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An Extensive Adoption with Analysis of Consumer Buying Attitude towards Purchase of Electric Four Wheelers

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Abstract

National Electric Mobility Mission Plan announced by the Government of India, which sets ambitious targets for electric vehicle positioning in India. In predicting the impact of EVs on the Indian grid will allow better planning of new generation and distribution infrastructure as the EV mission is moved on and also forecast the grid impacts from EVs requires information about the electrical energy consumption of different types of EVs in Indian driving conditions. The outcomes indicate purchase price, operating cost, and charging time have a significant negative influence on the intention to adopt electric four-wheelers, while driving range and charging facilities have a significant positive impact, context of safety and reliability are found to be the biggest barriers to the adoption of electric vehicles followed by lack of infrastructural readiness while environmental benefits are found to be the biggest motivators for electric four-wheeler adoption. This study develops an integrated choice and latent variable (ICLV) model to analyse the impact of vehicle attributes, service attributes and supporting government schemes on the likelihood to choose an electric four-wheeler in Tamil Nadu, India.

Keywords: Electric vehicle, adoption, generation environment

I. INTRODUCTION

Government of India actively promoting, supporting the transition to electric mobility to reduce the country's dependence on fossil fuels and curb air pollution (NITI Aayog, 2023). It has commitment to sustainable mobility is underscored by its proactive policy interventions and initiatives. These initiatives reflect a concerted effort to create an enabling environment for electric vehicles through financial incentives, research, development support, and the establishment of charging infrastructure. The rapid and uncontrolled expansion of the motorized vehicle population in recent decades has raised significant concerns regarding the deterioration of environmental quality, heightened reliance on oil, depletion of fossil fuel reserves, escalating greenhouse gas productions, and the consequent rise in global temperatures. The transportation industry, heavily contingent on petroleum as its primary energy source, faces substantial challenges posed by soaring fuel prices and increasing energy demands.

Furthermore, these concerns transcend national and local boundaries. The transport industry in India contributes to over ten percent of all energy-related carbon production and constitutes a significant source of air pollution (Jain et al., 2016). The carbon dioxide emissions from the automotive manufacturing sector are anticipated to increase three-folds if no adequate measures are taken to curb it. Energy security is also a critical concern for India, as the country is heavily reliant on overseas crude oil to satisfy its petroleum demands, with approximately 80% of its requirements being imported. Recognising these threats, several nations, including India, have made commitments to lessen their reliance on non-renewable fossils and subsequently decrease their exhaust emissions. To fulfil these commitments, the transportation sector is viewed as a key industry requiring transformation to achieve significant decarbonization. The growth and transition towards electrified mobility are considered viable solutions, leading to the formulation and implementation of a range of policies, programs, and initiatives aimed at realizing this goal.

The global electric vehicle market has experienced faster growth than anticipated by witnessing a five-fold increase over the past five years (IEA, 2022) with electric vehicles materialising as a promising substitute to conventional petroleum fuelled vehicles. In 2021, electric vehicle sales demonstrated an impressive growth, contributing to approximately 9% of total car sales worldwide (IEA, 2022). Globally, numerous impediments to acceptance of electric vehicles have been recognised including high upfront costs, limited driving range, lack of service and charging infrastructural facilities and a deficiency of confidence in developing electric vehicle technology. India's focus on electric mobility began in 2011 when the central government introduced a scheme to incentivize electric vehicle manufacturers.

However, regardless of the beneficial and lucrative incentives being provided to both the producers and the customers, the adoption and penetration rates of electric vehicles in India remain relatively low, with electric vehicles struggling to make substantial inroads into the market, where penetration rates currently hover around 1% (Aayog, 2022). In fact, adoption patterns in most developing economies, except for China, exhibit similarly low levels, indicating a substantial window of opportunity for electric vehicles to revolutionize mobility behaviour.

Challenges for Acceptance

Several challenges inhibiting the widespread acceptance of electric four-wheelers are particularly prominent in developing economies. These obstacles include constrained consumer disposable incomes, inadequate infrastructure, and a limited understanding of rapidly evolving electric vehicle technology (Vidhi and Shrivastava, 2018). The inclination of Indian consumers towards electric vehicles is a pivotal determinant of governmental policy efficacy. Despite the importance that this field deserves, the studies understanding the elements affecting the adoption of electric four-wheelers in the context of developing economies are limited. This research paper aims to contribute empirically to the discourse surrounding the adoption of electric four-wheelers in urban India in the following ways.

In this study examines a comprehensive list of variables sourced from extant research that influence electric vehicle adoption behaviour and introduces crucial factors such as daily travel distance, frequency of long journeys, existing electric vehicle ownership, and electric vehicle knowledge, which are expected to influence electric vehicle purchase intent yet have been neglected in prior research. It estimates the willingness to pay for various electric four-wheeler attributes such as operating cost, driving range, charging time, charging facilities, and emissions.

