon or not. Additionally, respondents were asked about their occupation and their highest level of occupation.

Question 6 was meant to test the respondent's knowledge of EV's and other vehicles that use alternative energy sources. The question was to test respondents' experience and perception of EV's. Question 7 was also multiple type-question inquired respondents on their interest in cars that use alternative energy sources and if they have no-interest that's means in future it will take time to change their

attitude and perception regarding EV's and with respect to high interest, they already have shown positive sign and in future that will lead them to adopt EVs. Wherein Question 8 was multiple type questions and respondents had to indicate whether they are environmentally conscious or not. If they are then it will increase the chances of the adoption of EV's and if they not, then it will decrease the chances of adoption of EV's.

Question 9-10 was again multiple-choice questions. We asked respondents directly to mark their interest in Electric Vehicles and later one to know from respondents the type they are aware of Electric Vehicles.

Question 11 was a Likert scale question. Respondents were provided a statement on all the types of Electric Vehicles and ICE cars, three types of electric vehicles were given and asked them to rank which appeals to them the most. For example, respondents had to indicate whether a hybrid electric vehicle appeals to them the most as compared to battery electric vehicles.

Question 12 was another Likert scale question. Respondents were provided with five attributes of EV's and asked respondents to rank the attributes which appeal to you the most. Decreased/ eliminate the use of petroleum, reduced greenhouse gas emission, look/style, and comfort were the following attributes of EV's. Question 13 was asked the respondents while purchasing EV how much kilometer vehicles range minimum should have before considered buying a battery-electric vehicle.

Question 14 was multiple-choice questions were respondents had to tell us the biggest concern about EVs or a major drawback of EV's. This question was the key question in the survey as they provided insights into the barriers to the adoption of EV's.

Question 15 was a dichotomous question where respondents had to indicate whether they consider charging an EV is inconvenience or not. Whereas the purpose of Question 16 was to shed more light on the battery's advancement and to know the respondent's anxiety related to batteries.

Question 17 inquired respondents on the idea of "battery swap station". This question was meant to test the respondent's knowledge of EV's. That will show that they are highly aware and motivated to adopt EVs in the future.

Question 18 was dichotomous and asked respondents does government incentivizes influence your decision to purchase EV's or not. While in Question 19 asked what if anything could be done to make you purchase an EV.

Question 20 inquired respondents whether they ready to pay more for EV as compared to Internal Combustion Engine Car. With the help of this question will let us know how much they are going to compromise. As per the other research EV's were going to cost high as compared to

ICEV's. Question 21 was a multiple-choice question where we asked questions on global warming. This question was included because are they believe that EVs can help in a reduction in global warming or not. Another and the last Question 22 was to know respondents whether there next car going to be electric vehicles or not and incoming how many years you're going to purchase an EV.

**5.4 Sample Selection.**

A convenience sampling method was used in the survey. A convenience sampling method was chosen to increase the sample size. Furthermore, a more diverse and representative sample was achieved by distributing the survey via multiple different channels in different social groups. In total, 80 people attempted to answer the survey.

**VI. FINDINGS**

**6.1 Demographics**

The survey included five different demographics question. All the data has been complied and converted into charts. The total number of respondents accounting of 80 (N=80). The sample was very male dominants at 60% (N= 48) Male and 40% (N=32) Female.

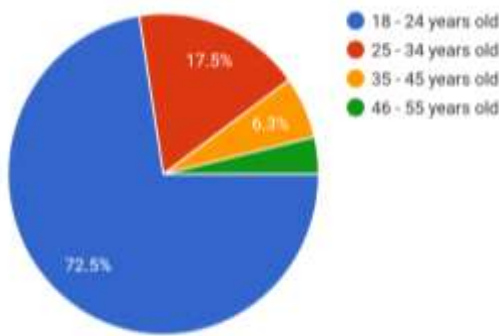


Figure 1: The gender of the respondents

Most respondents were young adults with people between the age 18-24 72.5% (N= 58) and the age 25-34 17.5% (N= 14) accounting for more than 90% of respondents.

