A CASE STUDY REPORT ENTITLED

"CONSUMER BEHAVIOUR TOWARDS ELECTRIC CARS IN SADGURU GADAGE MAHARAJ COLLEGE, KARAD"

A SURVEY REPORT SUBMITTED TO

DEPARTMENT OF STATISTICS

SADGURU GADAGE MAHARAJ COLLEGE,

KARAD.

FOR THE PARTIAL FULFILLMENT OF THE DEGREE

MASTER OF SCIENCE

IN

STATISTICS

SUBMITTED BY,

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M.Sc. II (Statistics)

Under the guidance of

Dr. Mrs. S. P. Patil

2020-2021

CERTIFICATE

This is to certify that the survey report entitled **consumer behaviour towards electric cars in Sadguru Gadage Maharaj College, Karad** being Submitted by **Mr. Rajeshirke Shrinath Ranjit & Mr. Kumbhare Vaibhav Anil** as partial fulfilment for the award of degree of M.Sc. (Statistics) is a record of work carried out by her under my supervision and guidance. To the best of my knowledge the matter presented in the survey has not been submitted earlier.

Place: Karad

Date:

Dr. Mrs. S. P. Patil

Project guide

Dr. Mrs. S. S. Dawari,

Head,

Department of Statistics,

Sadguru Gadage Maharaj College,

Karad.

ACKNOWLEDGEMENT

We have taken efforts in this survey however it would not have been possible without the kind of support & help of many individuals. We would like to extend our sincere thanks to all of them.

It's our great pleasure to express our sincere thanks with deep sense to Dr. Mrs. S. P. Patil for their valuable guidance & constant encouragement during the course of work & for providing us necessary facilities as well as for providing necessary information regarding the survey.

We would also like to thank Dr. Mrs. S. S. Dawari Head, Department of Statistics, Dr. Mrs. S. P. Patil for their precious co-operation. Also, we would like to thank all non-teaching staff of our department for their help & Co-operation.

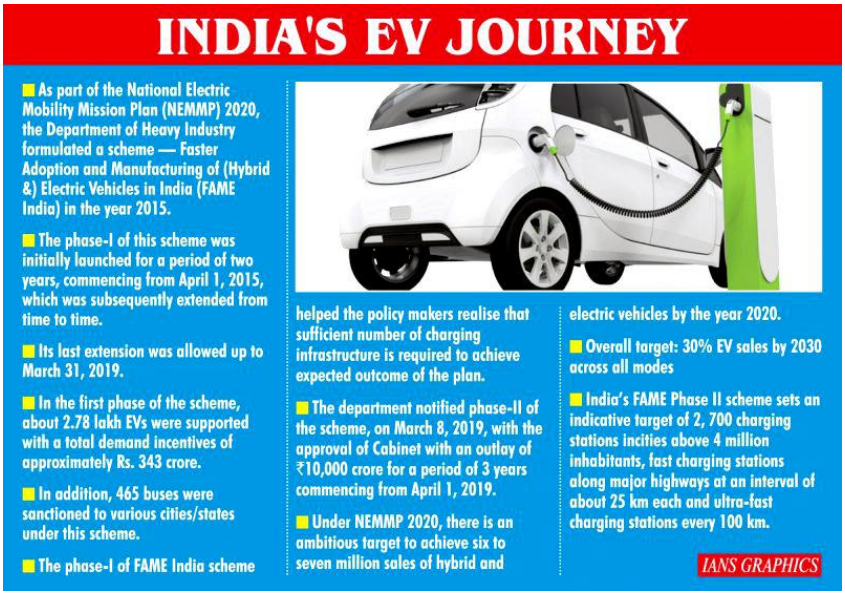
We thank all teachers for spending their valuable time for our data collection. We thank all my friends and research students for their co-operation and help which we received from them during the work throughout.

CONTENTS

INTRODUCTION

The **electric vehicle industry** in India is a growing industry. The central and state governments have launched schemes and incentives to promote electric mobility in the country and some regulations and standards are also in place. While the country stands to benefit in a large way by switching its transport from IC engines to electric motor-powered, there are challenges like lack of charging infrastructure, high initial cost and lack of electricity produced from renewable energy. Still, e-commerce companies, car manufacturers, app-based transportation network companies and mobility solution providers have entered the sector and are slowly building up electric car capacity and visibility.

First Electric Vehicle in India - Lovebirds (1993, New Delhi)

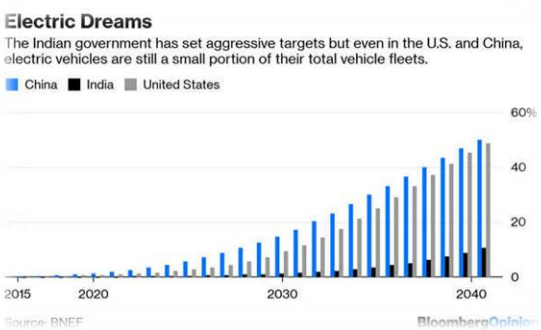


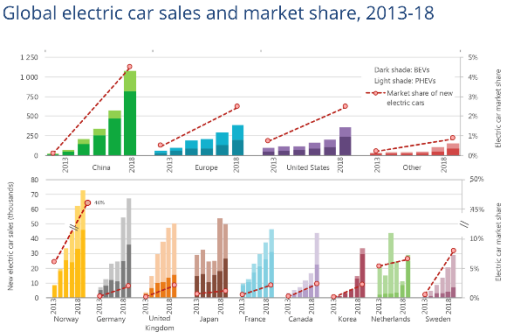
India's EV Journey

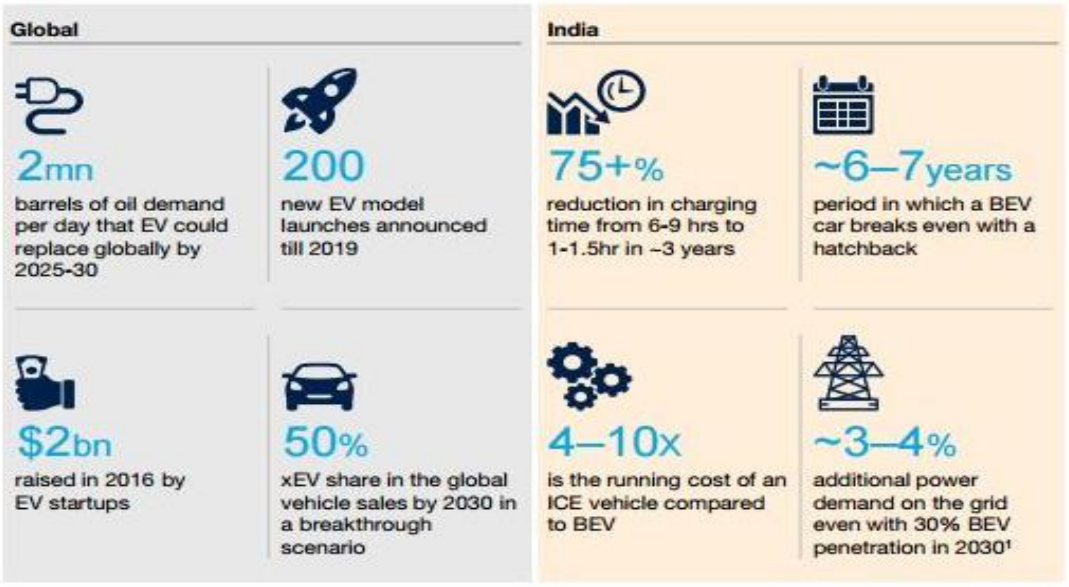
BENEFITS OF ELECTRIC VEHICLES

- Electric vehicles are around 3-5 times more efficient than internal combustion vehicles in utilising energy.
- Electric vehicles save energy by regenerative braking. Around 30%-70% of the energy used for propulsion can be recovered, with higher percentages applicable to stop-and-go city driving.
- Electric vehicles are much quieter and may contribute to a reduction in noise pollution levels in the cities.

- Through smart charging, electric vehicles can help to balance the balance-supply variations in the electricity grid, and provide a buffer against electricity supply failures.
- Electric vehicles have much fewer moving parts as compared to vehicles with IC engines. Thus, being simpler, they are cheaper and easier to maintain.
- Electric motors can deliver high torque at low speeds. As a result, electric vehicles deliver much better performance while starting off and on slopes than IC engine-powered vehicles.

