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Is Electric Car's Purchase Restricted to Metro Cities Only?

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INTRODUCTION:

Driving a car without the traditional fuel based system might bring in a lot of inhibition on the part of the Indian consumers; more so with respect to operational efficiency of such cars. The emergence of electric cars in the Indian market is an example of it. Unfamiliarity with the technology of an electric car and concern over the maintenance aspect of it is a big inhibition in the minds of the Indian consumers. The life of the battery of an electric car and the cost of replacing it further adds fuel to the fire. Keeping all these things into consideration, a pertinent question which arises here is that 'Whether the Indian consumers across different types of cities will accept these electric cars or not?' Or 'whether the electric cars will remain restricted to the metro cities only?' These questions are worth pondering over and have been taken up in this paper. Following which, it will give an insight about the preferences of purchasing an electric car across different city type and help the organizations in developing their marketing strategies to suit the disposable incomes of consumers across the diverse nature of these cities. The Indian Government is also providing tax relief on the purchase of electric cars under Section 80EEB of the Income Tax Act. Maximum of Rs. 1.5 lakh deductions can be claimed by the consumer on purchase of an electric car. Furthermore, the owners of the electric cars would have to pay no road tax. And on top of it, no greenhouse emissions will be produced as it is a non fuel based car. This is a win-win situation for the Indian consumers who not only benefit from the financial benefits but also from the health benefits. Hence acceptance of the electric cars will be more across different types of cities rather than being limited to one or few cities only. In other words, we can say that the Indian consumers are aware of the long term benefits of purchasing an electric car even though the initial cost of purchase might be high. And this is the reason that the Indian Government is giving subsidies to the consumers to purchase an electric car.

RESEARCH METHODOLOGY:

Quantitative research is an integral part of this research paper. A statistical tool in the form of a chi square test is chosen to undertake this study. For this purpose, a survey method was adopted and proper tabulation of the data was done. Chi square testing procedure was used for analysis and interpretation of the data so collected.

Data Collection: After conducting a literature survey, a questionnaire was prepared and the primary data was collected. This data was collected by administering the questionnaire on the selected sample by posting a link on the whats app, Bol De app or through e mails. Care was taken that the data obtained consisted of respondents belonging to different geographical territories across different types of cities.

Sample Size:

The sample size of the survey is around 213 respondents. These 213 respondents were spread across metro cities, tier 1 cities, tier 2 cities and tier 3 cities. The sample unit consists of respondents ranging from housewives, salaried working males, salaried working females, female students and male students (from the Universities as they are the future prospects), male entrepreneurs and female entrepreneurs, practicing professional males and practicing professional females, retired male respondents and retired female respondents. Geographical basis of segmentation is used for this survey comprising of different regions and cities.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Tools/Techniques used for Data Analysis:

A Chi Square Test will be performed for testing the hypothesis. It is used as a statistical tool to analyze and interpret the data so collected. This test is used to study the relationship between two categorical variables; i.e. to determine if the two categorical variables have statistically significant differences or not. The two categorical variables included in this study are type of cities (metro cities, tier 1 cities, tier 2 cities and tier 3 cities) and type of fuel or energy used by the car (CNG, diesel, petrol, hybrid and electric). Through the Chi Square Test, the researcher tries to determine whether the difference between the observed values and the expected values is statistically significant or not.

To undertake this test, firstly framing of the hypothesis is done. Hypothesis is nothing but a proposition which has to be tested by making use of statistical tools. There are two types of hypothesis namely the null hypothesis and the alternate hypothesis. Therefore null hypothesis and alternate hypothesis is accordingly framed. Null hypothesis is denoted as (H_0) and alternate hypothesis is denoted as (H_1).

Hypothesis:

The null hypothesis and alternate hypothesis identified for this research paper are:

Null Hypothesis (H_0): There is no relationship between the type of cities and the type of fuel or energy used by the car, i.e. they are independent.