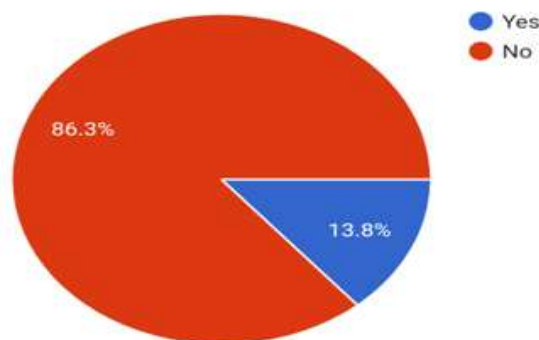


Figure 2: Marital status of Respondents

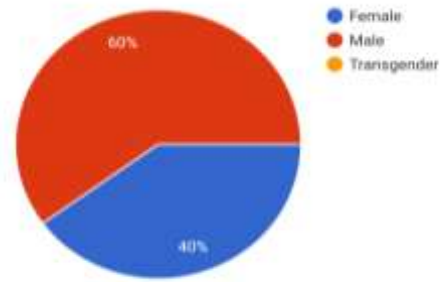


Figure 3: the respondents Marital Status

Furthermore, a large portion of respondents were unmarried 83.6% (N= 69) and married ones are 13.8% (N=11). These results were expected as the survey was mainly distributed to university students. Most of our respondents were students accounting for more than 50% and others respondents were employed.

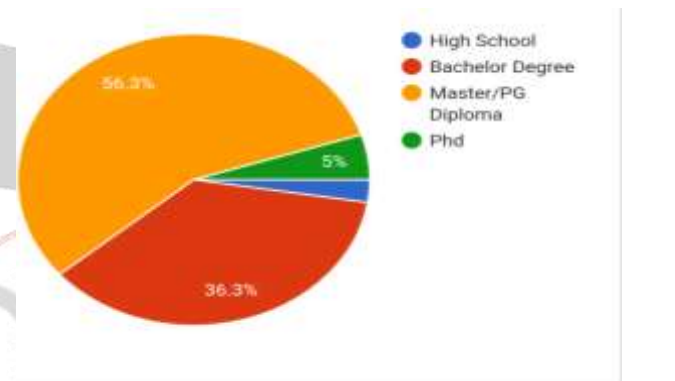


Figure 4: The education Level of respondents

Furthermore, large portion of respondents were pursuing or have their masters degree accounting for 56.3% (N= 45), followed by Bachelor Degree 36.3% (N= 29) and only 5% (N= 4) pursued or currently working on their PhD Degree and only 2.5% (N= 2) have completed their high school.

**6.2 EV experience, interest and knowledge.**

In Question 6 we had asked respondents to showcase your experience with Electric Vehicles or others vehicles that use alternative energy sources. Interestingly the majority of respondents at 48.8% (N=39) said that they had experience with Battery Electric Vehicle and out of 80 respondents and 36.3% (N= 29) said that they don't have any prior experience with any kind of electric vehicles or alternative energy source vehicles and 23.8% (N= 19) have experience with bio-fuel vehicles, 13.8% (N= 11) with hybrid vehicles, and 11.3% (N= 9) with Plug-in hybrid Vehicles.

It is interesting to see that most of the people had an overall experience with BEV as compared to HEVs and PHEVs, BEVs are not as widespread as HEVs and PHEVs.



