e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com

ELECTRICAL VEHICLES IN INDIA: CHALLENGES AND BARRIERS

Vishal Mahor*[1]

*[1]Department Of Electrical Engineering Madhav Institute Of Technology And Science, Gwalior, India.

ABSTRACT

As we all know; we are going towards the major share of renewable energy to minimize the Green House Gases (GHG). The exhaustion of petrol and diesel, the escalating prices of fuel, and an ambitious program by the Indian Government have encouraged multidisciplinary research on Electric Vehicles. Since transport is the main source of Green House Gases, Electric Vehicles could be used as an alternative. Although Electric vehicles give various advantages and can be used in various applications there are several challenges in the majority of them. The charging infrastructure is one of the core requirements of Electric Vehicle market growth. This paper summarizes the advantages/uses of EVs and barriers to their popularization.

Keywords: Electric Vehicles, GHG, Hybrid Electric Vehicles, Charging Infrastructure, Energy Demand.

I. INTRODUCTION

The transport sector plays a crucial role in air pollution, resulting in climate change due to the Green House Gases (GHG), whereas replacing the internal combustion vehicles with the energy vehicles such as Electric Vehicles seems to be a very promising step towards urban sustainability. The government of India has announced its National Electric Mobility Mission Plan in 2012[1] to establish 6 to 7 million Hybrid Electric Vehicles (HEVs) and Electric Vehicles (EVs) by 2020 and recently in 2017 it has announced the ban on diesel and petrol vehicle sales from 2030[2]. Currently, the increasing number of EVs in India is close to 0.4 million by 2017[3] which is about 0.1% of the existing conventional Internal Combustion Vehicles. The government of India (Department of Heavy Industries) is also providing incentives through the FAME scheme (Faster Adoption and Manufacturing of Electric Vehicles) since 2015[5] to reduce the price of EVs. The government of India has ordered 10,000 EVs, the world's largest single electric vehicle procurement that is to be used by government agencies [6]. Even though with all these initiatives since last few years the growth of the EV market is still lagging in India because of many factors such as lack of charging infrastructure, higher charging times, drive vs range, and the lack of awareness among the customers. The majority of these factors are affecting the EV growth because of the charging infrastructure which is explained further. The challenges in charging infrastructure growth are meeting the energy demands from the utility grid, non-availability of charging standards, lack of government support for the infrastructure growth which is explained in section 3. And at last, the development needs and improvements to be done for the large-scale growth of charging infrastructure are explained in section 4.

II. FACTORS AFFECTING THE EV ADAPTATION IN INDIA

The major barriers to the Electrical Vehicle adaption in India include lack of charging infrastructure, higher charging time, the price vs range factor, non-awareness about the EVs and lack of EV manufactures.

A. Lack of charging Infrastructure:

Currently, in India, there are very few DC fast-charge stations that are installed by EV manufactures. There are also public AC slow charging points existing in India with less than a 3.3KW rating which is limited by the onboard charger capacities of EVs. The availability of AC and DC fast charging infrastructure makes people show interest in EVs. The charging infrastructure (public AC slow charging points) needs less investment when compared to fuel stations but still, the growth of charging infrastructure in India is not up to the mark, as it requires continuous support from the government agencies, utility grid authorization and EV manufactures.

B. Higher Charging Times:

The available Electric Vehicles in India take 7 to 8 hours for a full charge if charging is initiated from a 230V single-phase supply. Typically, almost 50% of Indian customers need charging time to be less than 4 hours [7]. The DC fast-charging stations reduce the charging time to less than 2 hours but the availability of these stations is limited. as it cannot be installed in domestic places. The charging time of an EV can be reduced by increasing the on-board and off-board charger power ratings for which charging infrastructure should be developed because of limitations on the residential loads.

C. Price vs Range Factor:

Currently in India, the price vs range factor is one of the major barriers to EV growth because the Battery Electric Vehicle (BEV) is having higher prices with a limited range when compared to the conventional ICE vehicles. Right now, in India, there are nearly 25 models of two-wheeler battery-operated vehicles and out of this only 4 to 5 models are using Lithium-ion batteries [8]. Since more than 60% of the respondents are expecting the range for BEV should be around 300 km per charge but currently, BEV is in the market are limited to be less than 150 km per charge. The range anxiety of an EV will not be a barrier if there is abundant charging infrastructure within & between the cities in India.

D. Lack of Awareness and Lack of EV manufactures:

Another factor for the hindrance of EV growth is the lack of awareness of more than 60% of the drivers in India. This is mainly due to the non-existence of EVs on the roads and also due to the lack of EV manufacturers. Currently, in India, there are 9 electrics two-wheeler companies and out of this only one company is making the two-wheelers with Lithium-ion batteries. The Electric Vehicle manufactures are already conducting campaigns for awareness and the government is expected to support it on a large scale. Considering all the above facts the key barrier to the EV adaptation in India includes lack of higher charging times, price vs range factor is related to charging infrastructure is one of the biggest obstacles in EV adaptation in India.