Alternate Hypothesis (H_1): There is a relationship between the type of cities and the type of fuel or energy used by the car, i.e. they are not independent.

The significance level for this study has to be identified. The significance level will be taken as 0.05 i.e. $\alpha = 0.05$

This indicates that there is a 5% risk of concluding that there exists an association between the variables taken when there is actually no association.

Once the hypothesis is framed, tabulation of the data will be done.

Table of Observed Values:

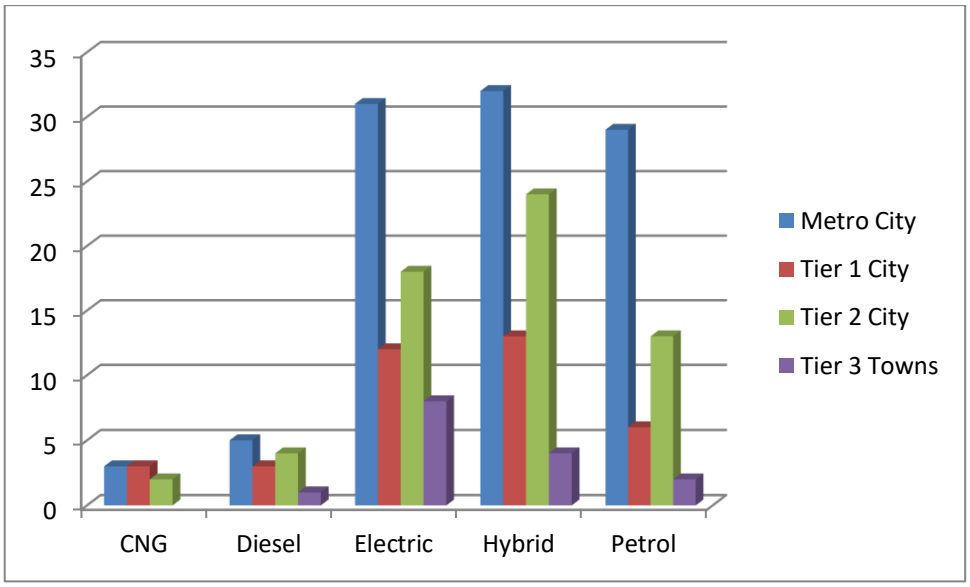
Observed value is the actual number of observations in a sample that belongs to a category. The observed value for each category combination is as follows:

Table 1

Type of Cities	Nature of Car on the basis of Type of Fuel/Energy					Grand Total
	CNG	Diesel	Electric	Hybrid	Petrol	
Metro	3	5	31	32	29	100
Tier 1	3	3	12	13	6	37
Tier 2	2	4	18	24	13	61
Tier 3		1	8	4	2	15
Grand Total	8	13	69	73	50	213

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

The plotting of the bar graph for the above table will help us to compare the observed value of the data across the two categories, ie fuel or energy type (CNG, diesel, petrol, hybrid and electric) and city type (metro cities, tier 1 cities, tier 2 cities and tier 3 cities).



Graph 1

The above graph majorly indicates the preference of electric cars, hybrid cars and petrol cars across metro cities, tier 1 cities, tier 2 cities and tier 3 cities. No doubt, maximum preference of electric cars can be seen in the metro cities, but preference for electric cars can also be seen in tier 1 cities, tier 2 cities and tier 3 cities. In fact, the preference for electric cars is more in tier 2 cities as compared to tier 1 cities. With the emergence of hybrid cars and electric cars in the Indian market, the preference for diesel cars has gone down tremendously. Petrol cars are still preferred by the consumers but not as much as their growing preference for electric cars and hybrid cars. A closer look at the graph indicates that the preference for electric cars, hybrid cars and petrol cars is much more in tier 2 cities as compared to tier 1 cities. Hybrid cars are more popular in the Indian market as compared to electric cars. But the preference for electric cars is also not less in the respective markets for different types of cities. The graph also indicates that in the tier 3 cities, preference for electric cars is the highest as compared to hybrid cars or petrol cars. This indicates that there is a huge growth potential in the tier 3 cities for the manufacturers of electric cars. Consumers in tier 2 cities prefer hybrid cars more but preference for electric cars is not far behind. In the case of tier 1 cities, there is more or less an equal preference of consumers for electric cars and hybrid cars. So, again there is more opportunity for manufacturers of electric cars in this category too.

