

Enablers of Electric Vehicles Adoption in India: A Review



Deepika Pandita, Vimal Bhatt, V. V. Ravi Kumar, Piyush Gotise

Abstract: India is moving towards electric vehicles. However, the road to the progress of EV adoption does not seem to be smooth and may need effort from the people and the government. With regard to the growth of Electric Vehicles in India, there is a need to find the factors that could hasten its progress. In this paper, we on the basis of the review of the relevant literature from the scientific database are suggesting a range of factors which requires the attention of policymakers and other stakeholders that could contribute to improving electric vehicle adoption in India. The factors are explained in detail along with its implication on electric vehicle adoption.

Keywords: Electric Vehicles, EV, Electric Cars, Adoption

I. INTRODUCTION

More than seven and a half lacs of electric vehicles are registered in India [1] and with around eighteen hundred charging stations [1] as of now in the country, India is trying to go electric. 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 climate is on the rise. The serious consequences of climate change and environmental degradation can be seen as the thinning of the ozone layer [2] and the gradual melting of glaciers [3] that could contribute finally to rising sea water levels [4] and many other natural calamities.

Fossil fuel-based transportation across the world is amongst the major sources of greenhouse gases (GHG) and other harmful toxic emissions that contribute to environmental degradation and climate change [5]. The harmful chemicals like carbon monoxide (CO), sulphur dioxide (SO₂), ozone (O₃), and nitrogen oxides (NO_x) in air pollutants coming from internal combustion engine vehicles (ICVs) are going beyond the level as prescribed by the National Ambient Air Quality Standards (NAAQS) in the cities of India [6]. These pollutants can be detrimental to individuals' health [7].

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. This plethora of Internal Combustion Engine based vehicles (ICV) transports causes a lot of pollution. Moreover, as the prices of fossil fuels are increasing [8] and also due to the limited availability of non-renewable resources, there is a need to find alternative energy resources. The pressure is on the governments of several countries from the masses, the environmentalists, environmental and climate control agencies, and from other agencies and authorities to lessen the reliance on fossil fuel as it is a limited resource [9]. Considering the matter, Electric Vehicles could be an alternate energy transport solution that could check the emissions of GHG and other air pollutants and help in extenuating the bad effects of it on climate change, the environment, and on people's health [10] [11].

II. LITERATURE REVIEW

Electric vehicles In India are making progress [9] with the support of the Indian government. Electric vehicles operating costs are considerably cheaper than fossil fuel-based ICVs. Not only EVs are economical they have also got several other advantages that make them better than ICVs. That is, EVs are tailpipe emissions-free.

They do not cause noise pollution except a slight noise at low speeds [12] and have low maintenance in comparison to internal combustion-based vehicles (ICVs). Furthermore, EVs are simpler in design and comfortable to use.

These days in the market, different sorts of EVs are available that vary from fully electric to partly electric. Some EVs are combined with ICVs engines. Typically, they could be categorized as hybrid electric vehicles (HEVs), battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and extended-range battery electric vehicles (E-REVs) [13]. In HEV, an internal combustion engine (ICE), as well as an electric motor, are there and the battery gets charged by regenerative braking and by the internal combustion engine [13]. As compared to hybrid electric vehicles (HEVs), a plug-in hybrid electric vehicle (PHEV) has a better battery capacity and could be plugged into a charger for recharging the battery [14] [13]. Nevertheless, the range in plug-in hybrid electric vehicles (PHEV) is short, that is, these vehicles cannot go long distances using battery power [13]. To deal with this problem of the short range of PHEVs, extended-range electric vehicles (E-REV) could be a better alternative. Extended-range electric vehicle (E-REV) has rechargeable battery and fuel tank which means they could be run both on electricity and fossil fuel and are made to go for longer range [13].

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Whereas, in a battery electric vehicle (BEV), there is no fuel tank as it is not fossil fuel-powered and runs fully on electricity stored in high-capacity recharging batteries that can be plugged in as needed [15] [13].

Regarding the adoption of EVs in India, there are some roadblocks (for e.g., lack of charging infrastructure, high battery prices, performance, range, and lack of consumer awareness) that are interfering with its progress in the country [16] [17]. There are psychological barriers also that interfere with the adoption [18]. For instance, subsequent to the incidents of fire reported in the news in relation to electric scooters [19] [20] [21], people might feel a bit insecure about buying electric scooters in India. Owing to such incidents reported in newspapers and other news media, potential EV buyers are rather concerned and confused and have fear regarding adoption. Identifying factors or constructs that are related to electric vehicle adoption is of prime importance so that it could be focused upon and could be dealt with accordingly [22] [21] [20] [23].

Adoption could be defined as a behavioural response that includes purchase as well as the use of an innovation [24] [13]. Several factors add to the adoption of electric vehicles and working upon them by the stakeholders of EVs (such as the government, the policymakers, the manufacturers, etc.) could lead to adoption. Thus, this research attempts to focus on the enablers (factors) that might accelerate adoption and could help in accelerating the growth of EVs in India by removing hurdles.

III. METHOD

The paper follows a thematic review approach based on the review of relevant literature available from Google Scholar and Scopus. For the relevant literature review, we first searched through the two databases (i.e., Scopus & Google Scholar). 60 papers that seem relevant were chosen. Then, the abstracts of these selected papers were read. 14 papers were found suitable for the study which were read fully for finding the major themes in alignment with the research purpose. Subsequently, all the major themes were developed conceptually and built upon some past literature.

