

# Scope of Electric Vehicles in India and Tourism: A Review Paper

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## Abstract

Air pollution is the major factor for mortality worldwide. Each year, more people die from air pollution-related disease than from any other cause. Switching to renewable energy resources could reduce the destruction caused from air pollution annually. Also due to the increasing oil price trend and the environmental issues, there are strong motivations and inceptions towards using sustainable environmental friendly alternatives. One such example is Electric Vehicles (EVs).

Emerging trends in transportation is preferred among all drivers, and particularly Millennials. Clean transportation advocates a timely and compelling opportunity to introduce new technologies to the tourism marketplace. Emerging among them is plug-in electric vehicles and pure electric vehicles technology, which has advantages like innovation, lower cost, and low-emission of harmful pollutants.

This paper reviews the basics about EVs, current trends, and future scopes of EVs in tourism.

**Keywords:** Tourism, India, Electric Vehicles, Pure EVs, Plug-in hybrid EVs.

## Introduction

The greatest achievement in human history is the development of Internal Combustion Engines (ICE) for automobiles. Automobiles are large contributors towards the growth and development of modern society. Automotive industries face rapid development and it has helped human society to progress from a primitive one to a highly developed one.

But as there are two sides to every coin, the automobiles used have certain disadvantages. The increase in the number of automobiles all around the world has caused and still continues to cause significant problems for the environment and human health. There are debates going on about the alarming rise in global warming, air pollution and speedy depletion of petroleum resources.

To overcome these problems researchers and people in general are looking for an efficient, clean and safe alternative. Battery or Pure Electric Vehicle (EV), Hybrid Electric Vehicle (HEV) and

Fuel Cell Electric Vehicle (FCEV) are considered as the best replacement or alternative of conventional ICE based vehicles.

## **EVs and Charging Infrastructure**

In this section a brief review about various types of EVs and their history.

The first electric vehicle was built by Frenchman Gustave Trouvé in 1881 and a vehicle similar to this was built in 1883 by two British professors. These early realizations didn't not attract much attention from the general public because the technology wasn't mature enough to compete with horse carriages[1]. The following two decades was a period during which electric vehicles competed with their gasoline counterparts. The limited range of EVs was not an argument. However, in Europe, the rise within the number of paved roads favored gasoline vehicles.

The first commercial electric vehicle was Morris and Salom's Electroboat. The Electroboat proved to be more profitable than horse cabs despite its higher price. The invention of regenerative braking by Frenchman M.A. Darracq on his 1897 coupe, was the most significant technical advance of that era. This method allows reusing the vehicle's kinetic energy while braking and recharging the batteries, which greatly enhances the driving range.

In 1945 a device was invented that was meant to revolutionize the world of electronics and electricity: the transistor, which allowed switching high currents at high voltages.

Despite the advances in battery technology and power electronics, their range and performance were still obstacles. The main reason was that in batteries the energy is stored in the metal of electrodes, which weigh far more than gasoline for the same energy content. The automotive industry therefore abandoned the electric vehicle to conduct research on hybrid electric vehicles.

The most significant effort was made by Japanese manufacturers in the development and commercialization of hybrid electric vehicles. In 1997, Toyota released the Prius sedan in Japan. Honda also released its Insight and Civic Hybrid[1]. These vehicles are now available throughout the world. They Achieve excellent figures of fuel consumption.

The only drawback of HEVs is that they use both batteries and ICE for propulsion. Even though the time for which the motor will be operated reduces, the pollutants will still be released and the danger to the environment and humans still remains.

In 1932, the first successful fuel cell device was developed with a hydrogen–oxygen cell using alkaline electrolytes and nickel electrodes, by Francis Bacon[1]. It was less expensive compared to the catalysts used by Mond and Langer. There were various technical hurdles faced by the researchers while working on fuel cells.

Also the biggest challenge with fuel cells is the production, storage, and distribution of hydrogen. This constraint proves that fuel cell-powered vehicles still have a very long way to go before they

can be commercially introduced in the market.