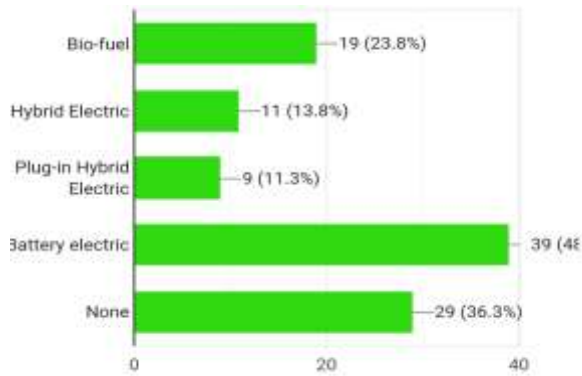


Figure 5: Experience with EVs

Respondents were also asked to rate their interest in AFVs and four options have given. However, most of them had shown a High interest of 48.8% (N= 39) in AFVs and 45% (N= 36) has shown a moderate interest in AFVs. 3.8% (N= 3) said they have little interest and 2.5% (N=2) said they have no interest. It is a very positive sign shown by the respondents. They could in the future replace their fossil fuel car with non-fossil fuel cars. Already, the majority of respondents have shown prior experience with Battery Electric Car.

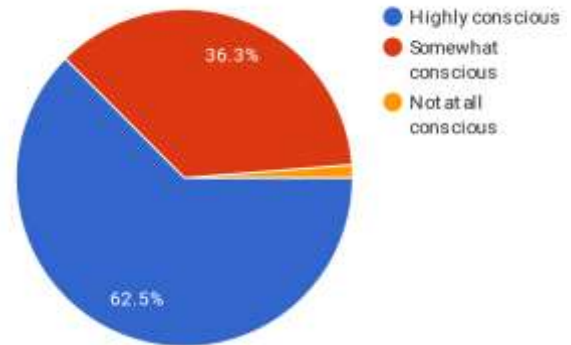


Figure 7: Conscious towards Environment

Out of 80 respondents, 51.2% (N= 41) said that they have an interest in EVs and 45% (N= 36) said that they have a moderate interest in EVs. This question was used to measure the respondent's interest in EVs. However, many of the respondents had limited experience with EVs and the results are very promising and in the future, the respondents who have moderate interest can be converted into high interest with the help of various attributes. Furthermore, people in the future tend to move away from traditional ICE vehicles and adopt EVs. Also, the interest of the consumer is directly proportional to the rise in fossil fuel prices and various benefits attached to EVs.

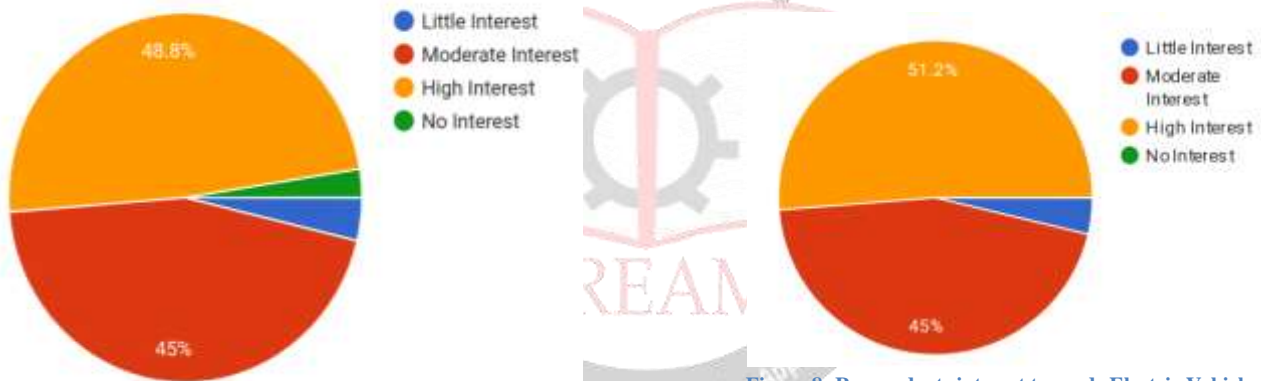


Figure 6: Respondents interest in AFVs

Also, there is one Question on Environment consciousness. The main purpose of this question was to know the level of consciousness with regard to the environment. The majority of the respondents 62.5% (N= 50) are highly conscious of the environment and 36.3% (N= 29) said that they are somewhat conscious of the environment. In India air pollution is of major concern and air quality is very much dissatisfactory and they believe CO2 emission from fossil fuel cars is the main reason behind it. Respondents who generally have positive views on EVs and who are also highly environmentally conscious can have very much desirable perception towards EVs.

