



e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 13, Issue 6, June 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.317

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☑ 6381 907 438

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A Review paper on Electric Vehicles & future in India

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ABSTRACT: Electric Vehicles (EVs) are gaining momentum due to several factors, including the price reduction as well as the climate and environmental awareness. This paper reviews the advances of EVs regarding battery technology trends, charging methods, as well as new research challenges and open opportunities. More specifically, an analysis of the worldwide market situation of EVs and their future prospects is carried out. One of the fundamental aspects in EVs is the battery, the paper presents a thorough review of the battery technologies—from the Lead-acid batteries to the Lithium-ion. Moreover, we review the different standards that are available for EVs charging process, as well as the power control and battery energy management proposals. Finally, we conclude our work by presenting our vision about what is expected in the near future within this field, as well as the research aspects that are still open for both industry and academic communities.

KEYWORDS: Electric Vehicles; Plug-In Hybrid Electric Vehicle; battery charging; batteries technology; charging modes; EV plugs

I. INTRODUCTION

The automotive industry has become one of the most important world-wide industries, not only at economic level, but also in terms of research and development. Increasingly, there are more technological elements that are being introduced on the vehicles towards the improvement of both passengers and pedestrians' safety. In addition, there is a greater number of vehicles on the roads, which allows for us to move quickly and comfortably. However, this has led to a dramatic increase in air pollution levels in urban environments (i.e., pollutants, such as PM, nitrogen oxides (NO_x), CO, sulfur dioxide (SO₂), etc.).

EVs offer the following advantages over traditional vehicles:

- **Zero emissions:** this type of vehicles neither emit tailpipe pollutants, CO₂, nor nitrogen dioxide (NO₂). Also, the manufacture processes tend to be more respectful with the environment, although battery manufacturing adversely affects carbon footprint.
- **Simplicity:** the number of Electric Vehicle (EV) engine elements is smaller, which leads to a much cheaper maintenance. The engines are simpler and more compact, they do not need a cooling circuit, and neither is necessary for incorporating gearshift, clutch, or elements that reduce the engine noise.
- **Reliability:** having less, and more simple, components makes this type of vehicles have fewer breakdowns. In addition, EVs do not suffer of the inherent wear and tear produced by engine explosions, vibrations, or fuel corrosion.
- **Cost:** the maintenance cost of the vehicle and the cost of the electricity required is much lower in comparison to maintenance and fuel costs of traditional combustion vehicles.
- **The energy cost per kilometer is significantly lower in EVs than in traditional vehicles.**
- **Comfort:** traveling in EVs is more comfortable, due to the absence of vibrations or engine noise.
- **Efficiency:** EVs are more efficient than traditional vehicles. However, the overall well to wheel (WTW) efficiency will also depend on the power plant efficiency. For instance, total WTW efficiency of gasoline vehicles ranges from 11% to 27%, whereas diesel vehicles range from 25% to 37%. By contrast, EVs fed by a natural gas power plant show a WTW efficiency that ranges from 13% to 31%, whereas EVs fed by renewable energy show an overall efficiency up to 70%.
- **Accessibility:** this type of vehicle allows for access to urban areas that are not allowed to other combustion vehicles (e.g., low emissions zones). EVs do not suffer from the same traffic restrictions in large cities,



especially at high peaks of contamination level. Interestingly, there was a recent OECD study that suggests that, at least in terms of Particulate Matter (PM) emissions, EVs will unfortunately not improve the air quality situation.

Electric Vehicles (EVs) can be classified into several categories based on various factors such as:

1. Type of Electric Motor:
 - DC Motor EVs
 - AC Motor EVs
 - Permanent Magnet Motor EVs
2. Source of Electricity:
 - Battery Electric Vehicles (BEVs)
 - Hybrid Electric Vehicles (HEVs)
 - Plug-in Hybrid Electric Vehicles (PHEVs)
 - Fuel Cell Electric Vehicles (FCEVs)
3. Range and Distance:
 - Short-range EVs (less than 100 km)
 - Medium-range EVs (100-200 km)
 - Long-range EVs (more than 200 km)
4. Charging Method:
 - Level 1 (120V, 12A)
 - Level 2 (240V, 32A)
 - DC Fast Charging
5. Vehicle Type:
 - Passenger EVs
 - Commercial EVs (vans, trucks, buses)
 - Two-wheelers (electric motorcycles, scooters)
6. Battery Type:
 - Lead-Acid Batteries
 - Nickel-Metal Hydride (NiMH) Batteries
 - Lithium-Ion (Li-ion) Batteries
7. Hybridization:
 - Series Hybrid
 - Parallel Hybrid
 - Mild Hybrid
8. Autonomy:
 - Level 0 (no automation)
 - Level 1 (driver assistance)
 - Level 2 (partial automation)
 - Level 3 (conditional automation)
 - Level 4 (high automation)
 - Level 5 (full automation)

These classifications help to differentiate EVs based on their characteristics, performance, and applications.

II. CHALLENGES OF ELECTRIC VEHICLE CHARGING

- **Purchase Cost:** Electric vehicles are more expensive to build than gasoline-powered ones, primarily because of battery technology.
- **Range Anxiety:** Americans are used to jumping in their cars and going wherever they want without worrying about finding a gas station for a quick fill-up when needed.
- **Limited Selection:** There is still a limited selection of EVs compared to gasoline-powered cars.
- **Difficulty Finding a Technician:** With the EV industry still comparatively small, there are relatively few trained EV repair technicians and even fewer qualified independent shops.
- **Charging Infrastructure:** The scarcity of charging stations in many areas of the country is increasing the incidence of range anxiety.
- **Charging Speeds:** Charging electric cars can be a problem for drivers who have trouble adjusting to the EV lifestyle, which can dictate a slower pace of life.