There is negligible scope for diesel cars and CNG cars across different types of cities. Hence they have not been considered as an important component of research in this research paper. From the graph it can be clearly observed that the preference for diesel cars and CNG cars across different cities is way below their counterparts in the form of electric cars or hybrid cars or petrol cars. Our analysis leads us to the fact that diesel cars and CNG cars are hardly preferred in the tier 3 cities. And their preference across metro cities, tier 1 cities and tier 2 cities is also miniscule. Diesel cars are preferred shade better than the CNG cars but have very little future. In relation to the CNG cars, the preference for diesel cars is much more n the metro cities, tier 2 cities and tier 3 cities. The preference is more or less the same as the CNG cars in the tier 1 cities. Hence these two types of cars are not considered for further analysis. The data obtained from the survey for both CNG cars and diesel cars does not predict a bright future for these cars. This can further be substantiated through the observed values and the expected values as depicted in table 1 and table 2 respectively.

Table of Expected Values:

The expected value is the frequency that would be expected in a cell if the variables are independent.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

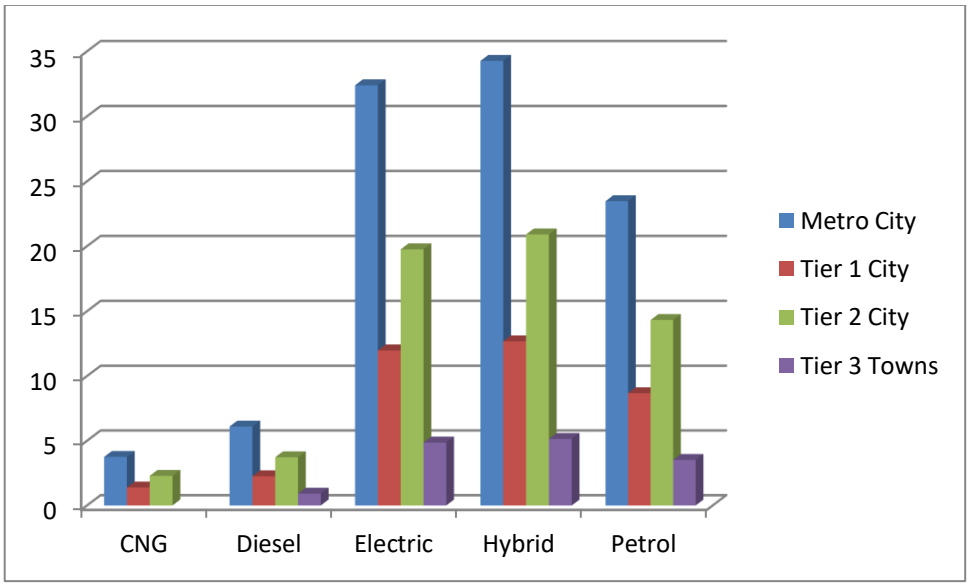
Expected Value: Row Total × Coloumn Total / Grand Total

The expected value for the respective corresponding row and coloumn is depicted in the table below:

Table 2

Type of Cities	Nature of Car on the basis of Type of Fuel/Energy				
	CNG	Diesel	Electric	Hybrid	Petrol
Metro	3.75	6.1	32.39	34.27	23.47
Tier 1	1.39	2.26	11.98	12.68	8.68
Tier 2	2.29	3.72	19.76	20.91	14.32
Tier 3		0.91	4.86	5.14	3.52

The plotting of the bar graph for the above table will help us to compare the expected value of the data across the two categories, ie fuel or energy type (CNG, diesel, petrol, hybrid and electric) and city type (metro cities, tier 1 cities, tier 2 cities and tier 3 cities).