III. EV CHARGING INFRASTRUTURE IN INDIA

Currently, in India, there is the very small-scale AC & DC charging stations available which are installed by EV manufacturers. Even though the AC slow charging infrastructure at our residences, public places, and workplace require very less investment when compared to fuel stations. But still, the growth of EV charging infrastructure in India is not up to the mark. To grow our charging infrastructure at a large scale in India requires continuous support from the government, utility grid authorities and automobile manufactures. The growth of the charging infrastructure is slow due to the undefined standards. Currently in India, the Bharat EV AC charger (BEVC-AC001) for AC charging with less than 3.3KW power rating and Bharat DC charger (BEVC-DC001) with less than 15KW power rating is expected to notify for both 48V and 72V charging system [9]. Also, the Automobile Research Authority of India (ARAI) published AIS138 Part-1 (Electric Vehicle conductive charging system) for AC charging standard in may-2017[10]. Now we can approach any of the methods to smoothen our research work:

1. Available Electrical Vehicle supply equipment

All the EVS (2W,3W & 4W) in India are operated with less than 100V DC battery systems. The electric vehicle supply equipment (EVSE's) is of two types which are categorized as AC & DC. The AC and DC charging stations that are available in India are as follows:

- Single phase, 230V portable and set or wall mounted with CEE16 (IEC 603309) outlet or with Type-2 (IEC 62196-2) outlet up to 3.3KW.
- DC charging stations with GB/T (20234.3) outlet up to 15KW.

Currently in India there are around 400 public AC charge points installed with less than 3.3KW rating and nearly 40 DC charge points are installed with less than 15KW rating.

2. Overview of Charging Standards

Standardization of protocol for charging is one of the major factors affecting the charging infrastructure growth in India. EV conductive AC charging has been defined in draft version of BEVC-AC001 & AIS138 part-1 standards which are derived from IEC 61851-1 [11] and EV conductive DC charging for 48V and 72V nominal systems defined in draft version of BEVC-DC001 standard which is derived from GB/T 20234.3[12] and GB/T 27930-2015 standards [13]. The BEVC-AC001 standard defines the AC charging up to 3.3KW power rating and outlet used is derived from IEC 60309 standard [14]. Derived outlet from BEVC-AC001 doesn't have control pilot signal between EVSE & EV. The BEVC-DC001 standard defines the conductive DC charging with 10KW and 15KW power ratings for 48V & 72V nominal systems and the communication is derived for, IEC 618.51-24 standard and outlet for DC charging is derived for, GB/T 20234.3 standard. The AIS138 part-1 standard also defines the AC charging up to 3.3KW power rating and Type-2 outlet for above 3.3KW power rating which is derived from IEC 62196[15] and IEC 61851-1 standard which is having control pilot signal between EVSE & EV.

3. Challenges in Growth of Charging Infrastructure

In this section, the challenges in charging infrastructure growth are explained:

1. Increase in Electricity Demand:

As the charging infrastructure installed on large scale, the energy required from the utility grid increases. In the following sections, the demand is electrical energy from the utility grid is projected if all the conventional vehicles were converted to BEV's based on the available data of fuel consumption in transportation sector in India. The automobiles production in India is at a CAGR of 9.03% from 2007 to 2017 [4]. The vehicle includes 79% of two wheelers, 15% of passenger cars, 3% of three wheelers and 3% of commercial vehicles out of these, close to 99.9% are conventional ICE vehicles are burning petrol and diesel for traction. Typically for an electric vehicle, the plug to wheel efficiency is more than 85% and therefore the energy losses are minimal. If all the conventional vehicles (both petrol and diesel) are converted into BEV's during the year 2016-17, the total energy required for the traction in the transportation sector is sum of energies of petrol & diesel vehicles. The generation of electricity in India during the year 2016-17 is 1160TWh [16]. The total electricity required, if all the existing ICE vehicles are converted into BEV's during the year 2017-17 is 439TWh which is 34.26% additional to the existing electricity generation. By 2030, the electricity generation in India will grow along with the demand in the domestic, commercial, industrial and agriculture sectors. Apart from this, there will be a growth in the production of automobiles in India by 2030 and if all these vehicles are 100% BEV's the required electricity generation demand on the utility grid increases.

2. Non availability of Indian Charging Standards:

Till now the EV manufactures in India (either 2W, 3W & 4W) are free to select any charging inlet and also any charging protocol even without any basic protections as there are no defined standards. In such cases, the infrastructure support from the government will be difficult if there will be multiple charging connectors and multiple charging protocols. Hence, the growth of charging infrastructure is lagging because of the undefined standards. Currently in India, the BEVC-AC001 for ACC charging with less than 3.3KW power rating & BEVC-DC001 with less than 15KW power rating are going to be notified for both 48V and 72V. Meanwhile the Automotive Research Authority of India (ARAI) also published AIS 138 Part-1 (Electric Vehicle conductive charging system) AC charging standard in May 2017 and AIS 138 Part-2 DC charging standard [17] is still in a draft stage which are derived from IEC 61851.

