

Study on Opportunities and Challenges of Electric Vehicles in India

Mrs. Ashwini Vinayak Kamble

Walchand College of Engineering, Sangli

Email: ashvin131111@gmail.com

Abstract: *Over the years, the exploitation and pollution of natural resources have created the need for renewable and environmentally friendly products. One of these products are electric vehicles. Electric vehicles are the replacement for petroleum-based vehicles. They are one of the emerging technologies as well as environmentally friendly and practical. Combining internal combustion engines with electric motors will significantly reduce pollution and have a positive impact on consumption. Countries around the world have implemented this technology AND are helping to improve the environment. We will see the opportunities and challenges India faces in EV adoption.*

1. INTRODUCTION

Using non-renewable and polluting sources to generate energy has taken pollution to a whole new level. Increasing global warming is forcing us to stop using non-renewable resources and reduce CO₂ emissions. The carbon content of the atmosphere has been increasing since the industrial age. Vehicle carbon emissions for a typical passenger car are 4.7 tons per year. The largest human source of carbon emissions is the burning of fossil fuels. The development of electric motors in vehicles has replaced the internal combustion engine and paved the way for electric vehicles (EV). Electric vehicles have been adopted in many countries since their development and are having a positive impact on the environment. We will now look at the opportunities and challenges arising from the adoption of electric vehicles in India.

Types of Electric Vehicles

A. Ground Vehicles

- Battery Electric Vehicles (BEVs)
- Hybrid Electric Vehicles (HEVs)
- Rail borne Electric Vehicles
- Space Rover Vehicles Estimation of MSW Generated Within the City

B. Airborne Vehicles

- Manned & Unmanned Electric Aerial Vehicles

C. Seaborne Vehicles

- Electric Boats

Battery Electric Vehicles (BEVs)

Battery Electric Vehicles are fully electric vehicles that run on electricity only and have no petrol/diesel engine, fuel storage or exhaust pipe. They use electric motors and motor controls to drive them. They don't have an internal combustion engine. They charge the battery via an external charging socket and are therefore also known as plug-in electric vehicles (PEVs).

There are different types of BEVs such as electric cars, buses, bicycles, scooters, trucks and trains. They even consist of fewer parts than vehicles with combustion engines. Compared to their counterparts, they produce even less noise.

Hybrid Electric Vehicles (HEVs)

Hybrid electric vehicles are not purely electric vehicles, as they use a combination of an internal combustion engine and electric drive systems. This primarily includes passenger cars, buses and trucks. The latest models use technologies to improve efficiency, such as regenerative braking, which converts the vehicle's kinetic energy into electrical energy to charge the battery, and other systems such as start-stop -System that shuts down the engine when idling and restarts it when necessary to reduce idling emissions and motor-generator. A hybrid electric motor produces far fewer emissions than a pure petrol hybrid, improving fuel economy while maximizing efficiency. There are also plug-in hybrid vehicles (PHEVs). They even generate less noise than pure hybrid vehicles.

2. Advantages of using Electric Vehicles

A. Cheaper to operate

EVs are cheaper to operate since they have high efficiencies and fuel economies thereby reduce cost for the owner. The electricity to charge an EV is about one third as much per kilometer to purchase fuel for vehicle [1].

B. Cheaper to maintain

BEVs have less moving parts than those had by conventional combustion engine vehicles. There is less servicing and no expensive systems such as fuel injection and exhaust systems, which are not needed in an EV. PHEVs have petrol engine and need servicing hence costing more than BEVs but they also have an electric propulsion system, which requires less moving parts leading to less depletion of petrol engine parts [2].

C. Environment Friendly

EVs are less polluting, as they have zero exhaust emissions [3]. If you opt to use renewable energy to charge your EV, you can reduce green house gas emissions even more. Some EVs are made of eco-friendly materials such as the Ford Focus Electric, which is made of recycled and bio based materials and the Nissan Leaf, which is partly made of recycled plastic bottles, old car parts and second hand appliances [4].

D. Health Benefits

The reduced harmful emissions will lead to better air quality, which is good for our health. EVs are also produce much less noise compared to petrol/diesel-based vehicles [31].

E. Safer

EVs have a low center of gravity thereby making them less likely to capsize. They also have low risk of fires and explosions. Their body construction gives them more durability hence making them safer during collisions [5]

Electric Vehicle Timeline

- 1832 – Robert Anderson develops First Crude Electric Vehicle [32].
- 1890 – William Morrison develops first successful electric vehicle in the USA [33].
- 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[34].
- 1908 – The Ford Model T is introduced by Henry Ford [35].

