Advancements and Challenges in Electric Vehicle Adoption in India

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ABSTRACT

The paper provides a comprehensive exploration of the factors influencing electric vehicle (EV) adoption in India, with a particular focus on barriers related to usability, infrastructure, safety, economics, and performance. The study employs various statistical methods to analyze and discuss the findings, offering valuable insights into the challenges and opportunities for EV adoption in Agra City. Agra city has a very low level of uptake of electric cars (ECs), despite significant efforts put in place by policy makers to stimulate their use. This paper investigates the barriers to wider EC adoption via a survey in May, 2023 to a representative sample (N = 165) of the population of Agra City. We discuss and rank the barriers, we discuss and rank the barriers on the basis of mean, tested H_0: All types of barriers have an equal effect on buying decision, through Chi-Square test. Also we discuss and rank the barriers aggregate them via principal component analysis (PCA) on the basis of the Varimax Rotated factor analysis to study the socio-economic determinants of the respondents. The findings of this paper suggest a series of improvements that could be made by various key players. To overcome the Barriers related to usability (BU), Barrier of infrastructure (BI), Barriers related to safety and technology (BST), Barriers related to economic uncertainty (BEU) and Barriers related to performance (BRP), the policy makers should recommend car manufacturers to bring cars to the market with solutions to these factors for the wider adoption of electric cars.

Keywords: *Electric cars, Barriers, Principal component analysis, Usability, Infrastructure, Economic uncertainty, Performance, Agra, Government policies.*

INTRODUCTION

Mounting successful of the general population in underdeveloped nations like India, has empowered a steady and huge ascent in their utilization level in all spaces imaginable. One of these spaces is the auto area, which has been developing quickly to satisfy rising client need. The incomes created by this industry have empowered it to assume a significant part in the worldwide economy's development. With a steepening ascend in worldwide populace; the interest of private responsibility for has likewise seen a fast increment. In 2010 itself, there were more than a billion vehicles running on the planet (Article: Engine Vehicle). The rising usage of standard vehicles in light of quick urbanization really impacted the environment as well as the dependence of the business on oil costs has engaged development in costs which continues to push buyers towards other better choices. In India, vehicles overall go downhill and the headways in them are seen as old, non-renewable energy source side-effect conveyed from those old (not in that frame of mind) as new advancement conventional vehicles contribute in a general sense to ground-level air pollution in the world (Gavaev and Ertman, 2020), the wellspring of which is from the inward start engine worked by the consuming empowers (Dey and Mehta,2020). The US Ecological Security Organization (EPA) has long proclaimed vehicles to be "portable sources" of air contamination, guaranteeing that more than 75% of carbon monoxide contamination in the US is because of vehicular discharges (Article: The amount Air Contamination comes from Vehicles?) which adds on to different veritable regular issues like destructive storm and an overall temperature change (Dey and Mehta 2020). The four-wheeler business has been under consistent assessment of the public power and buyers in their headway for making and gathering EV which will assist with handling vehicular radiation. Progressing plan of indispensable institution, and vehicle release rules and further develop traffic, the wide system has compelled various makers to find a prevalent replacement instead of the traditional oil subordinate driven cars, which won't add up to regular pollution and will moreover satisfy the need of present and future. EVs are hence thought to be as a superior option in such manner and are supposed to limit the unsafe effect on the climate. Considering past examinations EVs have shown to reduce carbon dioxide by 30-40% (Asadi, Nilashi, Samad, Abdullah, Mahmoud, Alkinani and Yadegaridehkordi 2020). The thought of the world vehicle market and clients are right now on EVs and are ceaselessly endeavoring to make EVs crucial section of future vehicle market.

In any case, prior to growing such an eco-accommodating auto a few certain issues and obstructions should be addressed to make EVs a more reasonable choice as opposed to ordinary vehicles.

LITERATURE REVIEWS

Barriers related to usability

A battery duration expansion of no less than half is important to make super capacitors savvy for the test vehicle at current costs (Carter et al., 2012). Fluffy rationale prompts the best improvement of reach and battery lifetime (Steinstraeter et al., 2022). Legislature of India's actions and needs to work with such an improvement are underscored (Kore et al., 2022). Brilliant charging procedure for a PEV network that offers various charging choices, including ac level 2 charging, dc quick charging, and battery trading offices at charging stations (Moghaddam et al., 2017).

