Abstract-

Most of the cities in India are facing severe problem of, heavy traffic and air pollution, due to fast paced growth of cities and automobile Industry. To curb this issue, there is a potential need for adopting alternative technology, which will assist in balancing the misbalance of Environment, caused by high emission of carbon into atmosphere. The focus of the study is to, explore various factors that integrates, with four wheeler Electrical Vehicle purchase intention of consumers. A sample size of 200 respondents were taken,to conduct this study. Based on 200 respondents, this study has taken SPSS, into consideration to conduct Reliability, Validity, Factor Analysis, Friedman Test and Correlation to test the determined factors. This empirical study indicates, lower charging cost, environmental friendliness, charging station, higher driving range, no noise feature, subsidized cost and price having a positive correlation with purchase intention of Electric Vehicle. This study also contributes, the relevant suggestions to policy makers and manufacturers about how to encourage consumers to encourage adoption of, four wheeler Electric vehicle in Nagpur City

Keywords: Sustainability, Electric Four Wheeler Vehicle, Adoption, Technology

Introduction-

Globally Countries are facing tremendous amount of challenges, pertaining to Global Warming caused by greenhouse gases, reason being, emission of enormous volume of carbon by conventional vehicles. India is nowhere lacking behind, in these issues, in fact, cities in India are granted to be one of the highest polluted cities in World. One such city is Nagpur, Maharashtra, ranked by World Health Organization 24[th]globally and 17th out of 32 in the country as most polluted city (2018). Although with its environmental concerns on one side, as per Oxford Economics report, Nagpur was projected to be fifth fastest growing city in world from 2019 to 2035, as one of the fastest developing cities. Even though Nagpur has its own set of Environmental challenges, it also has potential to curb the issue.

Government is planning to bring Electric Mass Mobility Ecosystem in Nagpur, which will change the transportation system in country. Countries largest mobility platform OLA had fleet of 200 Electric Vehicle (2017) in city. Nagpur is taking a step forward, towards sustainable transportation, this will not only cure its environmental problems but will also inspire other countries, and cities dealing with environmental issues, to take climate change earnestly. It is seen by past data, developed countries take keen interest in curbing the environmental problems, creating policies to reduce the issues, which also encourage people in driving the Electric vehicle. For example in Finland if anyone buys an electric four wheeler vehicle there's lower tax, subsidy on purchase, free toll, free gas station. These policies highly encourages people to buy these vehicles.

If we see past data trends the, growth has been significant, making India a hot market for Electric Vehicle. Electric vehicle sales excluding E-Rickshaws in India grew by 20% at 1.56 lakhunits sold in 2019-2020, driven by two wheelers. Society of Manufacturers of Electric Vehicles (SMEV), projected Electric Vehicle market to grow by 37% during 2018 to 2023. Report by Avendus Capital (2020) projected Electric Vehicle market to be Rs 50,000 Crore opportunity in India by 2025.With such high growth projected in future, it becomes essential to understand, what could be the key factors that would influence consumers to purchase Electric Vehicle.

Research Problem

Conventional Fossil Fuel carrying vehicle emits heavy amount of carbon which triggers increase in greenhouse gases causing in, increase in temperature. This puts severe impact on environment,also resulting in climate change, (irreversible damage) and incurring environmental cost globally. This was a major problem, resulted potential need to adopt technological advancement in automobile industry such as electric vehicle.

Research Objective

To study factors affecting consumer's perception towards Electric Vehicle.