Figure 8: Respondents interest towards Electric Vehicles.

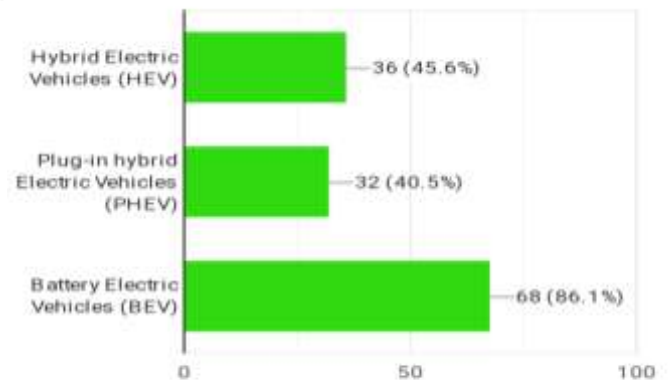


Figure 9: EVs types Awareness

Also, in Question 10 we try to understand from the respondents with regard to the awareness about the types of EVs. Out of 80 respondents, 79 had attempted this question and 86.1% (N= 68) said that they are very much aware of the BEVs as compared to PHEV, and HEVs. An about 45.6%

(N= 36) have voted their awareness towards HEVs and followed by PHEVs 40.5% (N= 35). Despite PHEV and HEV had already launched way-back but still many of our respondent's aware BEV type. This wasn't surprising because recently the government of India has taken many steps to increases the penetration of EV in India and announced various attributes in their respective schemes. Furthermore, also BEVs has been launched by the automobile giants. Overall all these steps have contributed to increases the awareness about the BEVs as compared to PHEV, and HEV.

### 6.3 Appealing Attributes of EVs

Questions 11 and 12 were used to measure the respondent's perception and knowledge of EVs on a Likert scale ranging from most appealing to least appealing. In Question 11 three types of EVs were given and them to rate which EVs appeal them the most 1 being the most appealing and 3 being the least appealing. So, in HEV the vast majority of the respondents (N=29) indicate that they are neutral. (N= 27) respondents indicate that HEV appeals to them the most as compared to (N= 24) respondents said HEV is least appealing for them. As there is a minor difference between the respondents that means neutral respondents can be attracted to HEV more via various attractive financial attributes. For PHEV, the vast majority of the respondents (N= 42) said they have neutral views on PHEV as only (N= 17) respondents said PHEV appeal them as compared (N= 21) respondents said PHEV least appeal them. And there is a huge difference between the respondents that mean the vast majority of the respondents don't have the experience with PHEV and it can be because PHEV is complex because they require two power train systems, and they still use fossil fuels. Furthermore, in BEV (N= 37) respondents have very neutral views. (N=22) respondents said that BEV appeals to them the most as compared to (N= 21) respondents indicated that BEV least appeal to them. In this too people very much have neutral views on BEVs and it isn't surprising because most of them don't have enough experience on BEVs they just have the knowledge and on those bases, they have attempted this survey question. If the majority of consumers get practical experience then the wide gap between neutral and most appealing can be reduced.

