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# Abating The Carbon Foot Print Reduction of Automotive Transports Through Adoption of Electronic Vehicles

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## ABSTRACT

*The reduction of carbon footprints has now become a crucial strategy in combating the environmental sustainability through the broad acceptance of electric vehicles (EVs) which has been regarded as one of the most effective solutions in this effort. This paper aims to address the role of electric vehicles in reducing carbon emissions by replacing the traditional internal combustion engine vehicles thereby leading to improved air quality and lower carbon footprints. This paper examines the environmental benefits of EVs, considering factors such as electricity sources, vehicle lifecycle emissions, and advancements in battery technology. The primary data is collected from 50 sample respondents who are the users of EV's from Chennai city. This study highlights the factors that induced the purchase and usage of these EV Vehicles are ascertained. Further, the study explores challenges such as additional requirement of infrastructure development, consumer adoption, and policy frameworks required by the consumers from the manufacturers of EV vehicles to support this transition to electric mobility. The findings of the study highlights the potentiality of green vehicles as a key component in achieving global carbon reduction goals and advancing towards a low-carbon future thereby supporting the sustainable development goals.*

**Keywords:** Carbon foot print reduction, Environmental sustainability, Electronic Vehicles

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## 1.0 INTRODUCTION

The environment is experiencing notable effects on climate due to the increasing exploitation of both natural and artificial resources. As a result, reducing carbon emissions has become a key objective for industries, governments, and individuals. The transportation sector, a major source of global greenhouse gas emissions, plays a crucial role in efforts to address this climatic changes. In this regard, the rise of Electric Vehicles (EVs) offers a hopeful solution to lower the carbon footprint linked to conventional internal combustion engine vehicles. Electric vehicles offer the potential to significantly lower emissions by replacing fossil fuel-powered cars with cleaner, more energy-efficient alternatives. However, the effectiveness of EVs in reducing carbon footprints depends not only on the vehicles themselves but also on factors such as the energy sources used for charging, the manufacturing processes involved, and the lifecycle emissions associated with vehicle production. As governments and businesses seek to accelerate the shift toward electric mobility, it is

essential to examine how the widespread adoption of EVs can contribute to global carbon footprint reduction goals.

This research explores the role of electric vehicles in reducing carbon emissions, focusing on their environmental benefits, challenges, and potential for large-scale implementation. By analysing the lifecycle carbon impact of EVs, including manufacturing, charging infrastructure, and end-of-life disposal, the study aims to provide a comprehensive understanding of the potential for EVs to help achieve long-term sustainability. Additionally, the paper investigates key policies, technological innovations, and market dynamics that can further promote the adoption of electric vehicles and enhance their role in combating climate change. Ultimately, this research seeks to contribute to a deeper understanding of how electric vehicles can play a pivotal role in reducing transportation-related carbon footprints, paving the way for a more sustainable and eco-friendly future.

## 1.1 STATEMENT OF THE PROBLEM

The transportation sector is a leading contributor to global greenhouse gas emissions, with traditional internal combustion engine (ICE) vehicles serving as a major source of carbon dioxide (CO<sub>2</sub>) emissions. As the world faces the growing impacts of climate change, the need to transition to more sustainable transportation systems has never been more urgent. Electric vehicles (EVs) have emerged as a promising solution to reduce carbon footprints and mitigate the environmental effects associated with traditional vehicles. However, despite the potential of EVs to significantly lower carbon emissions, several challenges hinder their widespread adoption and optimal environmental performance.

## 1.2 OBJECTIVES

The main aim of this study is to accomplish the following objectives which are as follows

- To determine the factors influencing the purchase decision of EVs.
- To analyse the relationship between factors influencing the purchase decision, concerns and the expected development of EVs.
- To identify the future developments expected in the production of EVs in the near future.

## 1.3 NEED FOR THE STUDY

The increasing urgency of addressing climate change has made it essential to explore every possible avenue for reducing carbon emissions across various sectors. The transportation industry, a major contributor to global greenhouse gas emissions, presents a significant opportunity for environmental impact reduction. This study is needed to bridge existing knowledge gaps by evaluating the real-world impact of EVs on carbon footprint reduction, with an emphasis on both technological advancements and societal adoption

## 1.4 SIGNIFICANCE OF THE STUDY

The significance of this study lies in its efficiency to influence the policy decisions, drive technological innovation, inform consumer behavioural pattern to the manufacturers of EVs,

and provide a comprehensive understanding of how electric vehicles can play a critical role in reducing carbon emissions and mitigating the effects of climate change. It will serve as a valuable resource for governments, businesses, and researchers working to promote a sustainable, low-carbon future.

