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## A Study on Opportunities & Challenges with Reference to Electric Vehicles in India

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### *Abstract*

*In global automotive industry there is a transformative shift towards sustainable mobility. Electric vehicles are the replacement for petroleum-based vehicles. Many countries around the globe have implemented this technology and are contributing towards amelioration of the environment. The Indian Government is trying to increase the electric vehicle in the automobile industries. Various factors such as economic, social, technical and environmental affecting the electric vehicles market in India are analyzed in this paper. In this paper ease of Electric vehicles in India will be studied and the compatibility of EVs in India will be discussed. Recommendations are then made considering opportunities and challenges with reference to EVs. This research paper explores the opportunities & challenges being faced by Indian customers for adoption of electric vehicles. The intention of this paper is to highlight the factors that are holding back Indian customers for transition to electric vehicles. We are going to see the opportunities and challenges faced in India over implementing electric vehicles.*

## **1. INTRODUCTION**

In near future it is possible that India will be among the top three largest car market in the world. India is amongst the growing economies and one of the world's most populous countries which amount to plenty of transport on the road to serve the need of the country. Electric vehicles could be an alternate energy transport solution.

India being an economy of around 140 crore people, our daily activities cannot be imagined without the use of vehicles. At present petrol and diesel are main source of fuel for the vehicles. Petrol prices hiking as much as up to 98 rupees liter, we are eagerly looking for a substitute.

Technological developments, and an increased focus on renewable energy and the potential reduction of transportation's impact on climate change and other environmental issues are major factors with reference to EVs.

There are several reasons why electric vehicles should be adopted in India and the world. Over the last few decades, the efforts and interest in protecting the environment and the climate is on the rise.

Transportation revolution is required in India if we want to achieve India's Net Zero Emission by 2070.

Indian government is trying to make India a 100% Electric Vehicle Nation within next 10 years.

The National Electric Mobility Mission Plan (NEMMP) 2020, Under NEMMP 2020, Government has launched Faster Adoption and Manufacturing of Electric vehicles in India to promote manufacturing of electric and hybrid vehicle technology.

The main objective of NEMMP is to achieve national energy security. Growth of domestic manufacturing capabilities in the automobile sector.

Electric Vehicles market is growing rapidly all over the world. In India also the EV market has gained significant momentum in present time. The implementation of FAME (Faster Adoption and Manufacture of Hybrid and Electric Vehicles) scheme in 2015 by Ministry of Heavy Industry and Public Enterprises is a game changer. In India the total EV sales in 2018 hit 365,920 Units and expected to grow at a CAGR of 36% till 2026 as per reports.

Electric cars can make India self-sustainable.

Indian government has already taken various initiatives to encourage EV adoption however decision makers have to take a long term perspective to get them implemented efficiently

## 2. REVIEW OF LITERATURE

**Potential Need for Electric Vehicles, Charging Station Infrastructure and its Challenges for the Indian Market: by Praveen Kumar and Kalyan Dash**, According to Praveen Kumar and Kalyan Dash, India should bring about smaller changes from time to time rather bringing bigger changes drastically. **Encouragement should be more toward home charging**. Before implementing the large scale charging infrastructure, Proper planning of place, population, traffic density, and safety should be considered. Importance should be given towards the integration of activities within the energy and transport fields. Different innovative policies and programs are the drivers of electrical cars and they must offer a financial consumer incentive, like tax credits, purchase subsidies, discounted tolls, free parking, and access to restricted highway lanes which will help the market to grow. (Dash P. K., 2013)

**Consumer preferences for electric vehicles: by Fanchao Liao, Eric Molin & Bert van Wee,** Problems like environmental pollution, global warming, and oil dependency will be solved by widespread adoption of EVs . The penetration of EV is comparatively low despite governments implementing strong promotion policies.

