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A Comparative Study Between the Sale of Petrol, Electric, and Diesel Four-Wheelers: An Indian Context

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Abstract

Petrol, diesel, and electric are the fuel types that are used all around the world. While electricity has gained popularity in recent years due to its low cost compared to fossil fuels, one of the main reasons for an exponential surge in electric vehicles is the development of advanced electric batteries. While discussing in the context of India mainly, the rising petrol prices resulted in consumers switching to electricity. Despite this, electric vehicles in India are facing the challenge of low sales. There are many reasons for this, which will be discussed in this study, but the main reason can be attributed to the lack of infrastructure development for electric vehicles. The present study compared the sale of petrol, electric, and diesel four-wheelers over 10 years, i.e., from 2014 to 2024. The study found that the sale of petrol cars showed a constant increase from 2014 to 2024 despite the ravaging effect of COVID-19 on the Indian economy. Still, the sale of electric four-wheelers showed an exponential increase in terms of growth. This means that the number of petrol vehicles grew linearly over time, which can be expected by a proper analysis of the auto sector. On the other hand, the electric four-wheelers showed an unpredicted exponential increase. Further, it can be said that in comparison with the sale of petrol and electric vehicles, petrol wins the race for total sales. Still, in terms of growth, electric vehicles increased over petrol. Diesel vehicles, on the other hand, showed lesser sales and growth when compared to petrol. In comparison with electric, it showed that diesel vehicles sold more than electric vehicles. However, linearly, it declined while electricity grew exponentially.

Keywords: Electric vehicles, petrol, diesel, four-wheelers, COVID-19

INTRODUCTION

Electric vehicles (EVs) have grabbed people's interest in many world regions throughout the past few years. Government incentives, growing environmental concerns, and technology developments are driving India's rapid electric vehicle (EV) sector expansion [1]. India hopes to expand its EV adoption and transform its transportation system to a more sustainable and innovative landscape via programs like FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) [2]. This is because India has realized that electric vehicles are the only way for the future transportation system [3]. However, despite EV's significant energy efficiency and comparatively fewer moving parts, buyers still steer clear of EV purchases primarily due to their high price [4]. It will not be long before EVs are the go-to car in India due to the dramatic decline in the cost of lithium (Li)-ion batteries [5]. Mahindra Rewa is the only firm that sells a limited number of cars annually [6]. Based on the current interest in EVs, the Indian government has set a target to increase the percentage sales of EVs to 30% for private automobiles, 70% for commercial, 40% for

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buses, and 80% for two and three-wheelers by 2030 [7]. At this rate, India can see 80 million electric vehicles on Indian roads by 2030 [8]. Further, the 'Make in India' project in India aims to achieve complete local EV manufacturing rather than relying on foreign manufacturers.

Government Initiatives

The Indian government has reaffirmed its commitment to electric vehicles (EVs), targeting 30% electric mobility by 2030. The budget introduced customs duty waivers on importing machinery and capital goods essential for manufacturing lithium-ion batteries, the key power source of EVs [9]. One significant initiative is the FAME II scheme for EVs, launched on 1 April 2019 with a funding allocation of USD 1.43 billion (Rs. 10,000 crore), of which 30% was designated for SMEs to procure manufactured or processed goods. This phase primarily focuses on electrifying public and shared transportation. To facilitate the sale of 1341459 EVs, subsidies totaling Rs. 5790 crores have been granted to EV manufacturers under FAME II [10].

This scheme also emphasizes demand incentives, aiming to support 7090 e-buses, 5 lakh e-wheelers, 55000 e-passenger cars, and 10 lakh e-2-wheelers. Additionally, efforts to build charging infrastructure are strongly encouraged. As of December 2023, Phase II of FAME India provided Rs. 5294 crore subsidies to manufacturers for selling 1179669 EVs [11]. A more ambitious plan to replace 8 lakh diesel buses with electric alternatives over 7 years is set to take shape, potentially replacing FAME III [12]. This transition will eliminate one-third of diesel buses from Indian roads (*Center for Science and Environment, 2023*) [13].

SIGNIFICANT CHALLENGES FOR EVS IN INDIA

Cost Concerns

By promoting EV adoption, the government aims to minimize vehicular emissions while enhancing infrastructure development for electric vehicles. However, the high initial costs of EVs continue to be a significant barrier to their widespread acceptance in India. Although there are substantial long-term operational savings, many consumers find it challenging to purchase electric scooters and bikes because they are still more expensive initially than their conventional counterparts.