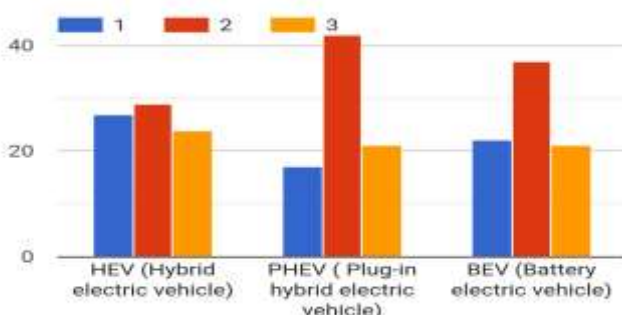


Figure 10: Most appealing EVs

A key focus of the study was to determine what respondents perceived to be the major benefit of EVs. While in Question 12 was used to determine if respondents were familiar with the benefit of EVs. The question was on a five-point Likert scale ranging from most appealing to least appealing. Five statements were given, 'decreased/eliminate the use of petroleum, less maintenance, reduced greenhouse gas emission, looks & style, and comfort'. Overall, respondents had a favorable view of EVs across multiple different attributes. Decreased/Eliminate the use of petroleum was rated the most favorable attributes (N= 41) of EVs closely followed by Reduced Greenhouse Gas Emission (N= 40). (N= 33) respondents said that Comfort appeals them a lot as compared to Look/style (N= 28) and Less Maintenance (N= 27). The vast majority of the respondents said that the decreased/eliminate use of petroleum is the major benefit of EVs. This would indicate the emphasizing the benefits of EVs on the environment is an effective way of increasing adoption rates and which is also supported by previous research. In India, an increase in petrol/diesel prices can influence mass chunks of the population to adopt EV. An increase in petrol/diesel prices can directly influence the sales of EVs in India. Interestingly, the respondents had chosen 'Reduced Greenhouse Gas Emission over Looks/style & Comfort. They are very highly inclined towards the Environment and it is a very promising sign. If they could carry this kind of mentality then in the future it will be very easier to adopt EVs by them. It shows that consumers are highly educated on the benefits of EVs. And for Comfort and less maintenance of EVs, the respondents are not that emphasizing a lot.

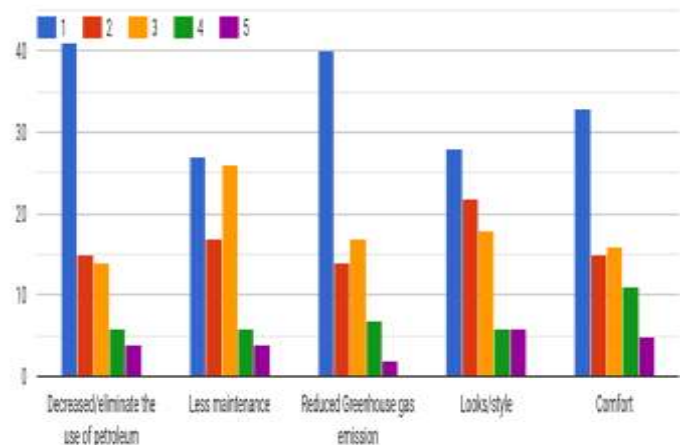


Figure 11: Attributes of EVs

### 6.4 Concerns about EVs

For sure, the Battery range of EVs is the biggest concern all over the world. In Question 13 we have asked respondents to tell us how many minimum kilometers would the EVs range have to be before you would consider buying a BEV. The vast majority of the respondents said a BEV must be between 200-500KM accounting for more than 38%.

In the next question, we have asked our respondents to consider your biggest concern about EVs and given them five out-most concerns regarding EVs namely, Battery range, high cost, charging infrastructure, safety, and others and ask only to mark one oval.

Most of the respondents said Charging Infrastructure constraints were rated as the most severe limitation of EVs 42.5% (N= 34). This isn't surprising as in India public charging infrastructure is still relatively underdeveloped compared to other countries like China, United Kingdom, United States, and Norway. However, according to the Market Watch, at present, there are about 250 public charging stations operating in India. In the coming years the number of charging infrastructure is expected to witness massive growth. And also as per the Kenneth Research, the Indian electric vehicle infrastructure market is expected to grow at a compound annual growth rate (CGAR) of over 40% during a forecast period 2019-2025. Further, the Indian government extensively implementing Faster Adoption and Manufacturing of (Hybrid) & Electric Vehicles in India (FAME II) for the development of electric vehicles charging infrastructures. The Indian government is aiming at setting up a 2,636 electric vehicle charging station in 62 cities across 24 states and union territories by 2023.