Graph 2

In comparison to the graph of the observed values, in the graph of expected values, it can be seen that there is a slight decline in the preference for electric cars in the tier 2 cities; however this difference may be termed as ‘statistically insignificant difference’. The same is the case for electric cars in tier 3 cities also, but this difference may also be considered to be as ‘statistically insignificant difference’. The graph of expected values also shows that the preference for hybrid cars in the tier 2 cities is less than its observed value. But this difference is also very less and may be termed as ‘statistically insignificant difference’. The preference for petrol cars in the tier 1 cities is less in the graph of expected values but this difference may also be considered to be as ‘statistically insignificant difference’.

The graph shows some variation in the expected values with respect to CNG cars and diesel cars across different types of cities. However, this variation is not significant enough to be considered for research purposes.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

Calculation of χ^2 Value:

The observed values from table 1 and the calculated expected values from table 2 are plotted in the chi square table.

(O-E) represents the difference between the observed value (O) and the expected value (E). This shows how much the observed value deviates from the expected value. If the deviation of the observed value from that of the expected value is less, then it supports the null hypothesis that there is statistically no significant relationship between the categorical values. And if the observed value deviates more from the expected value, then it supports the alternate hypothesis claiming that statistically significant differences exist between the categorical variables. Since the deviation between the observed value and the expected value is less, it supports the Null Hypothesis (H_0) 'There is no relationship between the type of cities and the type of fuel/energy used by the car' and does not support the Alternate Hypothesis (H_1) 'There is a relationship between the type of cities and the type of fuel/energy used by the car'. However, further verification of the null hypothesis and the alternate hypothesis can be done by calculating the chi square (χ^2) value.

The squared difference between the observed value (O) and the expected value (E) is represented as $(O-E)^2$. Upon squaring the difference, the result will always be positive and not negative. This is because for calculating the chi square (χ^2) value, the magnitude of deviation is important and not its direction.

Furthermore, larger value of $(O-E)^2/E$ indicates that there is no match between the observed value and the expected value; thereby indicating that the null hypothesis may be rejected and the alternate hypothesis may be accepted. This can further be cemented by comparing the chi square (χ^2) calculated value with the chi square (χ^2) tabular value by taking into consideration the required degrees of freedom and significance value of 0.05

Table 3

Observed Value (O)	Expected Value (E)	(O-E)	$(O-E)^2$	$(O-E)^2/E$
3	3.75	-0.75	0.5625	0.15
5	6.1	-1.1	1.21	0.1984
31	32.39	-1.39	1.9321	0.0596
32	34.27	-2.27	5.1529	0.1504
29	23.47	5.53	30.5809	1.303
3	1.39	1.61	2.5921	1.8648
3	2.26	0.74	0.5476	0.2423
12	11.98	0.02	0.0004	0.00003
13	12.68	0.32	0.1024	0.0081
6	8.68	-2.68	7.1824	0.8275
2	2.29	-0.29	0.0841	0.0367
4	3.72	0.28	0.0784	0.0211
18	19.76	-1.76	3.0976	0.1568

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

24	20.91	3.09	9.5481	0.4566
13	14.32	-1.32	1.7424	0.1217
1	0.91	0.09	0.0081	0.0089
8	4.86	3.14	9.8596	2.0287
4	5.14	-1.14	1.2996	0.2528
2	3.52	-1.52	2.3104	0.6564
			Summation	$\chi^2 = 8.5439$
			$(O-E)^2/E$	

The Chi Square Calculated Value is **8.5439**

A comparison of the Calculated Value of the χ^2 with the Tabulated Value at the required degrees of freedom and significance value of 0.05 will be done.