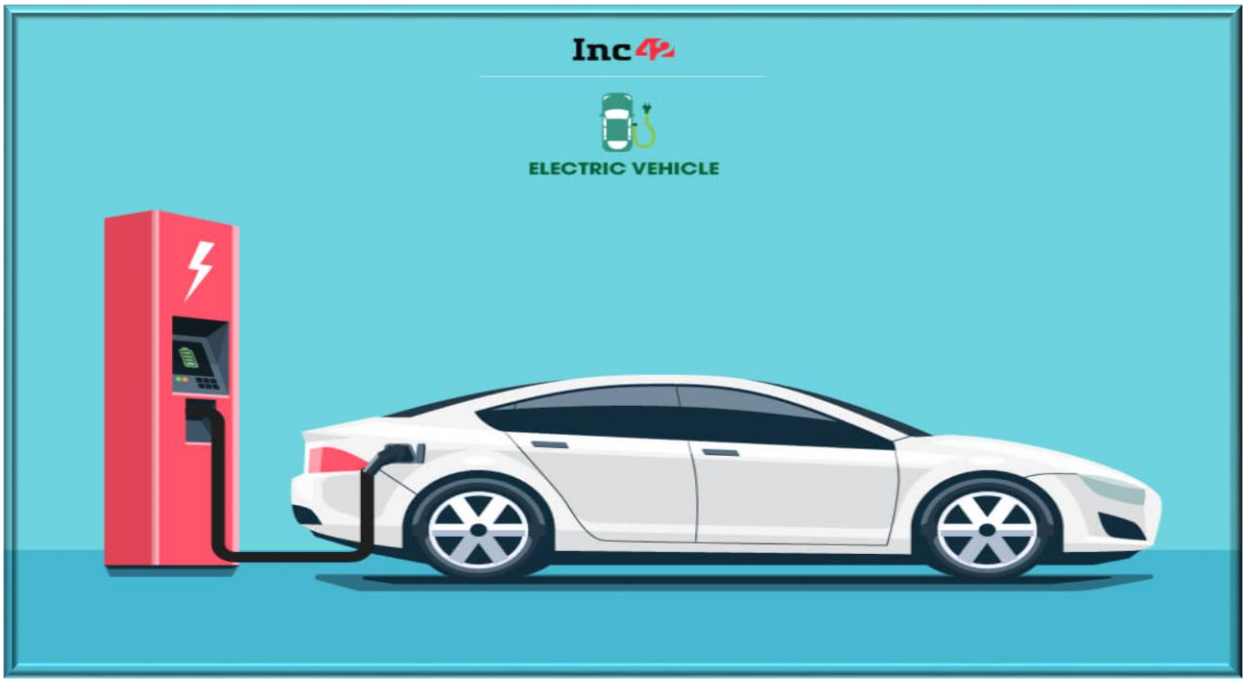






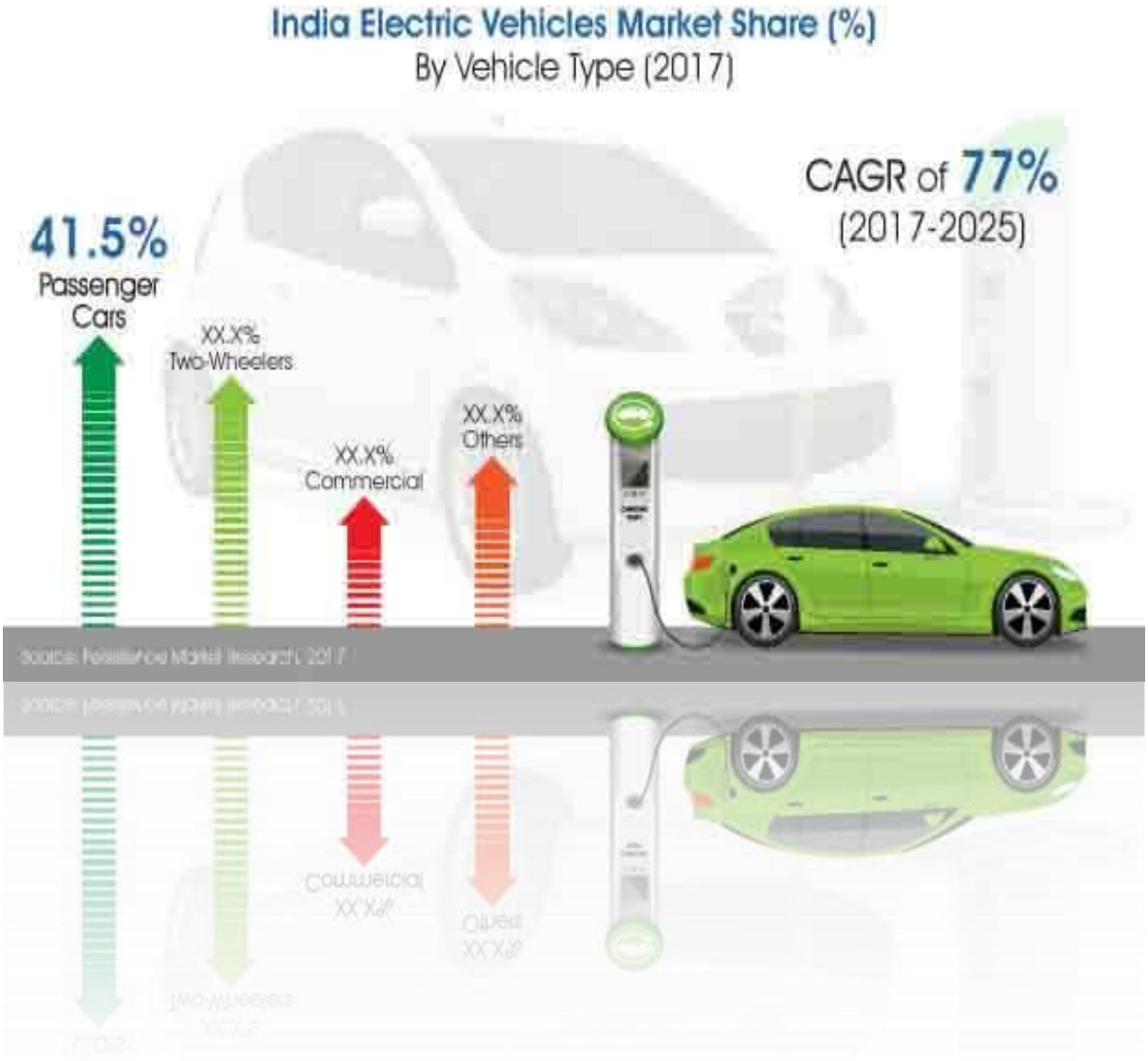
CHALLENGES FACED

- The charging infrastructure for electric vehicles in India has not been fully developed yet.
- Cost - The cost of EVs is very high mainly due to the cost of Li-ion cells. The battery packs are imported and cost a lot, about $275/KWh in India. This combined with the GST of 28% and the lack of lithium in India, further increase the cost of batteries. Most EVs in India provide a range of 110 km and cost between Rs 6-8 lakhs which does not give a cost advantage compared to higher range cars in the same price range.
- Lack of renewable energy & grid infrastructure - In India electricity is mainly produced by burning coal, which produces a great amount of greenhouse emissions. With the introduction of EVs and charging infrastructure, the electricity demand will go up a lot and the whole point of introducing EVs to reduce GHG emissions would be ineffective, if all this electricity was produced by burning coal. Moreover, India's Distribution companies hold debts and are unable to suffice the energy requirement of the whole country adequately. If EVs were to enter this equation, the sudden increase in electricity requirement would put extra load on these companies. Moreover, there are a lot of factors that would go into deciding pricing of the electricity as well the demand on the grid.
- Charging infrastructure - The Government of India has declared public charging stations and EV charging businesses as a de-licensed activity. The government has laid down that there should be at least one charging station in a grid of 3 km x 3 km in cities and one station every 25 km on both sides of highways. This coverage is to be achieved in cities with a population of more than 4 million and all existing expressways and important highways connected to these mega cities by 2022.



OBJECTIVES

- Consumer thoughts about electric cars
- Factors encouraging and discouraging to buy electric cars
- Awareness about electric cars in India
- Influence of electric cars on image of consumer



RESEARCH METHODOLOGY

DATA SOURCE

- In our survey we take data of teachers in the Sadguru Gadage Maharaj College, Karad. We collect the data through the questionnaire.