Hypothesis Formulation

1. H0: Lower Charging Cost does not significantly affect customer's adoption of EV

   H1: Lower Charging Cost significantly affect customer's adoption of EV

2. H0: Environmental Friendliness does not significantly affect customer's adoption of EV

   H1: Environmental Friendliness significantly affect customer's adoption of EV

3. H0: Infrastructure [Charging Station] does not significantly affect customer's adoption of EV

   H1: Infrastructure [Charging Station] significantly affect customer's adoption of EV

4. H0: Higher Driving Range does not significantly affect customer's adoption of EV

   H1: Higher Driving Range significantly affect customer's adoption of EV

5. H0: No Noise Feature does not significantly affect customer's adoption of EV

   H1: No Noise Feature significantly affect customer's adoption of EV

6. H0: Government Policy [Subsidized Cost] does not significantly affect customer's adoption of EV

   H1: Government Policy [Subsidized Cost] significantly affect customer's adoption of EV

7. H0: Price does not significantly affect customer's adoption of EV

   H1: Price significantly affect customer's adoption of EV

Review of Literature

(Pretty Bhalla, 2018)The study is aimed at understanding perception and consumer intention of electric vehicles in India. It includes factors such as low cost, comfort, Environmental concern, Technology, Infrastructure. Based on the factors, it was found that Government of India should invest highly in "Social Acceptance". It was found in study, respondents were well aware of environmental benefits of Electric Vehicle. Research depicted there is no positive correlation between Perception of Electric Vehicle and Trust.

(Sita Mishra, 2019)The research focuses at exploring various purchase intention of customers to buy Electric Vehicle in India, by proposing 'Framework based on Utility Theory'. The study is made on total of six factors (performance, environmental concerns, social influences, financial benefits, infrastructure, and cost of ownership). A positive association was indicated with respect to performance and purchase intention of Electric Vehicle. Further a positive association was depicted between purchase intention and environmental concern.

(Jian Wang, 2019))- The study aims to understand the factors affecting Chinese consumers' willingness to purchase electric vehicle. They conducted research on total of six factors (Charging Infrastructure, Driving Range, Government Financial Incentives, Perceived Social Influence and Individual Environmental Awareness). It was found, other than Purchase Cost and Driving Range,all factors were significant, for Chinese Consumers purchase willingness. It was also found that high purchase cost do not affect negatively on Chinese consumers to purchase Electric Vehicles.

(Schmid, 2017)Theresearch paper investigates environmental impact of Electrical Vehicles. The Research communicates negative environmental effect caused due to high, carbon and greenhouse gases emission. It discusses the high potential of Electric Vehicle technology, and the difference it could create in balancing the misbalance of environment caused due to conventional vehicles and others. It also discusses how government intervention can make this process more significant and effective.

(Craig Morton, 2016)- The researchaims at studying Consumer demand for Electric Vehicles by examining the influence of Customer's innovativeness along with attitude concerning to functional capabilities of Electric Vehicle's over Electric Vehicle Preferences. The conceptual framework is developed, which includes innovativeness at both level (Adoptive &Innate), another framework measures attitude with respect to functional performance of Electric Vehicle.

(Wenbo Li, 2017)- The research paper aims at understanding consumer's intention, to adoption of Battery Electric Vehicles. The study has categorized factors into three main forms i,e Psychological, Demographic, Situational. It was found that intention of consumer's adoption of Battery Electric Vehicle is mixture of Psychological, Demographic, and Situational Factors. They also depicted Purchasing Cost, Driving Range and charging problem are the core situational barriers.

(Seiho Kim, 2017)- The study is aimed at investigating relation between purchase of Electric Vehicle and Driving Range of Electric Vehicle. It was found that, there was a significant relation between purchase of Electric Vehicle and Driving Range of Electric Vehicle. It was also found that mainstream segment would compromise the factor of increased purchase cost with high Driving Range of Vehicle.

(Nicolas Misdariis, 2018)- The research paper aims at understanding if the silent sound of engine produced by Electric vehicles is Safe for passing cars and even for pedestrians. It also suggests better ways of making the vehicle safer. The research paper involves safety of electric vehicle and what could be the potential solutions necessary.

Research Methodology

An empirical study is conducted while using quantitative research. The research follows an exploratory and descriptive research methodology to study Factors influencing customer adoption of four wheeler

electric vehicle in Nagpur City. Primary data was collected from a sample size of 200 respondents including businessman, professionals and service person from the Nagpur City.

