GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS

16th Urban Mobility India Conference cum Exhibition 2023

16th Urban Mobility India Conference & Expo 2023

27th - 29th October, 2023

Paper ID: 115

Exploring the Influence of Socio-Demographic Factors on Electric Vehicle Type Preferences

Under The Guidance Of:
Prof. A. RAMESH
Joint Faculty, CTRANS
IIT ROORKEE

Presented By:
SHAURYA MALL
Ph.D Student, CTRANS
IIT ROORKEE

Contents

- Introduction
- EV in India
- Dependent Variable
- Independent Variable
- Methodology
- Results and Discussion
- Conclusion

Introduction

- Electrical vehicles(EVs) have greatly helped **lower tailpipe emissions**
- EV reduces greenhouse emissions and **improve environmental conditions**
- The take-up of **EVs is increasing** rapidly.
- **Norway** having the maximum percentage and China had the larger number of EVs in 2020 ("Glob. EV Outlook 2020," 2020)
- Besides reducing environmental pollution, EVs have **less operation cost** than conventional Internal combustion engine vehicles (ICEVs)

Source: Author

EV in India

- In EV 30@30 campaign, which aims to reach at 30% market shares for electric vehicles in all modes except for two wheelers by the year 2030
- Reduction of dependency on fossil fuel is a step closer to green mobility
- Despite of the environmental benefits of EVs over ICEVs, widespread adoption of the electric vehicle is still a challenge

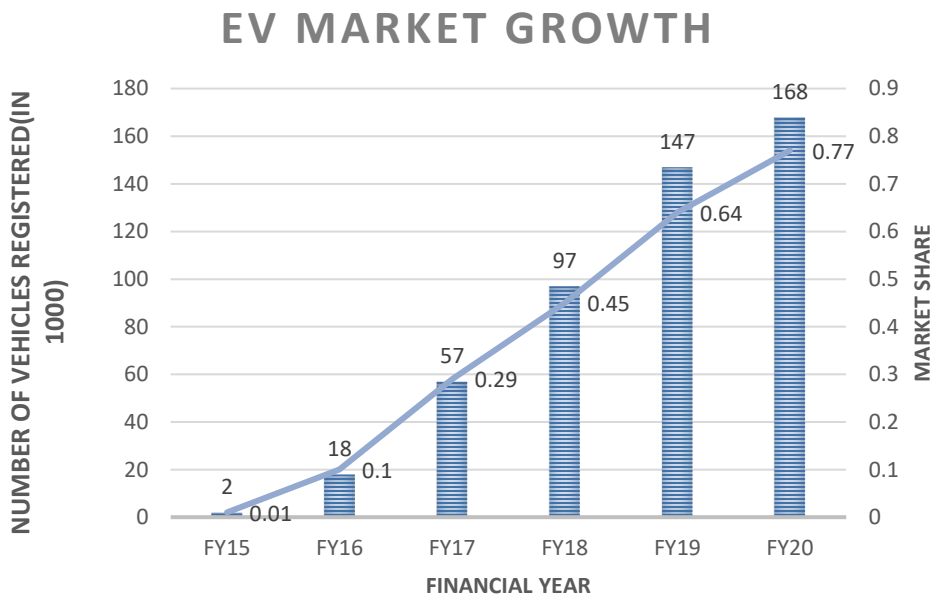


Figure1: EV market growth trend in India (Source: NITI Ayog (Government of India, 2021))

EV in India

- There can be a possibility of **barriers** hindering adoption at various levels, such as social, economic, or pro-environmental.
- When we segregate the market of electric vehicles **based on their types** (based on the number of wheels), it is observed that the **adoption rate varies** significantly for different types of vehicles
- This motivates this study to investigate **socio-demographic factors** which might be causing a huge difference in adoption rates of different types of electric vehicles