χ^2 Tabulated Value:

For this, the degrees of freedom have to be calculated. The formula for calculating the degrees of freedom is:

Degree of Freedom = (Coloumn -1) (Row-1)

f = (5-1) (4-1)

f = 4×3

f = 12

The degrees of freedom for the above table is 12.

Then using the chi square table for degrees of freedom 12 and significance value of 0.05, the χ^2 Tabulated Value is calculated.

So the χ^2 tabulated value will be 21.026

If the Chi Square Calculated Value is less than the Chi Square Tabulated Value or the critical value, then the Null Hypothesis (H_0) is accepted and the Alternate Hypothesis (H_1) is rejected. Accordingly, the Null Hypothesis (H_0) 'There is no relationship between the type of cities and the type of fuel or energy used by the car' is accepted and the Alternate Hypothesis (H_1) 'There is a relationship between the type of cities and the type of fuel or energy used by the car' is rejected.

As the calculated value is less than the critical value, we have sufficient evidence to say that there is no association between the type of cities and the nature of car preferred on the basis of type of fuel or energy. Hence the Null Hypothesis (H_0) 'There is no relationship between the type of cities and the type of fuel or energy used by the car' is accepted and the Alternate Hypothesis (H_1) 'There is a relationship between the type of cities and the type of fuel or energy used by the car' is rejected.

This further shows that the as the critical value is lesser than the expected value, any observed differences are the result of a random chance and there is no significant difference between the observed and the expected (predicted) value.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

This can further be ascertained by calculating the p value.

Calculation of p value:

The two tailed p value with a Chi Square Calculated Value of 8.5439 and degrees of freedom 12 equals 0.7413. If the p value is more than 0.05, then the variables do not have a statistically significant association and the Alternate Hypothesis (H_1) can be rejected.

ie. $p > \alpha$

or $p>0.05$

or $0.7413>0.05$

i.e. 0.7413 is greater than 0.05

If the p value (0.7413) is more than the significance level (0.05), then the Null Hypothesis (H_0) is accepted and concluded that there is no statistically significant association between the variables. And going by the conventional criteria, the difference is considered to be not quite statistically significant. Therefore, the Null Hypothesis (H_0) 'There is no relationship between the type of cities and the type of fuel or energy used by the car' can be accepted and the Alternate Hypothesis (H_1) 'There is a relationship between the type of cities and the type of fuel or energy used by the car' can be rejected.

Also, from the graph, it can be seen that people belonging to different cities purchase all types of cars on the basis of fuel or energy. Therefore, we can say that there is no relationship between the type of cities and the type of fuel or energy used by the car. Hence the null hypothesis is accepted and the alternate hypothesis is rejected.

Table 4

Type of cities	Values	Nature of Car on the basis of Type of Fuel/Energy					Total
		CNG	Diesel	Electric	Hybrid	Petrol	
Metro	Observed Value	3	5	31 (31%)	32 (32%)	29 (29%)	100
	Expected Value	3.75	6.1	32.39	34.27	23.47	
Tier 1	Observed Value	3	3	12 (32.43%)	13 (35.13%)	6 (16.22%)	37
	Expected Value	1.39	2.26	11.98	12.68	8.68	
Tier 2	Observed Value	2	4	18 (29.51%)	24 (39.34%)	13 (21.31%)	61
	Expected Value	2.29	3.72	19.76	20.91	14.32	
Tier 3	Observed Value		1	8 (53.33%)	4 (26.67%)	2 (13.33%)	15
	Expected Value		0.91	4.86	5.14	3.52	
Total		8	13	69	73	50	213

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

The above table also throws some light on the preference to purchase electric cars across different city types as against the other types of cars, ie. hybrid cars or petrol cars or diesel cars or CNG cars. The following observations can be made from the above table:

In the case of metro cities, it can be observed that there is an equal chance of purchase of electric cars (31%) vis-à-vis the hybrid cars (32%) and the petrol cars (29%). So, we can say that electric cars, hybrid cars and petrol cars have a huge market in the metro cities. The electric cars will face a stiff competition from the hybrid cars and petrol cars in this market.