High Battery Costs

One of the most significant barriers to purchasing an electric vehicle is still the high cost of batteries. The cost of the expensive components keeps the electric scooter price inflated despite continuous improvements in battery technology and manufacturing efficiency, which affects affordability and market penetration [14].

Charging Infrastructure Limitations

Inadequate infrastructure for electric charging solutions is a significant obstacle to adopting electric vehicles in India. The lack of charging stations, especially in rural and semi-urban areas, increases the anxiety associated with running out of power and makes using electric bikes and scooters for extended distances challenging.

Extreme Weather Challenges

India's diverse climate presents significant difficulties in maintaining the efficiency of electric vehicles and the lifespan of their batteries. Extreme heat, high humidity, and prolonged monsoon rains can all impact a vehicle's battery life, overall performance, and range. Engineers must carefully consider every aspect of vehicle design to ensure dependable operation regardless of weather conditions [15].

TYPES OF ELECTRIC VEHICLES

1. Light Motor Vehicles (LMVs) in India refer to compact vehicles designed for transporting passengers or goods. These vehicles are lighter and smaller than heavy-duty options, making them favored for fuel efficiency, adaptability, and ease of navigation in city environments.

LMVs can be divided into transport and non-transport. Non-transport LMVs, such as personal cars, are intended for individual use, whereas transport LMVs are utilized to convey passengers and cargo.

2. In India, a Medium Goods Vehicle (MGV) is a commercial vehicle designated for transporting goods, distinct from light motor vehicles. To operate an MGV, a specific driver's license is necessary, applicable to vehicles with a gross vehicle weight (GVW) ranging from 7500 to 12000 kg.
3. In India, the term HMV refers to heavy motor vehicles, and obtaining an HMV license permits individuals to operate commercial vehicles such as trucks, buses, and cranes. Various categories of HMV licenses are available.
    - *Heavy Passenger Vehicle (HPV):* Designed for operating buses and coaches.
    - *Heavy Goods Vehicle (HGV):* Intended to operate trucks, trailers and tankers.
    - *Heavy Special Vehicle (HSV):* Used for maneuvering specialized heavy vehicles, such as specific industrial machinery.
    - *Heavy Construction Equipment (HCE):* meant for the operation of construction machinery.

LITERATURE REVIEW

1. *In their study, "Electric Vehicles in India:* Market Analysis with Consumer Perspective, policies, and Issues*," Pritam K. Gujarathi, Varsha A. Shah, and Makarand M. Lokhande (2018)* [4] suggested the viewpoint of the consumers to understand the realities of the ground. Their study is focused on the topic of EV charging tariffs. Issues related to the expansion of the Indian market, necessary policies, and promotional efforts are examined, accompanied by workable solutions and a global outlook.
2. *Patole, U. R., Deshmukh, A., Karpe, V., Nimbalkar, P., & Ugale, S. (2023*) [1]: The report outlined the operation of an electric vehicle and compared them with hybrid and internal combustion engine vehicles. A few benefits and drawbacks of the electric car were listed in the report. Furthermore, a brief outlook on the future of technology is provided. The study shows that electric vehicles have numerous advantages over internal combustion engines. It has drawbacks despite being far more effective and cleaner. It is more expensive, heavier, and has a shorter range before recharging. The EV's battery is what will determine its fate.
3. *Tupe et al.*: It is concluded that India has to move to more energy-efficient automobiles due to the depletion of fossil fuels and the ongoing rise in fuel prices [16]. The government has acted to reduce pollution by endorsing electric vehicles and providing financial aid for their purchase. The government has loosened FDI regulations to increase output. In India, several new brands are introducing EVs. The government and industry players should provide the necessary infrastructure and foster an environment conducive to electric vehicles.
4. *Prakash et al.*, in their analysis of the ISM approach to adopting electric vehicles in the Indian auto industry, found that consumer traits and government incentives are the most significant obstacles to the mass market adoption of electric cars [17].
5. *Bhattacharyya and Pradhan's* research primarily provides an overview of the challenges and issues associated with electric vehicles in India [18]. The electric vehicle industry in emerging economies faces various barriers and bottlenecks, ranging from minor inconveniences to significant factors that significantly impact the growth dynamics. Alongside targeted interventions, tackling social issues as new challenges continually arise is essential. India has established a highly ambitious objective of achieving 100% electric mobility by 2030, serving as a prime example that compels manufacturers to seek solutions to these challenges. The Paris Declaration on Electro Mobility advocated a worldwide electric vehicle transition.
6. *Kesari et al.* emphasize that formulating a robust strategy for the widespread adoption of electric vehicles (EVs) in India and ensuring effective implementation poses significant challenges for the government [19]. The country's geographical diversity will necessitate innovative solutions to address these issues. Procurement by the public is anticipated to play a crucial role in driving the growth of EVs, mainly through the acquisition of four-wheeled vehicles for

