A Study of Propensity among Users in Lower Income and Lower Middle Class to shift to Electric Two Wheelers

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Abstract

With increased focus on environmental protection and rising petro-fuel costs, the lower middle class is particularly hard pressed for conserving their funds for optimal utilization. Two wheelers are extensively used by this group for running household errands as well as a mode of transportation to work place or college/school. Electric two wheelers have found increasing acceptance among this class. Governmental support is also pushing for enhanced use of electric vehicles to assist Indian government in meeting their international commitments. This qualitative study is based on primary data collected using a structured questionnaire on usage of two wheelers, features of two wheelers that users consider as important, the perceived pros-and-cons of electric and petrol based two wheelers and the sources trusted by lower and lower-middle class people in taking decisions on purchase of vehicles. The study emphasizes the need to address battery/charging issues and performance concerns of electric two wheelers to increase their usage in India.

Keywords: Electric vehicles, two-wheelers, petrol vehicles, lithium-ion, battery

Introduction

Electric Vehicles (EVs or BEVs) are either partially or entirely powered by a source of electric power. These vehicles can be either fully electric or plug-in hybrids (PHEVs). The reason why electric vehicles are catching the imagination of people at large is on account of enhanced awareness about environmental preservation as well as their lower running cost resulting from less moving parts. The battery used can be of different kinds including lead-acid batteries, nickel metal hydride batteries or the highly popular lithium-ion batteries on account of their long life and an ability to retain power for long [17]. The challenges electric vehicles face includes assuring customers of long-term cost advantage, high safety standards and ability to traverse long distance without interruptions.

Given the urgent need to meet international commitments on emissions and reverse environmental degradation, the Government of India made rich allocations for different types of electric vehicles. Department of Heavy Industry of India notified FAME II (FAME being acronym for Faster Adoption and Manufacturing of Electric (& Hybrid) Vehicles) scheme from 1st April 2019 wherein purchase subsidy of about 86 Billion INR was proposed with the total budget being 100 Billion INR. This aimed at subsidy of one million two wheelers at INR 20000/vehicle. Alongside this subsidy, the battery cost fell from USD 1160/KWH to USD 156/KWH during from 2010 to 2019. EVs are expected to reach price parity with Internal Combustion engines only after battery process dip to USD 100/KWH, something that could happen by 2024. All these factors are likely to make electric two wheelers an attractive proposition for households in India causing a jump in its sales bringing in the possibility of electric two-wheeler sales crossing 3 Million units by 2025 [4].

The Covid-19 pandemic caused severe disruption in the lives of households across the world with income levels taking a severe beating in almost all countries across the world. For the developed (OECD) countries, in the second quarter of 2020, when the impact of lockdowns was beginning to show its severe impact, the GDP fall ranged from close to -14% for UK to about -7% for Australia with Japan, Germany, USA, France, Italy and Canada having a GDP fall between -7% and -14%. The compensation paid to employees by companies fell from over 2% fall Australia to over 9% in France with other countries reporting figures within this range (-2.2% to -9.4%) [9]. India too witnessed significant drop in income levels with the household income falling by about 9% in February 2020, a drop that become very severe by mid-April and reached upto 45.7% [15]. Such a severe income drop makes the need to conserve wealth much more than a necessity.

The dual factors of attraction from falling prices and need for environmental protection point to a need to assess perception of present and potential customers as regards two wheelers and features that are likely to make electric two wheelers more attractive to people at large. This study aims to take up the need above and examine factors that make electric two wheelers a product of choice among prospective customers.

Literature Review

Benefits of using electric vehicles has caught the imagination of decision and policy makers all over the world, especially so for personal transportation. Though patented way back in the 1890s, electric bikes are beginning to witness their best period of acceptance only now. India has the largest sales in the world for electric three wheelers with the possibility of 80 percent three wheelers in India being electric vehicles. With innovative solutions like BAAS (Battery As A Service) emerging, the emerging business systems are more likely to support electric vehicles than was observed in the past [13]. The factors contributing to this include meeting personal transportation needs through domestic resources while also reducing carbon emissions. This will remain true for the US market with sufficient energy being available to support growing electric vehicles' requirements even in the year 2030, the higher likely to see highest EV growth [19]. The scenario in India is one where, while on one hand Internal Combustion Engine (ICE) based two wheelers are becoming less attractive while the cost of batteries is falling and the infrastructure for electric vehicles improving. The rising cost of ICE based two wheelers comes, at least partly, from the added regulation to ensure safety (eg. Anti-lock Braking System and Combi Braking System) or norms for reduced emission (eg. leapfrogging from BS-IV to BS-VI). Even operating costs of ICE based two wheelers has jumped due to growth in petrol prices with governmental taxes not giving reasons for fuel price reduction [8].