**Fanchao Liao, Eric Molin & Bert van Wee** presented a comprehensive review of studies on consumer preferences for EV aiming to convey policy-makers and give direction to further research. A comparison was made between the economic and psychological approach towards consumer preference for Electric vehicles. There is a significant impact of the financial and technical attributes of EV on its utility including its purchase and operating cost, driving range, charging duration, vehicle performance, and brand diversity in the market. There is a positive effect brought by density of charging stations on the promotion of EV. The impact of incentive policies, tax reduction is quite effective. (Fanchao Liao, 2017)

**Study on Electric Vehicles in India Opportunities and Challenges: by Mohamed M, G Tamil Arasan, and G Sivakumar,** With the replacement of ICE with electric engines pollution will be reduced to a great extent and will be profitable to consumers. Contributions have been made by many countries in adopting this technology and bringing improvement of the environment. The researcher gave a through look at the opportunities and challenges faced in India on implementing EVs. Opportunities such as Government Initiatives, Batteries, Industries, and Environment are already considered. Special consideration was given to The challenges like the cost of EVs, the efficiency of EVs in India, and demand for EVs. The implementation of EVs in India focuses to roll back greenhouse emissions and cut oil expenses. The Indian government should make the foremost out of the opportunities available and find suitable ways to handle the challenges. (Mohamed M, 2018)

**Electric Vehicles in India: Market Analysis with Consumer Perspective, Policies and Issues: Pritam K. Gujarathi, Varsha A. Shah, Makarand M. Lokhande** In India, the current market share of EV/PHEV is around 0.1%. Presently almost all vehicles consider non-renewable energy source based transportation. The existing fuel system generally pollute the environment by emission of harmful gases. The gap between domestic petroleum production and consumption is increasing. 70% of oil requirement per year in India is fulfilled by Import. Therefore we need to explore more factors and challenges for sustainable and cleaner alternative sources. (Pritam K. Gujarathi, 2018)

**Perception and Awareness Level of Potential Customers towards Electric Cars: Masurali. A Surya P,** According to Masurali. A Surya P, India contributes around 18 % in the transport sector alone in terms of compared to combustion-engine vehicle carbon emission. The Electric Vehicle (EV) is one of the best possible alternative solutions to face the existing challenges. Several automotive companies are introducing EVs and are expanding their portfolio of cars. Promoting EVs can reduce dependence on fuel as well as

reduce pollution. As people are getting educated they are more influenced towards buying Electric vehicles. Apart from manufacturers, Indian Government should try hard to spread awareness and influence positive perceptions among potential customers of the automobile market. (Masurali. A, 2018)

**Electric Vehicles for India: Overview and Challenges: by Mr. A. Rakesh Kumar, Dr. Sanjeevikumar Padmanaban** As per the opinion of Mr. A. Rakesh Kumar, Dr. Sanjeevikumar Padmanaban , Global pollution is increasing day by day and each effort made, is to cut back the CO2 emissions and save the atmosphere. The Indian government has come up with ambitious plans of introducing EVs to the Indian market and confine pace with the event of EVs globally. The National Electric Mobility Mission Plan 2020 has included an in-depth report on EVs. India encompasses a huge challenge in shifting the transportation sector from ICE engines to EVs. This needs lots of planning along with R&D. There is an immediate need to focus on building Charging infrastructure and to address the range issue with reference to Electric Vehicles. (Mr. A. Rakesh Kumar, 2019)