government use, three-wheeled cars, and buses for public transportation. Additionally, investments from fleet operators such as Ola and Uber and food distribution service providers are expected to contribute to the initial surge in adopting two- and four-wheeled electric vehicles. Nevertheless, private electric cars may take approximately 5 to 6 years to achieve widespread popularity and acceptance.

OBJECTIVES

1. To compare sales of four-wheelers among three different fuel segments between 2014 and 2024.
2. To investigate the reason for sales fluctuations among the different fuel segments of vehicles.

RESEARCH METHODOLOGY

1. Data collected is secondary and is collected from the E-Parivahan site.
2. Data analyzed is between the period of 2014 and 2024.
3. The year studied is financial.
4. Data is collected for four-wheelers only.
5. Data is studied and analyzed for three fuel segments vehicles only; the fuel types are Diesel, Petrol, and Electric (BOV).
6. The vehicles covered under each fuel include 4WIC, LMV, MMV, and HMV.

Research Plan

The data studied is put through various graphical representations and charts for easy and detailed observation. Certain variations in the increase or decrease of sales are checked with the help of line charts.

DATA ANALYSIS AND INTERPRETATION

Table 1 shows the sales distribution for each four-wheeler fuel over each financial year. Based on Table 1, four-line charts are obtained, which are used to interpret Table 1.

Interpretation 1

Figure 1 is the line chart showing the variation in sales of the three fuels segment vehicles over 10 financial years. As can be observed from the chart in Figure 1, diesel vehicle sales gradually declined from 2014 to 2024, while petrol vehicle sales continued to rise. The sale of e-vehicles showed a straight line far below the sales of petrol and diesel. The sale of diesel vehicles dropped at its lowest during COVID-19, but gasoline sales continue to increase gradually, almost displaying a steady linear increase.

Table 1. Year-wise distribution of different fuel types of vehicles.

	Vehicle Type		
Year	***Diesel***	***Electric (BOV)***	***Petrol***
2014–15	1150283	566	1110204
2015–16	1072133	666	1270803
2016–17	1027770	616	1442785
2017–18	1091132	906	1651630
2018–19	998200	1216	1671962
2019–20	847652	1059	1645699
2020–21	418713	4795	1801691
2021–22	532051	17646	1948248
2022–23	655589	40405	2167419
2023–24	658422	80314	2150537
Total	**8451945**	**148189**	**16860978**

Source: Authors' creation

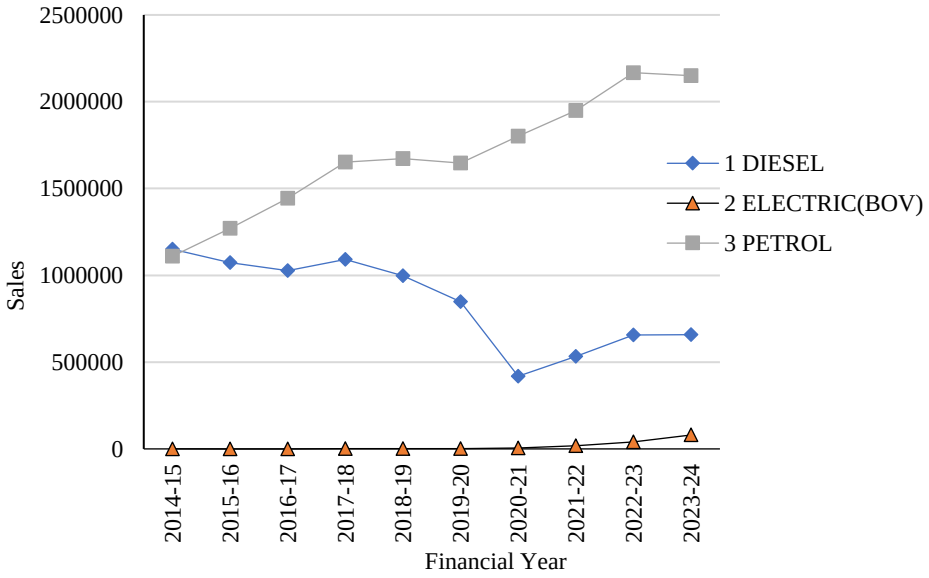

Figure 1. Sales volume comparison of three fuels four-wheelers vehicles.
Source: Authors' creation.