3. Non-adaptability of Global DC charging Infrastructure:

Currently there are multiple charging protocols and connectors are available for Electric vehicle DC charging (which is referred as fast quick charging). At present, the available DC connectors are GB/T, CHAdeMO, Type 1 combo, Type 2 combo and Tesla super charger. Each of these connectors are physically different and also having various communication protocols like CAN & PLC.

Currently in India, the available EV's are operating on either 48V or 75V and globally all the passenger cars are operating on 400V systems. The Type 2 CCS and Type 1 CCS fast chargers mostly operates from 200V to 600V or 1000V which are not suitable for charging low voltage vehicles (<100V). The CHAdeMO & GB/T DC connectors are operating from lower voltages and can be adapted easily to charge the low voltage vehicles but because of the maximum current limits of these connectors, the output power is limited.

4. Lack of Incentives for Charging Infrastructure:

The government of India is providing incentives for purchasing the electric vehicles and it is expected to provide incentives for installing the public charging infrastructure also currently in India, the BEV manufacturer Mahindra Electric is installing the DC charging stations compatible with GB/T connector. As per the FAME scheme, the government allocated 300 Million INR (5 million USD) for charging infrastructure during the year 2015-17 but the major contribution of this budget is allocated for the standardization and for running few pilot projects regarding charging infrastructure.

5. Development needs and Improvements:

To achieve India mission plan on deployment of 6 to 7 million electric vehicles by 2022 and to ban petrol and diesel vehicle sales from 2030 onwards inn order to reduce the greenhouse gas emissions, the growth of charging infrastructure plays a very crucial role. The large-scale charging infrastructure requires a sufficient energy from the utility grid and generating this using renewable sources will help us to achieve the mission.

The government of India is planning to avail the renewable energy capacity to 175GW by the year 2022. Since, currently in India, the total renewable installed capacity is 57.2GW out of which installed solar power is 12.5GW and wind power is 32GW.

As one Jan'2021, if India was having 100% BEV's in transportation sector, only 11.02% of energy would have been accommodated from existing solar plants and remaining energy would have been accommodated form other sources. But with target of 100GW solar power by 2022, 32.45% of the required energy (600TWh) can be accommodated from solar plants for the existence of BEV's during the year 2022-23.

Charging time and driving range are linked to technology and charging infrastructure. Charging time can be reduced through fast charging stations and similarly the driving range can be addressed by selecting higher energy batteries through a well distributed infrastructure or battery swapping technology. This helps in creating the awareness in people and also helps in creating the competitive market.

IV. CONCLUSION

The major obstacle to the adaptation of EV's in India are lack of charging infrastructure, charging time, driving range, lack of awareness and lack of EV manufactures. The charging time and driving range can be addressed by improving the charging infrastructure installed on a large scale. The challenges in growth of charging infrastructure are determined by meeting the energy demand from the utility grid, availability of charging standards and contains support from government, EV manufactures and utility grid authorities for installations. The government of India is planning to notify the charging infrastructure growth. In India, the electricity required for the existence of 100% BEV's would be 37% higher than the estimated electricity generation by 2030. Hence by 2030, all these initiatives will improve the availability of large-scale infrastructure in India and subsequently higher adaptation of EV's can be achieved.

V. REFERENCES

[1] Department of Heavy Industry, Government of India, National Electric Mobility Mission Plan-2020,2012, https://dhi.nic.in/writereaddata/content/nemmp2020.pdf
[2] CII press release, "Rs 3 will be benchmark price for all power in medium term" By Piyush Goyal, Apr 29th 2017, www.cii.in/PressreleasesDetail.aspx?id=54513
[3] SMEV India, http://www.siamindia.com/statistics.aspx?mpgid=8&pgidtrail=14
[4] SIAM, http://www.siamindia.com/statistics.aspx?mpgid=8&pgidtrail=14
[5] Government of India, Ministry of Heavy Industries & Public Enterprises, "FAME India Scheme," 23 November 2016, http://pib.nic.in/newsite/mbErel.aspx?relid=154119
[6] http://www.thehindu.com/bussiness/tata-motors-bags-eesl-order-for-10000-e-cars/article197783336.ece
[7] "Gaining traction: Will consumers ride the electric vehicle wave?" DTTL Global Manufacturing Industry group. Global electric vehicle survey. 2011
[8] FAME India, http://www.fame-india.gov.in/
[9] Bharat EV charger specifications, "Committee Report on Standardization of Public EV Chargers", 2017
[10] AIS 138 Part 1, Electric Vehicle Conductive AC Charging system, 2017
[11] IEC 61851-1:2017, "Electric vehicle conductive charging system - Part 1: General requirements",2017
[12] GB/T 20234.3-2015," Connection Set for Conductive Charging of Electric Vehicles – Part 3:DC Charging Coupler"
[13] GB/T 27930-2015, "Communication Protocols between Off-Board Conductive Charger and Battery Management System for Electric Vehicle"
[14] IEC 60309-1:1999, "Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements
[15] IEC 62196-1:2014, "Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements"
[16] Electricity consumption in India, http://powermin.nic.in/en/content/power-sector-glance-all-india
[17] Finalized draft AIS 138 Part 2, Electric Vehicle Conductive DC Charging system,2017.