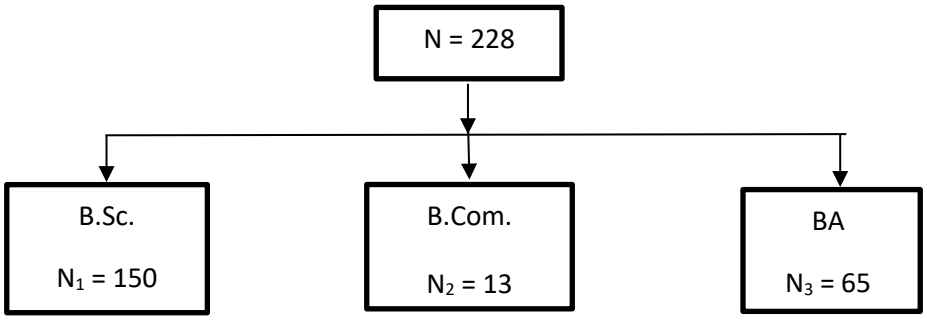
DATA COLLECTION

- Firstly we collect the strength of all post graduate students of Arts, Science and Commerce faculty in the Sadguru Gadage Maharaj College, Karad.

SAMPLING

- In our survey we use stratified sampling with proportional allocation. Here College is our geographical area with population N. The three main strata's are faculties such as arts, commerce and science.

SAMPLING STRATEGY



Our population is wide. Study of whole population is difficult. So, we choose samples from the population. We decide the sample size by Yamane's formula & then use stratified sampling with proportional allocation for this population,

DETERMINATION OF SAMPLE SIZE

YAMANE'S FORMULA –

The sample size for survey is determined by Yamane's (1962) formula. Yamane's provides a simplified formula to calculate the sample size as follows –

$$n = \frac{N}{1 + (N * e^2)}$$

Where, N – Population size

e = Level of precision

Where, N = 1540, e = 0.07 for 93% confidence level

$$n = \frac{228}{1+(228*(0.07)^2)} = 108$$

For choosing representative of each and every class, we use stratified sampling under proportional allocation –

$$n_i = \frac{n}{N} N_i$$

Where, n_i is sample size of i^{th} strata
N_i is the population size of i^{th} strata

SAMPLING METHODOLOGY

Firstly we made three main strata's such as arts, commerce and science. Here we consider N=1540 as a population and Na , Nc , Ns as a strata size such that Na + Nc + Ns = N.

Then by using proportional allocation we find na , nc , ns respectively. Where na , nc , ns be the sample size such that na + nc+ ns=n corresponding to three strata's arts, commerce and science respectively.

$$n_i = \frac{n}{N} N_i \text{ ; i = 1,2,3}$$

Again we made department wise substrata's for each faculty.

For Example, For Science faculty we make department wise 9 sub strata's like Nd1, Nd2, ... , Nd9. Here we consider Ns as a population then by using proportional allocation we find a sample sizes of nd1, nd2, ... , nd9.

$$n_{di} = \frac{n_s}{N_s} N_{di} \text{ ; i = 1,2,…..,9}$$

For all sample sizes of substrata's refer Appendix

We have numbered respondents from 1 to 228. Then, we use random number generation method by using excel to select the respondent.

TOOLS & TECHNIQUES

STATISTICAL TECHNIQUES

- Graphical representation
- Contingency table
- Discrete data analysis

STATISTICAL SOFTWARE'S

- Microsoft Excel
- R studio

RELIABILITY OF DATA

CRONBACH'S ALPHA

- Cronbach's alpha is used to estimate the reliability of a psychometric test or internal consistency of a set of scale or test items.
- The reliability of given measurement refers to the extent to which it is a consistent measure of a concept & Cronbach's alpha is one way of measuring the strength of that consistency.
- Cronbach's alpha is computed by correlating the score for each scale item with the total score for each observation & then comparing that to the variance for all individual item scores.

Formula:

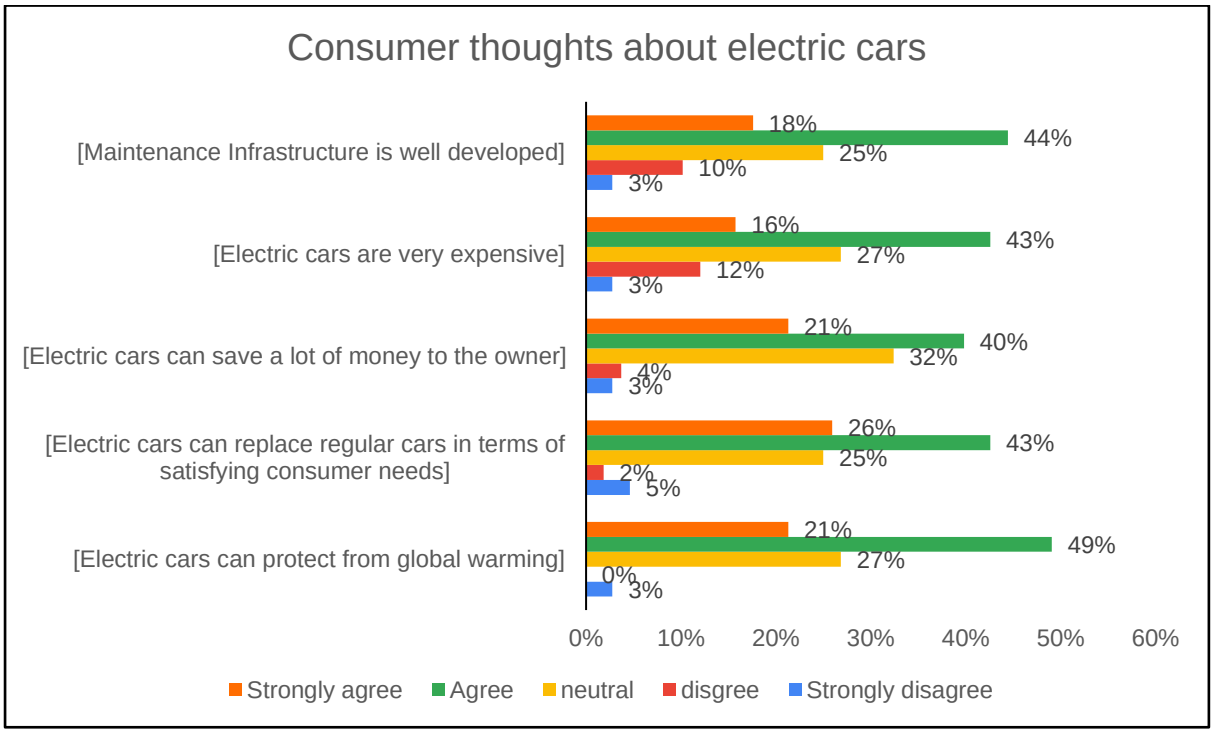
$$\alpha = \left(\frac{K}{K-1}\right) * \left(1 - \frac{\sum_{i=1}^{k} \sigma_{yi}^2}{\sigma_x^2}\right)$$

Where,
K = Number of scale items.
σ^2_{yi} = The variance associated with item i.
σ^2_x = The variance associated with the observed total scores.
$\alpha = 0.73$
Therefore, α lies in the acceptable range that is $0.7 \leq \alpha \leq 0.8$.
Hence, we conclude that our likert scale will reliable & also we say that internal consistency of likert scale is acceptable.