The Sampling Method used was the Non-Probability Sampling Method as not all elements from the population have an equal opportunity of being selected as the sample for the research conducted, falls Under Non-Probability and Convenience Sampling method was used. A Structured Questionnaire was used to collect data from the respondents. The questionnaire was filled by the respondents via google Form and a reliability test is conducted on all the variables (Cronbach's alpha value: 0.704). Secondary information was collected from research journals and reports.

Data Analysis & Interpretation

The collected data were converted into a data matrix using IBM SPSS 26 software to test the various hypothesis Reliability, Validity, Factor Analysis, Friedman and Correlation test was used.

1. Reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.704	32

Table 1 (Source: Output of SPSS)

Cronbach's alpha is a common degree of Reliability. It is used to check the reliability of, multiple Likert scales in a questionnaire. From Table 1 we can interpret that Cronbach's Alpha is 0.704, which designates an adequate level of Internal Consistency for a scale with specific sample.

2. Validity Test

	Sum Pearson Correlation	Sig. (2-tailed)	N
Charging time	.434	.000	200
Charging cost	.568	.000	200
Subsidized Cost	.647	.000	200
Lower Bank Rate of Interest	.636	.000	200
Environmental Friendliness	.566	.000	200
No Noise Feature	.436	.000	200
Resale Price	.426	.000	200
Reliability	.263	.000	200
Driving Range	.670	.000	200
Charging Station	.652	.000	200
Service Station	.536	.000	200
Battery Exchange	.576	.000	200
Lower Maintenance Cost	.639	.000	200
Price	.540	.000	200

Table 2 (Source: Output of SPSS)

Validity is a degree of validity, or the Validity of certain research Instrument. An instrument could be declared as valid if it can divulge the data of variable. Based on the significant value obtained by the Sig. (2-tailed) of 0.000<0.05, so it can be concluded to 1st item i.e. Charging Time is valid. Based on the count value obtained i.e. Pearson Correlation value 0.434 > 'r' table product-moment 0.139, so it can be concluded that the item 1st is valid.

Similarly, if we see in Table 2, we observe that for all the items Pearson Correlation values are greater than 0.139 and significance values are less than 0.05, it means that all the items are valid.

3. Factor Analysis

Factor Analysis was carried out between **fourteen** independent factors with an overall Perception as a dependent. All the independent factors somehow affect the purchase of Electric Vehicles by customers

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.780
Bartlett's Test of Sphericity	Approx. Chi-Square	1071.15 1
	df	91
	Sig.	.000

Table 3 (Source: Output of SPSS)

KMO Test is used for measuring sample adequacy. A value of less than **0.6** indicates the sampling is not adequate. This test has a KMO value of **0.780**, hence the sampling is adequate and Bartlett's' test value is **0.000**. Factor analysis helped to reduce and combine variables of the same kind. The results are as follows:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.330	30.930	30.930	4.330	30.930	30.930	3.109	22.207	22.207
2	2.317	16.552	47.483	2.317	16.552	47.483	2.782	19.869	42.076
3	1.280	9.145	56.628	1.280	9.145	56.628	1.958	13.983	56.059
4	1.107	7.906	64.534	1.107	7.906	64.534	1.186	8.474	64.534
5	.950	6.782	71.316						
6	.810	5.786	77.102						
dimension 0 7	.650	4.642	81.743						
8	.535	3.820	85.563						
9	.461	3.290	88.853						
10	.449	3.204	92.056						
11	.403	2.877	94.934						
12	.291	2.082	97.016						
13	.238	1.702	98.717						
14	.180	1.283	100.000						

Extraction Method: Principal Component Analysis.
Table 4 (Source: Output of SPSS)

The total variance contribute, the amount of variance in, original variables accounted by each component. Based on Factor analysis, we can see in **Table 4** four components extracted with a cumulative of 64.534%