The electric two wheeler industry in India was born in 2013 due to a startup Ather Energy and has seen rapid growth since then. Despite governmental resolve to move entirely to electric vehicles by 2030, the rate of growth could have been faster but for poor infrastructure, relatively low level of awareness and a some resistance to accept the new types of two wheelers given its poorer performance in terms of speed and power. At present, the factors driving growth have a greater impact than those acting as a drag since growth is driven by three important factors, namely,

increased disposable income, governmental support as well as subsidies and enhanced concern for environmental protection [6].

Given the scenario of rising costs on all fronts, Indians must try to save on transportation costs through shared transportation and that will also reduce congestion on roads too. The need to be independent of any constraint of timings that public transportation entails, two wheelers have emerged as the vehicle of choice with close to one third Indians using it to commute to and from work. This has, unfortunately, added to the congestion on roads as well as pollution levels necessitating finding innovative solution to this dual problem with shared electric vehicles being a strong contender as the solution of choice for all intra-city movement [1]. While estimates vary on the extent of growth that two-wheelers sales will witness in the years to come, there is little doubt that it will surge in the post covid period, particularly so because this was one of the sectors that suffered heavily due to Covid-19 restrictions/lockdown in India. The total cost of ownership/100 KM for electric and internal-combustion engine based two wheelers is USD 2.48 and USD 3.78 respectively. The comparative figures for four-wheelers are USD 4.07 and USD 6.08 respectively. The cost advantage of electric two wheelers along with incentives from governments, falling battery prices and greater consumer acceptance could raise total sale of two wheelers in 2030 to about 9 Million with electric two-wheelers making up to 40% of the total sales. Another trend that could boost two wheeler sales is enhanced requirement of shared mobility [12].

With the UN Climate Change Conference 2015 adopting the Paris Agreement, a legally binding international treaty aimed at global peaking of greenhouse gas emissions at the earliest, all countries including India need to work on addressing the challenge on a war footing. The result has been most noticeable in the transport and power sector, partly on account of the extent to which these sectors had historically contributed to greenhouse gases [18]. India, in particular, needs to address the challenge of pollution as 44 percent of world pollution since 2013 emanated from India besides India being the world's second most polluted country on account of annual particulate pollution increasing by 61.4 percent since 1998 [5].

Electric vehicles are a step towards reducing vehicular pollution, one of the biggest contributing factors to air pollution in India. This has to be seen in the context of volumes and size of Indian market. India represented the 4th largest auto market in 2017 with year-on-year sales growing at 9.5 percent reaching 4.02 Million (excluding two wheelers) in 2017 and emerged as the 7th largest manufacturer of commercial vehicles in the world. While the nation demonstrated great strength in terms of meeting the export as well as domestic demand, it is two wheelers and passenger vehicles that dominated the domestic demand with two wheelers accounting for 81 percent of the domestic demand in 2017-18. India could emerge as the leader in shared mobility by 2030 with potential opportunities for electric and autonomous vehicles. This is, at least, partly due to the cost advantage India possess over Europe and Latin America leading the estimated FDI flows in the automotive sector reaching 8-10 Billion USD between 2019 and 2023 [2]. Historically too, India has been a trend setter as regards two wheelers through the first two-wheeler manufacturer from India. The relatively low per capita income in India (USD 1500) tends to push consumers towards a low-cost option that can provide personal mobility making two-wheelers a highly preferred option in India with the result that there are six times as many two wheelers as four wheelers in India. The two-wheeler penetration in India per thousand people was 102 (rose to 143 in 2019, about 40 percent increase) compared to 281 in Indonesia and 291 in Thailand with the number of two-wheelers in India crossing 190 Million. Indian two-wheelers are exported to countries like Nigeria, Sri Lanka, Nepal, Bangladesh, Philippines among others. The usage pattern of two-wheelers points to a need for personal mobility with 33 percent owners using them to go to work while 60 percent rural households possessing two wheelers. The annual income bracket that drives two-wheeler sales is the 3-5 lacs/annum bracket [11]. While two wheelers have begun to emerge as a common Indian's preferred mode of transport, its widespread use has also led to two-wheelers