PILOT STUDY CONCLUSION

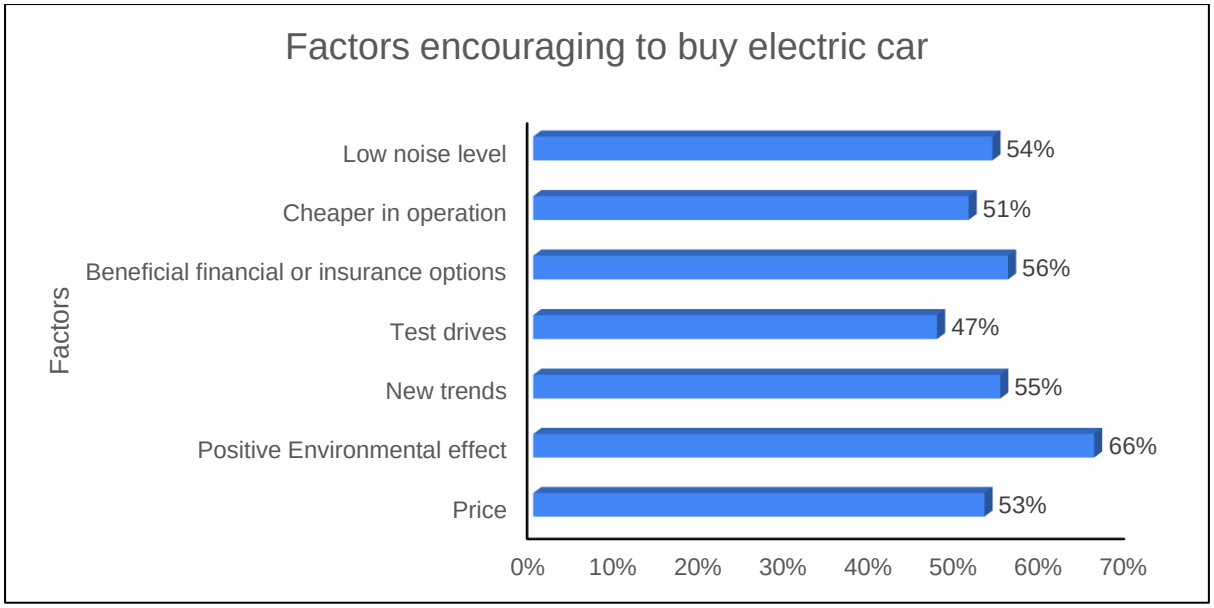
We have done pilot study to check the reliability of questions. Reliability of questions is measured using Cronbach's alpha.
Form analysis of pilot study reliability of questions is 0.73. So we extend this survey for large sample.

DATA ANALYSIS

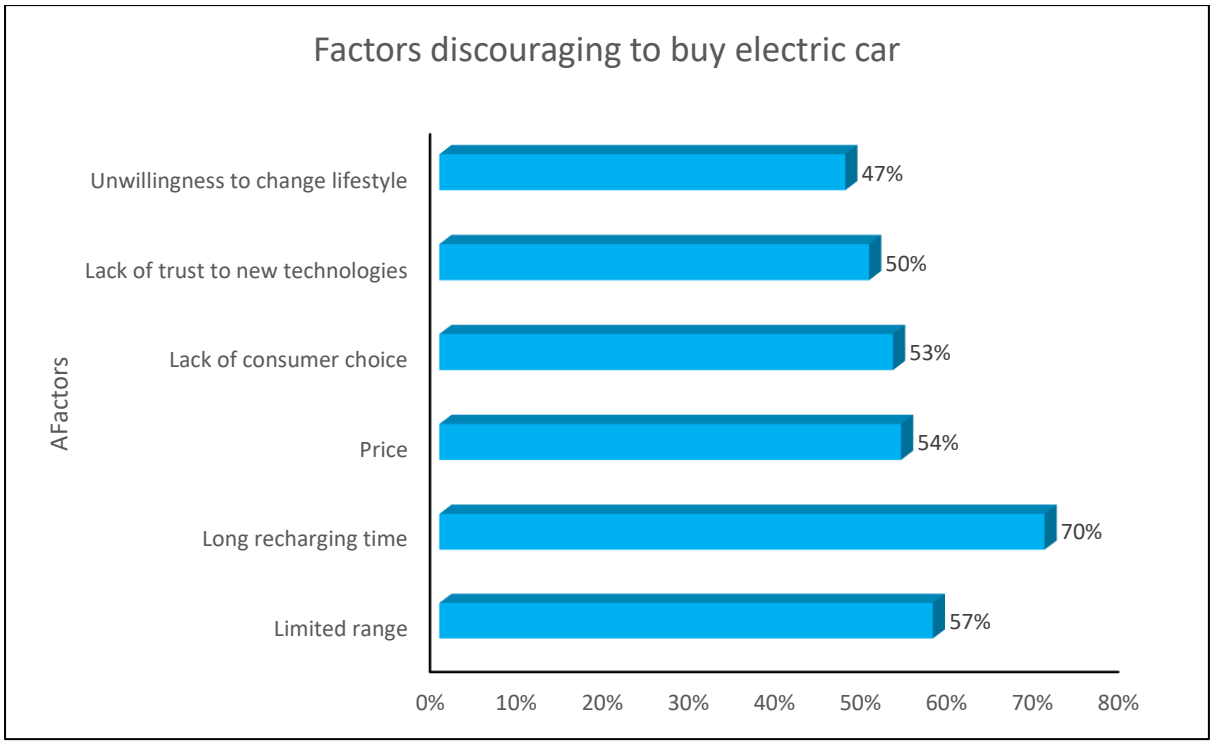


Conclusion –

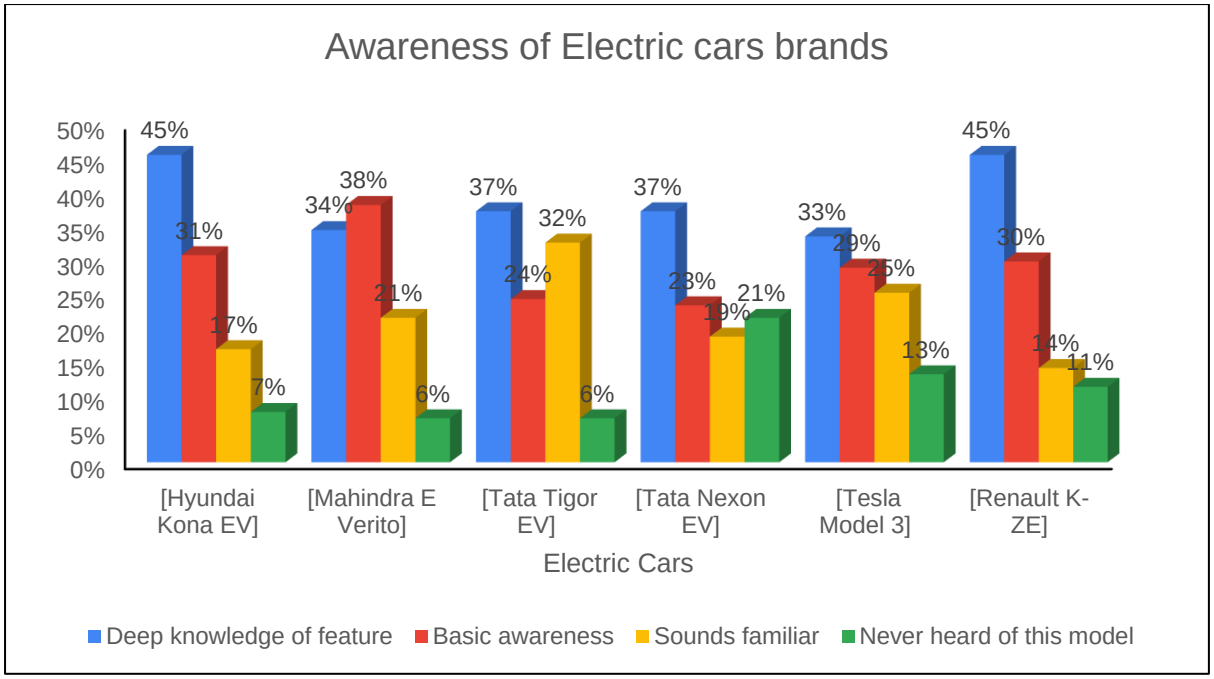
- About 70% of the respondents agree with the statement that the electric cars can protect from global warming.
- About 69% of the respondents agree with the statement that the electric cars can replace regular cars in terms of satisfying consumer needs.
- About 61% of the respondents agree with the statement that the electric cars can save a lot of money to the owner.
- About 59% of the respondents agree with the statement that electric cars are very expensive.
- About 62% of the respondents agree with the statement that the maintenance infrastructure is well developed.



Conclusion – Positive environmental effect is the most encouraging factor consider for buying electric car.