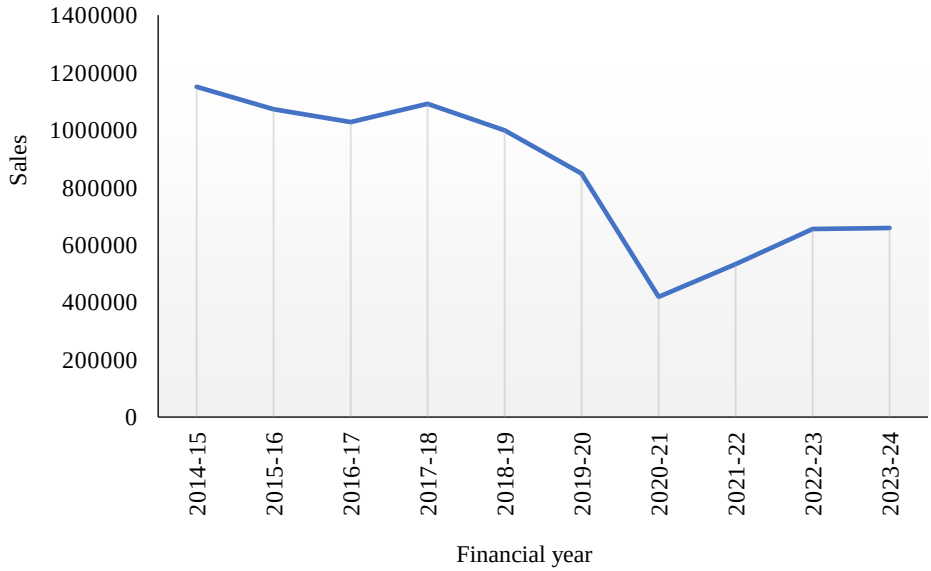

Figure 2. Line chart showing a constant decrease in sales volume for diesel fuel four-wheeler vehicles.
Source: Authors' creation.

Interpretation 2: The constant decline in diesel 4-wheelers
Reason for the transition in Figure 2

i. *Policy shifts and environmental concerns:* After 2014, there was a growing awareness about environmental pollution and its impact on health. Several cities and regions in India are now implementing restrictions on diesel vehicles due to their higher emissions and inefficiency. Apart from this, Stricter emission norms (such as Bharat Stage VI) were introduced, making diesel engines more expensive to produce and maintain. Manufacturers had to invest in cleaner technologies, which affected the overall cost of diesel vehicles.
ii. *Fuel price dynamics:* Historically, diesel was cheaper than petrol in India. However, the gap narrowed significantly over time due to changes in government policies and taxation. As the price difference decreased, the cost advantage of diesel vehicles diminished. Diesel prices became

more volatile, leading buyers to consider the long-term cost of ownership. Uncertainty about future fuel prices influenced purchasing decisions.

iii. *Shift Toward Petrol and Alternative Fuels:* Petrol cars gained popularity due to improved fuel efficiency, reduced noise levels, and lower upfront costs. Buyers found petrol vehicles more convenient for city driving. Apart from this, the buzz around EVs grew stronger. While EV adoption is still in its early stages, the promise of zero emissions and lower operating costs attracted environmentally conscious buyers.

iv. *Other reasons:* Apart from the principal above, other reasons include consumer perception and resale value, technological advancements, urbanization, traffic congestion, etc.

