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Consumer Perception Towards Electric Vehicle In INDIA

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ABSTRACT

The main goal of this study is to analyze the consumer perception of electric vehicles in India. It has been observed since 2015 that EV companies have taken a major step toward economic and environmental factors while producing their vehicles. In the current dynamic scenario, consumers are constantly looking for better eco-friendly products along with cost-efficiency to it. This study takes a quantitative approach (survey) to know the perception of the consumers to accept electric vehicles as a legitimate substitute for petrol/diesel vehicles. This research throws light on the positive and negative factors which affect the consumer's perception when approaching electric vehicles in India.

In this study we also take into account the relationship between barriers and the perception towards EV and also to find out this we have used statistical tools and graphs, which are done using one factor ANOVA test.

Also, some attributes related to the consumer are also taken into account and how they influence it perception and how these attributes affect the factors and barriers for the EV perception and adoption.

KEYWORDS: Customer, EV, Sustainable development, Attributes

INTRODUCTION

Globally Electric vehicles are growing at a rapid pace with a compounded annualized growth rate (CAGR) of 21.7 percent, by 2030 it is supposed to grow from 8.1 million units to 39.21 million units. The enormous growth has been influenced by several factors like efficiency, pollution, and environmental concerns. All over the planet governments have started to encourage EV industries by providing subsidies as the consumer continuously demands eco- friendly vehicles rather than petroleum or diesel vehicles.

Coming to the scenario, in India, the future of Electric Vehicles is still standing at a critical point. Whenever there is a hike in oil prices or a change in climate electric vehicles are the first solution to be discussed and approached. Indian companies entering the EV industry take a lot of risk and efforts to normalize the EV segment, but it has not happened yet. More than 15 years have surpassed but the EV industry has not hit the potential that was predicted. Today when we look at the roads, a small proportion of electric vehicles are spotted compared to traditional vehicles. Now in 2022, the EV industry has all the tools to hit its highest potential and finally take off.

As the Government of India has been providing various schemes and benefits for EV manufacturers, collaborations between companies and the government have been beneficial in increasing EV production

and market in India. Top CEOs of India's automobile industries praised the government's new "vehicle scrappage policy" introduced in Union Budget, 2021-22. As per budget 2023, for Fast Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) has been projected at Rs. 2,908 crores which are three and a half times more than the budget year of 2022 (FAME) amounting to Rs. 827 crores.
Viewing the positive and the negative impacts, the consumer's perception of electric vehicles in India has drastically changed. Innovation has taken a quantum leap which encourages the consumer to think more about affordability, eco-friendliness, and excellent service for an e-vehicle. Constant promotion from the governmenthas resulted in a better mindset and knowledge about e- vehicles in the minds of the consumers. This entertains EV companies like Tata Motors, Hyundai, Mahindra, and many more to improve their products eventually improving the perception of the e-vehicles in the minds of consumers.

EV concept is well proven nowadays, people still lack the knowledge or trust in it. They are skeptical about the safety and reliability of electric vehicles. Therefore, this research has been conducted to analyze people's perceptions as per the negatives and positives for electric vehicles and the technology included within.

In India, electric 3-wheelers have been relatively popular, but still very little distribution of electrical power. Vehicles existed between two wheelers, four wheelers and an armada for urban transport. Techno-funding anyway, tests show that electric bikes can be financially feasible by 2020 and by 2030 electric four wheelers willbe a prominent option for innovation, if government offers incentive charging forces and underpinnings are available. The strong atmospheric approach to propel the reason electrical machines. The administration is excited about the advent of electric vehicles. Minister of defense power it has also set an ambitious goal of being 100% electric by 2030. Alternative programs, in particular, the Minister of Road Transport and Highways madea powerful proclamation to the society of Indians Automobile Manufactures (SIAM) annual custom that has terrified the car industry. Anyway, definition of strategies would require contributions to terms of dimension of help required, suggestions for spending plans of government, approach instruments required and utilizing the private part.