Barrier of infrastructure

To open the ecological and financial open doors related with market take-up, three strategy procedures are best: cost-intelligent valuing, insightful innovation, and incorporated foundation arranging (Hildermeier et al., 2019) Government is concentrating towards natural agreeable environment and according to its main goal to decrease fossil fuel byproduct from the vehicle area, arrangement of EV's and establishment of EVCS is the greatest concern (Pareek et al., 2020). PEV charging won't affect power matrices on the present moment, but charging may should be overseen when the vehicles are conveyed in more noteworthy numbers (hardman et al., 2018). Appropriation on power bill will affect decidedly on e-vehicle reception (Scorrano et al., 2020).

Barriers related to safety and technology

Batteries ought to be taken as a major start hotspot for electric vehicles and fire perils could happen during driving, charging or in any event, when not being used (W.k. CHOW C.l. CHOW, 2022) More ready for the impending computerized reasoning vehicle times and to carry out the technique of advancing homegrown improvements with assistance of an

innovation driven car industry. (Zhiqiang Lv, 2019) The presentation of electric transports for of public vehicle in the city would be advantageous both financially as well as ecologically. The electric transport likewise makes substantially less clamour, consequently diminishing commotion contamination and makes less vibration when contrasted with the diesel transport. This outcomes in a more agreeable excursion for the travellers. (Adheesh et al.,2016). Licenses and cycles intended for reusing Li-particle batteries and the new advancements on pyro-, hydro-, and bio-metallurgical courses have been changed. (Martins et al.,2021). Optimizing the power structure, overhauling battery innovation, and further developing the reusing effectiveness are of extraordinary importance for the huge scope advancement of EVs, shut circle creation of batteries, and practical improvement of the assets, climate, and economy. (Xiaoning Xia, Pengwei Li,2022).

Barriers related to economic uncertainty

At low unambiguous power and late at night, coal was the significant fuel utilized, while charging all the more intensely during busy times prompted more utilization of ignition turbines and joined cycle plants. (Stanton W. Hadley, 2007). On account of significant progressions in the framework, item and creation advances (Massimo Guarnieri, 2012). They presented the parts of electric vehicles, including investigations of government strategies, charging techniques, key methods, charging impacts and answers for related issues in a brief way. Considering the conversations on the flow situation of electric vehicles, a concise report on the significant realities concerning the section of electric vehicles has been made (Pandey, et al.,2020). They examines the issues looked by EVs, strategy outline, maintainability perspective, the business part of abuse of assets and restraining infrastructure, and work double-dealing practices of EVs and the EV inventory network Obstructions connected with execution . (Talin Badhwar and Abhinav Galodha 2022). Suggestions are given on utilization of the proposed answer for foothold instruments, which ought to meet expanded necessities to speed increase of electric-engine vehicles (Belousov et al., 2017) They found eight subjects of importance for future examination and strategy. These incorporate frequently talked about bits of knowledge like an EV's ecological supportability, range, charging or cost, yet in addition experiences around topics like economic wellbeing, sound, and speed increase. (Kester et al.,)

OBJECTIVES OF THE STUDY

To identify the factors which are becoming barriers to buy Electric Car in Agra City.

HYPOTHESIS OF THE STUDY

The present study tested the following Null hypothesis.

H01: There is no significant difference among the factors becoming barriers to buy electric car.

H02: All types of barriers have an equal effect on buying decision-making.

PERIOD OF THE STUDY

This study covers a period of two months of April and May 2023.