High costs of EVs were also rated as severe limitations. 28.7% (N= 23) respondents indicated that the High cost of the EVs was the biggest concern for them. 17.5% (N= 14) respondents think the Battery range is the biggest concern for them. High cost and the Battery range are the biggest drawbacks of the EVs. However, initially, EVs prices will higher than ICEVs due to its battery cost but from the past few years, there is a steady reduction in the price and the size of batteries. And range anxiety is still common is a mass consumer. Things are changing rapidly like falling price in lithium-ion batteries means can decrease the price of the EVs and also the development that took place in battery technological advancement. These two hurdles can be tackled by boosting manufacturing and decreasing the procurement cost of EV components or by providing incentives to the buyers of EV so that the overall cost of ownership becomes lower. For the mass adoption of electric vehicles, the High cost and Battery range concern need to be tackled soon especially in India.

Despite the fact in India safety of mobility was never the priority of the Indian consumers and only 7.5% (N= 6) respondents identified that safety is the biggest important concern.

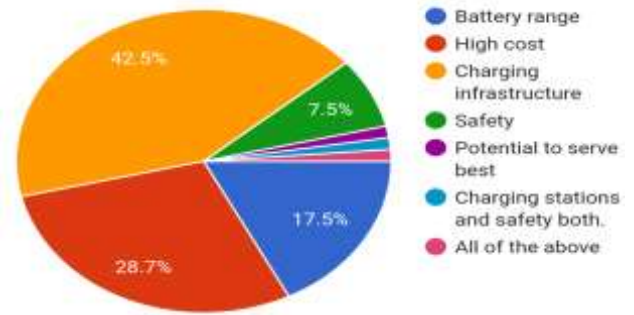


Figure 12: Biggest Concern regarding EVs

The slow charging speed of the EVs is another severe limitation. Most of the EVs usually takes 8 to 12 hours to fully charge and still electric vehicles charging infrastructure is very nascent in India. In Question 15 we asked our respondents inconvenience while charging an EV. The vast majority have said they are unsure 36.3% (N= 29) followed by 35% (N= 28) said "yes" and 28.7% (N= 23) said "no". However, when many of us have access to comprehensive charging, have the option of charging at home, workplace, and shopping mall, then inconvenience becomes less of an issue. The development of the charging infrastructure is the utmost requirement for widespread EVs in India. If in India proper infrastructure established then the consumers will change their perception and attitude towards EVs and become more optimistic and then they don't hesitate to purchase EVs over ICEVs. Furthermore, widespread adoption of Electric Vehicles is possible. As far as the degradation or possible failure of EVs battery the vast majority of the respondents think that they are somewhat worried 76.3% (N= 61) and it might be or might not be a major concern while purchasing an EVs. 15% (N= 12) have expressed their opinion as they are very worried followed by 8.8% (N= 7) are not worried regarding the possibility of EVs Battery failure.

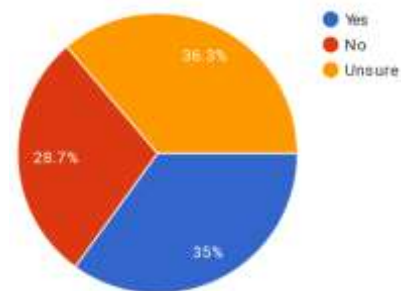


Figure 13: Inconvenience while Charging EV



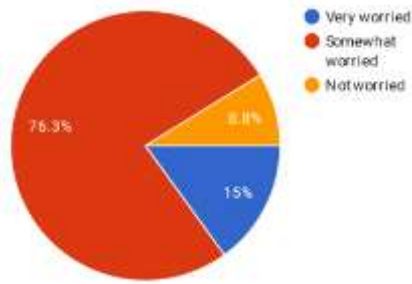


Figure 14: Possible failure of EVs battery

Another area of concern is battery swapping or battery swap station. Battery swapping technology will eliminate wait time for charging, make better use of Land, the size of the batteries in vehicles and will give an increased available run time. A very positive response received from our respondents, 78.8% (N= 63) respondents indicate that they like the idea of “battery swap station” and followed by only 7.5% (N= 6) respondents don’t like the idea and 13.7% (N= 11) respondents were unsure. The EV battery-swapping station demand is rising in India and the market is likely dominated by three-wheeler and two-wheeler. Since with each full charge, these vehicles run less than 100 km, and these are required to be charged twice a day.