All about Electric Vehicle

According to (Wikipedia) an **electric vehicle** (**EV**) is a vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines havebeen the dominant propulsion method for motor vehicles for almost 100 years, but electric powerhas remained commonplace in other vehicle types, such as trains and smaller vehicles of alltypes.

How does the electric engine work?

Electric cars function by plugging into a charge point and taking electricity from the grid. They store the electricity in rechargeable batteries that power an electric motor, which turns the wheels. Electric cars accelerate faster than vehicles with traditional fuel engines – so they feel lighter to drive.

How does charging work?

You can charge an electric vehicle by plugging it into a public charging station or into a home charging unit. There's plenty of charging stations around the UK to stay fully charged while you're out and about. But to get the best deal for home charging, it's important to get the right EVelectricity tariff, so you can spend less money charging and save more on your bill.

What types of electric cars are there?

There are a few different types of electric vehicle (EV). Some run purely on electricity, these are called pure electric vehicles. And some can also be run on petrol or diesel, these are calledhybrid electric vehicles.

Plug-in electric - This means the car runs purely on electricity and get all their power when they're plugged in to charge. They don't need petrol or diesel to run so don't produce any emissions like traditional cars.

Plug-in hybrid - These mainly run on electricity but also have a traditional fuel engine so you can use petrol or diesel too. If you run out of charge, the car will switch to using fuel. When it's running on fuel, these cars will produce emissions but when they're running on electricity, they won't. Plug-in hybrids can be plugged in to an electricity source to recharge their battery.

Hybrid-electric - These run mainly on fuel like petrol or diesel but also have an electric battery too, this is recharged through regenerative breaking. These let you switch between using your fuel engine and using 'EV' mode at the touch of a button. These cars cannot be plugged in to an electricity source and rely on petrol or diesel for energy.

What are the inner parts of an EV?

EVs have 90% less moving parts that an ICE (Internal Combustion Engine) car. Here's abreakdown of the parts that keep an EV moving:

Electric Engine/Motor - Provides power to rotate the wheels. It can be DC/AC type; however,AC motors are more common.

Inverter - Converts the electric current in the form of Direct Current (DC) into AlternatingCurrent (AC)

Drivetrain - EVs have a single-speed transmission which sends power from the motor to thewheels.

Batteries - Store the electricity required to run an EV. The higher the kW of the battery, thehigher the range.

Charging - Plug into an outlet or EV charging point to charge your battery.

Factors responsible for EV adoption (dans, 2021)

1- Reduce overall cost - The price of electric vehicles is considerably somewhat higher than that of conventional vehicles, but we are getting ever-closer to parity, and also there is growing evidence that in terms of total costs, running an electric vehicle is far cheaper as compared to the gasoline powered vehicle.

2- Sustainable environment- EVs can, in fact, also help reduce air and noise pollution. By choosing an electric car, one can reduce their carbon footprint, impacting to environment in a better way. Also, by this way we will not depend only on a single source of fuel and energy.

3- Pollution regulations- The implementation of emissions limits for vehicle manufacturers in the India by introducing an upgrade in the form Bharat stage VI. More and more companies are now considering their engine plants as assets that need to be disposed of urgently, disinvesting atan accelerated pace if emissions targets are to be met. In addition, several countries have brought forward the ban on the sale of petrol and diesel vehicles

4- Technology of the future- Electric Vehicles (EVs) are ahead of the conventional vehicle withadvanced technology. EVs are safer and more comfortable than vehicles running on petrol and diesel. Also battery technology continues to improve considerably, meaning we could soon be able to travel hundreds of kilometers on a five-minute charge, and having practically no problems with degradation over time.

LITERATURE REVIEW

EV industry in India

(Briefing, 2021) according to them The Indian automotive industry is the fifth largest in theworld and is slated to be the third largest by 2030. Catering to a vast domestic market, relianceon the conventional modes of fuel intensive mobility will not be sustainable. In an effort to address this, federal policymakers are developing a mobility option that is “Shared, Connected, and Electric” and have projected an ambitious target of achieving 100 percent electrification by 2030.