The evaluation overlooked impact of diverse incentives by the Government, such as toll tax reductions and exemptions, provision of complimentary and reserved parking facilities for electric vehicles in central business districts, and access to priority lanes (Dogra, 2019, Gupta, 2020). The environmentally friendly and sustainable character attributed to electric vehicles renders them particularly appealing to environmentally conscious consumers, thereby intertwining consumers' identity traits and latent variables with their adoption behaviour. This also analyses the impact of risks related to the perceived safety and reliability of electric four-wheelers, particularly in developing economies, have often sampled data focused on specific demographics profile. In contrast, specifically targets a distinct cohort termed "potential electric four-wheeler buyers," encompassing recent purchasers, thereby offering distinctive insights into this consumer segment. By addressing these gaps within the existing literature, by uncovering these dynamics, the study aspires to offer insights that can guide

policymakers and decision-makers in crafting strategies to accelerate the transition to electric mobility in developing economies such as India.

Review of Literature

The analysis of consumer preferences regarding electric vehicles has garnered noteworthy consideration in the recent past. The existing body of literature primarily focuses on investigating the motivators and barriers that impact electric vehicle adoption behaviour, including vehicle attributes, socio-demographic characteristics, policy incentives, and latent factors. Regarding vehicle attributes, existing research has studied the influence of purchase price (Ghasri et al., 2019, Li et al., 2022.

Some of the earlier mentioned impediments to the extensive adoption of electric vehicles are particularly prominent in developing economies, where consumers face lesser discretionary incomes, inadequate infrastructural facilities, and limited understanding about electric vehicle technology (Vidhi and Shrivastava, 2018).

Research Methodology

The concise overview of the methodology employed for this study has been explained in the subsequent subsections are used to study the influence of vehicle attributes, socio-demographic characteristics, various monetary and non-monetary benefits, and latent factors on electric four-wheeler adoption intention. Data concerning this study was gathered through a survey questionnaire, within this section, participants were presented with a choice between electric and conventional four-wheeler based on seven distinct attributes: initial purchase cost, operational and maintenance costs, range achievable on a single charge, charging infrastructure availability, charging. The assessment of the multi-item questionnaire's reliability, convergent validity, and discriminant validity was carried out using the lavaan package in R Studio for confirmatory factor analysis (CFA).

Table -1: Demography of Electric Car Customers

Demography	Distribution	Number	Percentage
Gender	Male	427	88.77%
	Female	54	11.23%
Age	Below 30 years	182	37.84%
	30 – 50 years	239	49.69%
	Above 50 years	60	12.47%
Education	School level	199	41.37%
	Under graduate	134	27.86%
	Post graduate	148	30.77%
Monthly income	Below Rs.50,000	355	73.80%
	Rs.50,000 – 1,00,000	80	16.64%
	Above Rs.1,00,000	46	9.56%
Occupation	Business	188	39.08%
	Employed	145	30.15%
	Retired/Farmer	148	30.77%

Source: Primary Data

Table 1 presents the customer demographics. In terms of gender, the data indicates that 88.77% of customers identify as male, while 11.23% identify as female. When examining age groups, it found that 37.84% of customers are under the age of 30 years, 49.69% fall within the range of 30 to 50 years, and 12.47% are above 50 years' age. Turning to education levels, it reveals that 41.37% of customers have a school-level education, 27.86% have completed undergraduate studies, and 30.77% hold postgraduate degrees. In terms of monthly income, it shows that 73.80% of customers earn less than Rs.50,000, 16.64% fall into the income range of Rs.50,000 to Rs.1,00,000, and 9.56% earn more than Rs.1,00,000. Occupation-wise, 39.08% of customers are engaged in business activities, while 30.15% are employed in both private and government organizations. The remaining 30.77% of customers belong to the retired or farmer category.

Impact of Demographic Outline on Research Constructs

The impact of demography of customers on research constructs are tested with One-way ANOVA. The proposed hypothesis ($H_{1.5}$) asserts that demographic outline has significant impact on research constructs.

Table 2: One-way Anova

	Age		Education		Monthly Income		Occupation	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Performance	.661	.517	2.715	.067	11.747	.000***	.020	.980
Environmental Consciousness	8.199	.000***	5.683	.004***	12.749	.000***	.260	.771
Supportive Policies	11.066	.000***	6.066	.003***	13.091	.000***	.197	.821
Customer Preference	3.921	.020**	.626	.535	10.175	.000***	.131	.877
Perceived Cost Savings	4.019	.019**	5.415	.005***	19.056	.000***	2.341	.097
Buying Attitude	4.623	.010**	2.324	.099	8.584	.000***	1.363	.257

***** Significant at 1%, ** Significant at 5%.**

Table 2 discloses that age has significant impact on environmental consciousness, supportive policies, customer preference, perceived cost savings and buying attitude. Post-hoc test is performed for the significant results of ANOVA. Gabriel post-hoc test formed three identical subsets like, 30 – 50 years in subset a; below 30 years in subset a, b; and above 50 years in subset b for environmental consciousness

II. CONCLUSION

This study uses data obtained through stated preferences from potential electric four-wheeler buyers to analyse the influence of different vehicle and service attributes such as purchase price, operating cost, driving range, charging time, charging infrastructure, and exhaust emissions, on the inclination to adopt electric four-wheelers. Despite existing national and state-level policies aimed at reducing purchase costs and improving charging infrastructure, current electric vehicle sales remain far below the target.

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