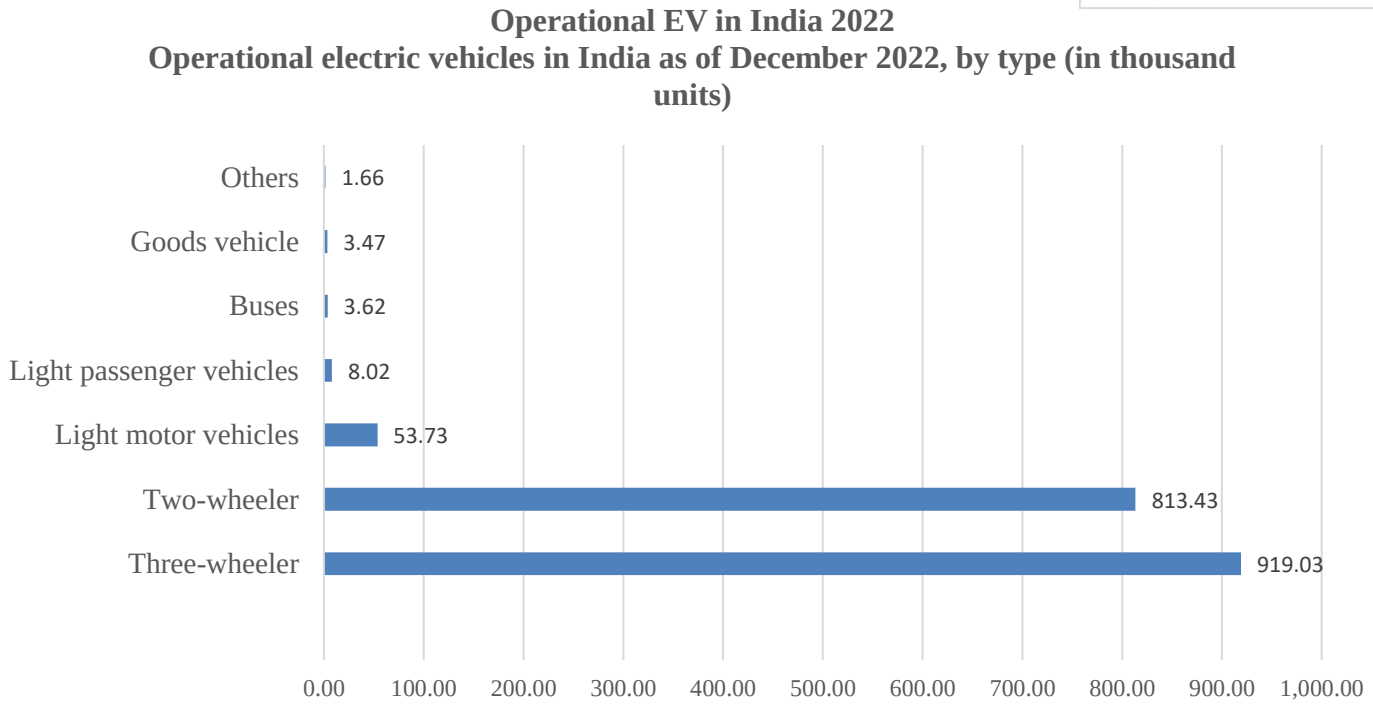


Figure: Operational EV in India by 2022 (Source: Statista)

Dependent variable

The type of vehicle is segregated based on the number of wheels of the vehicle

S. No	Type of EV	Explanation	Models available in India
1	Two Wheelers	E-bikes, electric motorcycles, and electric scooters fall within the category of two-wheeled electric vehicles. These cars are made to fit one or two passengers.	Ola S1, Ola S1 Pro TVS iQube Electric, Ather 450x
2	Three Wheelers	Although less popular, three-wheeled electric vehicles come in various designs, including enclosed electric three-wheelers. These vehicles are appropriate for specific niche markets and applications because of their steadiness and balance.	Mahindra Treo, Lohia Comfort F2F, Kinetic Safar Smart
3	Four Wheelers	Electric vehicles with four wheels are the most prevalent type of EV and come in various designs. Four-wheeled EVs' size, functionality, and features can vary, ranging from little city cars to opulent electric sedans and SUVs.	MG Comet EV, Tata Tigor EV, Tata Nexon EV
4	Six Wheelers	Six-wheeled electric cars are less common and usually specialised automobiles created for certain uses, such as electric trucks for hauling heavy loads.	Ashok Leyland BOSS EV, Tata Ultra E.9 Truck

For our study, the six-wheelers were not selected as a category as the target sample was not interested in the six-wheelers

The Four Wheelers in this study only refer to cars as the respondents were not interested in buying buses and trucks