## 1.5 METHODOLOGY

The methodology section outlines the approach and techniques used to conduct the research. For this study, Quantitative data is analysed using statistical methods to assess the potential reduction in carbon emissions from the adoption of electric vehicles. Tools like Excel and SPSS will be used to perform calculations and generate results.

## 1.6 RESEARCH DESIGN

A descriptive research design was carried out to study the impact of Electronic Vehicles in reducing the carbon foot print reductions. The primary data was collected in the form of a structured questionnaire from the users of these electronic vehicles for their day today transportation.

## 1.7 LIMITATIONS OF THE STUDY

- The study was restricted to the geographical limits of Chennai city.
- Sample survey method has been used to collect data from the respondents. Hence sampling error may occur.
- The sample respondents are limited in number due to time constraints.

## 2.0 REVIEW OF LITERATURE

Literature review plays a pivotal role in discussing the general view of the research topic and helps in identifying the research gap.

**DongyingSun et al(2023)** have conducted a study to undersand the relationship between battery electric vehicles (BEV) and carbon dioxide emission (CO<sub>2</sub>) and their significant environmental outcomes. The researchers have adopted cross-sectionally augmented autoregressive distributed lag CS-ARDL technique to evaluate the variables long-run elasticity. The results demonstrate that

increased economic growth, urbanization, and population growth accelerate carbon emissions and environmental depletion. However, BEVs were found to be more energy efficient and the adoption of BEVs would reduce Co2 emissions.

**Janos Lucian Breuer et al (2021)** proposed a study to analyse fuel cell-electric vehicles, battery-electric vehicles and overhead catenary line trucks, taking a closer look at their potential to reduce greenhouse gas emissions and air pollution and also considering the investment and operating costs of the required infrastructure. The results indicated that air pollution is only partially reduced by switching conventional articulated trucks to electric drive models. The overall results show that a comprehensive approach such as fuel cell-electric drives for all trucks would most likely be more beneficial.

**Michela Longo et al (2015)** have proposed a study to demonstrate how the adoption of Renewable energy resources, electric vehicles has contributed for the improvement of air quality. The study indicates that the adoption of EVs is not widespread and suggests the government to implement policies and strategies in order to encourage people to adopt these vehicles.

**Kesar Chand (2019)** have conducted a research to indicate how Electric vehicles seem to be a new and innovative approach to conserve ecological sensitive areas from air pollution. The author concludes that in order to minimise the impact of air pollution the adoption of electric vehicles is vital

**Daniel E Horton et al (2021)** conducted a study in china to analyse the potential reduction in air pollution and carbon emissions due to adoption of electric vehicles. The researchers have also assessed the acute public health benefits attained through the adoption of electric vehicles.

### 3.0 CARBON FOOTPRINT

A carbon footprint refers to the gross amount of greenhouse gases (GHGs) emitted into the atmosphere as a result of human activities, which is typically measured in units of carbon dioxide equivalent (CO<sub>2</sub>e). It represents the environmental impact of individuals, organizations, products, or

services in terms of the amount of carbon dioxide and other GHGs produced throughout their lifecycle, from production to disposal.

### 3.1 CARBON FOOT PRINT REDUCTION

**Carbon Footprint Reduction** refers to the strategies, actions, and measures taken to decrease the amount of greenhouse gases (GHGs) released into the atmosphere. Reducing carbon footprints is essential to mitigate the impacts of climate change and move towards a more sustainable, low-carbon economy. Carbon footprint reduction is a vital part of global efforts to combat the climate change. By adopting various strategies at individual, organizational, and governmental levels, we can significantly reduce greenhouse gas emissions and work towards a more sustainable, low-carbon future.

#### **Benefits of Carbon Footprint Reduction:**

- **Mitigating Climate Change:** Reducing GHG emissions is essential in limiting global warming and avoiding the worst effects of climate change, such as extreme weather events, sea-level rise, and biodiversity loss.
- **Improving Public Health:** Reducing carbon emissions from transportation and industry can decrease air pollution, leading to better public health outcomes, especially in urban areas.
- **Cost Savings:** Energy efficiency measures often result in long-term cost savings for individuals and organizations, as they reduce energy consumption and operational costs.
- **Enhancing Reputation:** Organizations that take proactive steps to reduce their carbon footprints often enjoy improved public perception and are seen as leaders in sustainability, which can lead to increased customer loyalty and market opportunities.