In the case of tier 1 cities, it can be observed that consumers prefer electric cars (32.43%) and hybrid cars (35.13%) more in comparison to petrol cars (16.22%). Therefore we can say that electric cars and hybrid cars have more market in the tier 1 cities. And consumers in the tier 1 cities have less preference for petrol cars. We can also conclude that people in tier 1 cities are moving away from the traditional fuel based system of transportation.

In the case of tier 2 cities, it is observed that hybrid cars (39.34%) are more preferred than the electric cars (29.51%). So, it can be said that the hybrid cars have more market than any other type of car in the tier 2 cities. Though the electric cars are behind the hybrid cars in terms of consumer preference; yet, the electric cars are more preferred than the petrol cars (23.31%). Therefore, the manufacturers of electric cars need to push these cars more in the tier 2 cities as they have a stiff competition from the hybrid cars.

In the case of tier 3 cities, it can be observed that consumers prefer electric cars (53.33%) more as compared to hybrid cars (26.67%) and petrol cars (13.33%). Surprisingly, there is a huge gap in the preference of electric cars over the hybrid cars. Market is dominated by the preference for electric cars which is substantially very large. Hence we can say that the consumers in tier 3 cities are more prone towards accepting electric cars; therefore it seems to be a lucrative market for the manufacturers of electric cars. This market of tier 3 cities should not be ignored at any cost.

The preference for CNG cars and diesel cars is declining across all the city types (metro cities, tier 1 cities, tier 2 cities and tier 3 cities). If possible, their manufacturers can identify new avenues where the CNG cars and the diesel cars can be successful.

The growing preference for electric cars can further be substantiated by the study regarding the number of consumers preferring electric cars across different cities.

A question was asked to the respondents that ‘Do you favor or prefer electric cars?’ The question was asked to identify whether the Indian consumers were ready for an electric car transportation market or not? And the Indian consumers heavily voted for a preference of an electric car.

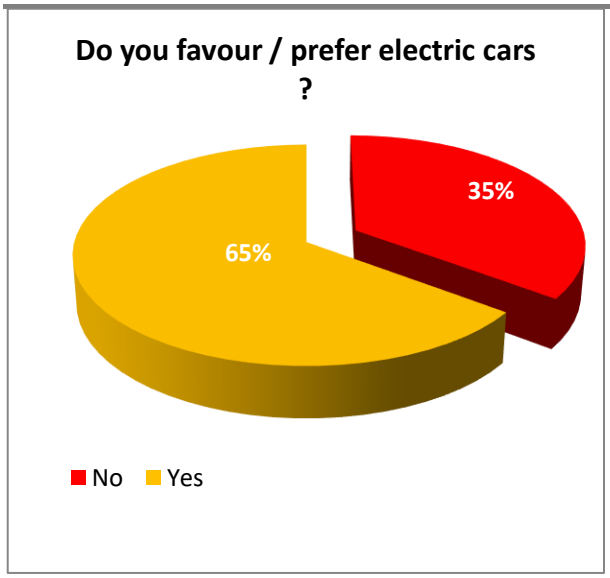
The response of the consumers is as follows:

Table 5

	Yes	No	Total
Prefer Electric Car	138	75	213

The above response was plotted onto the pie chart. The plotting of the pie chart for the above table will help us to identify the contributions of different categories to the entire whole. In the pie chart below, the contribution of people preferring electric car (yes respondents) and not preferring electric car (no respondents) is depicted in the form of percentages for a whole (total number of respondents).