being responsible for 20 percent of total CO2 emissions and 30 percent of total particulate emissions in urban areas contributing to a situation where 7 of the 10 most polluted cities in the world are in India. The environmental advantages are expected to compliment cost considerations in increased use of electric-two wheelers in the country and NITI Aayog has set a penetration target of 30 percent for electric two wheelers by 2030. The electric two wheelers saw a CAGR of 62 percent in the period from 2016 to 2020. After 2024, the cost of batteries USD 100/KWH and bring parity in the price of electric two wheelers and internal combustion engine based two wheelers [10].

The total cost of ownership of electric two wheelers is highly favourable to customers as compared to internal combustion propelled two wheelers. This is due to much lower maintenance and fuel costs for electric two wheelers. Electric Two wheelers may yet take some time to be the product-of-choice over IC engine two wheelers till they are at par in terms of performance (power, range, charging time and charging infrastructure) and the manufacturers are able to better differentiate electric two wheelers [7].

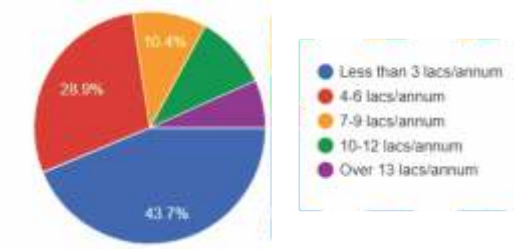
Globally, PRC has the highest production of electric two wheelers. Peoples Republic of China was producing over 20 Million e-bikes annually around 2009 with the rise being attributed to factors like restriction on gasoline motorcycles, enhanced public/personal transport congestion and extensive infrastructure to support bicycle use. Usage of electric two wheelers in India was hampered by poor performance of electric two wheelers, lower load carrying capacity than desired, inadequate after-sales support and use of models that were not sturdy enough for Indian conditions [3]. This will continue to remain important in the future too. Future penetration of electric two-wheelers would depend upon a host of factors that are a challenge to predict. Based on variation in three important factors, namely, (i) period for which demand incentives are given, (ii) vehicle performance as measured in terms of power and range, and (iii) battery costs, it is seen that improvement in technology aimed at performance enhancement and battery costs are key to increased penetration of electric two wheelers while demand incentives also provide useful push. However, the range of penetration can vary a lot based on the extent of fall in battery costs and performance improvement with charging infrastructure also playing an important role in making electric two wheelers the vehicle of choice for people [10].

While four wheelers as well as two wheelers can use electric power instead of carbon-based fuels, the challenge for two wheelers is providing the required battery/electric power through light batteries requiring less space. The source of electricity for two wheelers are a battery and an alternator. The battery provides Direct Current (DC) to the vehicles electronics even after the engine is turned off besides providing current to crank up the engine. It is here that lithium-ion batteries are scoring over other competing batteries. The alternator generates electricity when the engine is started. It produces alternating current (AC) that is converted to Direct Current over a regulator. The regulator also regulates the amount of current that is sent to various electronic components installed [16]. The preferred technology of electric motorbikes are beginning to gravitate to a lithium ion battery (due to easier usage features as compared to lead-acid batteries), brushless DC motors (though frame mounted motors continue to be in use to a lesser degree) and fixed battery pack due to relative ease of manufacture (with the removable battery pack option also developing in a catch up mode as it offers greater convenience to the end users). As far as charging goes, both types of charging, namely, 3-pin plug charging as well as fast charging have their merits and demerits with fast charging coming at an added cost [20].

The challenges to transitioning from petro-fuels to electric vehicles in India include (i) reliance on India's electric distribution system that suffers from higher distribution losses, reduced cost recovery and relatively lower investments; (ii) Possibility of increased reliance on Chinese imports as India's Lithium resources (for Lithium ion batteries) are far behind the reserves possessed by Chile, China or Argentina; (iii) The EV infrastructure is in its infancy and given the large employment provided by the automotive sector, any disruption needs care in terms of its social impact [14].