Table no.1

Category	Statements
Barriers related to usability	BU-1Given the short battery life, it is quite challenging to utilize an electric automobile on a regular basis.
	BU-2If I had an electric vehicle, I would be concerned about the battery life all the time.
	BU-3Due to a scarcity of charging facilities, using an electric car for long distance is a challenge.
	BU-4It takes a long time to charge an electric vehicle while travelling.
Barrier of infrastructure	BI-1where to charge an electric car and how much it will cost is particularly problematic for people.
	BI-2I think there should be more charging stations than there are right now. I'd rather wait.
	BI-3Building a domestic charging infrastructure is a costly and bureaucratically challenging task, especially in Agra.
	BI-4 I'm concerned that the cost of household electricity will cause my bill to go up significantly.
Barriers related to safety and technology	BST-1Given the size of the battery and the possibility of a fire, I would not feel secure operating an electric vehicle

	BST-2The complicated new technologies on which electric automobiles are built do not have my faith. I like more basic vehicles.
	BST-3Given that power is also produced using coal and oil, I am not convinced that electric automobiles are less polluting than traditional vehicles.
	BST-4Due to battery disposal, I'm not convinced that electric automobiles are less polluting than conventional vehicles.
	BST-5The cost and lifespan of the batteries used in electric vehicles remain unknown.
Barriers related to economic uncertainty	BEU-1The cost of the purchase is still excessive. I'd rather wait.
	BEU-2If many people move to electric vehicles, the price of electricity is likely to rise, making them less beneficial.
	BEU-3A significant chance exists that the electric vehicle purchased today may lose value very rapidly.
	BEU-4There aren't enough mechanics trained to work on electric automobiles since there aren't many of them.
Barriers related to performance	BRP-1Electric vehicles can't accelerate quickly enough.
	BRP-2When shifting gears, electric automobiles don't let you hear the engine roar.
	BRP-3Extreme weather conditions will adversely affect the battery life of Electric car
	BRP-4Use of AC consumes more power and will cause reducing the battery life as claimed by companies
	BRP-5Boot Size and safety features will cause reducing battery life as claimed by the companies
	BRP-6Cost of battery replacement is not disclosed by manufacturers so far or if so it is too high

Table 2 - Descriptive/Demographic Statistics of the Sample.

Demographic factors		N	Percentage of Responses
Gender	Male	121	73.3
	Female	44	26.6
Academic Qualification	Upto 8th Standard	24	14.5
	Upto 12th Standard	23	13.9
	Upto UG	37	22.4
	Upto PG	68	41.2
	Professional Degree	13	7.87
Occupation	Owned Business	49	29.6
	Private Service	41	24.8
	Government Service	24	14.5
	Profession	51	30.9
Age	19 to 30	36	21.8
	31 to 40	68	41.2
	41 to 50	35	21.21
	51 to 60	17	10.3
	60+	9	5.45
Annual Income in Lakhs	Upto 5	92	55
	Upto 10	32	23.3
	Upto 15	28	16.9
	Upto 20	8	4.8
	20+	5	3.03
Marital Status	Single	76	46.06
	Married	89	53.9
Family Members	Upto 2	18	10.3
	Upto 3	14	44.8
	Upto 4	42	25.4
	Upto 5	74	8.48
	6 or More	17	10.9

Average Kilometers Travel a Day	**Upto 15**	**26**	**15.7**
	Upto 30	**50**	**30.3**
	Upto 45	**62**	**37.5**
	Upto 60	**15**	**9.09**
	75 or more	**12**	**7.27**

Males 121 (73.3%) and 44 females (26.6%) share of the respondents. The majority of the respondents were qualified up to 12th i.e 68 (41.2%), followed by graduates (22.4%), professional degree holders (14.5%), up to PG were (13.9%) and upto 8th (7.87). Most of the respondents (41.2%) were 31 to 40 years old i.e 68. Majority of the respondents i.e 92 (55%) had an annual household income less than ₹5 Lakhs Monthly. Most of respondents were married (53.9%) i.e 89. Majority of respondents had a family up to 3 people i.e 74 (40.90%).Mostly respondents Travel Up to 45 Km Average a Day , 62 (37.5%).