Interpretation 3: The steady increase in petrol four-wheelers

Reason for the transition in Figure 3

The main reason for the constant increase in petrol 4-wheelers can be understood by the reasons mentioned for the decline in diesel 4-wheelers in interpretation 2. A few more reasons are discussed below:

i. *Economic growth and rising income levels:* Since 2014, India has experienced significant economic growth. As the commoner's disposable income increases, so does the motivation to buy petrol 4-wheelers. Apart from this, straightforward loan processes by banks and finance companies also contributed to the rise in sales.

ii. *Rapid urbanization and infrastructure development:* Urbanization refers to the rapid expansion of cities, which resulted in increased demand for personal transportation and a decline in public transit, as public transport systems could not always keep up. Owning a car provided convenience and flexibility, especially for daily commuting. Also, the government invested in road infrastructure, connecting previously underserved areas. Better roads meant that people could travel more comfortably, encouraging car ownership.

iii. *Diesel price differentials:* Historically, diesel was subsidized in India. However, the government gradually reduced these subsidies, narrowing the price gap between petrol and diesel. As a result, petrol cars became more attractive.

iv. *Global crude oil prices:* While this is not specific to India, it is essential to consider. Crude oil prices fluctuate globally, affecting fuel prices locally. When global oil prices are low, petrol prices tend to be more stable, making cars appealing.

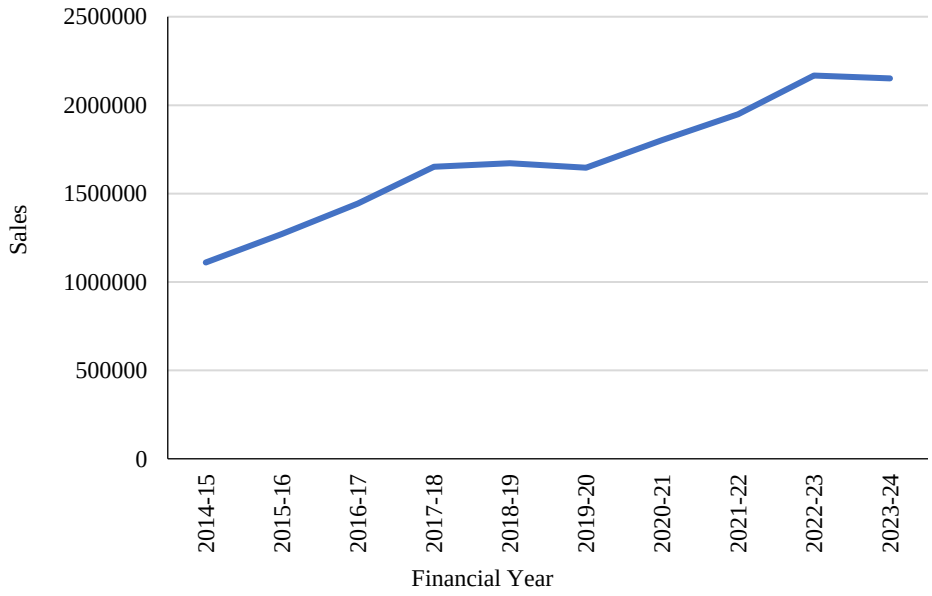

Figure 3. Line chart showing a constant increase in sales volume for petrol fuel four-wheelers vehicles.

Source: Authors' creation.

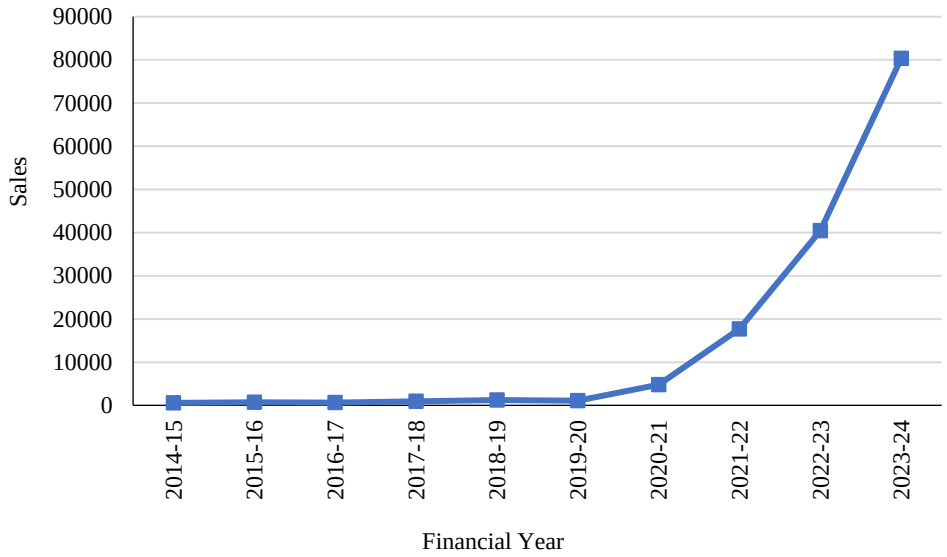

Figure 4. Line chart showing an exponential increase in sales volume for electric (BOV) fuel-wheeler vehicles.
Source: Authors' creation.