### **3. RESEARCH OBJECTIVES**

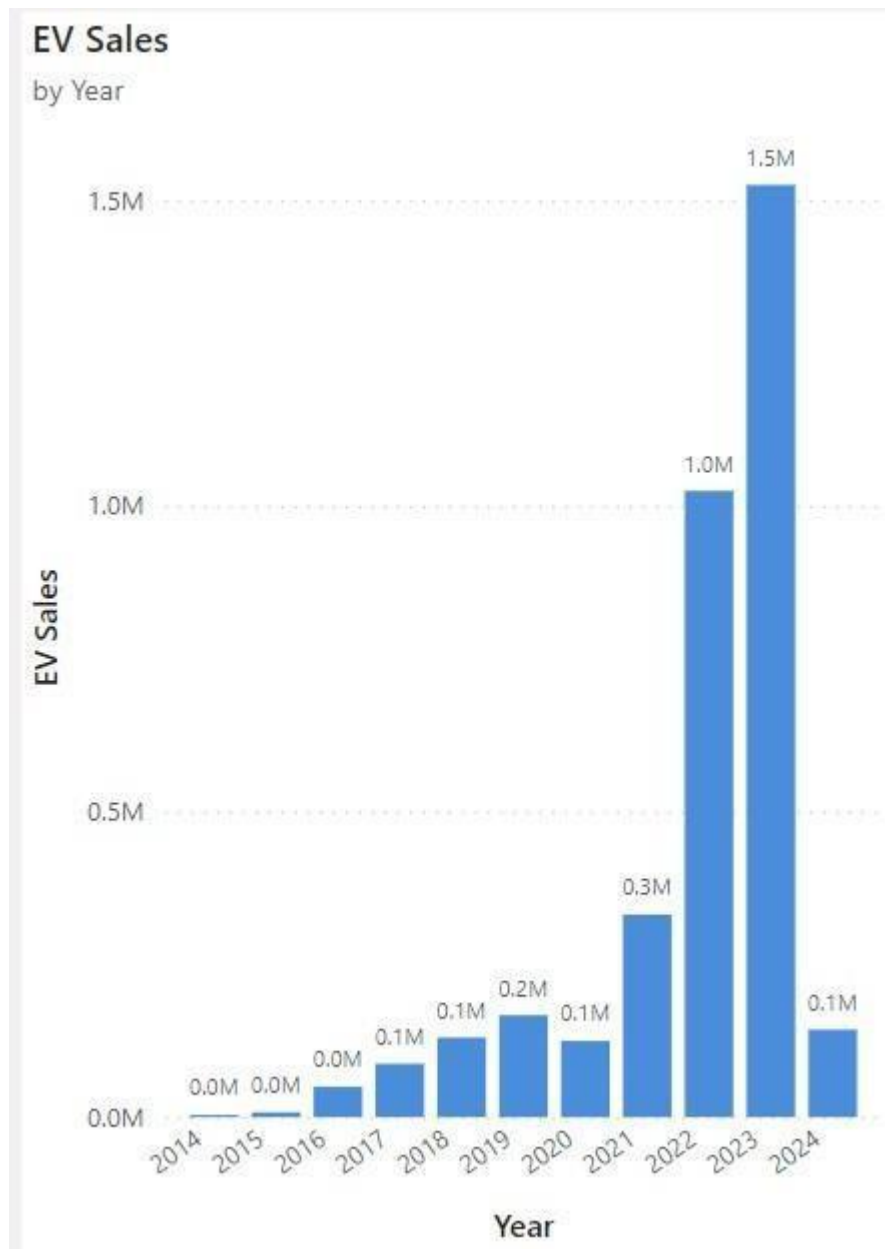
1. To understand the Indian Automobile sector with reference to Electric Vehicles.
2. To study the major factors affecting EV adoption.
3. To analyze Government Initiatives with reference to Electric Vehicles.
4. To identify the opportunities and challenges of using EVs
5. To critically analyze the recent trends and progress in EV market

### **4. RESEARCH METHODOLOGY**

Considering the nature of the research, it is based on the secondary data of national and international journals, government reports, articles, books, newspapers and magazines, covering the wide collection of academic literature on electric vehicles sales in Indian automobile market.

Considering the research objectives, we have used descriptive research design to ensure rigorous analysis of research study. Available secondary data was extensively used for academic research only. Scope of the paper is limited to Indian electric vehicles scenario considering certain parameters. The study is done to present information about the Indian Automobile sector with reference to electric vehicles. Due to practical and time constraints the research provides a review of EV based on the secondary data only.