Independent variable

S. No.	Factors	Explanation
1	**Age (A1)**	Age is a key demographic factor that is used to divide people into several groups according to their chronological ages.
2	**Education (A2)**	In research and statistical analysis, education is a crucial socio-demographic characteristic that is used to understand and classify people or communities according to their level of education
3	**Gender (A3)**	gender is a demographic variable that is frequently used to classify people according to their sex or gender identity. It is a crucial socio-demographic factor that aids researchers in understanding how men and women or other gender identities are distributed and distinct within a society
4	**Diving license holder (A4)**	Driving license holders as a variable is used for categorising people who have them differently from those who don't.
5	**Profession (A5)**	The profession as a demographic variable can tell us a lot about the type of job that people in a certain group do.
6	**Ownership of House (A6)**	This variable describes whether people have their own house, or they live on rent as it can create the issue of parking and charging at home can prevail in case of paying guests as compared to those who own their house.
7	**Type of House (A7)**	The type of house describes whether the respondents belong to a low-income group (LIG), Middle-income group (MIG) or High-income group (HIG)
8	**Category of House (A8)**	This variable indicates whether the respondent lives in a single-story house or in multiple story type like an Apartment style, as this factor can increase the parking and charging issue for the EV
9	**Household Structure (A9)**	The household structure tells whether the respondents have any elderly or a child at home. Or they are living alone.
10	**Experienced an EV (A10)**	This variable tells whether the respondents have ever driven an EV. This helps to categorise the respondents who have experienced the technology differently than those who have not experienced the technology in person.
11	**Vehicle ownership (A11)**	This variable captures how many vehicles the respondent already own

Methodology

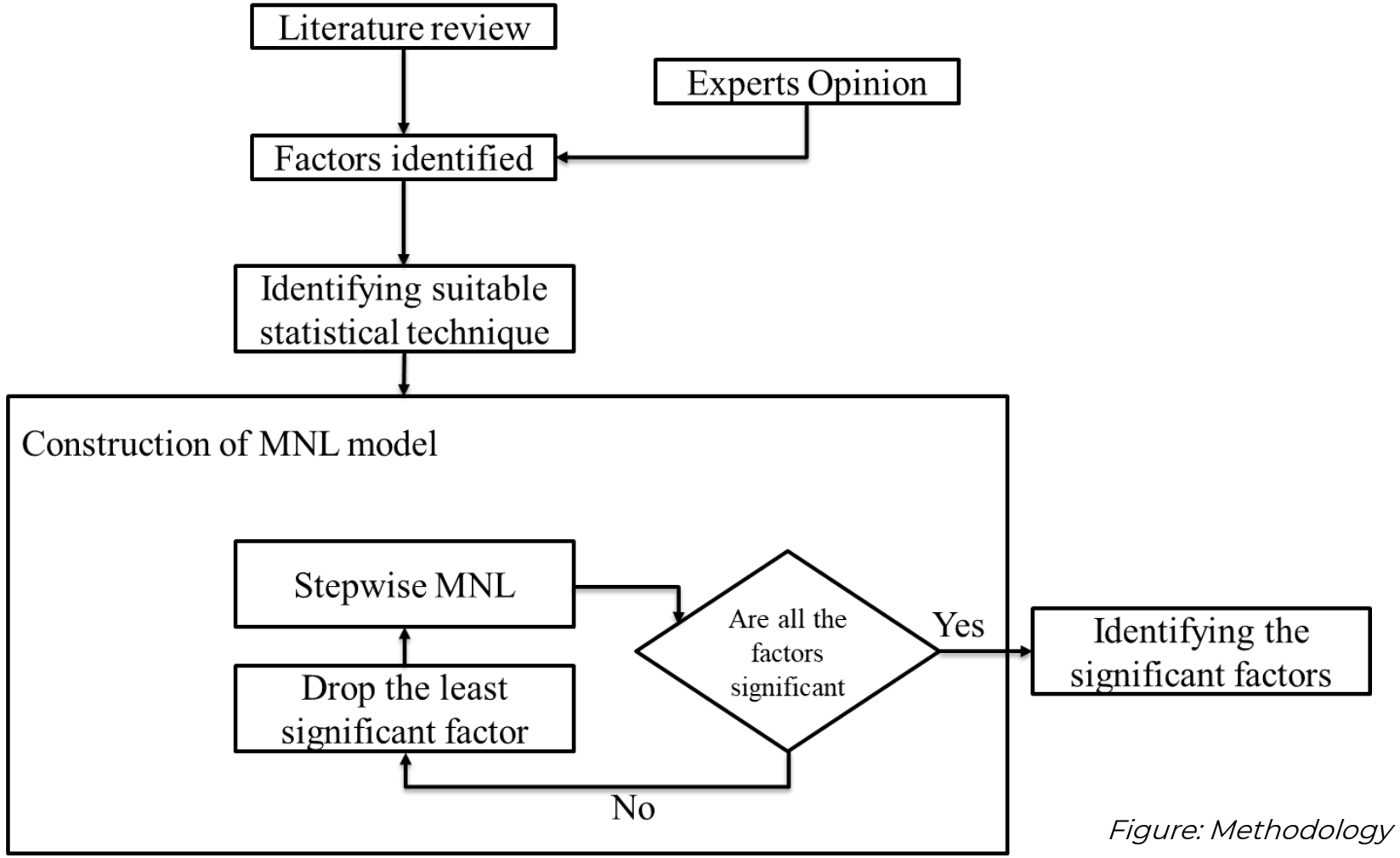
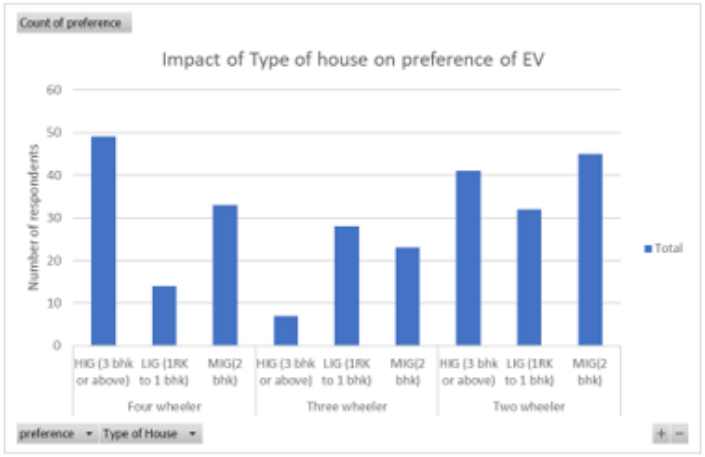
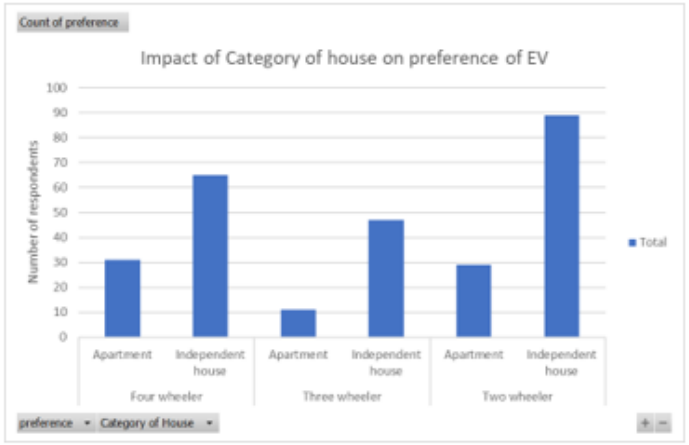