Also, by making the shift towards electric vehicles (EVs), India stands to benefit on many fronts: it has a relative abundance of renewable energy resources and availability of skilled manpower in the technology and manufacturing sectors. This will ultimately help India to broaden its horizons in terms of growth and manufacturing

(Briefing, 2021) the American electric vehicle and clean energy company Tesla Inc. marked its entry into India by incorporating its subsidiary, Tesla India Motors and Energy Pvt Ltd, in Bengaluru.

In February 2021, Ather Energy, India’s first intelligence EV manufacturer moved its US$86.5 million factory from Bengaluru (Karnataka) to Hosur (Tamil Nadu). Ather Energy’s factory is said to have an annual production capacity of 0.11 million two-wheelers.

This week, Ola Electric, the subsidiary of the unicorn Indian ride-hailing start-up, also

announced that it would be setting up the world's largest electric scooter plant in Hosur (which is a two and a half-hour drive from Bengaluru) over the next 12 weeks, at a cost of US$330 million, and aiming to produce 2 million units a year. By 2022, Ola Electric wants to scale up production to pump out 10 million vehicles annually or 15 percent of the world's e- scooters.

Recently, Sterling and Wilson Pvt Ltd (SWPL), India's leading engineering, procurement, and construction company announced its entry into the electric mobility segment in India. It has signed a 50-50 joint venture with Enel X, to be incorporated on April 1, 2021, to launch and create innovative charging infrastructure in India

India's EV market: Growth projections and government policyProjections

In April 2019, NitiAayog, the federal think tank, published a report titled "India's Electric Mobility Transformation", which pegs EV sales penetration in India at 70 percent for commercial cars, 30 percent for private cars, 40 percent for buses, and 80 percent for two- and three- wheelers by 2030. These targets, if achieved, could lead to a net reduction of 14 exajoules of energy and 846 million tons of CO2 emissions over the deployed vehicles' lifetime. Electric vehicles sold until 2030 can cumulatively save 474 million tons of oil equivalent over their lifetime, worth US$207.33 billion.

This will help India fulfill its global commitments to lower carbon emissions and increase use of cleaner sources of energy and transportation as required by the Nationally Determined Contributions (NDCs) under the United Nations Framework Convention on Climate Change (UNFCCC) and EV30@30.

However, this study emphasized only on the infrastructure part does not take into account theother individual or psychological factors which prevent the consumer for switching to the EVs Also, there are some cities which are performing really very despite the lack of infrastructure.

(Liao et al., 2016).In the article of Fanchao Liao (Consumer preferences for electric vehicles: a literature review) they mention that the various studies concerning EV adoption can be roughly divided into two categories: economic and psychological. The most widely applied methodology among economic studies is discrete choice analysis in which EV adoption is described as a choice among a group of vehicle alternatives described by their characteristics or "attributes". Consumers make decisions by making trade-offs between attributes. Economic studies focus on estimating the taste parameters for attributes which denote their weights in the decision. Psychological studies focus on the motivation and process of decision-making by examining the influence of a wide range of individual-specific psychological constructs (attitudes, emotion, etc.) and perceptions of EV on intentions for EV adoption.

Report by (WIRE, 2021) they found out that the: -

1. There is a considerable difference between customers' understanding about a certain technology and their actual awareness. There is a need to create awareness of technologies to build understanding and interest.

2. Although reliability and safety are the most important factors for choosing a vehicle, car owners more often take into account the performance and personalization of the vehicleas they are paying a premium over a conventional vehicle.

3. Electric range is a higher priority compared to performance and the preferred range is between 100 km and 150 km (90% of customers wanted a minimum 100 km range from EVs).

Technology - reliability, fuel economy, range, easy availability of the fuel, good everyday performance, low cost of ownership, good resale value, low noise and vibration, inexpensive to purchase, very low/ zero emissions, sporty performance, tax credits and other incentives, electric vehicles. 65% of customers want EVs to look different.