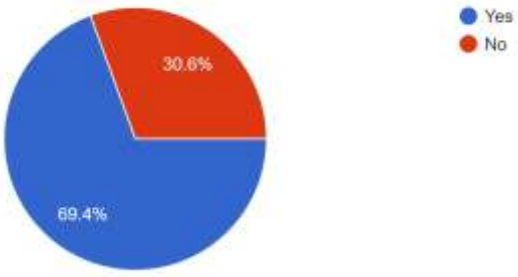
Research Methodology

This study is a qualitative study that is exploratory in nature. It was carried out with the intent of understanding user preferences as regards two wheelers and the source of data that users trust when making decisions regarding buying two wheelers. Primary data for the study was collected through a structured questionnaire based on purposive sampling so as to get an understanding from present and prospective users of two wheelers about features that matter more to them and what would get them to buy an electric two wheeler instead of a petrol based two wheeler. A sample size of 144 was used for the analysis. The sample was made up, largely, of people from families on the lower side of middle class with nearly 3/4th coming from families whose annual income was less that Rs.6 lacs/annum.

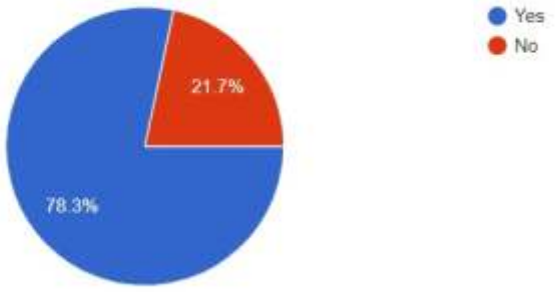


Data And Analysis

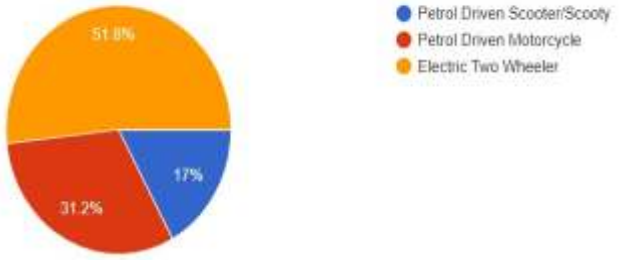
1. Close to 70% respondents own a two wheeler showing its high acceptance and usage.



2. Close to 80% owners of two wheelers use it, at least, twice or thrice a week. Further the average age of those who do not use two wheelers, at least, twice or thrice a week is 21.29 years while those who do is 22.27 years suggesting that age may not be an important factor in deciding upon frequency of use of two wheelers.



3. As two wheelers, particularly electric two wheelers continue to evolve, their enhanced attractiveness for potential buyers is beginning to show with over 50% potential buyers saying they would prefer and electric two wheelers and the percentage of petrol driven motorcycle being just above 30%.

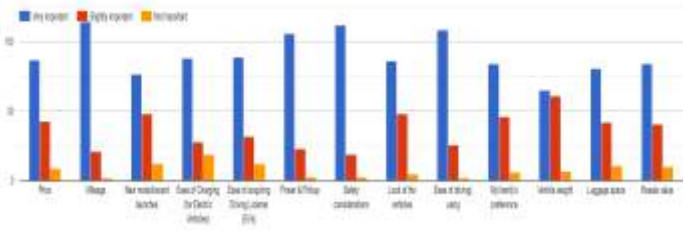


The percentages are comparable even if respondents were asked what kind of two wheeler would they like to receive as gift. The percentage of respondents who would want an electric two wheeler was over 53%, petrol driven motorcycle close to 31% and petrol driven scooter/scooty about 16%. This suggests a clear tilt towards electric two wheelers.

4. The reason for such a high percentage of participants preferring to purchase two wheelers include two major factors, namely, cost of operating petrol driven vehicles and environmental friendliness of electric vehicles. As regards those who expressed preference for petrol driven two-wheelers, the key factors were the relative scarcity of charging infrastructure and the fact that two petrol driven two wheelers have been around for so long that users have greater comfort using them besides having doubts about electric two wheelers. The doubts about two wheelers include concerns about their safety.