FINDINGS

Table no.3 Reliability and Validity of Barriers to Buy of Electric Cars in Agra City Questionnaire

Reliability Scale Statistics					
Items	N of Items	Mean	Variance	Std. Deviation	Cronbach's Alpha
Barriers to buy Ecar	23	97.25	129.874	11.396	.943

Source: Primary data

Table no.4: Factorial Validity by KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.866
Bartlett's Test of Sphericity		4741.866

	Approx. Chi-Square	
	Df	253
	Sig.	0.000

Source: Primary data

Table no.5 Loading of scale items on factors by Rotated Factor Matrix

ABB.	**Barriers to Buy Electric Cars Components**	**Component**				
		1	2	3	4	5
BU-1	BU-1 Given the short battery life, it is quite challenging to utilize an electric automobile on a regular basis.	0.939				
BU-2	BU-2 If I had an electric vehicle, I would be concerned about the battery life all the time.	0.939				
BU-3	BU-3Due to a scarcity of charging facilities, using an electric car for long distance is a challenge.	0.857				
BU-4	BU-4It takes a long time to charge an	0.739				

	electric vehicle while travelling.					
BI-1	**BI-1** where to charge an electric car and how much it will cost is particularly problematic for people.	0.939				
BI-2	I think there should be more charging stations than there are right now. I'd rather wait.		0.91			
BI-3	Building a domestic charging infrastructure is a costly and bureaucratically challenging task, especially in Agra.		0.727			
BI-4	I'm concerned that the cost of household electricity will cause my bill to go up significantly.		0.676			

BST-1	Given the size of the battery and the possibility of a fire, I would not feel secure operating an electric vehicle			0.714		
BST-2	The complicated new technologies on which electric automobiles are built do not have my faith. I like more basic vehicles.			0.913		
BST-3	Given that power is also produced using coal and oil, I am not convinced that electric automobiles are less polluting than traditional vehicles.			0.911		
BST-4	Due to battery disposal, I'm not convinced that electric automobiles are less polluting than conventional vehicles.			0.879		

BST-5	BST-5 The cost and lifespan of the batteries used in electric vehicles remain unknown.			0.863		
BEU-1	The cost of the purchase is still excessive. I'd rather wait.				0.791	
BEU-2	If many people move to electric vehicles, the price of electricity is likely to rise, making them less beneficial.				0.934	
BEU-3	A significant chance exists that the electric vehicle purchased today may lose value very rapidly.				0.911	
BEU-4	There aren't enough mechanics trained to work on electric automobiles since there aren't many of them					

BRP-1	Electric vehicles can't accelerate quickly enough.					0.883
BRP-2	When shifting gears, electric automobiles don't let you hear the engine roar.					0.769
BRP-3	Extreme weather conditions will adversely affect the battery life of Electric car					0.743
BRP-4	Use of AC consumes more power and will cause reducing the battery life as claimed by companies					0.793
BRP-5	Boot Size and safety features will cause reducing battery life as claimed by the companies					0.752
BRP-6	Cost of battery replacement is not disclosed by manufacturers so far or if so it is too high					0.726

	Extraction Method: Principal Component Analysis.	
	Rotation Method: Varimax with Kaiser Normalization	
	. a. Rotation converged in 5 iterations.	

Table no.6 Correlation Matrix

Correlations					
	BU-1Barriers related to usability	**BI--1Barrier of infrastructure**	**BST-1Barriers related to safety and technology vehicle**	**BEU-1Barriers related to economic uncertainty**	**BRP-1Barriers related to performance**
BU-1Barriers related to usability	1				
BI--1Barrier of infrastructure	.445**	1			
BST-1Barriers related to safety and technology	.612**	.545**	1		
BEU-1Barriers related to economic uncertainty	.527**	.546**	.658**	1	

BRP-1Barriers related to performance	.692**	.343**	.397**	.343**	1
**. Correlation is significant at the 0.01 level (2-tailed).					

Table no. 7 : Mean and Standard Deviation

Items	Mean	SD
BU-1	4.291	0.679
BU-2	4.261	0.713
BU-3	3.952	1.037
BU-4	4.200	0.795
	4.176	0.806
BI-1	4.309	0.629
BI-2	4.248	0.708
BI-3	3.994	1.012
BI-4	4.267	0.731
	4.205	0.770
BST-1	4.248	0.717
BST-2	4.339	0.588
BST-3	4.012	1.003
BST-4	4.327	0.595
BST-5	4.212	0.761
	4.228	0.733
BEU-1	4.200	0.818
BEU-2	4.291	0.633
BEU-3	3.952	1.066
BEU-4	4.170	0.857
	4.153	0.844
BRP-1	4.218	0.747

BRP-2	4.248	0.766
BRP-3	4.133	0.864
BRP-4	4.206	0.790
BRP-5	4.188	0.783
BRP-6	4.176	0.845
	4.195	0.821

Table no. 8

Ho: All types of barriers have an equal effect on buying decision-making.