- **Charger Compatibility:** Level 2 chargers are mostly coordinated, with all automakers except Tesla using the same type of charging port. However, there are three different types of DC fast chargers.
- **Grid Capacity:** Changing to EVs means millions of people will rely on the electric grid in new ways, and grid capacity will need to increase to avoid strain.
- **Charging Station Financing and Ownership:** Public EV charging stations can be expensive to install.
- **Charging Price Structures:** EV charging includes several different pricing structures, unlike gasoline which is always priced by the gallon.
- Electric Vehicles offer numerous advantages such as decreasing pollution levels and reduction in oil import bills, but there is considerable amount of threats in establishing the Electric Vehicles in India.
- The major pollutants emitted from the automobiles are hydrocarbons, nitrogen dioxide, lead, carbon monoxide, Sulphur dioxide, and particulate matter.

III. CHALLENGES OF ELECTRIC VEHICLES IN INDIA

- High Initial Cost: The upfront cost of purchasing an electric vehicle is higher than conventional vehicles.
- Limited Charging Infrastructure: The lack of a robust and widespread charging network makes it inconvenient for EV owners.
- Battery Technology and Supply Chain: India currently relies heavily on imports for battery manufacturing, leading to supply chain challenges.
- Limited Model Options: The availability of electric vehicle models in India is relatively limited.
- Charging Time: The charging time of EVs is longer than the refuelling time of conventional vehicles, which affects their convenience and usability.
- Lack of Awareness: Majority of Indians are indifferent to sustainability and are not even aware about emissions.
- Affordability: Higher upfront cost of electric vehicles.
- Convenience: Charging a vehicle is not as simple as refilling fuel.
- The population of electric vehicle in India is increasing at the rate of 37.5%.
- The government is focusing on more concern towards the Electric Vehicles and charging stations.
- The main hindrance behind commercial viability of EVs in India is inadequate charging infrastructure.
- Range anxiety is one of the most significant roadblocks to EV adoption.

The government has taken a number of steps to incentivize and promote the deployment of electric vehicles and public charging infrastructure to achieve significant electrification by 2030.

The acceptance of Electric Vehicles (EVs) among Indian people is growing, but still has its challenges. Here are some insights:

- A survey by Tata Motors found that 75% of Indians are open to considering EVs for their next car purchase.
- Another survey by Mahindra Electric noted that 71% of Indians believe EVs are the future of transportation.
- However, the same survey found that 63% of Indians are concerned about the limited charging infrastructure.
- Range anxiety and high upfront costs are also significant concerns for many Indians.
- Despite these challenges, India's EV market is growing rapidly, with sales increasing by 200% in 2022 compared to the previous year.
- Government initiatives, such as the FAME II scheme, have helped increase awareness and adoption of EVs.
- Many Indian companies, like Tata Motors, Mahindra Electric, and Ola Electric, are investing heavily in EV technology and infrastructure.
- There is a growing interest in EVs among young Indians, who are more environmentally conscious and tech-savvy.

Overall, while there are still challenges to overcome, the acceptance of EVs among Indian people is increasing, and the market is expected to continue growing in the coming years.

The scope of electric vehicles (EVs) in India is promising, with the Indian automobile industry being the third largest in the world ¹. Here are some key points about the scope of EVs in India ^{2 3 1}:

- India plans to go 100% electric by 2030, reducing carbon emissions by 37% and promoting eco-friendly transportation.
- The Indian EV market is expected to grow at a CAGR of 47.09% from 2022 to 2027, driven by government initiatives and increasing demand.



- As of March 2023, there were over 2.3 million electric vehicles on Indian roads, with two and three-wheelers dominating the market.
- The government has launched schemes like FAME II to promote e-mobility, aiming for 30% EV penetration by 2030.
- Despite challenges like charging infrastructure and high costs, India's EV market offers significant opportunities for growth and development.
- States like Uttar Pradesh, Madhya Pradesh, and Gujarat are actively involved in EV research and development, focusing on battery technology and charging infrastructure.
- The Indian government has set a target of 2,900 charging stations by 2023, up from just 300 in 2022.
- Educational institutions are starting to introduce EV-related courses to address the need for a skilled workforce in the industry.

IV.SECURITY

Safety point of view, some risks associated with Electric Vehicles (EVs) include:

1. Electric shock: Risk of electrical shock from high-voltage components, such as batteries, motors, and cables.
2. Battery fires: Risk of fires due to thermal runaway, electrical faults, or physical damage to batteries.
3. Thermal runaway: Uncontrolled temperature increase in batteries, potentially leading to fires or explosions.
4. Short circuits: Risk of electrical shorts due to damaged wiring, connectors, or other components.
5. Overheating: Risk of overheating due to excessive charging, discharge, or electrical faults.
6. Crash safety: Risk of electrical shock or fire in the event of a crash.
7. Battery rupture: Risk of battery rupture due to physical damage or excessive pressure.
8. Electrical arcing: Risk of electrical arcing due to damaged components or poor maintenance.
9. Overvoltage: Risk of overvoltage due to faulty charging stations or electrical faults.
10. Lack of standardization: Risk of inconsistent safety standards and protocols across different EV manufacturers.

It's important to note that while these risks exist, they can be mitigated through proper design, testing, and safety protocols, as well as proper maintenance and use of EVs.

VI.CONCLUSION

Electric Vehicle is the need of present time because population of India increasing day by day and need of energy also increasing. The EV is eco-friendly so population of India now accepting the EV, Indian government also promoting the EV and launching the many schemes. In coming year diesel & petrol based vehicles.

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