Communalities

	Initial	Extraction
Charging Time	1.000	.433
Reliability	1.000	.382
Governmental Policies [Subsidized Cost]	1.000	.764
Environmental Friendliness	1.000	.748
Governmental Policies [Lower Bank Rate of Interest]	1.000	.622
No Noise Feature	1.000	.708
Resale Price	1.000	.376
Price	1.000	.759
Infrastructure [Battery Exchange]	1.000	.547
Infrastructure [Service Station]	1.000	.662
Infrastructure [Charging Station]	1.000	.795
Driving Range	1.000	.833
Lower Maintenance Cost	1.000	.700
Lower Charging Cost	1.000	.706

Extraction Method: Principal Component
Analysis.

Table 5 (Source: Output of SPSS)

After analyzing the loadings in **Table 5**, it can be interpreted that the most important factors which influence consumer to purchase electric vehicle are: Environmental Friendliness, Government Policy [Subsidized Cost], Lower charging Cost, Charging Station, Price, Higher Driving Range and No Noise Feature

4. Friedman Test

The Friedman test associates, mean ranks among the related clusters, and shows how the groups diverged, and it is encompassed for this cause

Ranks

	Mean Rank
Lower Charging Cost	4.72
Environmental Friendliness	4.33
Infrastructure [Charging Station]	4.14
Higher Driving Range	4.05
Government Policies [Subsidized Cost]	3.66
No Noise Feature	3.60
Price	3.52

Table 6 (Source: Output of SPSS)

Table 6 shows the key factors which influences customer to adopt EV (Lower charging Cost. followed by Environmental Friendliness, Charging Station and Higher Driving Range)

Test Statistics[a]

N	200
Chi-square	73.350
df	6
Asymp. Sig.	.000

a. Friedman Test

Table 7 (Source:Output of SPSS)

Test Statistics (Table 7) notifies, of the genuine outcome of, Friedman test and whether, there was an overall statistically significant difference between the mean ranks of related clusters.

Here the $\chi^{2\,value}$ is 73.350, the p value is **0.000** and the level of significance is 0.05 (χ^2 = 73.350, DF = 6, p ≤ 0.05

Correlation

H1: There is a significant relationship between Environmental Friendliness and Customer adoption of EV

Correlations

		Overall Perception	Environmental Friendliness
Overall Perception	Pearson Correlation	1	.594[**]
	Sig. (2-tailed)		.000
	N	200	200
Environmental Friendliness	Pearson Correlation	.594[**]	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 8**(Source:Output of SPSS)

The above (Table 8) represents the correlation of two variables Environmental Friendliness and Overall Perception are positively correlated (r=0.594, p=0.000). There is a moderate relationship between Environmental Friendliness and Overall Perception which is significant. Hence we can say that null hypothesis is rejected

H2: There is a significant relationship between Government Policy [Subsidized Cost] and Customer adoption of EV

Correlations

		Overall Perception	Government Policies [Subsidized Cost]
Overall Perception	Pearson Correlation	1	.847[**]
	Sig. (2-tailed)		.000
	N	200	200
Government Policies [Subsidized Cost]	Pearson Correlation	.847[**]	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 9**(Source:Output of SPSS)

The above (Table 9) represents the correlation of two variables Subsidized Cost and Overall Perception are positively correlated (r=0.847, p=0.000). There is a moderate relationship between Subsidized Cost and Overall Perception which is significant. Hence we can say that null hypothesis is rejected

H3: There is a significant relationship between Infrastructure [Charging Station] and Customer adoption of EV

Correlations

		Overall Perception	Infrastructure [Charging Station]
Overall Perception	Pearson Correlation	1	.717**
	Sig. (2-tailed)		.000
	N	200	200
Infrastructure [Charging Station]	Pearson Correlation	.717**	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 10**(Source:Output of SPSS)

The above (Table 10) represents the correlation of two variables Charging Station and Overall Perception are positively correlated (r=0.717, p=0.000). There is a moderate relationship between Charging Station and Overall Perception which is significant. Hence we can say that null hypothesis is rejected