As the usage of two wheelers increases and more research goes in designing electric two wheelers for Indian roads, it can be reasonably expected that factors such as these will diminish in importance.

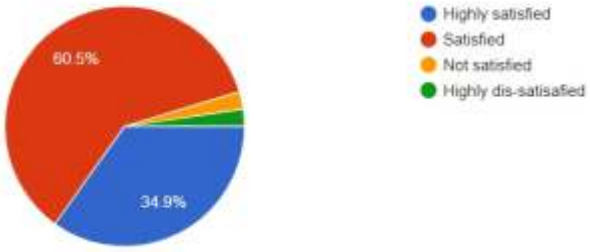
5. Having checked what on attractive features for electric and petrol driven two wheelers, specific responses were sought on factors that reduce the attractiveness of electric two wheelers. The factors that stand out are battery/charging related (eg. battery backup, ability to cover long distances in one charging, charging infrastructure and charging time), performance related (eg. speed, power and pickup) and safety related.
6. The most important features of two-wheelers from user perspective are: (i) Mileage; (ii) Safety; (iii) Power & pickup; and (iv) Ease of driving/using the vehicle. Vehicle weight is the least important meaning that companies can consider changes without worrying excessively about vehicle weight.



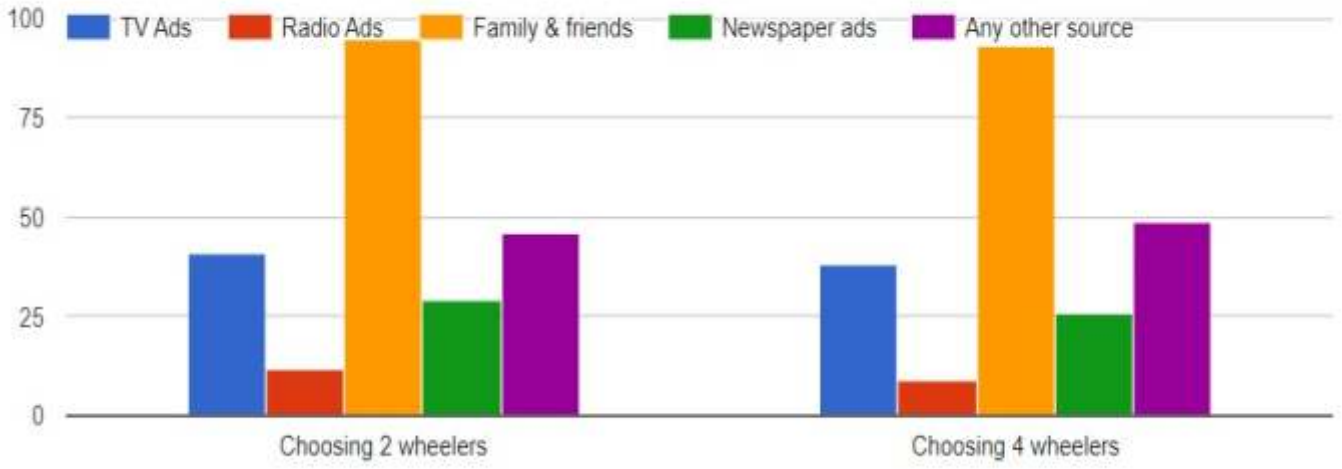
7. The open ended question on what features should be provided to enhance attractiveness of a two wheeler provided almost the entire range of features a two wheeler can have with innovative features also included like possessing GPS features, keyless start, fog lights, adjustable suspension etc. but running cost again appears as a very important criteria in deciding the user preference/acceptance of two wheelers.
8. In terms of features that make the key competing products, namely, petrol driven scooters/scooty and motorcycles attractive, here is a brief list of some of the factors that contribute to their attractiveness:
   a. Mileage. The fact that mileage of petrol driven vehicles has improved over the decades only adds to their attractiveness. Further, the supporting infrastructure of petrol driven vehicles is well developed and superior to that available for electric two-wheelers;
   b. Performance as regards power, pickup, speed, reliability and driving experience;
   c. Low maintenance requirements;

The fact that petrol can be carried in small cans on a trip is also mentioned as an attraction as it makes petrol driven vehicles more reliable. Other features mentioned are luggage space

9. One of the challenges that electric two-wheeler producers are likely to face is the high level of satisfaction among users/owners of two wheelers with majority being users of petrol driven vehicles. A satisfied user of petrol driven vehicle may well recommend the same so migration to electric two wheelers from those who presently own/use petrol driven two wheelers will take time and may require deeper understanding of how users take decisions that involve higher expenses that are beyond routine expenses.