Figure: Methodology Flowchart

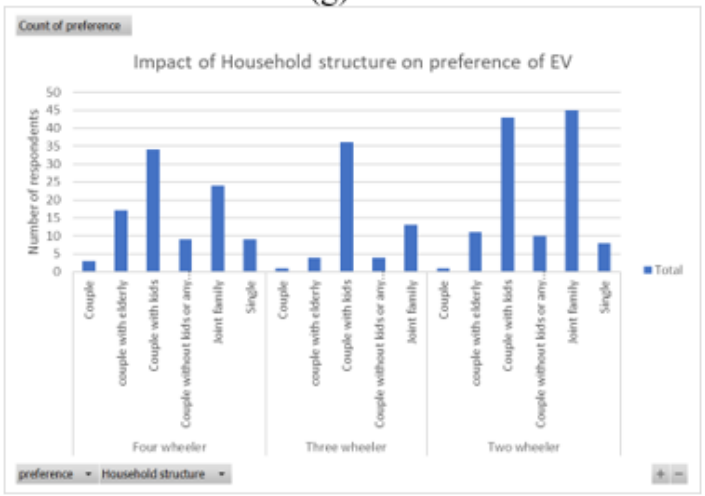
Results and Discussion



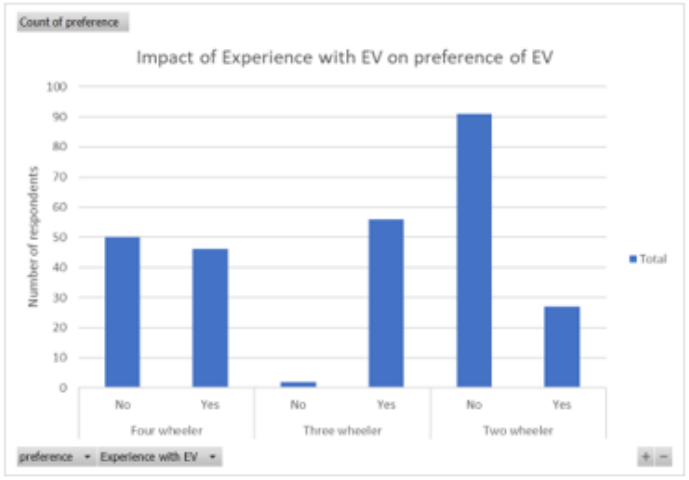
(g)



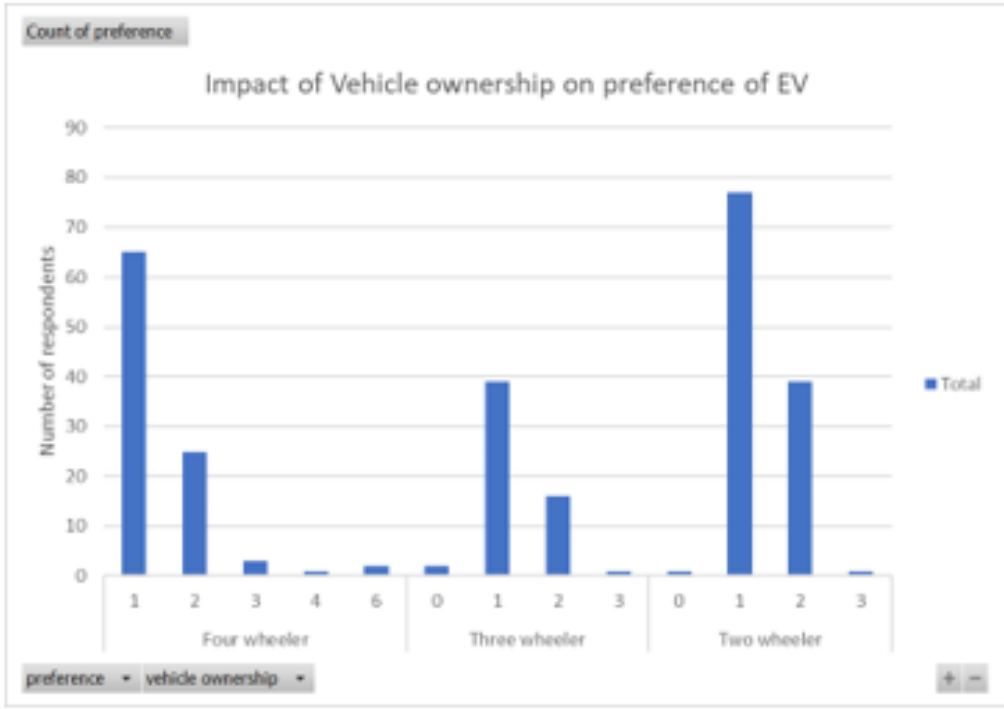
(h)



(i)



(j)



(k)

Figure: Impact of different independent factors on preference of EV

Result and Discussion

- Factors such as gender, age, category of house, and household structure, **do not significantly influence the preferences** for the type of electric vehicles as they show similar trends for two-wheelers, three-wheelers, and four-wheelers
- However, **they do affect the intention of purchasing** Electric vehicles
- As it is visible in descriptive statistics that in both the cases of **males and females the preferences** of EV types are the **same**, we can conclude that **"Gender"** is **not impacting** the preference type of EVs
- This the same in case of factor **"Age", "Category of house" and "Vehicle ownership"**
- For the rest of the factors there are changes in preference of EV types for different categories within the respective factors

Results and Discussion

Likelihood Ratio Tests				
Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	194.31	0.000	0	
Age (A1)	204.69	10.384	8	0.239
Education (A2)	234.31	39.999	10	0.000**
Gender (A3)	194.38	0.071	2	0.965
Diving license holder (A4)	204.56	10.251	2	0.006**
Profession (A5)	240.18	45.869	10	0.000**
Ownership of House (A6)	200.21	5.897	2	0.052*
Type of House (A7)	201.99	7.680	4	0.107
Category of House (A8)	197.59	3.284	2	0.194
Household structure (A9)	209.50	15.187	12	0.231
Experienced an EV (A10)	228.71	34.397	2	0.000**
Vehicle ownership (A11)	203.49	9.177	10	0.515