## 5. DATA ANALYSIS

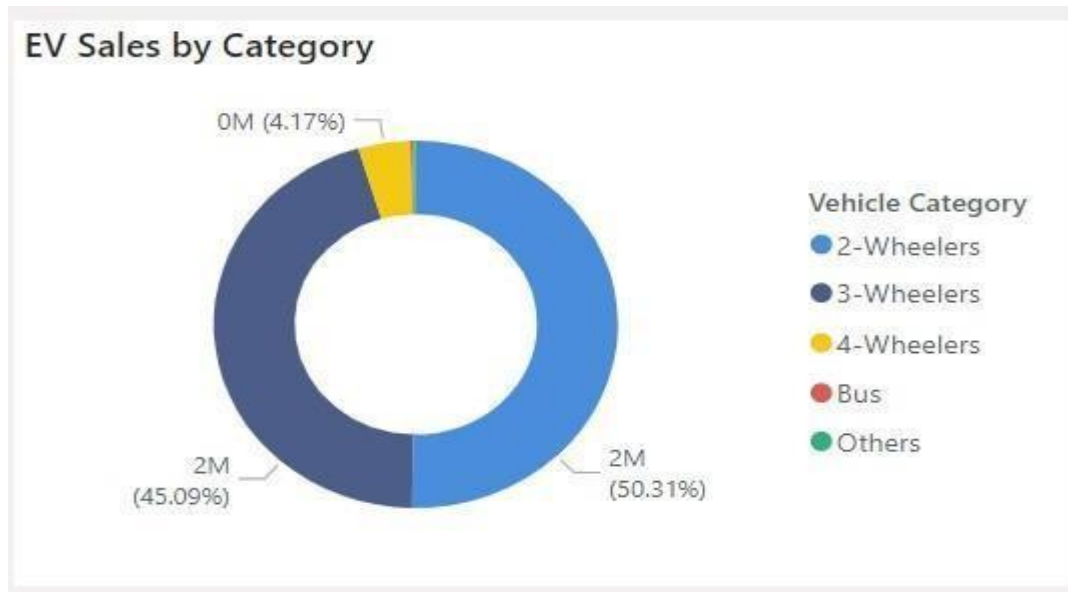


**Figure 1 : EV sales in India by year**

Source : Indian Government owned Vahan Dashboard

The dashboard highlights EV sales across the country. It shows data of EV sales from 2014 to till date from the Indian Government owned Vahan dashboard and presents it in a simplified and user-friendly manner that enables analysis and comparisons of vehicle sales in best possible manner.

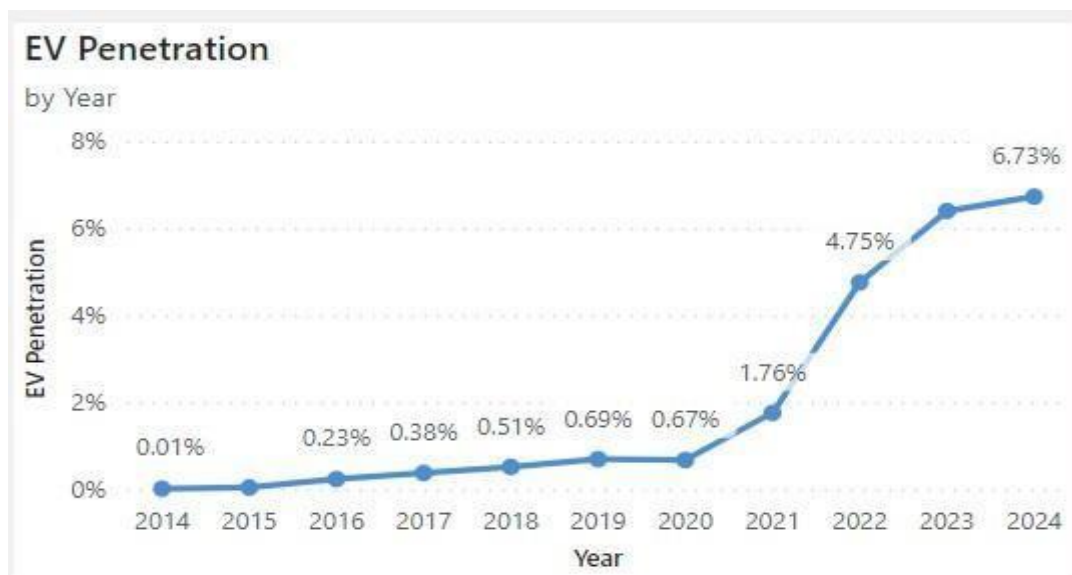
As we can see from the figure 1, a significant rise in the sales of EVs is seen since 2016 with the maximum units sold in year 2023.