H4: There is a significant relationship between Higher Driving Range and Customer adoption of EV

Correlations

		Overall Perception	Higher Driving Range
Overall Perception	Pearson Correlation	1	.342**
	Sig. (2-tailed)		.000
	N	200	200
Driving Range	Pearson Correlation	.342**	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 11**(Source:Output of SPSS)

The above (Table 11) represents the correlation of two variables Higher Driving Rangeand Overall Perception are positively correlated (r=0.342, p=0.000). There is a moderate relationship between HigherDriving Range and Overall Perception which is significant. Hence we can say that null hypothesis is rejected

H5: There is a significant relationship between Price and Customer adoption of EV

Correlations

		Overall Perception	Price
Overall Perception	Pearson Correlation	1	.416**
	Sig. (2-tailed)		.000
	N	200	200
Price	Pearson Correlation	.416**	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 12**(Source:Output of SPSS)

The above (Table 12) represents the correlation of two variables Price and Overall Perception are positively correlated (r=0.416, p=0.000). There is a moderate relationship between Price and Overall Perception which is significant. Hence we can say that null hypothesis is rejected

H6: There is a significant relationship between No Noise Feature and Customer adoption of EV

Correlations

		Overall Perception	No Noise Feature
Overall Perception	Pearson Correlation	1	.639**
	Sig. (2-tailed)		.000
	N	200	200
No Noise Feature	Pearson Correlation	.639**	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 13**(Source:Output of SPSS)

The above (Table 13) represents the correlation of two variables No Noise Feature and Overall Perception are positively correlated (r=0.639, p=0.000). There is a moderate relationship between No Noise Feature and Overall Perception which is significant. Hence we can say that null hypothesis is rejected.

H7: There is a significant relationship between Lower Charging Cost and Customer adoption of EV

Correlations

		Overall Perception	Lower charging cost
Overall Perception	Pearson Correlation	1	.821**
	Sig. (2-tailed)		.000
	N	200	200
Lower charging cost	Pearson Correlation	.821**	1
	Sig. (2-tailed)	.000	
	N	200	200

. Correlation is significant at the 0.01 level (2-tailed). Table 14**(Source:Output of SPSS)

The above (Table 14) represents the correlation of two variables Lower Charging Cost and Overall Perception are positively correlated (r=0.821, p=0.000). There is a moderate relationship between Lower Charging Cost and Overall Perception which is significant. Hence we can say that null hypothesis is rejected.

Results

1. 98% of respondents were aware of Electric Vehicle

Electric Vehicle Awareness
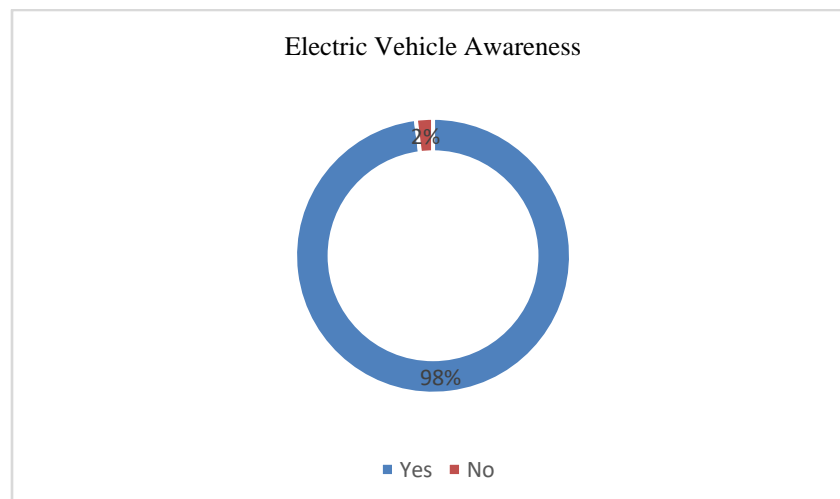
2. 96% of Respondents planning to adopt Electric four wheeler vehicle in Future, out of which 65.5% are Male, and 35.5% are Female