At the same time, they (40%) want the EVs to be priced below the price of a conventional vehicle. Industry challenges - Consumer perception on electric vehicle technology, range anxiety, and value addition offered by electric models have negatively impacted sales growth of EVs. Thus, OEMs are standardizing fast chargers for every EV model and exploring opportunities in vehicles with longer range and offering competitive pricing as compared to conventional vehicles.

The respondents were questioned based on numerous factors such as technology awareness, preferred vehicle range, features, ease of charging, usage pattern, resale value, low noise and vibration, inexpensive to purchase, very low/ zero emissions, sporty performance, tax credits and other incentives to understand what motivates them to consider purchasing a hybrid and electric vehicle.

Objective of the study

- To find out the overall forces and barriers that act as a hurdle in the path of the consumerfor adopting the EV
- To study the impact of demographic features on consumer perception towards EV-
- To study the effect of age on the consumer perception towards the EV
- To study the effect of Education level on the consumer perception towards the EV
- To study the effect of Income level on the consumer perception towards the EV

RESEARCH METHODOLOGY

Data Collection: Data collection is characterized by standard validated techniques as the method of gathering, measuring and analyzing accurate insights for study. The most important goal of data collection is to ensure that data-rich and accurate data is obtained for statistical analysis in order to make data-driven research decisions.

Primary Data: Primary data is information obtained from first-hand sources by a researcher, using techniques such as surveys, interviews, or experiments. It is compiled, straight from primary sources, with the research project in mind. In comparison with the term secondary data, the information already present is used.

Secondary Data: Secondary data refers to knowledge that is gathered by someone other than the user. Censuses, data gathered by government agencies, operational records and data originally gathered for other research purposes are popular sources of secondary data for social science.

For this project the primary data was used with the help of a questionnaire designed. And some previous researches were also analyzed in view of this project. The responses for the survey and analysis were captured using an electronic questionnaire. The survey questionnaire was distributed to respondents majorly from towns and cities in India. A Likert-scale having five points was used in the questionnaire:1,2,3,4, 5 represent “Highly Disagree”, “Slightly Disagree”, “ Neutral ” , “ Slightly Agree ” , “ Highly Agree ” and some open ended questions were also used. A total of 58 valid questionnaire responses have been selected through the electronic survey.

Research Instrument: Research instrument adopted in the research is “questionnaire” which was convenient and helpful in obtaining the responses from the respondents. The questionnaire in the form of Google Forms is used. Questionnaire consists of a number of close ended questions and Likert scale question were also designed in a particular order.

Sample:A sample, as the name applies, is a smaller representation of larger whole. The selected respondents constitute what is technically called a sample and the selection process is called sampling. The sample is collected mainly from the metropolitan cities of the India.

Sample size: The number of people in your survey depends on the population size and how accurately you want the findings to reflect the population as a whole. It refers to the number of sampling units selected from the universe for investigation. The sample size of 58 Indianrespondents has been taken.

DATA ANALYSIS AND INTERPRETATION

This research is based on the Indian respondents' perception, and awareness mostly focusing towards the electric vehicles in the metropolitan cities. The factors which act as a hurdle in respondents to buy an electric vehicle in the near future would then be used to determine and analyze and does this factor really affect the purchase of an EV.

Result of the survey

The result from the survey showed that around 58.6% of respondents were male and the remaining 41.4% respondents were female. The majority of the respondents have completed a bachelor's degree with the percentage being 70.7% and 25.9% had completed their master's degree and the remaining 1.7% accounts for PhD and again the 1.7% accounts for high school.

The survey also found out that the respondents were in the age group of under 25 years to 50 years, where in the maximum age group which is under 25 years accounted for 79.3% and in 26- 30 years age group accounted for 13.8% and the age group of 41-50 years accounted for 3.4% and the age group of over 50 years accounted for 3.4%

Factors which acted as a hindrance for EV adoption

Barriers	Percentag(%)
Limited option for recharging car	24.5%
Limited driving time	11.1%
Higher price	22.2%
Lack of consumer technology	23.4%
I don't trust the technology	18.8%

(Table 1 showing factors acting as a hindrance to consumer perception)

CREATION OF THEORETICAL STRUCTURE AND HYPOTHESIS

Age impact on perception on EV

Hypothesis

H1: The different age groups have different perception towards electric vehicle.H0: All the age groups have same perception towards electric vehicle.