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025



Graph 3

And surprisingly, 65% consumers were in favor of electric cars and only 35% were not in favor of electric cars (as depicted in graph 3) . These respondents were spread across metro cities, tier 1 cities, tier 2 cities and tier 3 cities. This further substantiates the study that electric cars are not preferred only in metro cities, but consumers residing in tier 1 cities, tier 2 cities and tier 3 cities also prefer electric cars. A larger chunk of the pie chart clearly indicates the growing preference of electric cars in the Indian market subject to just and fair positioning by the manufacturers. Since it is new product launched in India, consumer awareness about electric cars is not too high. Therefore, a lot of risk is associated with the purchase of electric cars. These products also involve a high switching cost and are characterized by high involvement of the consumers because they come under the category of expensive products. Therefore, the manufacturers of electric cars should try to reduce the risk factor associated with the purchase of these cars. In other words, the electric car manufacturers should try to convert the dissonance aspect of the consumers buying behavior into the consonance type. This, in turn, will motivate consumers to purchase electric cars. The role of the manufacturing organization should be to highlight the benefits of driving an electric car vis –a - vis the other cars.

Furthermore, test driving is another important factor which might affect the purchase of an electric car. A question was asked in the survey that 'Have you ever test driven an electric car?' It can be seen from the data below that majority of the respondents spread across different types of cities have not test driven an electric car. Yet they exhibit a preference for electric cars. This, in itself, is a strong indication of a direct relationship between test marketing and purchase of electric cars. Since the data is showing a preference for an electric car, therefore we can say that the more test marketing of electric cars take place, more the purchase of electric cars will take place.

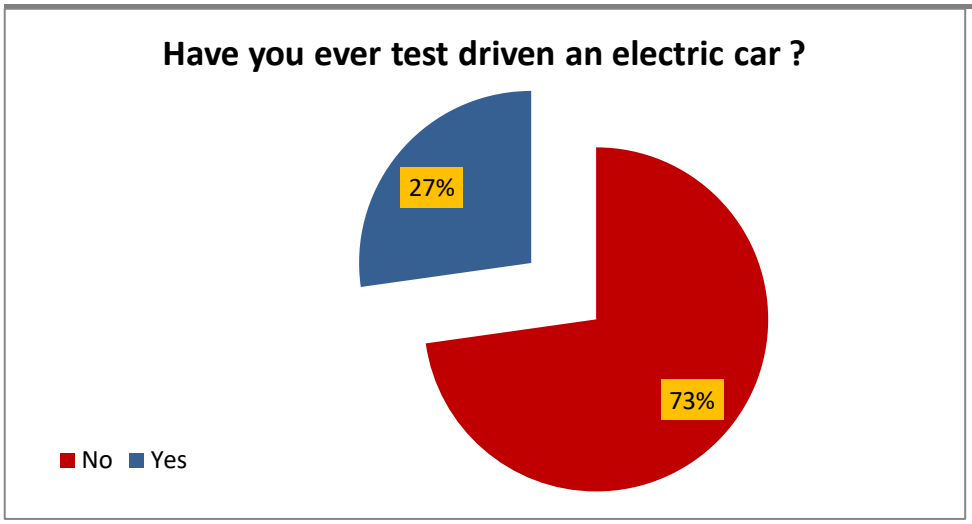
The response of the consumers is as follows:

Table 6

	Yes	No	Total
Test Driven Electric Car	58	155	213

The values from the above table were plotted with the help of a pie chart. The plotting of the pie chart for the above table helps us to identify the contributions of different categories to the entire whole. In the pie chart below, the contribution of people having test driven an electric car (yes respondents) and having not test driven an electric car (no respondents) is depicted in the form of percentages for a whole (total number of respondents).