### 3.2 ELECTRONIC VEHICLES

Electric Vehicles (EVs) are vehicles that run fully or partially on electricity. They are powered by electric motors that draw energy from rechargeable batteries, in contrast to traditional vehicles that use internal combustion engines (ICE) to burn fuel for



energy. EVs provide a more eco-friendly alternative to conventional vehicles, helping to reduce the environmental impact of transportation by cutting greenhouse gas emissions and enhancing energy efficiency.

### 3.3 CARBON FOOTPRINT REDUCTION THROUGH ADOPTION OF ELECTRIC VEHICLES

The adoption of electric vehicles (EVs) plays a crucial role in reducing carbon footprints and mitigating climate change. Transportation is one of the largest contributors to global greenhouse gas emissions, particularly from internal combustion engine (ICE) vehicles that burn fossil fuels like gasoline and diesel. By transitioning to EVs, which are powered by electricity stored in batteries rather than conventional fuels, we can significantly lower emissions and reduce the environmental impact of transportation systems.

#### Key Mechanisms of Carbon Footprint Reduction:

The following factors are considered as key mechanisms of carbon footprint reduction.

- Zero Emissions during Operation:
- Reduced Lifecycle Emissions:
- Energy Efficiency:

- Shift to Renewable Energy
- Reduction in Oil Consumption:
- Encouraging Sustainable Practices:

### 3.4 CHALLENGES ENCOUNTERED IN ADOPTION OF ELECTRIC VEHICLES:

The adoption of electric vehicles represents a key solution in the global effort to reduce carbon footprints and combat climate change. By transitioning to EVs, society can drastically lower emissions from the transportation sector, reduce dependence on fossil fuels, and contribute to a more sustainable future. While challenges remain, continued advancements in technology, infrastructure development, and supportive policies will drive the widespread adoption of electric vehicles, making a substantial impact on carbon footprint reduction and climate change mitigation.

- High Upfront Cost
- Charging Infrastructure
- Battery Lifespan and Recycling

### 4.0 DATA ANALYSIS & INTERPRETATION

Data analysis is the process of sorting, modeling, and analyzing data using various statistical and logical methods and techniques. Data analysis is the interpretation of the data collected from the sample respondents.

**TABLE 4.1 KMO AND BARLETT'S TEST**

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		<b>.865</b>
Bartlett's Test of Sphericity	Approx. Chi-Square	130.292
	df	28
	Sig.	<b>.000</b>

Source: Computed data

**TABLE 4.2 TOTAL VARIANCE IN THE FACTORS INFLUENCING THE PURCHASE OF ELECTRIC VEHICLES**

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.840	35.505	35.505	2.599	<b>32.489</b>	32.489
2	1.640	20.501	56.006	1.483	<b>18.540</b>	51.030
3	1.002	12.522	68.528	1.400	<b>17.498</b>	68.528
4	.887	11.090	79.618			
5	.613	7.665	87.283			
6	.469	5.868	93.150			
7	.395	4.941	98.092			
8	.153	1.908	100.000			

Source: Computed data

The above table 4.1 indicates the KMO measure of sampling adequacy for factors influencing the purchase decisions of EV's is **0.865**. Higher values of KMO more than 0.5 indicate that the factor analysis is useful for the data. The value of Chi-Square statistic in Bartlett's test is **0.000** (highly significant). Therefore, principal component analysis is an appropriate methodology to analyse the importance of selected indicators in purchase decision influencing factor.

The table 4.2 reveals the variance explained by the components after extraction and after rotation. The components have been extracted applying Kaiser

Criteria and rotated imposing Varimax rotation method. It is noted that only 3 components out of 8 are enough to explain the total variation in factors influencing the purchase of Electronic Vehicles. Rotation sums of squared loading indicate the first rotated component which explains 32.489% of total variation in factors influencing the purchase of Electronic Vehicles. The second rotated component explains 18.54% of total variation in factors influencing the purchase of Electronic Vehicles while the third component explains 17.498 % of total variations. The eight components altogether account for 68.538% of the total variations.

**TABLE 4.3 ROTATED COMPONENT MATRIX FOR FACTORS INFLUENCING THE PURCHASE OF ELECTRIC VEHICLES**

	Component		
	1	2	3
Environmental concerns	<b>.871</b>	-.029	-.041
Charging infrastructure availability	<b>.798</b>	-.246	-.017
Price	<b>.746</b>	.219	.058
Performance and technology features	<b>.738</b>	-.397	-.186
Brand reputation	-.177	<b>.863</b>	-.109
Government incentives like tax credits, rebates subsidies	.106	<b>.682</b>	.562
Lower maintenance costs	-.234	.078	<b>.794</b>
Range of the vehicle	.071	.035	<b>.634</b>

Source: Computed data

**INTERPRETATION**

**Component 1** includes Environmental concerns, charging infrastructure availability

Price, Performance and Technology features. They altogether explains 32.489% of total variations and represent the vehicle features related factors.