**Figure 2: EV sales in India by Category**

Source : Indian Government owned Vahan Dashboard

There are various categories of EVs i.e. 2 wheeler, 3 wheeler, 4 wheeler, Bus and others. It shows EV sales in India across all vehicle categories.



**Figure 3: EV penetration in India by year**

Source : Indian Government owned Vahan Dashboard

The above dashboard shows how EV penetration in India has increased in the last 10 years i.e. 2014 to 2024. It is self explanatory that transition to electric Vehicles is promising specially during 2021 to 2024.

## 5.1 Electric Vehicle Timeline

- 1832 – Robert Anderson develops First Crude Electric Vehicle
- 1890 – William Morrison develops first successful electric vehicle in the USA
- 1899 – Electric Cars gain popularity
- 1900 – Electric Cars are the trend
- 1901 – The World First Hybrid Electric Car, the “Lohner –Porsche Mixed” is created by Ferdinand Porsche
- 1908 – The Ford Model T is introduced by Henry Ford
- 1912 – The Electric Starter is introduced
- 1920 – 1935 – Decline in electric vehicles due to use of crude Texas Oil as fuel
- 1960s – Interest in electric vehicles regain as Fuel prices Soar
- 1971 – First Manned Electric Vehicle for the moon, NASA’s Lunar Rover is developed
- 1973 – Many Automakers explore alternative options to fuel
- 1974 – Sebring Vanguard introduces the ‘Citi Car’
- 1979 – Interest in Electric Cars fade due to drawbacks
- 1990 – Clean Air Amendment Act is passed
- 1992 – Energy Policy Act is passed
- 1996 – General Motors launch EV1
- 1997 – Toyota produces the first mass produced hybrid, the ‘Prius’
- 2006 – TESLA announces production of luxury electric cars
- 2008 – TESLA produces its first electric vehicle, the Roadster with range of 244 miles per charge
- 2009 – US Energy Department invests in nation-wide charging infrastructure
- 2010 – General Motors introduce first Plug In Hybrid, the Chevy Volt
- Nissan introduces LEAF, an all electric, zero emission cars
- 2012 – TESLA introduces Model S with battery range of 270 miles per charge
- 2013 – Cost of Electric Vehicle Batteries drop by 50%
- 2014 – TESLA announces plan to build ‘Gigafactory’ and double worlds 2014 battery production figures
- 2016 – BMW Group, Daimler AG, Volkswagen Group with Audi and Porsche along with Ford Motor Company (European Division) agree to build ultra fast charging sites across Europe by 2020
- 2017 – Toyota announces sales of 10 million hybrids since production of Prius’.
- 2019 – Expected date by which Swedish Automaker Volvo announces to produce only electric and hybrid cars
- 2020 – China’s expectation of 10% of auto imports and production will be only electric vehicles
- 2025 – Expected date by which Norway and Netherlands plan to ban sales of petrol and diesel cars
- **2030 – Expected date by which India plans to promote an all-electric car fleet .**
- 2040 – Expected date by which Britain and France announce plans to ban sales of all new petroleum based vehicles

