Equitability of Barriers in Two Wheeler Electric Vehicle Sales

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ABSTRACT

The two-wheeler EV market is rapidly growing due to increased demand for environmentally friendly transportation options and awareness of the benefits of electric vehicles. However, factors preventing customers from purchasing EVs need to be identified to improve sales, and manufacturers should tailor their marketing strategies based on consumer segments. This research is based on data collated from 200 customers from 5 major two wheeler showrooms in Chennai city. It was found that the major barrier intwo-wheeler EV sales was "Range Anxiety" with a Weighted score of 1837. The least ranked barrier was "Battery drain and battery replacement cost in few years" with a Weighted score of 1309. However these factors are not equitable when income of customers is considered. The ranking of various barriers differs significantly based on the income of the customers.

Keywords: Two Wheeler Electric Vehicles, Barriers in EV Sales, Ranking of Challenges to EV sales, Income and EV Sales.

INTRODUCTION

The two-wheeler electric vehicle (EV) market has been growing rapidly in recent years, driven by the increasing demand for environmentally friendly transportation options and the growing awareness of the benefits of electric vehicles. The market introduction of two-wheeler EVs has been supported by several factors, including government initiatives, advancements in battery technology, and the introduction of new and innovative models. According to a report by Bloomberg NEF, India's EV market is expected to reach 30.7 million units by 2040, accounting for 80% of all vehicle sales in the country. The government has set a target of 30% EV penetration by 2030 to reduce carbon emissions and dependence on fossil fuels.The Indian government too has helped by implementing encouraging policieslike the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, which provides incentives for the purchase of EVs and the development of charging infrastructure. and National Electric Mobility Mission Plan (NEMMP) to promote the development and manufacturing of EVs in India. Despite all these there still are many factors which are holding back customers from buying Electric two wheelers. It is important to identify these factors and understand if they equally affect consumers of varying income group. The result will help manufacturers of EVs customize their marketing strategy based on the segment of customers and improve the sales of their EVs.

LITERATURE REVIEW

Lingamurthy, S, Pani, Amrita, &rao, vengala (2023) in their research contribute to the understanding of the demand for electric vehicles in the context of transition to electric vehicle dependent transportation . The collected data was analyzed using a decision tree algorithm and the results of the survey shows thatsignificant proportion of the population is interested in electric vehicles .The study also revealed a risk-averse attitude ofrespondents.

Goswami, Rajeev (2022)carried out survey in in six cities of India :Delhi, Bengaluru, Mumbai, Nagpur, Kolkata, and Dehradun to gauge the willingness of consumers to adopt EVs based on behavioural factors such as age, environmental consciousness, price, brand, and performance. The study reveals that behavioural factors do impact willingness of consumers to adopt EVs.

Singh, Deepanshu, &Kumawat, Manoj (2022) studied the India's electric mobility scenario. They also studied the barriers in adopting electric vehicles. They found that travel range, battery charging period, initial cost, charging infrastructure are some of the major factors which are hindering the rapid growth of electric transportation .

Kambli, Rujuta O. (2022) outlines the present scenario of EVs and states that EVs hold great promise to replace internal combustion engine vehicles . EVs can provide a number of benefits like reducing reliance on petroleum, reducing emissions and improving air quality. EVs can help in urban micro mobility and can be part of "mobility as a service solutions".

V, James Prasadh (2022) investigated the public's perception of electric vehicles in 2022. The aim was to determine whether promoting electric vehicles as a brand or promoting specific brand names is more effective. The study also examined the safety of electric vehicles and identified areas for improvement in their manufacturing. The analysis included a review of the range of electric vehicles and how this can be improved to increase their performance and appeal to consumers.

OBJECTIVES OF THE STUDY
- Rank the major factors which affect the sales of Two Wheeler Electric Vehicles.
- Examine if income affects the ranking of barrier factors significantly
- Determine the importance of various barriers based on the income group of customers.