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025



Graph 4

The huge growth potential across different types of cities in the electric car category can also be predicted because though the preference for electric cars is very high, around 73% of the consumers have not even test driven the car. Test driving an electric car will definitely lead to an increase in the conversion rate of the consumers across different cities. (Conversion rate is the movement of the consumers from preference to purchase of an electric car.) Through test driving, the consumers will get a first- hand experience of driving an electric car. One striking difference the consumers can identify while driving an electric car is that it makes less or no noise when in motion on road as compared to the other types of cars available in the market. On the other hand, the manufacturers and their dealers will have a very good opportunity to highlight on its unique features and also on the benefits of driving an electric car. The experience of the consumers during a test drive and the dealer showcasing the benefits of an electric car is a perfect blend for the consumers to make up their mind to purchase an electric car. Therefore, we can say that test driving results into consumers taking an informed decision to purchase an electric car. Hence it can be said that the sales potential of electric cars will increase throughout the country once a test drive is given to the consumers. Accordingly, a huge opportunity exists for electric car manufacturers to tap the market across different types of cities and a huge opportunity also exists for consumers to participate in the green initiative process by driving an eco safe product and contribute in making the world a better place to live in.

CONCLUSION:

This study has identified that the market for electric cars is present in the Indian sub continent and is present not only in the metro cities but is also spread across the tier 1 cities, tier 2 cities and tier 3 cities also. The consumers are also aware of the long term cost benefit involved in buying electric cars as these cars will be more economical as compared to fuel based cars. India might see a shift from the traditional fuel based system to alternative sources of energy applicable to the car manufacturing industry. With the gradual elimination of fuel based cars from the Indian markets and acceptance of electric cars across all geographical boundaries throughout the country, the Indian consumers will be taking a positive step towards the environmental concerns facing the Indian society. Reduced air pollution will result in a better Air Quality Index (AQI) which in turn will result into lesser cardio-vascular diseases, low absenteeism, lesser spending on medicines and hospitalization and a better standard of living.

The manufacturers of electric cars should instruct their dealers to promote electric cars in terms of the tax benefits given to the consumers on purchasing an electric car. The registration fee is also much less as compared to the registration of hybrid cars or petrol cars or diesel cars. Proper communication of these two factors by the dealers of the electric cars would certainly boost the sale of these cars.

Educational campaigns should be undertaken by the Government to make their initiative of complete electrification by the year 2030 a success. Consumers are not aware of the incentives given by the Government

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VII July 2025

on purchase of electric cars. If a Government run campaign is initiated, then it enhances the credibility of the said proposition. This will certainly shift the mind of the consumers towards purchasing an electric car.

Test drives should be organized by the dealers for the consumers to experience driving an electric car. There should not be dearth of availability of test models with the dealers. Benefits like less environmental pollution, lower maintenance cost, countering the high price of petrol and diesel fuels, smooth acceleration, lesser noise, advanced features etc. may be communicated to the consumers. This might also shatter some of reservations of the consumers in buying an electric car.

Computer simulation model or simulators can be designed by the electric car manufacturers and can be provided to the dealers. This will provide the consumers with a virtual test drive which will enable them to identify the battery consumption with respect to the distance covered, the style of driving and so on. It will also enable the consumers to check the performance of an electric car while driving through cities or across highways.

Even though the price of an electric car may be higher than the hybrid cars or the petrol cars, but based on the incentives given by the government, higher purchasing power of the consumer across different types of cities, availability of easy loans from the bank and the willingness to contribute towards an eco friendly environment, the probability of purchase of an electric car is much higher across the metro cities, tier 1 cities, tier 2 cities and tier 3 cities.

The electric car manufacturers can also target organizational consumers like travel agencies and promote their product. The benefits extended to them can be in the form of lesser fuel expenses and lesser carbon emissions. Purchase of electric cars by organizational consumers can also reflect their green image and concern for environment to their eco friendly consumers.

Hence, by undertaking all these activities, the sale of electric cars across metro cities, tier 1 cities, tier 2 cities and tier 3 cities will see a new high. The consumers will be highly convinced and determined to take a well informed decision in purchasing an electric car; thereby reducing their post purchase dissonance. There will be a huge demand for electric cars. The consumer's positive word of mouth publicity will spread like a fire in the jungle. And India will move towards having a more eco friendly environment.

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