Respondents planning to purchase Electric vehicle in future

4%

96%

■ Yes ■ No
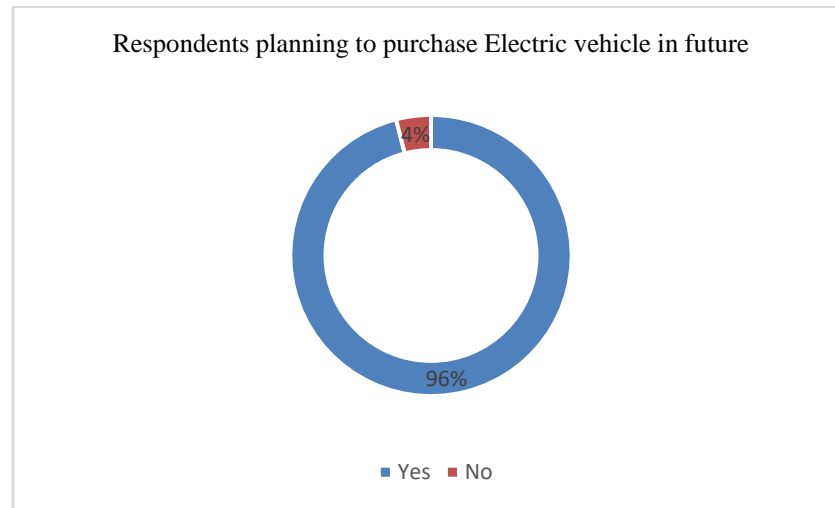
3. Lower Charging Cost emerged as key factor with mean rank 4.72 followed by Environmental Friendliness and Driving Range with 4.33 and 4.14 respectively, that influenced customers to buy EV

Key Factors

Lower Charging Cost — 4.72

Environmental Friendliness — 4.33

Charging Station — 4.14

3.8   4   4.2   4.4   4.6   4.8
■ Mean Rank
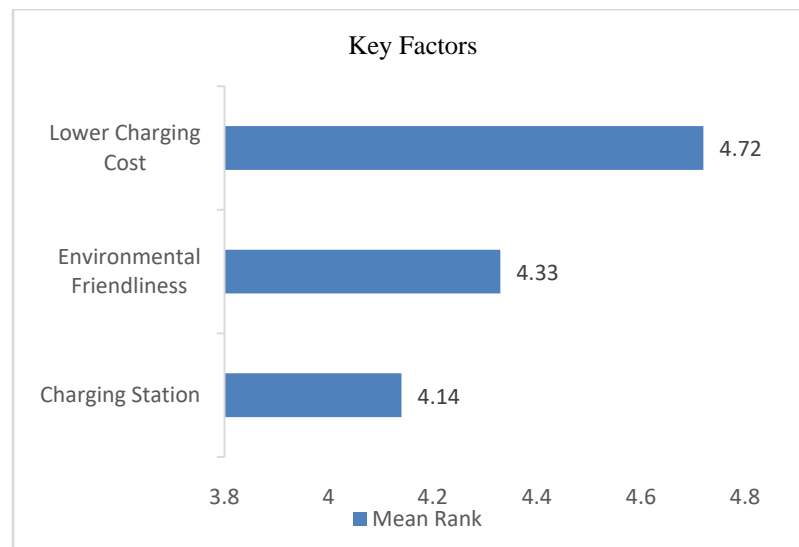
4. Family and Friends (Social Influence) 40% could play great role, in influencing respondents to purchase EV, followed by T.V Advertisement at 36%, News and Magazine at 14%, Outdoor Advertisement at 10%