Particular	Mean	E Mean	(M-EM)	(E-EM)2	(E-EM)2/EM
BU	4.176	4.203	0.027	0.001	0.000
BI	4.205	4.203	0.002	0.000	0.000
BST	4.228	4.203	0.025	0.001	0.000
BEU	4.203	4.203	0.000	0.000	0.000
BRP	4.203	4.203	0.000	0.000	0.000
	21.014	21.014	0.000	0.001	0.000

The Chi-Square value is less than the table value, so Ho is accepted.

ANALYSIS AND DISCUSSION OF RESULT

Reliability:

Cronbach alpha is the most widely used method for checking the reliability of scale, and item analysis was conducted for testing validity. It may be mentioned that its value varies from 0 to 1 but satisfactory value is required to be more than 0.6 for the scale to be reliable (Cronbach 1951; Ismail and Velnampy, 2013;). In this study reliability statistics for 23 Barriers of buying electric cars items was .943 as shown in Table no.3. High reliability indicates that these items for mostly suitable for analysis.

KMO and Bartlet's Test of Sphericity:

Measure of Kaiser-Meyer-Oklin (KMO) is another method to determine the appropriateness of data for factor analysis. KMO Statistics varies between 0 and 1. Kaiser (1974) recommended that values greater than 0.5 are acceptable; between 0.5 to 0.7 are moderate; between 0.7 to 0.8 are good and between 0.8 to 0.9 are superior (Field, 2000). Bartlet's test of sphericity is the final statistical test applied in this study for verifying its appropriateness (Bartlet, 1950). In this study, the value of KMO for 23 factors barriers to buy items was .866. In Table no.4 This indicated sample taken to process factor analysis was statistically significant.

Factor Analysis:

After examining the reliability of the scale and the appropriateness of data, the barriers to buy electric car questionnaire was subjected to Principal Component Factor Analysis followed by Varimax Rotated Factor Analysis, which yielded five factors. The solution was obtained by using fixed number of factors. Accordingly, 4 items were selected for factor 1- Barriers related to usability, 4 items were selected for factor 2- Barrier of infrastructure, 5 items were selected for factor 3 – Barriers related to safety and technology, 4 items were selected for factor 4- Barriers related to economic uncertainty, 6 items were selected for factor 5- Barriers related to performance.

Correlation Matrix

As shown in the table no.6, there is high degree of correlation between the barriers to buy electric cars. From the table, Barriers related to usability are inter-correlated with Barrier of Infrastructure, Barriers related to safety and technology, Barriers related to economic uncertainty, Barriers related to performance with significant at 5% level. Factors are inter-correlated with significant at 1% level. Based on correlation value, since P value less than 0.01, null hypotheses (H01) rejected at 1% level and since P value less than 0.05, null hypotheses rejected at 5% level.