**Component 2** includes brand reputation and Government incentives and it explains 18.54% of total variations and represent External factors.

**Component 3** includes Lower maintenance cost and Range of the vehicle. It explains 17.498% of total variations and it also represents the vehicle features related factors.

**TABLE 4.4 MEAN AND STANDARD DEVIATION OF EXPECTD DEVELOPMENTS IN THE MANUFACTURING OF ELETRIC VEHICLES**

Expected Developments	Mean	Std. Deviation	Rank
Faster Charging	4.91	0.293	<b>1</b>
Higher energy Density	4.20	0.683	<b>5</b>
Electrification of Heavy duty vehicle	4.72	0.685	<b>3</b>
Electrification of Public transport	4.30	0.633	<b>4</b>
Solar power charging facilities	4.76	0.671	<b>2</b>

Source: Computed data

## INFERENCE

From the above table 4.4 it is concluded that faster charging and solar power charging facilities are considered to be the most expected developments followed by Electrification of Heavy duty vehicles and Public transport.

### 4.5 IMPACT OF FACTORS INFLUENCING THE PURCHASE DECISION OF ELECTRIC VEHICLES, CONCERNS ASSOCIATED WITH IT TOWARDS EXPECTED DEVELOPMENTS

Multiple linear regression has been performed to analyse the impact of the factors influencing the purchase decision of electric vehicles, concerns associated with it towards expected developments.

#### Dependent variable:

- Expected developments

#### Independent variables:

- Factors influencing the purchase decision of electric vehicles(X 1)
- Concerns associated with electric vehicles(X 2)

TABLE 4.5 MODEL SUMMARY

Model	R	R square	Adjusted R Square	Std. Error of the estimate
1	0.960	0.777	0.774	1.49695

#### Source: Computed data

From the above table 4.5 it is observed that Expected developments have a positive relationship with the factors influencing the purchase of EV's and concerns associated with it since the R value is

0.76. And R Square is 0.577 representing 57% of the variations in expected developments is enhanced by factors influencing the purchase of EV's and concerns associated with it

TABLE 4.6 ANOVA TABLE

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	89.050	2	44.525	19.870	.000
	Residual	114.283	51	2.241		
	Total	203.333	53			

#### Source: Computed data

From the above table 4.6 it is inferred that the dependent value is more reliable and model is good, since the significant value less than 0.05(p=0.000)

TABLE 4.7 COEFFICIENT TABLE

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.927	2.769		2.140	.037
	Factors influencing	.428	.088	.606	4.860	.000
	Concerns	.089	.118	.094	.755	.454

#### Source: Computed data

The fitted multiple regression is,

$$Y=5.927+0.428X_1+0.0089X_2$$

Hence it is observed that Expected developments have a positive impact towards factors influencing the purchase of EV's and the concerns associated with it.

## FINDINGS

Through the **Factor Analysis test** performed for the factors influencing the purchase decisions it is observed that

- Component 1 includes Environmental concerns, charging infrastructure availability

- Price, Performance and Technology features. They altogether explain 32.489% of total variations and represent the vehicle features related factors.
- Component 2 includes brand reputation and Government incentives and it explains 18.54% of total variations and represent External factors.
- Component 3 includes Lower maintenance cost and Range of the vehicle. It explains 17.498% of total variations and it also represents the vehicle features related factors.
- By analysing the **mean rank** and **standard deviation**,
- It is concluded that faster charging and solar power charging facilities are considered to be the most expected developments followed by Electrification of Heavy duty vehicles and Public transport.
- The **Multiple regression line** was performed and,
- It is observed that factors influencing the purchase of EV's and the concerns associated with it have a positive impact towards Expected developments

## SUGGESTIONS

The study suggests the manufacturers of Electric vehicles to provide a wide variety of vehicles, improve the battery density and charging time consumption. The up gradations made in this purview will promote the rapid growth of the electronic automotive industry. And the successful widespread usage of these vehicles will enhance the ecosystem conditions thereby ensuring environmental sustainability.

## CONCLUSION

As we march towards the achievement of Sustainable Development Goals (SDG) by addressing the carbon footprint reduction as a primary goal, the adoption of Electric Vehicles would pave way for an ethical ecosystem. The emission of these carbon into the atmosphere

should be reduced by the automotive sector in order to attain a clean and green environment. And this could be attained only by the adoption and usage of the electric vehicles. Abating the carbon footprint in the atmospheres ensures the SDG goals and also enhances the quality and maintains the balance of our ecosystem.

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