10. It is seen that family & friends are, by far, the most trusted sources when the matters involves big purchases like two wheelers or four wheelers. Advertisements, TV, Newspaper or Radio based advertisements, are also trusted but to a lesser degree. One can, therefore, say that acceptance of electric two wheelers in India will progress relatively slowly for some time to come till research and development of electric two wheelers has convinced a critical mass in the society that these are a superior option.



Based on these observations, it is possible to construct a 95% confidence interval for the following characteristics:

Based on the data above, 95% confidence intervals were constructed for various indicators as given below:

Sl.No.	Parameter	95% Confidence Interval
1.	Ownership of two wheelers	77.48% to 62.52%
2.	Use of two wheelers, at least, twice/thrice a week	84.77% to 71.23%
3.	Prefer electric two wheelers for purchase	59.96% to 43.64%
4.	Importance of mileage for two-wheeler customers	89.55% to 77.12%
5.	Importance of Safety for two-wheeler customers	89.85% to 77.31%
6.	Importance of Power & Pick-up for two-wheeler customers	87.09% to 73.52%
7.	Importance of driving ease/using for 2-wheeler customers	86.31% to 72.81%

Factor Analysis of the data collected shows that over 75 percent of the total variance can be explained by just three factors as per details given below:

	First Factor	Second Factor	Third Factor	Communality
1. Price	0.519	0.374	0.327	0.517
2. Mileage	0.526	0.427	0.318	0.560
3. New model/Recent launches	0.496	0.431	0.317	0.532
4. Ease of Charging (for EVs)	0.524	0.375	0.340	0.531
5. Easy Driving License (for EVs)	0.574	0.376	0.332	0.581
6. Power and Pickup	0.690	0.283	0.262	0.625
7. Safety Consideration	0.729	0.330	0.241	0.699
8. Look of Vehicle	0.457	0.469	0.360	0.559
9. Ease of driving using	0.719	0.304	0.255	0.675
10. Family Preference	0.602	0.308	0.290	0.542
11. Vehicle Weight	0.537	0.395	0.356	0.571
12. Luggage Space	0.566	0.332	0.336	0.544
13. Resale Value	0.696	0.348	0.271	0.680
Eigen Values	4.589	1.774	1.253	
Percentage of Variance Explained	45.89	17.74	12.53	
Cumulative Variance Explained	45.89	63.63	76.16	

Conclusions And Recommendations

The data collected highlights the fact that two wheelers are an important part the lives of lower middle class households and that electric two wheelers are gaining in acceptance among them. There are a host of factors that are driving users to electric two wheelers including operating costs, governmental support and a growing understanding that environmental protection is every body's responsibility. For the lower income and lower middle class users, a very important reason for enhanced acceptance of electric two wheelers is rising petrol prices leading to the operating cost of electric two wheelers being significantly below petrol driven vehicles. However, electric two wheelers continue to face challenges while competing with petrol driven vehicles in terms of limitations on long distance use due to relatively weaker charging infrastructure and performance of electric two wheelers on speed, power and pick-up. The fact that petrol driven two wheelers have performed quite well for several decades now means that the shift to electric two wheelers could be gradual. However, since cost is a very important driving force for lower income and lower middle class users, electric two wheelers stand a good chance of in the future but producers of such vehicles would need to focus on: (i) Increased travel per charging; (ii) Better charging support; and (iii) Better performance on Indian roads. The challenge of achieving these results is only increased on account of the high level of satisfaction of all two wheelers including petrol driven ones and the fact that buyers make decisions on purchase of vehicles based on inputs of friends and relatives more than advertisements.

Limitations of the study and Areas of Further Research

This study being qualitative in nature provides very useful pointers to factors that matter to present and prospective users from the lower income and lower middle income groups as regards two wheelers. A quantitative analysis would next be required to quantify the various parameters. This, then, represents the key limitation of the study and also highlights an area for further research.

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