Results showed that reliability statistics for 23 Barriers to buy electric cars at .943 indicates high reliability. Of these 23 items KMO value of this study at.866, indicates sample taken to process factor analysis to be statistically significant. In addition to KMO Bartlett's test of Sphericity chi-square value was 4741.866. This value also confirmed that it was statistically significant. This value indicates that data were statistically significant for the factor analysis. In this study, 23 factors forcing to buy electric car items were taken for factor analysis. By using fixed number of factors, items were subjected to Principal Components Factor Analysis, which yield Barriers related to usability Barrier of infrastructure, Barriers related to safety and technology, Barriers related to economic uncertainty and Barriers related to performance factors. Out of 23 items, 4 items indicate the Barriers to buy electric cars related to usability, 4 related to the Barriers of infrastructure, 5 Barriers related to safety and technology, 4 Barriers related to economic uncertainty and 6 Barriers related to performance, From the correlation matrix table, using the 5 factors were inter-correlated with them. Barriers related to usability is highly correlated with Barrier of infrastructure for e-car, because the respondents believe that using an electric car will be inconvenient for them as they believe there are very few charging stations in the city, they don't believe much in latest battery technology and perceive it unsafe. Barriers related to usability are highly correlated with Barrier of infrastructure. According to table No.6 null hypothesis is rejected at 1% and 5% level of significance. So, there is significant relationship between the Barriers related to usability and Barrier of infrastructure. The researchers found that the Barriers related to usability, Barrier of infrastructure, Barriers related to safety and technology, Barriers related to economic uncertainty, Barriers related to performance are barriers to buy E-cars in Agra city.

Chi-Square

As shown in the table no.6, we can see that Barriers related to usability are inter-correlated with Barrier of Infrastructure, Barriers related to safety and technology, Barriers related to economic uncertainty, Barriers related to performance All types of barriers have an equal effect on buying decision-making.

Hence, The Chi-Square value is less than the table value, so Ho1 All types of barriers have an equal effect on buying decision-making is accepted.

FINDINGS

In this study out of 23 items, 4 items indicate the Barriers to buy electric cars related to usability, 4 related to the Barriers of infrastructure, 5 Barriers related to safety and technology, 4 Barriers related to economic uncertainty and 6 Barriers related to performance.

- From the Barriers related to usability BU-1 and BU-2 are the major barriers having highest mean 4.291 and 4.261 respectively
- From the Barriers of infrastructure BI-1 is the main barrier has the highest mean i. e, 4.309.
- From the Barriers related to safety and technology BST-2 and BST-4 are the primary reasons of barrier in buying electric car having mean 4.339 and 4.327.
- From Barriers related to economic uncertainty BEU-2 Is the main factor becoming barrier with having mean 4.291 and
- From the Barriers related to performance BRP-1 and BRP-2 having mean 4.218 and 4.248 respectively, are the major challenges with in wider adoption of Electric Cars in Agra city.

SUGGESTIONS

1. People are Concerned for short battery life manufacturers should Work on producing long battery life for daily use.
2. Challenge of Charging Infrastructure should be covered soon and there should be enough charging stations in the city either private or Govt.
3. People find new technologies complicated they do not have faith on which electric automobiles are built so, awareness and knowledge should be spread for common public by either manufacturing companies or government.
4. Due to battery disposal, people are not convinced that electric automobiles are less polluting than conventional vehicles there should be a solution for it with cutting edge technique.
5. If many people move to electric vehicles, the price of electricity is likely to rise, making them less beneficial. It seems mandatory to maintain low on- road price of electric cars.

6. People perceive that the Electric vehicles can't accelerate quickly enough, the manufacturing companies should give solution for quick acceleration.
7. When shifting gears, electric automobiles don't let you hear the engine roar, there should be some indicator given for shifting of gears.

REFERENCES

1. Rebecca Carter; Andrew Cruden; Peter J. Hall, Optimizing for Efficiency or Battery Life in a Battery/Supercapacitor Electric Vehicle DOI: 10.1109/TVT.2012.2188551 (2012),
2. Matthias Steinstraeter, Johannes Buberger, Katharina Minnerup, Dimitar Trifonov, Patrik Horner, Bastian Weiss, Markus Lienkamp, Controlling cabin heating to improve range and battery lifetime of electric vehicles (2022)
3. Hemant Harishchandra Kore, Saroj Koul Electric vehicle charging infrastructure: positioning in India ISSN: 1477-7835, 2022
4. Zeinab Moghaddam; Iftekhar Ahmad; Daryoush Habibi; Quoc Viet Phung; Smart Charging Strategy for Electric Vehicle Charging Stations (2017)
5. Julia Hildermeier, Christos Kolokathis, Jan Rosenow, Michael Hogan, Catharina Wiese and Andreas Jahn Smart EV Charging: A Global Review of Promising Practices (2019)
6. Pareek, S., Sujil, A., Ratra, S., & Kumar, R. (2020, February). Electric vehicle charging station challenges and opportunities: A future perspective.
7. Scott Hardman, Alan Jenn, Gil Tal, Jonn Axsen, George Beard, Nicolo Daina, Erik Figenbaum, Niklas Jakobsson, Patrick Jochem, Neale Kinnear, Patrick Plötz, Jose Pontes, Nazir Refa, Frances Sprei, Tom Turrentine, Bert Witkamp,
8. A review of consumer preferences of and interactions with electric vehicle charging infrastructure,2018, Pages 508-523, ISSN 1361-9209, https://doi.org/10.1016/j.trd.2018.04.002.
9. Mariangela Scorrano, Romeo Danielis, Marco Giansoldati, Dissecting the total cost of ownership of fully electric cars in Italy: The impact of annual distance travelled, home charging and urban driving, Volume 80, 2020, ISSN 0739-8859, https://doi.org/10.1016/j.retrec.2019.100799.