- 1912 – The Electric Starter is introduced [36].
- 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 [37].
- 1973 – Many Automakers explore alternative options to fuel
- 1974 – Sebring Vanguard introduces the ‘Citi Car’ [38].
- 1979 – Interest in Electric Cars fade due to drawbacks
- 1990 – Clean Air Amendment Act is passed [39].
- 1992 – Energy Policy Act is passed [40].
- 1996 – General Motors launch EV1 [41].
- 1997 – Toyota produces the first mass produced hybrid, the ‘Prius’ [42].
- 2006 – TESLA announces production of luxury electric cars
- 2008 – TESLA produces its first electric vehicle, the Roadster with range of 244 miles per charge[43].
- 2009 – US Energy Department invests in nation-wide charging infrastructure [44].
- 2010 – General Motors introduce first Plug In Hybrid, the Chevy Volt [45].
- Nissan introduces LEAF, an all electric, zero emission cars [46].
- 2012 – TESLA introduces Model S with battery range of 270 miles per charge [47].
- 2013 – Cost of Electric Vehicle Batteries drop by 50% [48].
- 2014 – TESLA announces plan to build ‘Gigafactory’ and double worlds 2014 battery production figures [49].
- 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 [50].
- 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 [25].
- 2020 – China’s expectation of 10% of auto imports and production will be only electric vehicles[51].
- 2025 – Expected date by which Norway and Netherlands plan to ban sales of petrol and diesel cars[52].
- 2030 – Expected date by which India plans to promote an all-electric car fleet [7]. Also, China expects to limit its carbon emissions, hence affecting sales of petroleum-based cars [53].
- 2040 – Expected date by which Britain and France announce plans to ban sales of all new petroleum based vehicles [54].

India’s Progress with Implementation of Electric Vehicles

The Indian government has set out to create a renewable energy revolution in the country by planning an electric vehicle transition by 2030[7]. The country is expected to cut its oil purchases by around US\$60 billion, cut emissions by 37% and curb demand for road infrastructure over the next 12 years[9]. India currently has around 1.3 billion inhabitants and around 21 million vehicles are sold annually [7].

3. Opportunities

A. Government Initiatives

- 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 [10].
- 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 [14].
- 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 [11].
- The Karnataka State Government has approved a policy to promote research and development in electric mobility making it mandatory to have charging points and pods in all major cities of the state [12].
- The Maharashtra State Government waived off some taxes for Electric Vehicles ever since it became India's First State to have an Electric Mass Mobility System.
- India is obligated to bring down its share of global emissions by 2030 as a signatory to the Paris Climate Agreement [8].
- The Government plans to setup lithium-ion battery making facility under supervision of Bharat Heavy Electricals Limited (BHEL) [17].
- The Goods and Services Tax (GST) Council has set a tax rate of 12% compared to 28% set for petroleum based vehicles [26].

B. Battery

- Presently, around 22,000 EV units are being sold, among which around 2000 of them are 4 wheeler vehicles [15].
- 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 [16].
- The storage capability of EV batteries can help with grid balancing

C. Industrial

- 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 [13].
- Suzuki has announced its plan to setup a \$600 million lithium ion battery facility [18].
- Mahindra has announced investment of around 60 million rupees to develop its EV division expecting to launch electric variants of its vehicles [23].
- 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 [19].
- JSW Energy has announced its plan to invest \$623 million in electric cars, batteries and charging infrastructure [20].
- Swedish Automaker Volvo has announced that they will phase out the internal combustion engine and manufacture only electric or hybrid vehicles by 2019 [25].
- 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 [24].

D. Environmental

- Most metropolitan cities are experiencing high Air Pollution rates, with vehicular emissions being one of the major pollutants.
- India's capital city Delhi has started experiencing smog through the city due to large amounts of air pollution [27].
- The use of recycled and old car parts in EVs makes it even more eco friendly
- Increase in awareness of Climate Change promotes the production and sales of EVs.
- Rise in Pollution awareness also promotes the production and sales of EVs.

4. Challenges

A. Cost of EVs

- The cost of EVs should be reasonable and the EVs produced should hold proper value for money.

B. Efficiency of EVs in India

- The EVs in India on an average provide around 120 km on a full charge in turn making them unsuitable for long drives [21].
- EVs in India lack speed, which may turn off buyers. The top two India made EVs have speed of 85 km/hr. [22].

C. Demand for EVs

- Increase in demand will help in achieving vision 2030.
- Increase in demand of EVs will lead to increase in requirement for energy and raw materials to for the battery.

D. Vehicle Quality

- Good vehicle quality will lure more customers.
- Better quality vehicles ensure trust among customers.

E. Batteries

- The batteries used by electric cars are made up of nickel, aluminum, cobalt, graphite and lithium, which are all rare earth materials.
- The availability of these materials is scarce and the amount of these materials available may not be able to produce enough batteries to power the expected amount of electric vehicles to be produced.
- The increasing demand for lithium around the globe given its scarcity on the Earth's surface will make it challenging to meet India's EV requirement.

F. Electricity Generation

- There must be enough electricity generation capacity to meet the increasing demands for charging infrastructure and local consumer utilization.
- There is presently shortage of electricity in many parts of India and a major part of energy generation of the country is still dependent on fossil fuels [30].

G. Anti – EV Elements

- Anti – EV activists, supposedly fringe elements hired by oil companies or fossil fuel dealers try to thwart growth of EVs. Amsterdam recently witnessed an Anti – EV vandalism case involving damaging of 2 TESLAs [28].

H. Global Energy Demand

- Any decrease in demand for oil by India and China will have wide geopolitical ramifications as the two countries together account for half of 1% growth in global energy demand in 2016 [6].

I. Land Availability

- Availability of land to setup charging stations in urban areas where land scarcity is present is a difficult task.
- Moreover, a substation nearby is a requirement for a charging station [29].

2. CONCLUSION

The implementation of EVs in India aims primarily to reduce greenhouse gas emissions and cut oil expenses. The vision 2030 put forth by the Indian Government is an ambitious and difficult task. The Government should make the most out of the opportunities available and find suitable ways to tackle the challenges impending over the implementation of EVs. India's obligation towards many environment friendly agreements has given it a situation where it is prompted to implement vision 2030.

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