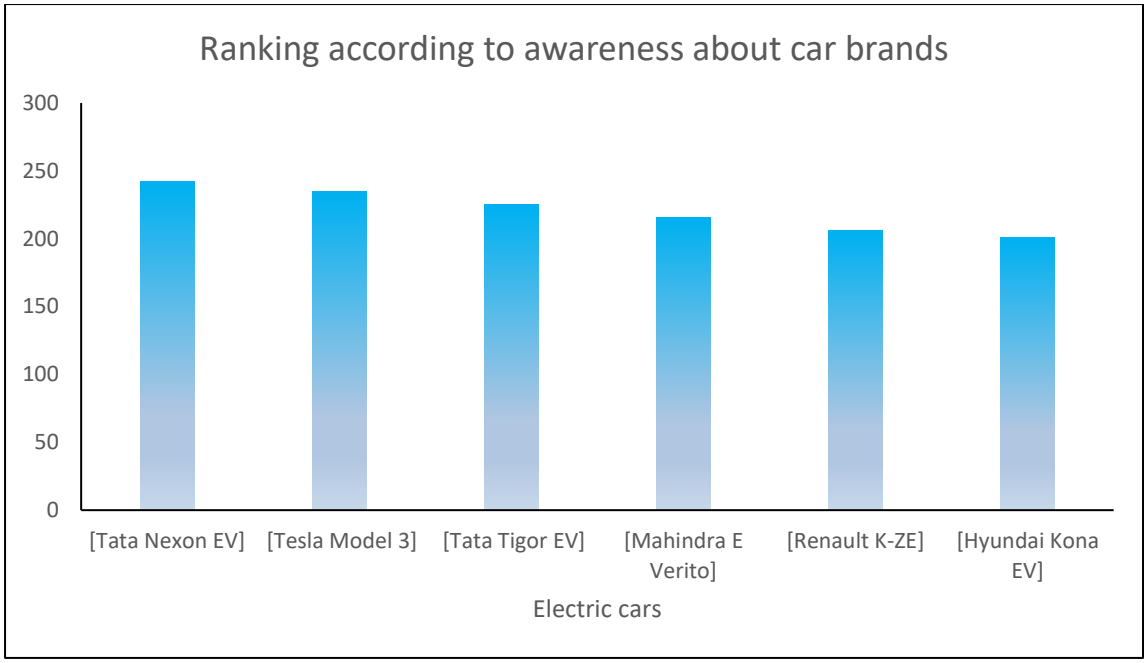


Conclusion – Long recharging time & limited range is the most discouraging factor consider for buying electric car.

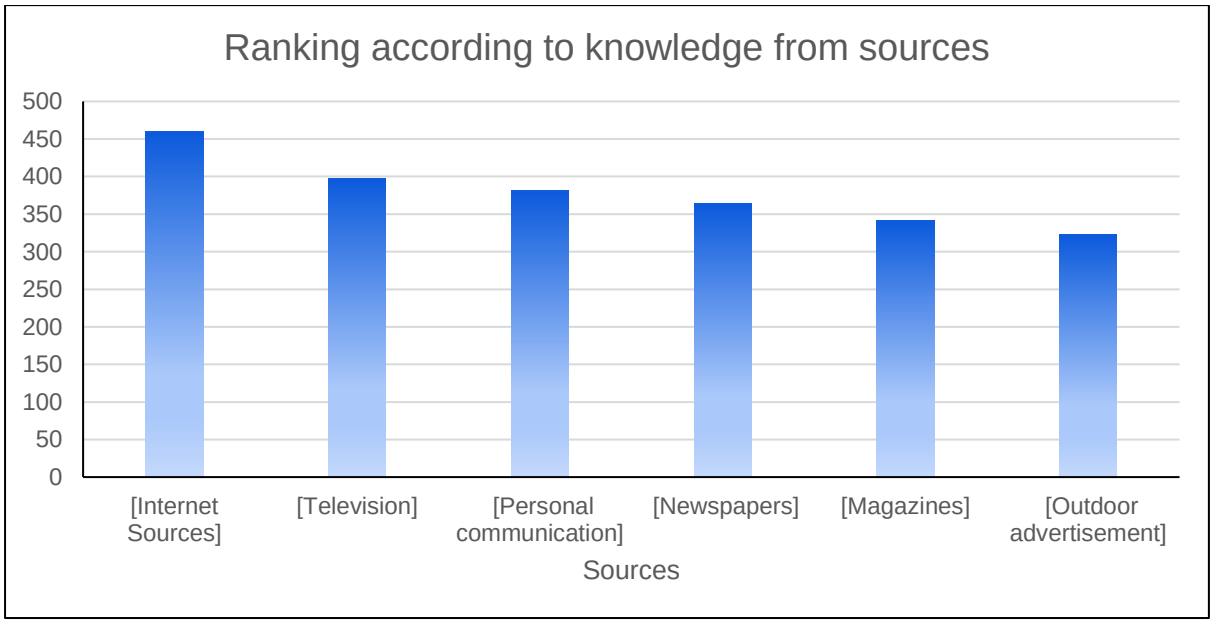


Conclusion –

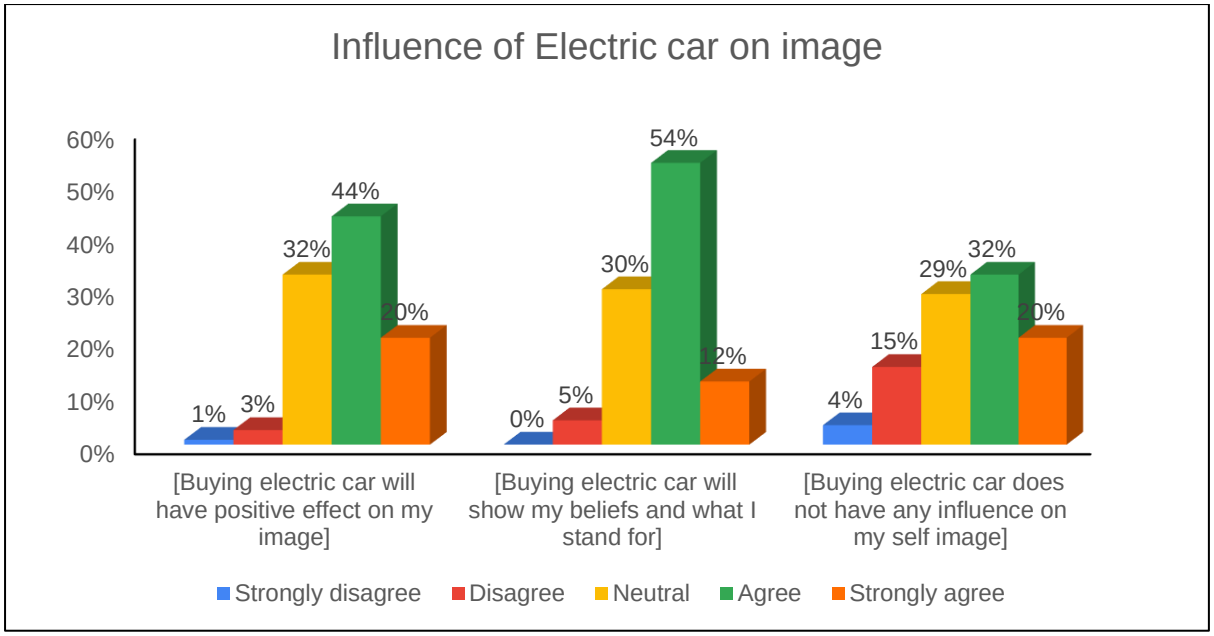
- Hyundai Kona EV – 55% of the respondents are aware about this model & 45% never heard about it.
- Mahindra E Verito – 66% of the respondents are aware about this model & 34% never heard about it.
- Tata Tigor EV - 63% of the respondents are aware about this model & 37% never heard about it.
- Tata Nexon EV - 63% of the respondents are aware about this model & 37% never heard about it.
- Tesla Model 3 – 67% of the respondents are aware about this model & 33% never heard about it.
- Renault K-ZE - 55% of the respondents are aware about this model & 45% never heard about it.



Conclusion – The above graph shows that the Tata Nexon EV is the well known model in the electric cars.