METHODOLOGY

Sample and Sampling Method

The sample size was 200 customers from 5 major two wheeler showrooms on Chennai city. Convenient sampling method was used to select the 5 showrooms. Simple random sampling was used to select the customers. Structured questionnaire was used to collate the data.

DATA ANALYSIS

Factors Affecting Two Wheeler EV Sales:
The major barriers to Two Wheeler Electric vehicles were Range Anxiety, Fire Hazard, Slow Charging, Not enough fast charger on route, Poor Service network, Non Removable battery/No charging facility in apartment complex, Battery drain and battery replacement cost in few years, Less Boot space and Poor resale value. These factors were ranked by the customers. The analysis of barrier ranks are tabulated below:

Table1 : Ranked Factors Affecting EV Sales

Rank	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Range Anxiety	130	30	10	15	7	8					200
Fire Hazard	60	30	25	10	25	27	8	7	3	5	200
Slow Charging	90	70	20	8	5	7					200
Not enough fast charger on route	60	40	30	11	19	16	10	14			200
Poor Service network	90	60	20	30							200
Non Removable battery /No charging facility in apartment complex	94	50	39	9	8						200
Battery drain and battery replacement cost in few years	15	20	20	42	40	33	30				200
Less Boot space	70	19	23	40	48						200
Poor resale value	50	22	20	80	28						200

The weighted score was computed for each barrier based on their ranking. Score of 10 was assigned to I, 9 was assigned to II, 8 was assigned to III, 7 was assigned to IV, 6 was assigned to V, 5 was assigned to VI, 4 was assigned to

VII, 3 was assigned to VIII, 2 was assigned to IX and score of 1 was assigned to X rank. The weighted score were analysed and the results are tabulated below:

Table 2: Weighted Scores OfFactors Affecting Sales Of Two Wheeler EVs

Factors	Weighted Score
Range Anxiety	1837
Non Removable battery/No charging facility in apartment complex	1813
Slow Charging	1811
Poor Service network	1810
Expensive (without subsidy)	1650
Less Boot space (Storage Space)	1623
Poor resale value	1586
Not enough fast charger on route	1553
Fire Hazard	1489
Battery drain and battery replacement cost in few years	1309

It is evident from table 2 that the most important barrier to two wheeler EV sales is Range Anxiety (Weighted Score: 1837) followed by Non Removable battery/No charging facility in apartment complex (Weighted Score: 1813) , Slow Charging (Weighted Score: 1811) , Poor Service network (Weighted Score: 1810) , Expensive -without subsidy (Weighted Score: 1650) , Less Boot space /Storage Space (Weighted Score: 1623) , Poor resale value (Weighted Score: 1586) , Not enough fast charger on route (Weighted Score: 1553) and Fire Hazard (Weighted Score: 1489). The least ranked factor is Battery drain and battery replacement cost in few years (Weighted Score: 1309).

Effect of Income on Factors Affecting Two Wheeler EV Sales:
To examine if income of customers affects the top ranked barrier, ANOVA analysis was carried out. The results are shown below:

Table3: Income Wise Break Up Of 1st Ranked Barrier

Factors	<Rs.20000	Rs.20000 - 50000	Rs.50000-Rs.80000	Rs.80000-1.10 lakh	>Rs. 1 lakh	Total customers who gave 1strank
Expensive (without subsidy)	61	8	5	4	2	80
Range Anxiety	60	46	20	2	2	130
Fire Hazard	10	20	23	5	2	60
Slow Charging	40	20	10	10	10	90
Not enough fast charger on route	30	20	3	3	4	60
Poor Service network	23	20	15	12	20	90
Non Removable battery /No charging facility in apartment complex	20	35	34	3	2	94
Battery drain and battery replacement cost in few years	5	2	4	2	2	15
Less Boot space	20	28	15	4	3	70
Poor resale value	20	17	8	3	2	50

Table 4: ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit

Rows	1709.78	9	189.9756	1.584553	0.157166	2.152607
Columns	4442.68	4	1110.67	9.263904	2.97E-05	2.633532
Error	4316.12	36	119.8922			
Total	10468.58	49				

The table 3 data and table 4 ANOVA shows the results of a two-way ANOVA . The 'rows' represent the barrier factors and the Columns represent the income groups. The "Rows," shows the variation due to the rows factor. The SS (sum of squares) is 1709.78, which indicates that the total variation in the data that can be explained by the rows factor is 1709.78. The df (degrees of freedom) is 9, which indicates10 different levels of the barrier factors. The MS (mean square) is 189.98, which is the SS divided by the df. The F (F-ratio) is 1.58, which is the MS of the rows factor divided by the error MS.