IV. FINDINGS ENABLERS OF EV

4.1 The Government Policies

The Indian government at the central and state level are making policies and regulatory frameworks that could promote EV adoption [25]. The government is also attempting to ease adoption by focusing on bringing schemes and initiatives that could bring the cost down for consumers and make it more affordable [26]. The government through subsidies, rebates on taxes, and through other such incentives are trying to motivate buyers to purchase an EV [27]. Furthermore, the government is putting effort to make way for better fast-charging infrastructure [27] so as to reduce range anxiety, to instil confidence in EV drivers regarding the availability of charging stations in exigencies and to ensure that they could reach their destination certainly and hassle-free.

4.2 Financial Incentives and Tax Benefits

For earlier and faster adoption of EVs, the Indian government is providing subsidies and tax benefits for buyers [27]. However, the subsidies are applicable only up to a certain

price range of EVs, not for all vehicles. Similarly, an individual buyer could avail of tax benefits by opting for an EV on loan [28]. Additionally, in some of the states like Madhya Pradesh, Uttar Pradesh, and Punjab, EV owners are exempted from paying road taxes [28]. Research suggests that financial incentives could impact the attitude of buyers [29] and these financial incentive policies and practices subsequently could act as a motivator for buyers to adopt EVs as Indian consumers are more focused on the financial aspect [30].

4.3 Fast Charging Time

One of the biggest issues with EVs is that they take too much time on charging [31] [32]. The AC charging for a typical EV with a 200-300 range usually takes around 6-8 hours for full charging, whereas the DC fast charging, usually takes 1.5 to 2 hours for a full charge. In long-distance travel and in rural areas where a person is away from his or her house, overnight charging is not possible and charging stations are the only options where an EV could be recharged [32]. The charging stations with high kilowatt take less time as compared to low kilowatt chargers. That is, the charging kilowatt should be increased to promote adoption. Otherwise, buyers may feel insecure and concerned about going long distances on an EV.

4.4 Affordability

The price of electric vehicles is an important determinant and motivating factor for automobile buyers [29]. India is a developing economy and is not a wealthy nation, that is, the purchasing power of a typical person in India is not very high [33]. EVs these days are coming at a premium cost in the market as compared to ICVs [32]. The price gap is quite significant and it could make a buyer reconsider his or her decision. The price gap should be lower and EVs should be made affordable so as to increase their adoption.

4.5 Fast Charging Infrastructure

Charging infrastructure in India is still in the nascent stage. It is a vital factor in the adoption of electric vehicles [34]. EVs can be charged at home, however, when people go long distances by an EV, the concern arises. In metro cities, within the urban boundaries, it is comparatively easier to find charging stations rather than on the highways and in rural areas. Even if, the charging stations are there, sometimes, they are not in working condition or are not compatible with all types of vehicles [35]. There should be compatible chargers which are high in kilowatts so that it could lessen the recharging time to a minimum and the number of charging stations should be more all along the highways, in rural and far-off places [25].

4.6 Increased Battery Capacity

People need high range and for that EVs should have high battery capacity [36] [37]. The size of battery pack should be smaller and lightweight. The range promised by car manufacturers fluctuates as per the driving style of drivers and reduces at higher speeds. The EV should deliver range as promised with minor fluctuations. The range is related to cost per kilometre, a higher range could make travel more economical and worry less which eventually could lead to adoption [37].



4.7 Increased EV Awareness and Education on EV

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 [32]. There is also a need to literate people on how to acquire an EV at affordable prices by highlighting subsidies and tax benefits. There is a necessity to generate awareness of EVs for encouraging adoption [17] [39]. Education also plays an important part in adoption [38]. Past research has found that customers who are highly educated are more aware of Electric Vehicles benefits and could increase the possibility of quick adoption of electric vehicles [29].

4.8 Availability of Skilled Labour

India has the added advantage of having skilled labour [40] at economical prices [32]. A proper scheme from the government towards the development of EV charging infrastructure and towards research and development by leveraging the human capital from the Indian market could help EV adoption in India.

V.CONCLUSION

Electric vehicles In India are gaining ground [9] with the support of the Indian government. These vehicles in the long run are considerably cheaper than fossil fuel-based ICVs. They are not only economical, but they also have several other benefits that make them better than ICVs. That is, EVs have zero emissions-They do not cause noise pollution except a slight noise at low speeds [12] and have low maintenance in comparison to internal combustion-based vehicles (ICVs). Furthermore, EVs are simpler in design and comfortable to use.

Nevertheless, the growth of EV adoption is not as expected and is quite slow and consists of hurdles. For adoption, it may need effort from the individuals and the government. With regard to the promotion of electric vehicles in India, there is a need to find the enablers that could hasten its progress. In this paper, we on the basis of the review of the relevant literature from the scientific database have suggested a range of factors which requires the attention of policymakers and other stakeholders that could contribute to improving electric vehicle adoption in India. The factors are: (i) the government policies; (ii) financial incentives and tax benefits; (iii) fast charging time; (iv) affordability; (v) fast charging infrastructure; (vi) increased battery capacity; (vii) increased EV awareness and education on EV, and (viii) 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.

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COMPETING INTERESTS

The authors have declared that no competing interests exist.

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