Testing of the hypothesis

Anova: Single Factor

SUMMARY				
Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	39	124.32	2.4516	0.4131
Column 2	5	21	1.5	0.2405
Column 3	1	1	#DIV/0!	#DIV/0!
Column 4	3	6.64	2.764	0.5322
Column 5	4	6.5	2.54	0.542

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.767991	4	0.19199775	0.3445008	0.84666461	2.65627
Within Groups	29.5380435	53	0.55732158			
Total	30.3060345	57				

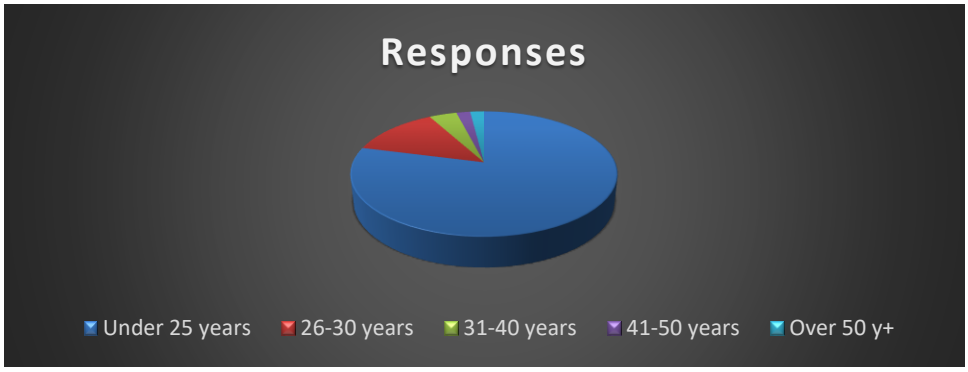
Table – 2, statistics of EV perception (based on the age group)

DECISION RULE

- If F stat > F critical, reject null and accept alternate hypothesis.

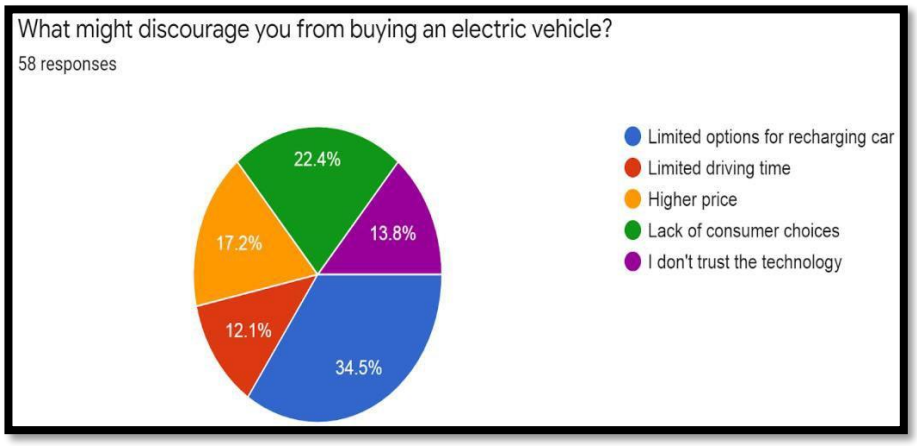
- If p value <α, reject null and accept alternate hypothesis

- **Result –** Here, F stat < F critical i.e., 0.34 < 2.54, so we will accept null and reject alternate hypothesis and p value >αi.e., is 0.84 > 0.05, we will accept null and reject alternate hypothesis.



INTERPRETATION

The above pie chart depicts the various age groups of the respondents and as we can see that the majority of the respondents are from the age group of under 25 years with 79.3% and then comesthe age group of 26-30 with 13.8%.