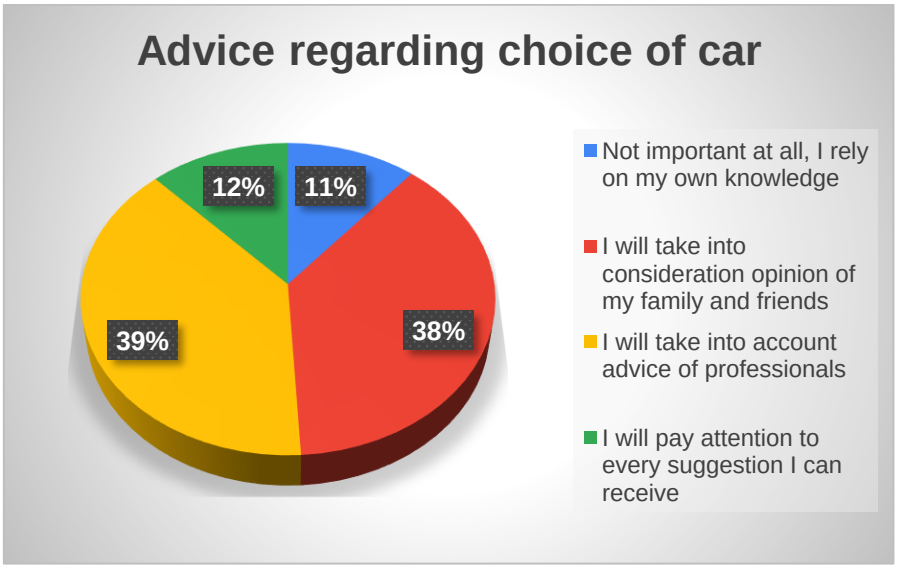


Conclusion – The above graph shows that internet sources & television is the most informative sources for getting knowledge about electric cars.

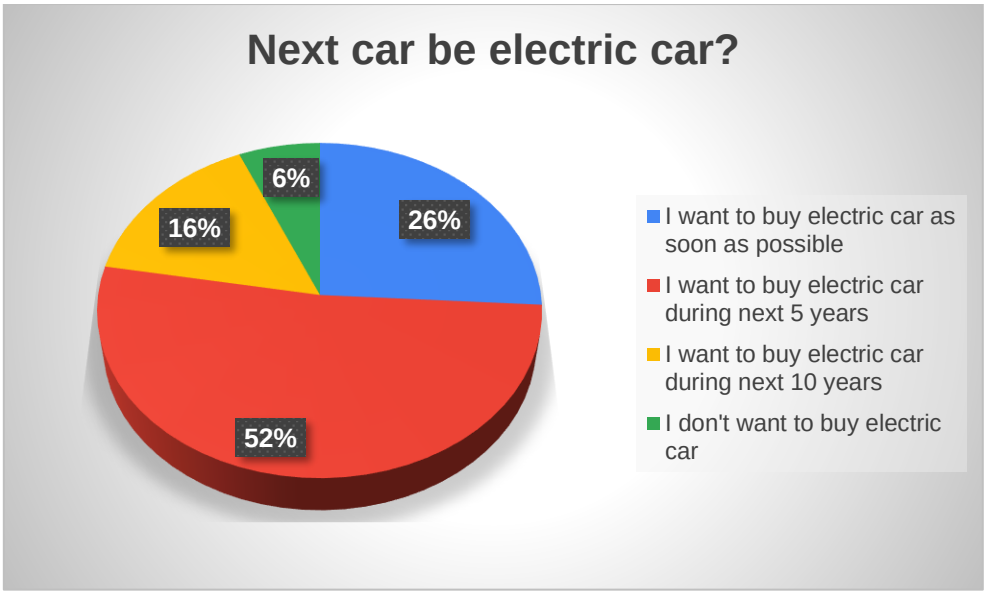


Conclusion –

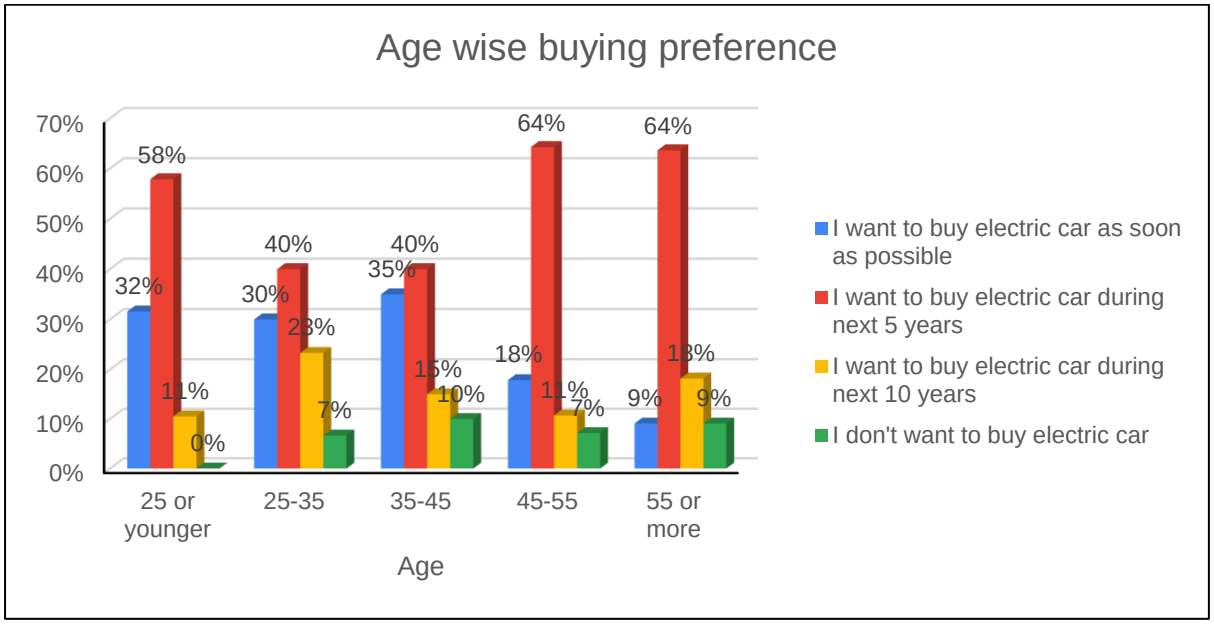
- 64% of the respondents agree that buying electric car will have positive effect on image.
- 66% of the respondents agree that buying electric car will show their beliefs & what they stands for.
- 50% of the respondents agree that buying electric car does not have any influence on self image.



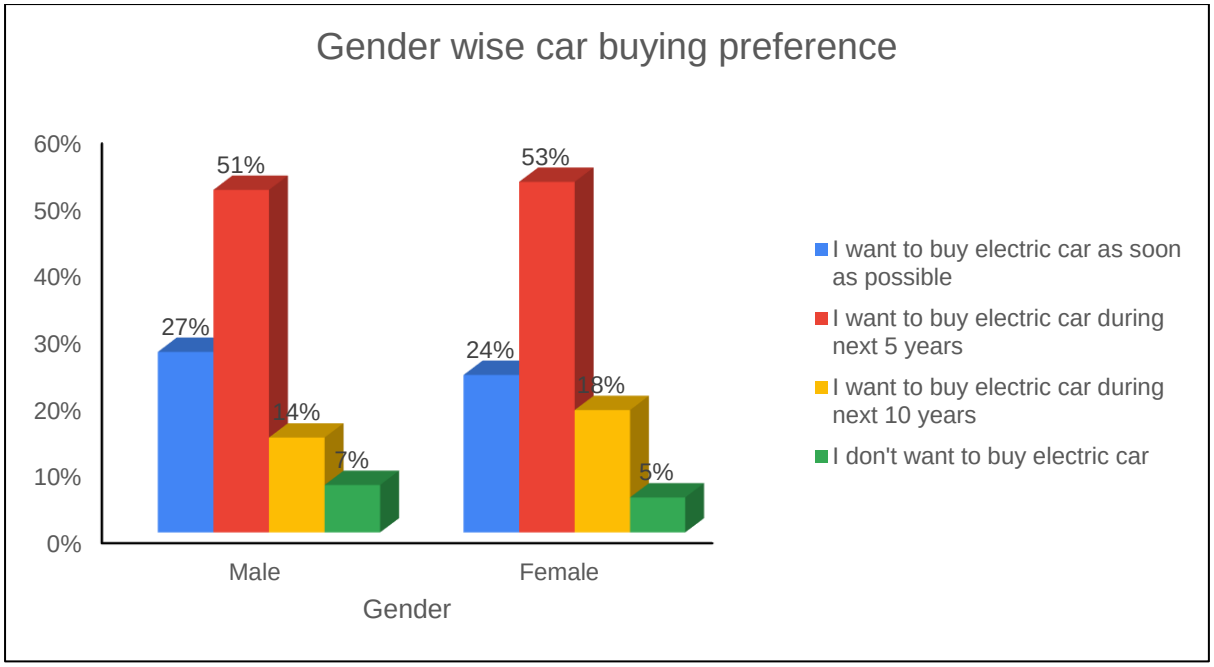
Conclusion – 39% of respondents take into account advice of professionals & 38% of respondents take into account opinion of family & friends.