v. *Consumer perceptions:* Petrol cars are often associated with smoother performance and quieter engines. As technology improved, petrol engines became more efficient, reducing the historical bias toward diesel.

Interpretation 4: The exponential increase in Electric 4-wheelers
Reason for the transition in Figure 4

Exponential growth occurs when a quantity increases over time at an ever-accelerating rate. In other words, the rate of change of the quantity is directly proportional to the amount itself.

i. Government initiatives and policies:
   - *FAME Scheme:* In 2015, the Indian government introduced the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme. This initiative aimed to accelerate the adoption of electric mobility by providing incentives, subsidies, and support for EV manufacturers and buyers.
   - *State-Level Policies:* Various states also launched their own EV policies, creating a conducive environment for electric vehicle adoption.

ii. Advancements in technology and cost reduction:
   - *Battery Technology:* Li-ion technology improvements led to better energy density, longer ranges, and reduced costs.
   - *Local Manufacturing:* As more components were manufactured locally, prices came down.

iii. Growing environmental awareness:
   - *Climate Concerns:* Increased awareness about climate change and air pollution drove consumers and policymakers to seek cleaner alternatives.
   - *Air Quality Issues:* Indian cities faced severe air quality challenges, making EVs attractive.

iv. Automaker commitments:
   - *Tata Motors, Mahindra, and Others:* Indian automakers committed to electrification. Tata Motors, for instance, aims to increase its EV portfolio's contribution to sales significantly [13].
   - *Global Players:* International automakers like Hyundai, MG, and Kia entered the Indian EV market, offering competitive models.

v. *Urban mobility needs:*
   - *Urban Congestion:* Indian cities face traffic congestion and pollution. EVs provide a cleaner, quieter alternative.

- *Short Commutes:* EVs suited short urban commutes, where range limitations were less of an issue.

vi. *Corporate commitments:*
- *Corporate Fleets:* Many companies adopted electric vehicles for their corporate fleets, promoting EV visibility.
- *Corporate Social Responsibility:* Companies aligned with sustainability goals by choosing EVs [12].

Limitations

1. Data is only studied for standard petrol, diesel, and e-vehicle four-wheelers; some categories are not considered, like petrol-hybrid, diesel-hybrid, etc.
2. Only 4-wheeler vehicles are studied; other types, like two-wheelers or three-wheelers, are not considered.

CONCLUSION

The sale of petrol cars showed a constant increase from 2014 to 2024 despite the ravaging effect of COVID-19 on the Indian economy. This further showed that the number of petrol vehicles grew linearly over time, which can be expected by a proper analysis of the auto sector. On the other hand, the electric cars, in this case four-wheelers, showed an exponential increase, which is unpredicted and cannot be ascertained before through analyses like that in linear. Further, it can be said that in comparison with the sale of petrol and electric vehicles, petrol wins the race for total sales, but in terms of growth, electric vehicles beat petrol. Diesel vehicles, on the other hand, showed lesser sales and development when compared to petrol. Compared with electric, diesel showed more sales than electric, but linearly, it declined while electric grew exponentially. Thus, it can be said that electric 4-wheelers can be considered a winner if a particular segment's growth is considered but not in terms of total sales. As of March 2024, India boasts a total electric four-wheeler fleet of approximately 148189 units, with significant growth year-on-year. Also, sales of electric 4-wheelers registered a whopping 114% growth in 2023 compared to the previous year. Further, the data is studied for standard petrol, diesel, and e-vehicle type four-wheelers, excluding categories like petrol-hybrid, diesel-hybrid, etc. The type of fuel studied is pure petrol, diesel, and electric battery-operated vehicles. Some other types of fuel, including mixed fuel, are not considered. Only 4-wheeler vehicles are studied; other types of cars, like two-wheelers or three-wheelers, are not considered. These gaps in this study can be a scope of future study by scholars.

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