INTERPRETATION

This pie chart represents that what all are the factors that affect the perception of the consumer towards the EV. 34.5% considers that the lack of infrastructure affects their perception toward EV. And the second most influencing factor turns out to be limited driving

Education level impact on perception on EV

Hypothesis

H1: The different education levels have different perception towards electric vehicle.H0: All the education levels have same perception towards electric vehicle.

Testing of the hypothesis

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	0	0	#DIV/0!	#DIV/0!
Column 2	2	3.62	2.64	#DIV/0!
Column 3	39	153.5	2.6527	0.4526
Column 4	13	58.5	2.7	0.23475
Column 5	2	3.75	2.53	#DIV/0!

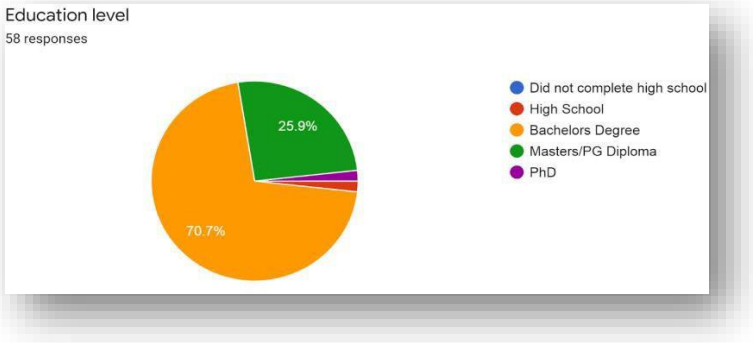
ANOVA

Source of Variation	*SS*	*DF*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.270058765	5	0.06715	0.11924	0.97575	1.54636
Within Groups	31.03597695	49	0.56664			
Total	30.30603457	47				

Table –3, statistics of EV perception (based on the education level of consumer)

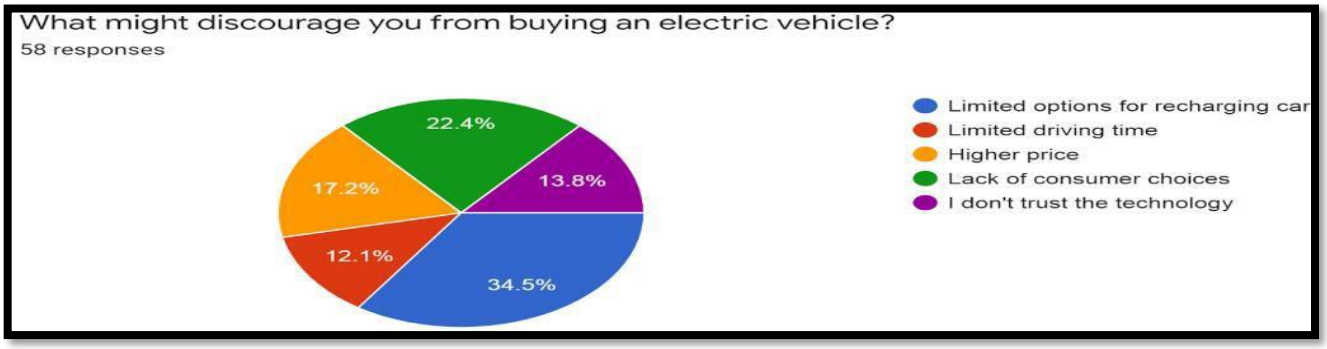
DECISION RULE

- If F stat > F critical, reject null and accept alternate hypothesis.
- If p value <α, reject null and accept alternate hypothesis
- **Result –** Here, F stat < F critical i.e 0.11< 2.54, so we will accept null and reject alternate hypothesis and p value >α i.e is 0.97> 0.05, we will accept null and reject alternate hypothesis



INTERPRETATION

The above pie chart depicts the information related to the education level of the respondents and in that the highest level of the education completed by the respondents was of bachelor degree with 70.7% and then followed by masters/PG diploma with 25.9%. The question was added to find the relationship between the education level of the consumer and the perception they hold towards EV.



INTERPRETATION

Also, again for comparison the pie chart which depicts all the factors which may influence consumer perception is shown here.