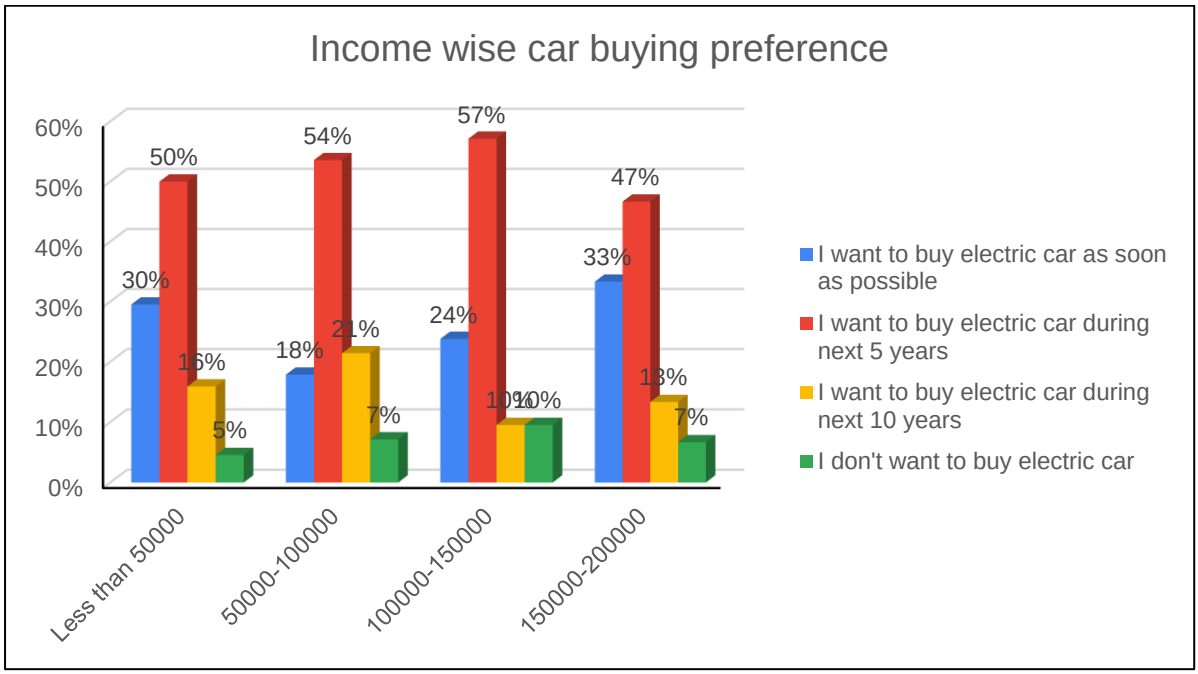
Conclusion – 52% of the respondents says that they want to buy electric car during next 5 years.



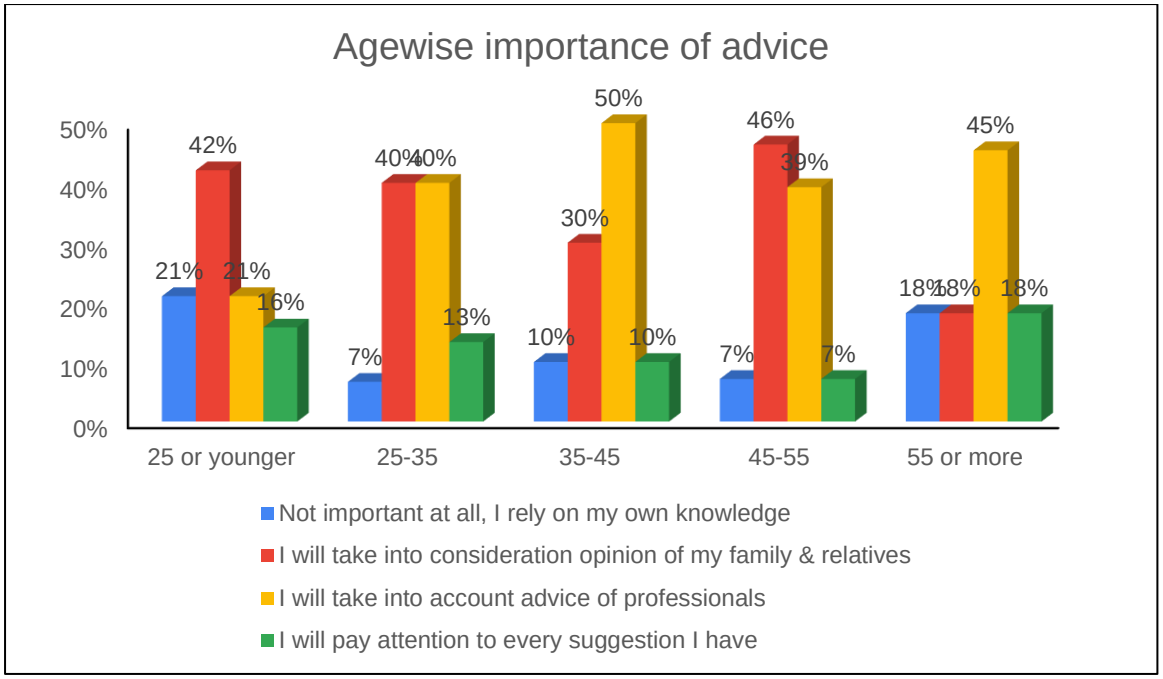
Conclusion – On an average 53% of respondents of each age group wants to buy electric car during next 5 years.



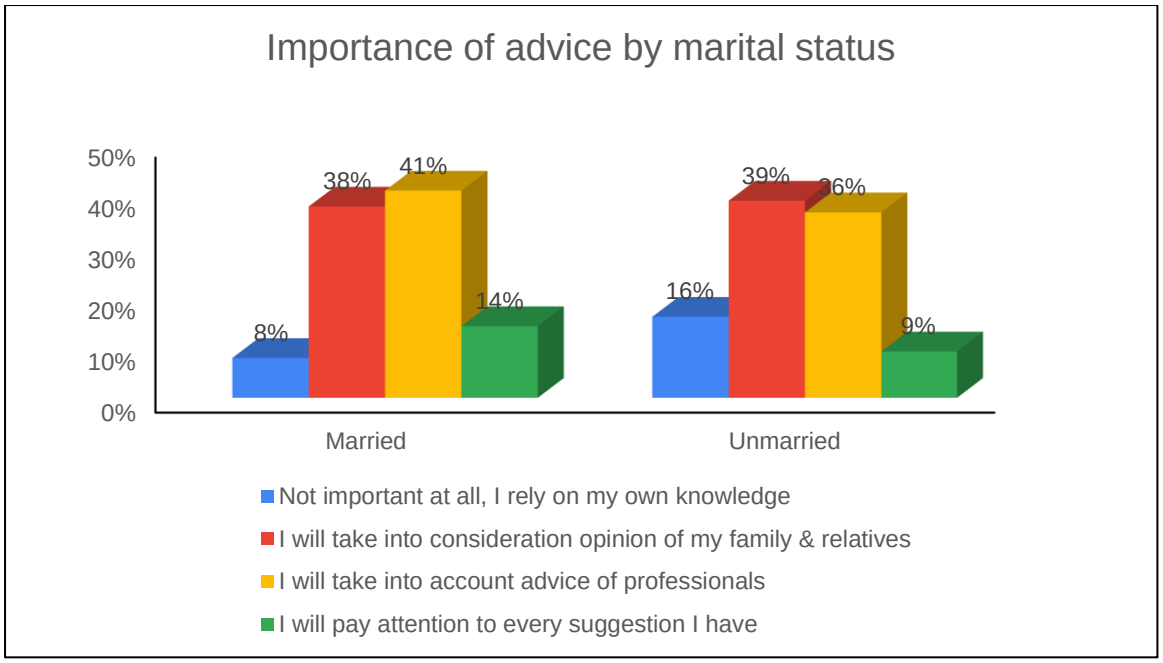
Conclusion – 51% of the male & 53% of the females wants to buy electric car during next 5 year.