## 5.2 Electric Vehicles In India

1) **Origin and Increasing Scope:** The push for Electric Vehicles (EVs) is driven by the global climate agenda established under the Paris Agreement to reduce carbon emissions in order to limit global warming. The rapid growth in electric vehicle (EV) uptake is due to global electric mobility revolution. About two in every hundred cars sold today are powered by electricity with EV sales for the year 2020 reaching 2.1 million . The global EV fleet totalled 8.0 million in 2020 with EVs accounting for 1% of the global vehicle stock and 2.6% of global car sales . Reducing battery costs and increasing performance efficiencies are fuelling the demand for EVs worldwide.

2) **Need for Electric Vehicles:** India is in need of a transportation revolution. Considering the eco-friendly nature of Electric Vehicle, the transition to electric mobility is a promising global strategy .

3) **India's Support to EVs:** India is among a handful of countries that support the global EV30@30 campaign, which aims for at least 30% new vehicle sales to be electric by 2030. Various ideas were espoused by India at the Glasgow summit, such as, renewable energy catering to 50% of India's energy needs, reducing carbon emission by 1 billion tonnes by 2030 and achieving net zero by 2070.

## 5.3 Opportunities

### 5.3.1 Government Initiatives

- The Government plans to setup lithium-ion battery making facility under supervision of Bharat Heavy Electricals Limited (BHEL) .
- The Goods and Services Tax (GST) Council has set a tax rate of 12% compared to 28% set for petroleum based vehicles .
- India is obligated to bring down its share of global emissions by 2030 as a signatory to the Paris Climate Agreement .
- In 2015, the National Electric Mobility Mission Plan was drafted to achieve fuel security by expecting to achieve sales of electric and hybrid cars to reach six to seven million by 2020 .
- State run firm Energy Efficiency Services Limited (EESL) has appointed the nodal agency to procure around 10,000 electric cars to replace existing government vehicles
- . In 2015, the Government introduced a scheme called the Faster Adoption and Manufacturing of hybrid and Electric vehicles (FAME) in order to promote electric vehicles .

### 5.3.2 Battery

- Battery prices have declined from \$600 in 2012 to \$250 in 2017 and are expected to fall to \$100 by 2024 making it cheaper than capital cost of petrol vehicles .
- The storage capability of EV batteries can help with grid balancing

### 5.3.3 Industrial Scenario

- Taxi aggregator OLA has launched OLA Electric project aiming to build an electric mobility ecosystem including charging infrastructure and vehicle fleets such as electric cabs, e-rickshaws and much more .
- Suzuki has announced its plan to setup a \$600 million lithium ion battery facility .



- Mahindra has announced investment of around 60 million rupees to develop its EV division expecting to launch electric variants of its vehicles.
- Cummins India, an engine manufacturer is researching on electric mobility solutions.
- Ashok Leyland has announced a partnership with SUN Mobility to develop battery swapping system for electric buses .
- JSW Energy has announced its plan to invest \$623 million in electric cars, batteries and charging infrastructure .
- Swedish Automaker Volvo has announced that they will phase out the internal combustion engine and manufacture only electric or hybrid vehicles by 2019 .
- Companies setting up charging infrastructure have an advantage; provided the lucrative market potential is projected to be about 90 billion units (BU) and India generated 1,107 BU in 2015 – 2016 .

#### **5.3.4 Environmental**

- Increase in awareness of Climate Change promotes the production and sales of EVs.
- The use of recycled and old car parts in EVs makes it even more eco friendly
- Rise in Pollution awareness also promotes the production and sales of EVs.

#### **5.4 Challenges**

India only has limited number of charging stations as per official reports. On the one hand EV manufacturers are required to boost infrastructure and on the other hand they must focus on reducing EV cost.