Income level impact on perception on EV

Hypothesis

H1: The different income levels have different perception towards electric vehicle.H0: All the income levels have same perception towards electric vehicle.

Testing of the hypothesis

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	40	152.75	3.81875	0.6794471
Column 2	10	35.75	3.575	0.2368056
Column 3	7	27	3.8571429	0.1845238
Column 4	0	0	#DIV/0!	#DIV/0!
Column 5	1	4	4	#DIV/0!

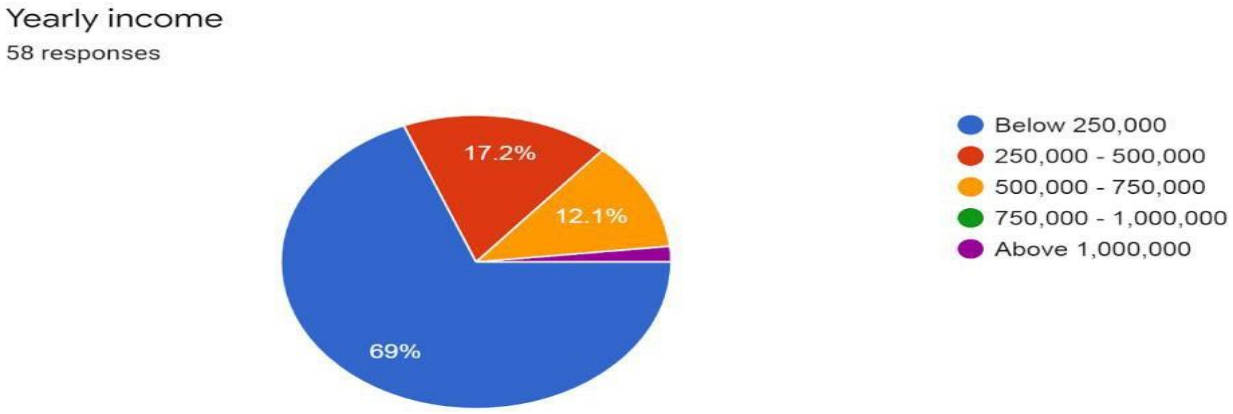
ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.56920413	4	0.142301	0.2536234	0.90619	2.54627
Within Groups	29.7368304	53	0.5610723			
Total	30.3060345	57				

Table –4, statistics of EV perception (based on the income level of consumer)

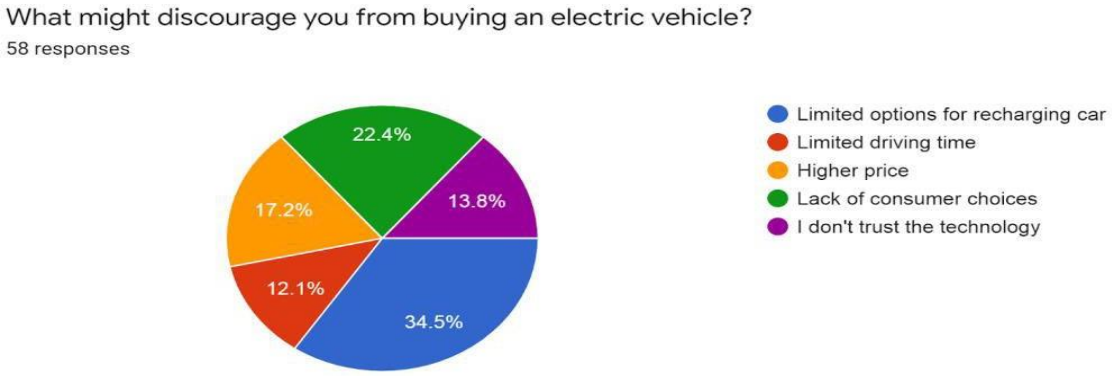
DECISION RULE

- If F stat > F critical, reject null and accept alternate hypothesis.
- If p value <α, reject null and accept alternate hypothesis
- **Result –** here, F stat < F critical i.e 0.25< 2.54, so we will accept null and reject alternate hypothesis and p value >αi.e is 0.90> 0.05, we will accept null and reject alternate hypothesis.