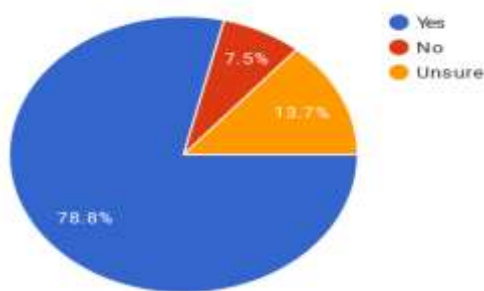


Figure 15: Battery Swapping

6.5 Influences by Government Incentives

Overall, most respondents to the survey felt that the government should incentivize the use of EVs more heavily. 50% (N= 40) of the respondents indicated that their decision can be influence by the government incentives. 32.5% (N= 26) respondents voted for maybe they can influence and 17.5% (N= 14) of the respondents are not agree with the survey (see figure 16). In order to increase the attractiveness of the EVs government incentives have a great impact on potential consumers. In any country, a good incentive is very effective in influencing and widespread adoption of EVs, for example, Norway. The access to Bus lane, subsidized electricity cost, more parking spaces for EVs, and lower parking fees are those incentives efficient alternative to expensive subsidies.

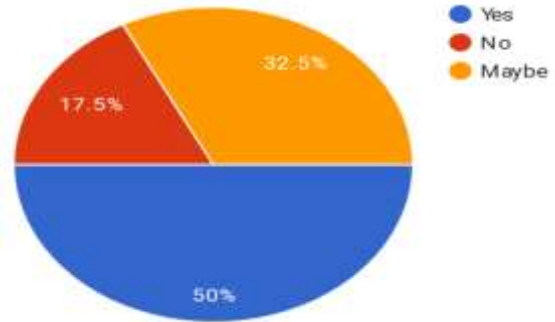


Figure 13: Opinion on government Incentives

6.6 Unaddressed concern about electric vehicles

In concluding the survey respondents were asked, “what, if anything, could be done to make you want to purchase an EV?” so most of the respondents indicated that the cost of the EV should below then only they are going to purchase the EV. And the cost is one of the main barriers to widespread EV adoption

The share of the global consumer that would consider purchasing an EV is on the rise. Consumers' EV preferences are also shifting. As we are aware cost is the major determinant of EV widespread adoption and especially the Indian market is too sensitive than the others market. In the last few questions we have asked our respondents are they ready to pay more for EVs as compared to ICEVs. Interestingly, just 39% (N= 31) respondents to the survey said not more than 20%, 31.3% (N= 25) respondents said not more than 10%, 8.8% (N= 7) respondents said not more than 30%, whereas, 21.3% (N= 17) respondents said won’t pay a higher price.

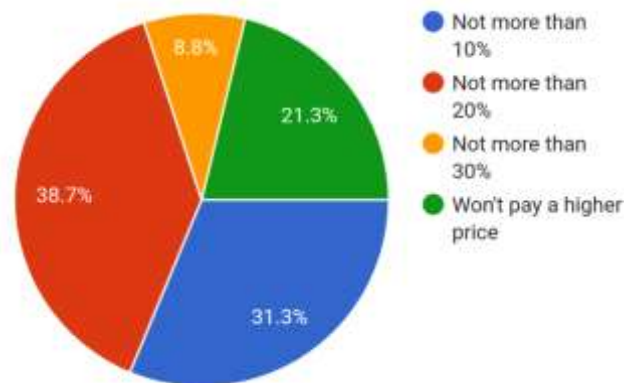


Figure 14: Pay more for EVs

In terms of environment impact, the majority of respondents believe that’s the Global Warming can be reduced by adoption of Electric Vehicles. 80% (N= 64) respondents said Yes, 15% (N= 12) said No, and 5% (N= 4) were unsure.