Conclusion – On an average 52% respondents of each income group wants to buy electric car during next 5 years.



Conclusion – On an average 73% of the respondents gives importance to other's advice of each ade group. Mostly opinion of family and advice of professionals is important for each age group.



Conclusion – 76% of married respondents & 75% of unmarried respondents gives importance to others advice. Mostly opinion of family and advice of professionals is important.

CHI SQUARE TEST OF INDEPENDENCE –

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{i,j} - E_{i,j})^2}{E_{i,j}}$$

Where,

χ^2 – Chi-square test statistic

$O_{i,j}$ – Observed values of the variables

$E_{i,j}$ – Expected value of the variables

r – Number of rows & c – Number of columns

KENDALL RANK CORRELATION COEFFICIENT TEST –

$$z = \frac{2(n_c - n_d)}{\sqrt{n(n-1)(2n+5)/2}}$$

Where,

n_c - Number of concordant pairs

n_d – Number of discordant pairs

n – Total number of items

1) To check association between age & electric car buying preference

Hypothesis –

H_o – There is no association between age & electric car buying preference.

H_1 - There is association between age & electric car buying preference.

Kendall's rank correlation test results (using R studio)

Z = 1.3031,p-value = 0.1926

τ = 0.1064

Here, p-value > 0.05

Hence, we fail to reject H_o at 5% level of significance.

Conclusion –

There is no sufficient evidence that there is association between age & electric car buying preference.

2) To check association between age & electric car buying preference

Hypothesis –

H_o – There is no association between gender & electric car buying preference.

H_1 - There is association between gender & electric car buying preference.

Observation table –

Gender	I want to buy electric car as soon as possible	I want to buy electric car during next 5 years	I want to buy electric car during next 10 years	I don't want to buy electric car	Total
Male	19	36	10	5	70
Female	9	20	7	2	38
Total	28	56	17	7	108

Pearson's Chi-square test results (using R studio)

$\chi^2 = 0.5223$, df =3 , p-value = 0.914

Here, p-value > 0.05

Hence, we fail to reject H_o at 5% level of significance.

Conclusion –

There is no sufficient evidence that there is association between gender & electric car buying preference.

3) To check association between income & electric car buying preference

Hypothesis –

H_o – There is no association between income & electric car buying preference.

H_1 - There is association between income & electric car buying preference.

Kendall's rank correlation test results (using R studio)

Z = 0.1526, p-value = 0.8767

$\tau = 0.0127$

Here, p-value > 0.05

Hence, we fail to reject H_o at 5% level of significance.

Conclusion –

There is no sufficient evidence that there is association between income & electric car buying preference.

4) To check association between age & importance to someone's advice

Hypothesis –

H_o – There is no association between age & importance to someone's advice

H_1 - There is association between age & importance to someone's advice

Observation table –

Age	Not important at all, I rely on my own knowledge	I will take into consideration opinion of my family & relatives	I will take into account advice of professionals	I will pay attention to every suggestion I have	Total
25 or younger	4	8	4	3	19
25-35	2	12	12	4	30
35-45	2	6	10	2	20
45-55	2	13	11	2	28
55 or more	2	2	5	2	11
Total	12	41	42	13	108

Pearson's Chi-square test results (using R studio)

$\chi^2 = 8.8096$, df = 12, p-value = 0.7191

Here, p-value > 0.05

Hence, we fail to reject H_o at 5% level of significance.

Conclusion –

There is no sufficient evidence that there is association between age & importance to someone's advice.

5) To check association between marital status & importance to someone's advice

Hypothesis –

H_o – There is no association between marital status & importance to someone's advice

H_1 - There is association between marital status & importance to someone's advice

Observation table –

Marital status	Not important at all, I rely on my own knowledge	I will take into consideration opinion of my family & relatives	I will take into account advice of professionals	I will pay attention to every suggestion I have	Total
Married	5	24	26	9	64
Unmarried	7	17	16	4	44
Total	12	41	42	13	108

Pearson's Chi-square test results (using R studio)

$\chi^2 = 2.2044$, df = 3, p-value = 0.5311

Here, p-value > 0.05

Hence, we fail to reject H_o at 5% level of significance.

Conclusion –

There is no sufficient evidence that there is association between marital status & importance to someone's advice.

MAJOR FINDINGS

1. Over 60% of respondents are agree with the positive effect of the electric cars. This shows that the consumer has positive thoughts about electric cars.
2. Positive environmental effect is the most encouraging factor consider for buying electric car.
3. Long recharging time & limited range is the most discouraging factor consider for buying electric car.
4. Most of the consumer just heard about the most of the models which are now present in Indian market. So, there is lack of awareness about the electric car models.
5. The Tata Nexon EV is the well known model as compared to other car models.
6. Internet sources & television are the most informative sources for getting knowledge about electric cars.
7. 65% of the respondents agree that buying electric car will have positive effect on image & show their beliefs.
8. 39% of respondents take into account advice of professionals & 38% of respondents take into account opinion of family & friends.
9. 52% of the respondents says that they want to buy electric car during next 5 years.
10. There is no association between age & electric car buying preference.
11. There is no association between gender & electric car buying preference.
12. There is no association between income & electric car buying preference.
13. There is no association between age & importance to someone's advice.
14. There is no association between marital status & importance to someone's advice.

LIMITATIONS

- Study time was limited. So we conducted survey only for teachers in our college.
- Survey done on a small population size.

SCOPE

- The same analysis can be carried out for a city or district.
- This case study will help to electric car companies to remove there drawbacks & improve quality.
- This case study also shows that people must be aware about Indian electric cars through different media's.

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APPENDIX I

Survey Questionnaire

Sadguru Gadage Maharaj College, Karad

Department of statistics

Class: M.Sc. II

Title of the Survey: consumer behaviour towards electric cars in Sadguru Gadage Maharaj College, Karad.

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1. What is your age?

- 25 or younger
- 26-35
- 36-45
- 45-55
- 55 or older

2. What is your gender?

- Male
- Female

3. What is your education level?

- Bachelor's degree
- Master's degree
- PhD

4. What is your approximate yearly income?

- Less than 50000
- 50000 – 100000
- 100000 – 150000
- 150000 – 200000
- More than 200000

5. Marital status

- Married
- Unmarried

6. What factors encourage you to consider buying electric car?

- Price
- Positively environmental effect
- Promotion
- References
- New trends
- Test drives
- Beneficial financial or insurance options
- Cheaper in operation
- Low noise level

8. What factors discourage you to consider buying electric car?

- Limited range
- Long recharging time
- Price
- Lack of consumer choice
- Lack of trust to new technologies
- Unwillingness to change in lifestyle

7. What do you think about following statements?

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Electric cars can protect from global warming					
Electric cars can replace regular cars in terms of satisfying consumer needs					
Electric cars can save a lot of money to the owner					
Electric cars are very expensive					
Maintenance infrastructure is well developed					

9. What are the electric cars that you know

Car	Deep knowledge of car	Basic awareness	Sounds familiar	Never heard of this model
Hyundai Kona EV				
Mercedes-Benz EQC				
Mahindra E Verito				
Tata Tigor EV				
MG ZS EV				
Tata Nexon EV				
Tesla Model 3				
Renault K-ZE				
BMW i3				

10. From what sources did you get the most of your knowledge about electric cars? 1 - the most informative, 6 - the least informative

- Newspapers
- Magazines
- Television
- Internet Sources
- Outdoor Advertisement
- Personal Communication

11. At your opinion, electric car has an influence on your image?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Buying electric car will have positive effect on my image					
Buying electric car will show my beliefs & what I stands for					
Buying electric car does not have any influence on my self image					

12. How important for you is someone's advice regarding choice of a car, particularly electric car?

- Not important at all, I rely on my own knowledge
- I will take into consideration opinion of my family & friends
- I will take into account advice of professionals
- I will pay attention to every suggestion I have

13. How likely that your next car will be electric car?

- I want to buy electric car as soon as possible
- I want to buy electric car during next 5 years
- I want to buy electric car during next 10 years
- I don’t want to buy electric car

APPENDIX 2

Table of Population size and sample size

Faculty	Total	
	N	n
Science	150	71
Commerce	13	6
Arts	65	31