INTERPRETATION

The above pie chart depicts the information related to the income level of the respondents and in that the level of the income of the respondents was below 250,000 with 69% and then followed by 250,000 – 500,0000 with 17.2%. The question was added to find the relationship between the income level of the consumer and the perception they hold towards EV.



INTERPRETATION

Also, again for comparison the pie chart which depicts all the factors which may influence consumer perception is shown here.

FINDINGS

Considering the case in electric vehicles as the person might lack the knowledge or feel to lack the knowledge required to make an informed decision. This ultimately forms a negative perception towards electric vehicles. A vehicle being a tangible and a visible asset, a person can be concerned about how much will the car drive on a single charge and where would I recharge it

and what would be the cost involved and will it be more expensive as compared to a conventional vehicle. Thus because of these reasons I conducted this research.

This research attempted to identify those factors influencing consumer perception towards electric vehicles in India and how much does these factors affect the perception of a consumer. Itconsidered various factors like demographic, education of the consumer and income level of the consumer as variables that affect the perception of a consumer. The research found a significant relationship between the factors and the perception towards an electric vehicle, by testing out the various hypotheses. This confirms that in addition to their demographic features, consumers are also influenced by education and income level to make a decision to buy an electric vehicle. The respondents usually perceived a strong infrastructural expectation for purchasing electric vehicles. The importance of these variables in predicting the perception towards electric vehicleis attributed to at least two factors an individual is strongly affected by their income level and theeducation and infrastructural condition of a country.

Also talking about Policies will have a strong impact on EV adoption. The world's EV cities deliver initiatives such as guidelines for fuel economy and discounts for cars with zero to low emissions, and emphasis on charging infrastructure. An ambitious EV strategy can help create trust among private suppliers and productive systems will boost demand for EVs. The incorporation of charging infrastructure within the FAME framework is likely to provide momentum to the construction of public charging facilities throughout the country. It would see the introduction of charging stations in not just in Tier 1 cities but also in Tier 2 cities and highways. One of the most important issues for customers is likely to be resolved – the india infrastructure regarding the charging facilities would also improve considerably. The incentives and subsidies under FAME are expected to give a big boost to the production of new battery materials and chemicals. These policies will enable the manufacturers to manufacture electric vehicles at a lower cost.And would also give rise to the mass production and thus it will makethe cost of production go down and again the overall cost of the electric vehicle will go down. This would mean that the electric vehicles might see a surge in demand and more buyers in the market.

CONCLUSION AND SUGGESTION

From the analysis, it can be concluded that the various factors affect the perception towards the electric vehicle. The impact will be cumulative of all the factors. And unlike the conventional gasoline engine vehicles, which can cover a larger distance per litre of oil, electric vehicles require frequent charging for covering the same distances. This is primarily due to the battery capacity of these vehicles. Hence, these vehicles might see a greater adoption and acceptance for short distance travels. Because of other facilitating factors, the growth of this segment will be largely propelled by the two-wheeler and three-wheeler vehicles, light motor vehicles (LMVs) and city buses. For long distance vehicles like trucks and UVs, further development is required in the battery capacity and technology and investment in the charging infrastructure.

Because of the limited use of the electric vehicles, it can be seen that the shift towards the adoption of electric vehicles might not have a very huge and robust but with all the facilitating factors stated below we can hope that the transition from gasoline powered cars to electric vehicles would be fast and humongous.

conventional lead-acid batteries were dominating the market. ..

"With more companies getting FAME-II certification in 2020, sale of high-speed electric two-wheelers is expected to increase rapidly," it added.

In terms of battery technology in the electric two-wheeler segment, lead-acid technology will becompletely out of the market in the next five years, it said.

Elaborating on the electric vehicle market the report noted that the demand in the vertical is expected to be driven with subsidy support from the Central government due to high upfront cost. Besides, the electric vehicle market is poised for growth in the upcoming years as many newmarkets such as Raipur, Indore, Bhopal, have opened last year.

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