Social Influence

- 40% Friends & Family
- 36% T.V Advertisemnet
- 14% News & Magazine
- 10% Outdoor Advertisement
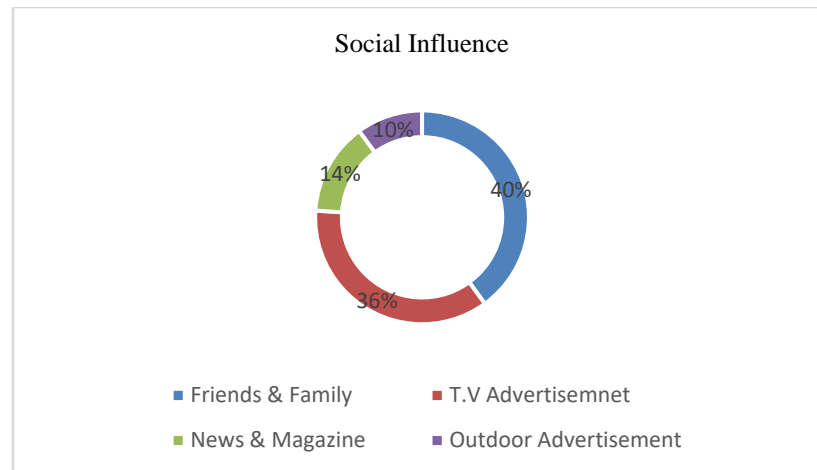
5. 62% Respondents responded negatively when asked, resale price would affect their purchase decision of Electric Vehicle

6. A Positive Correlation was found between Environmental Friendliness, Higher Driving Range, Charging Station, Government Policy, Price and Lower Charging Cost

7. Statistical Analysis proved the Proposed Hypothesis.

Discussion

The aim of this study is to understand several factors that would influence consumers to purchase Electrical Four Wheeler Vehicle. Based on previous research papers, the current research identified seven key factors Lower Charging Cost, Environmental Friendliness, Charging Station, Higher Driving Range, Subsidized Cost, No Noise Feature and Price. Findings of current research revealed positive correlation with respect to considered factors with purchase intention of the customer.

Even though the presence of these Electrical vehicles might not be as high as compared to Conventional Vehicles in future, they might outgrow, conventional vehicles, given the benefits and contribution towards the balance of Environment, taking a big step towards sustainability.

A positive correlation was found between Environmental benefits and Purchase Intention. It seems people are aware of Environmental benefits of Electric Vehicle and negative impact of conventional Vehicles on Environment, therefore ready to accept new technology, which will reduce the emission of Carbon dipping the pollution levels.

A positive correlation was found between Higher Driving Range, Lower Charging Cost and Purchase intention, therefore depicting, people are looking for options that will be more economical when it comes to running cost of vehicle. Past studies have shown an Electric vehicle can cover approx. distance of 150kms with a cost of 150Rs -160Rs depending on the region.

This shows people are ready, to adapt to alternate technology which is not only better for environment but also economical when it comes to cost in long run.

Conclusion

A total of seven factors were explored, by going through previous research papers. The aims was to find key factors that would influence consumers to purchase Electric vehicles in Nagpur City. In this research, the motive is fulfilled by proving all the hypothesis. It can be concluded that alternate hypothesis to be accepted, proven statistically. There's Positive Correlation between Purchase intention of consumers and Lower Charging Cost, Environmental Friendliness, Charging Station, Higher Driving Range, Subsidized Cost, No Noise Feature and Price

Suggestions

1) The study indicated how social factors could highly affect, the purchase of Electric Vehicle. Marketers should focus on, WOM (Word of Mouth) & T.V advertisements for promotion, as these two factors emerged as top in Social Factors.

2) Furtherthis study revealed a positive correlation between Environmental Friendliness and Purchase Intention. Government and Companies should make sure they, they highlight these factor and encourage people in combating environmental concerns.

3) Lower Charging cost and Higher Driving Range emerged as key factors. Companies should promote their vehicles with regards to running cost, being much more economical, compared to Conventional vehicles. This could be there USP.

4) Charging Station emerged as one of the key factors. Government and Companies should make sure, there are ample amount of charging stations, available in city.

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