The p-value is 0.157 and is larger than 5% significance level of 0.05. The F crit is 2.152607 and is larger than the F value of 1.584553 . It can thus be inferred that there is no significant difference between the means of the groups of barrier factors at 5% level of significance.

The "Columns," shows the variation due to the income group. The SS is 4442.68, which means that the total variation in the data that can be explained by the income group is 4442.68. The df is 4, which indicates that there are 5 different levels of Income group. The MS is 1110.67, which is the SS divided by the df. The F is 9.26, which is the MS of the columns factor divided by the error MS.

The p-value is less than 0.05 (2.97 $*10^{-05}$) and the F critvalue of 2.633532 is less than F value of 9.263904. These results lead to the conclusion that there is significant difference between factors based on the income group of customers at 5% significance level. The results prove that barriers in two wheeler electric vehicle sales are not equitable. Hence, based on table 3 data it can be concluded that

- 76.25% in income group of less Rs.20000 consider *Expensive (without subsidy)* factor as major barrier while only 2.5 % in greater than Rs. 1 lakh income group consider it to be top barrier to EV sales.
- 46.15% in income group of < Rs.20000 consider *Range Anxiety* factor as major barrier while only 1.54 % in income group of greater than Rs. 1 lakh consider Range Anxiety to be top barrier
- 38.33% in income group of Rs. 50000-80000 consider *Fire Hazard* factor as major barrier while only 3.33 % in income group of greater than Rs. 1 lakh consider Fire Hazard to be top barrier
- 44.44% in income group of < 20000 consider *Slow Charging* factor as major barrier while only 11.11 % in income group of greater than Rs. 1 lakh consider Slow Charging to be top barrier.
- 50% in income group of < 20000 consider *Not enough fast charger on route* factor as major barrier while only 5 % in income group of Rs.80000-1.10 lakh consider Not enough fast charger on route to be top barrier
- 25.56% in income group of < 20000 consider *Poor Service network* factor as major barrier while only 13.33 % in income group of Rs.80000-1.10 lakh consider Poor Service network to be top barrier
- 37.23% in income group of Rs.20000 - 50000 consider *Non Removable battery/No charging facility in apartment complex* factor as major barrier while only 2.13 % in income group of > 1 lakh consider Non Removable battery/No charging facility in apartment complex to be top barrier
- 33.33% in income group of <Rs.20000 consider *Battery drain and battery replacement cost in few years* factor as major barrier while only 13.33 % in income group of >Rs. 1 lakh consider Battery drain and battery replacement cost in few years to be top barrier
- 40% in income group of Rs.20000 - 50000 consider *Less Boot space* factor as major barrier while only 4.29 % in income group of >Rs. 1 lakh consider Less Boot space to be top barrier
- 40% in income group of <Rs.20000 consider *Poor resale value* factor as major barrier while only 4 % in income group of >Rs.1 lakh consider Poor resale value to be top barrier

CONCLUSION

The growth in two wheeler EV sales is critical to reduce India's energy dependence on fossil fuel, reduce import bills, improve balance of payment and to reduce environmental pollution. Reducing the barriers to EV sales is thus of paramount importance. This research article has brought forth not only the ranking of barriers but has also shown that the barriers' ranking are not equitable. They differ based on the income group of customers. The EV companies can fine

tune their marketing based on income segment of the target customers and policies can be formulated to address the segment wise barriers for better EV sales.

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