##### **5.4.1 High Price Of Electric Vehicles**

Further, the average cost of electric cars in India is around INR 13 Lakh, much higher than the average INR 5 Lakh for economical cars run on traditional fuel. The price of electric scooters and motorcycles in India is between the price range of 70 thousand to 1.5 lakh.

##### **5.4.2 Range Anxiety**

The electric vehicle might not have sufficient range to take you to your destination. This is deeply linked to the lack of charging infrastructure in the country, and while conventional vehicles can be refueled at petrol stations, such regularized infrastructure is not yet available for EVs.

##### **5.4.3 Infrastructure**

The infrastructure for electric vehicles is still incomplete, which would certainly affect the price and acceptability of the vehicle among Indian consumers.

## **6. FINDINGS**

1. Electric vehicles will contribute to improving the overall energy security situation as the country imports over 80% of its overall crude oil requirements.
2. The push for EVs is also expected to play an important role in the local EV manufacturing industry.
3. With recent technology disruptions, battery storage has great opportunity in promoting sustainable development in the country, considering government initiatives to promote e-mobility and renewable power.
4. The Indian government at the central and state level are making policies and regulatory frameworks that could promote EV adoption.
5. The government is also attempting to ease adoption and make it more affordable.
6. The Indian government is providing subsidies and tax benefits for buyers.
7. Charging infrastructure in India is still in the nascent stage. It is the most important factor in the adoption of electric vehicles.
8. India has the added advantage of having skilled labour at economical prices.
9. India was reported to have only limited charging stations, which is quite less.
10. The cost of a basic electric car is much higher than the average price of a car running on conventional fuel.
11. India is technologically deficient in the production of electronics that form the backbone of the EV Industry, such as batteries, semiconductors, controllers etc. EVs have higher servicing costs which require higher levels of skills.
12. Battery is the single most important component of EVs. India does not have any known reserves of lithium and cobalt which are required for battery production.

## **7. CONCLUSION**

1. Electric Vehicles in India are gaining ground with the support of the Indian government. There are several benefits that make EVs better than traditional vehicles.
2. The growth of EV adoption is not as expected and is quite slow and consists of hurdles.
3. A range of factors requires the attention of policymakers and other stake holders that could contribute to improving electric vehicle adoption in India. The factors are :

- i) The government policies
- ii) Financial incentives and tax benefits
- iii) Affordability
- iv) Fast charging Infrastructure and fast charging time
- v) Increased battery capacity
- vi) Increased EV awareness and education on EV
- vii) Availability of skilled labour

These enablers are not exhaustive but could contribute to an increase in adoption subsequent to putting the effort from the public, EV stakeholders and the government most importantly.

4. The effective integration of EVs into power systems presents numerous opportunities for synergistic improvement of the efficiency and economics of electromobility and electric power systems, with EVs capable of supporting power system planning and operations in several ways.
5. There are many challenges that are being faced in the initial investment and adoption of market, but due to the opportunities the EV market will expand.

## 8. RECOMMENDATIONS

1. An EV charging infrastructure that draws power from local electricity supply can be set up at private residences, public utilities such as petrol and CNG pumps, and in the parking facilities of commercial establishments like malls, railway stations and bus depots.
2. The Indian market needs encouragement for indigenous technologies that are suited for India from both strategic and economic standpoint.
3. People need high range and for that EVs should have high battery capacity. The size of battery pack should be smaller and light weight.
4. EV might have several benefits, however, if it is not properly communicated and known by the masses, it is of no use. In order to increase adoption, the government and other bodies should educate people about the benefits of EVs.
5. Electric Vehicle market is poised for significant growth in the coming years. With supportive government policies, increasing consumer awareness and advancements in technology, the country is well positioned to transition towards a more sustainable and ecofriendly mode of transportation.
6. Government should focus on introducing EV production quotas for automakers.
7. More tax incentives must be provided in all states
8. Immediate need of skilled workforce who can repair the EVs as per the requirement.
9. Manufacturers should try to reduce the total cost to make it affordable.

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