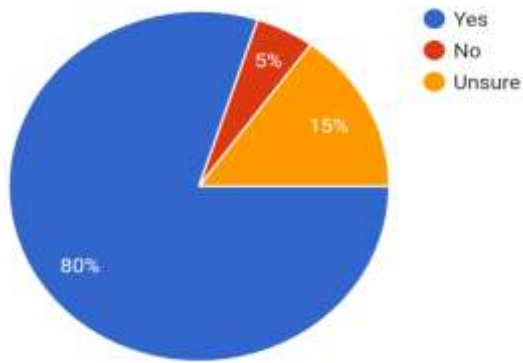


Figure 15: Can EVs reduce Global Warming.

In India, the last few years, trends suggest a rise in interest among the common masses for electric cars. So, 36.2% (N= 29) respondents were unsure about their next car will be Electric, whereas 23.8% (N= 19) respondents will buy one electric car in the next 10 years. 20% (N= 16) will buy in the next 5 years, and 16.3% (N= 13) will buy as soon as possible. 3.7% (N= 3) have no intension of purchasing EV.

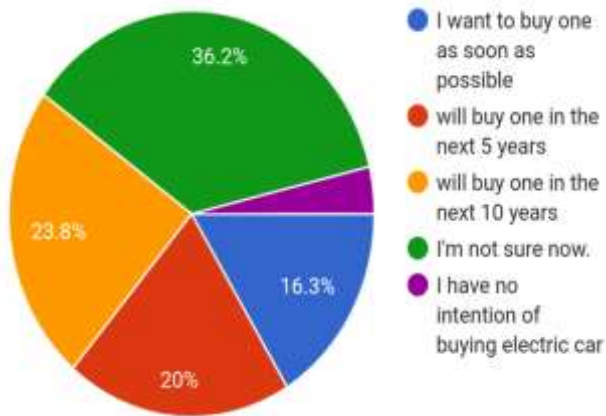


Figure 16: Respondents chances of purchasing EVs.

## VII. CONCLUSION

The sample used in this study may not be representative of the entire population due to environmental awareness, education, and income of the majority of respondents; however, it provides helpful insights into the preference and attitude of consumers. Our result shows that attitude, knowledge, and perception related to EVs are pretty much positives. Furthermore, most of them are aware of electric mobility and also have a good amount of knowledge and interest in EVs. Although the sustainability and environmental benefits of EVs have a major influence on EV adoption. The current research indicated that most of them have shown interest in AFV and EVs. In general attitude towards EVs are mostly positive as per the survey. Some major challenges faced by EVs include Battery technology, Battery cost, and charging infrastructure. However, consumer acceptance is important as it is key to the commercial success or failure of EVs; even if the other criteria are met. A major potential barrier

to widespread EV adoption detected among our target group is the uncertainty associated with the charging infrastructure and the high cost of EVs. The result indicated that improving charging infrastructure is an apparent priority as charging infrastructure constraints were rated as the most severe limitation of EVs. This presents an opportunity for the Indian government as well as private companies to improve the charging infrastructure across the country in order to increase the adoption rate. Therefore, increasing the number of charging locations and improving charging speed are key priorities for increasing the adoption rate in India. As far as EVs attributes are concern most of them said Decreased/Eliminate the use of petroleum and Reduced Greenhouse gases emission are the most influential. As a matter of fact, Battery Electric Vehicles are the most appealing vehicles for most of them. Due to the less charging infrastructure in India, the majority of them have a perception of inconvenience while charging EVs. There have been many initiatives taken by the Indian government to develop charging infrastructure by implementing various schemes. It will take a few years for developing charging infrastructure near offices, charging stations, malls, and households. Current incentives such as tax credit to subsidies the cost of EVs may have little effect on EV market penetration if consumers have low confidence in the technology. Therefore, in India, most of them feel that government incentives can influence decision-making. And most of them are ready to pay more for EV than ICEVs as per the survey. Individuals who have high environmental awareness or values may consider purchasing EVs. In the future, the adoption rate is going to increase because most of them are going to purchase EVs in-coming 5 to 10 years mostly.

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