10. W.k. CHOW C.l. CHOW Electric vehicle fire hazards associated with batteries, combustibles and smoke Year 2022, Volume: 6 Issue: 2, 165 - 171, 30.06.2022
11. Zhiqiang Lv, Observations and Reflections on Electric Automobile Industry Developments, 2019, ISSN 2706-655X Vol.1, Issue 1: 98-104, DOI: 10.25236/IJFET.2019.010110
12. Adheesh, S. R., Vasisht, M. S., & Ramasesha, S. K. (2016). Air-pollution and economics: diesel bus versus electric bus. *Current Science*, *110*(5), 858–862. http://www.jstor.org/stable/24907969
13. Lívia Salles Martins, Lucas Fonseca Guimarães, Amilton Barbosa Botelho Junior, Jorge Alberto Soares Tenório, Denise Crocce Romano Espinosa, Electric car battery: An overview on global demand, recycling and future approaches towards sustainability, Journal of Environmental Management, Volume 295, 2021, 113091, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2021.113091.
14. Xiaoning Xia, Pengwei Li, A review of the life cycle assessment of electric vehicles: Considering the influence of batteries, Science of The Total Environment, Volume 814, 2022, 152870, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2021.152870.
15. M. Guarnieri, "Looking back to electric cars, "*2012 Third IEEE HISTory of ELectro-technology CONference (HISTELCON)*, Pavia, Italy, 2012, pp. 1-6, doi: 10.1109/HISTELCON.2012.6487583.
16. S. W. Hadley, "Evaluating the impact of Plug-in Hybrid Electric Vehicles on regional electricity supplies," *2007 iREP Symposium - Bulk Power System Dynamics and Control - VII. Revitalizing Operational Reliability*, Charleston, SC, USA, 2007, pp. 1-12, doi: 10.1109/IREP.2007.4410538.
17. Pandey, Anoop and Manocha, Dr. Sanjay and Saini, Pankaj, A Study on an Automobile Revolution and Future of Electric Cars in India (April 4, 2020). International Journal of Management (IJM), 11 (3), 2020, pp. 107–113, Available at SSRN: https://ssrn.com/abstract=3568382.
18. T. Badhwar and A. Galodha, "Electric Vehicles: A Comprehensive Review on sustainable, financial, political-policy prowess and prospects in India with labour policies of China and Africa," 2022 IEEE International Power and Renewable Energy Conference (IPRECON), Kollam, India, 2022, pp. 1-6, doi: 10.1109/IPRECON55716.2022.10059516.

19. Belousov, E.V., Grigor'ev, M.A. & Gryzlov, A.A. An electric traction drive for electric vehicles. Russ. Electr. Engin. 88, 185–188 (2017). DOI https://doi.org/10.3103/S1068371217040034
20. Johannes Kester, Gerardo Zarazua de Rubens, Benjamin K. Sovacool, Lance Noel, Public perceptions of electric vehicles and vehicle-to-grid (V2G): Insights from a Nordic focus group study, Transportation Research Part D: Transport and Environment, Volume 74, 2019, Pages 277-293, ISSN 1361-9209, https://doi.org/10.1016/j.trd.2019.08.006.