## Charging Standards

AC Charging-IS: 17017 specifies Bharat EV Charging standard AC001[3]. It requires 15 A, 230 V, 3.3 kW, and an IEC 60309 connector. Using a regular 220V-15 A household supply that delivers around 2.5 kW power, EVs can be charged. There is no specific policy defined for at home EV charging. Bharat EV specifications recommend the installation of a Residual Current Circuit Breaker to ensure safety and using an IEC 60309 Industrial connector[2].

DC charging-DC 001 is the public DC Charging Standard. It requires 200 A, 15 kW, and a GB/T 20234 connector. Maximum DC O/P Voltage is 100 VDC. There are very few cars in the market with these standards like Mahindra e20 and Tata Motors e-Tigor[4].

There are basically two types of chargers based on the location of the AC-DC converter, that is an On-board battery charger and an Off-board battery charger.

## Current Scenario of EVs in India

The Union Road Transport Minister of India has estimated that India will be a manufacturing hub for electric vehicles within the next few years. The ministry has asked Indian automotive companies to increase their electric vehicle technology and also to focus on doing research to find better alternatives to lithium-ion battery technology, which would help India to become the next global manufacturing hub for electric vehicles.

To address the issues of National energy security, vehicular pollution and growth of domestic manufacturing capabilities, India presented the 'National Electric Mobility Mission Plan 2020' in 2013[5][6]. Reiterating its commitment to the Paris Agreement, the Government of India has plans to make a major shift to electric vehicles by 2030[7][8][9].

There are two-pronged strategies released by the Government, keeping both buyers and manufacturers under consideration, in which it offers \$1.4 billion in subsidies to buyers, while imposing a hike on import tariffs to increase manufacturing of these vehicles by domestic companies[10]. This policy also earmarks \$140 million to develop charging infrastructure which should further help the development of the EV industry in India[10].

## What to expect and advantages of EVs in Tourism Industry

- Electric vehicles are 3-5 times more efficient as compared to internal combustion vehicles.
- Electric vehicles save energy by regenerative braking. Around 30%-70% of the energy used for propulsion can be recovered, with higher percentages applicable to stop-and-go city driving[11].
- Air quality indices related to India[12][13] indicate that the air in many cities of India is no longer healthy.

- India can become a global manufacturer of various parts of EVs and set an example in the world for providing clean mobility solutions that are affordable.
- Through smart and fast charging, electric vehicles can help to balance the balance-supply variations in the electricity grid.
- Electric vehicles have less moving parts as compared to IC engine vehicles. Therefore, being simpler, cheaper and easier to maintain[14][15].

Tourism can provide the best platform for a common man to interact and see the advantages of EVs. Tourism Industry is known for growth and boost in economic activities, infrastructure development, source of employment generation etc., so even this industry can contribute towards investing in a charging station, to charge EVs and use it as an opportunity to promote itself.

### **Gaps to be filled**

**Lack of charging infrastructure:** The charging infrastructure for electric vehicles in India has not been fully developed yet[16].

**Cost:** The cost of Li-ion cells is high which makes the overall cost of EVs very high. The battery packs are imported and cost a lot, about \$275/KWh in India[17].

**Lack of renewable energy and grid integrated infrastructure:** In India electricity is mainly produced by burning coal, which produces a great amount of carbon dioxide, methane, nitrous oxide etc emissions.

**Li-ion limitation:** The global lithium resource is estimated to be about 39 Mt (million tonnes), whereas the highest demand scenario does not exceed 20 Mt for the period 2010 to 2100[18].

### **Conclusion**

The rapid depleting fossil fuels and increasing environmental concerns plays an important role in promotion and acceptance of EVs and their charging infrastructure. In this review paper, it is found that the recent development in EV area is more focused on the development of new and fast EV charging infrastructure that can minimize the charging time, increasing the utilization of available renewable energies for EV charging and minimization of grid dependency for EV charging. It is important to consider the environmental sustainability concerns that can be raised when new constructions for establishing EV charging stations will take place. The alternative to that can be use of On-board battery chargers. Adoption of new technologies like V2G, multiple inputs etc., for EV charging will be very helpful.

In the coming future, the development of charging stations will grow at a rapid pace but it is strongly recommended to take into account the environmental burdens and the global warming potential from these developments. It is therefore highly suggested to consider On-board battery chargers and its advantages. In India, both Central and State governments, through their policies and regulatory frameworks, are encouraging the adoption of EVs.

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