*Significant at the level of 90% confidence
** Significant at the level of 95% confidence

	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	550.67			
Final	196.26	354.410	42	0.00

Conclusion

- The factor **"Category of House (A8)",** whether the respondents lives in a single-story house or in multiple story type, **doesn't play any significant role** in selecting the type of electric vehicle; however, the factor **"Ownership of House (A6)"** whether they own a house or are on rent as well as **"Type of House (A7)",** whether they lives in an MIG or HIG type house **significantly affect** whether they are likely to buy a Two-Wheeler, Three-Wheeler or a Four-Wheeler electric vehicle
- It is observed from the result that factors such as the profession of the respondents, possession of a driving license, number of vehicles owned by them and whether they already own an electric vehicle are significant factors
- The analysis and results also show that the factors of **Gender, Age, Category of the house** (whether they are single story or apartment type) **and Vehicle ownership** (how many vehicles they own) does **not play any significant role**
- The **results of descriptive analysis** also **align with the MNL** model results
- These results and findings of this study can provide **insights to the Government** of India and the manufactures to **target their potential respondents** for each type of EV (based on the wheelers)
- This can help them to **form and push various schemes** to help **promote adoption** in different segments of Evs
- It has been observed in this study that the respondents who **live in HIG and MIG** housings are more inclined towards **buying four wheelers** and two wheelers whereas, respondents living in **LIG** housings have more inclination for **buying a three-wheeler**
- The **government can run schemes** for promoting four and two wheelers among people belonging to medium and high-income groups and can push three wheelers among those who belong to low-income groups

References

- World Health Organization, “WORLD HEALTH STATISTICS - MONITORING HEALTH FOR THE SDGs,” *World Heal. Organ.*, p. 1.121, 2016.
- N. Wang, L. Tang, and H. Pan, “A global comparison and assessment of incentive policy on electric vehicle promotion,” *Sustain. Cities Soc.*, vol. 44, no. October 2018, pp. 597–603, 2019.
- P. Mohanty and Y. Kotak, *Electric vehicles: Status and roadmap for India*. Elsevier Inc., 2017.
- S. Mall and R. Anbanandam, “A Fuzzy Analytic Hierarchy Process and VIKOR Framework for Evaluation and Selection of Electric Vehicle Charging Technology for India,” *Transp. Dev. Econ.*, vol. 8, no. 1, p. 14, 2022.
- C. Thrane, “Examining tourists’ long-distance transportation mode choices using a Multinomial Logit regression model,” *Tour. Manag. Perspect.*, vol. 15, pp. 115–121, 2015.
- T. H. Rashidi, J. Auld, and A. K. Mohammadian, “A behavioral housing search model: Two-stage hazard-based and multinomial logit approach to choice-set formation and location selection,” *Transp. Res. Part A Policy Pract.*, vol. 46, no. 7, pp. 1097–1107, 2012.
- G. Caggiano, P. Calice, and L. Leonida, “Early warning systems and systemic banking crises in low income countries: A multinomial logit approach,” *J. Bank. Financ.*, vol. 47, pp. 258–269, 2014.
- P. B. Y. Authority and N. E. W. Delhi, “FAME II Policy Document,” *Gaz. India*, vol. 2019, no. D, pp. 1–10, 2019.
- M. K. Hidrue, G. R. Parsons, W. Kempton, and M. P. Gardner, “Willingness to pay for electric vehicles and their attributes,” *Resour. Energy Econ.*, vol. 33, no. 3, pp. 686–705, 2011.
- P. Bansal, R. R. Kumar, A. Raj, S. Dubey, and D. J. Graham, “Willingness to pay and attitudinal preferences of Indian consumers for electric vehicles,” *Energy Econ.*, vol. 100, p. 105340, 2021.
- T. Munshi, S. Dhar, and J. Painuly, “Understanding barriers to electric vehicle adoption for personal mobility: A case study of middle income in-service residents in Hyderabad city, India,” *Energy Policy*, vol. 167, no. March, p. 112956, 2022.
- Z. Y. She, Qing Sun, J. J. Ma, and B. C. Xie, “What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China,” *Transp. Policy*, vol. 56, no. March, pp. 29–40, 2017.

Thank You