# Electric Mobility in India: Potential and Policy Imperatives

**Dr. Sanjay Gupta[1], Pintu Saini[2]**

*[1]Professor and Head, Department of Transport Planning, SPA Delhi- 110002 Email: drsgupta19@gmail.com*

*[2]Research Associate, Department of Transport Planning, SPA Delhi- 110002 Email: pintusaini43@yahoo.com*

**ABSTRACT:** India is embarking on the path of adopting electric vehicles in the country with the target of all electric vehicles fleet by 2030. This seems quite ambitious considering at present the electric vehicle fleet is less than one percent. A review of global research and practices in electric mobility shows that electric vehicles are very costly as compared to conventional vehicles while the technology is also comparatively new to reach a significant level in the vehicular fleet in any country. In such a case, in order to promote electric mobility in India and achieve the targets set by the government by 2030, various supportive policies, incentives programme, technology improvement and charging infrastructure will have to be provided in order to create an enabling ecosystem for electric mobility. Further all these shall have to be done in a time bound manner and organized manner. The present paper provides an overview of electric vehicles policy initiatives in the country, global practices of electric vehicles, issues of electric mobility and its policy imperatives.

***Keywords:*** *Electric vehicles, subsidy, tax break, incentives, policy imperatives*

## 1. Introduction

India like many other developing countries is urbanizing at a very rapid pace. At present, more than 31% of India's population lives in urban areas. Based on the United Nations estimates, these numbers are likely to grow to 52% by 2050 (IUT and CSTEP 2014). Rapid urbanization coupled with segregated land use planning practice have created immense need of mobility for all the sections of the society. Consequently, mobility is becoming very important day by day and hence travel demand is also increasing at a very high pace. Projections show that the passenger travel demand from urban areas will double by 2021 [1,448 Billion Passenger Kilometers (BPKM)] and triple by 2031 (2,315 BPKM), relative to 2011 levels (IUT and CSTEP 2014). This increasing travel demand in the context of inefficient and poorly planned public transport is putting more and more private vehicles on the road. The resultant issues like traffic congestion, delays, air pollution, noise pollution, accidents have created threats to sustainability (Rameshwar Dayal Sharma, 2011; Singh, 2012; T.V. Ramachandra and Shwetmala, 2009).

The increasing motorization and vehicle dependency have also increased the dependency on fossil fuel based energy sources and consequent greenhouse gas (GHG) emissions have increased rapidly (Ramachandra, T.V, 2009). The transport sector in India consumes about 16.9% of total energy involving use of coal, diesel, petroleum (gasoline) and electricity. Road sector is responsible for around 80% of total emission out of which vehicular emissions account for about 60% of the GHG's from various activities in India (TEDDY, 2006, Patankar, 1991). As most of the Indian vehicle fleet is fossil fuel based, these are adding large number of pollutants to the environment. Diesel based vehicles release large number of pollutants due to the process of

combustion of fossil fuel (T.V. Ramachandra and Shwetmala, 2009). Considering this scenario, Indian government understood the need to explore green fuel vehicles which will be producing less emission or zero emission. The recent emphasis on adoption of electric vehicles is a concrete step in that direction. In order to move towards zero emission vehicles, government has decided to move toward electric vehicle at a very rapid pace. Government has targeted to have all electric fleet by 2030. National Institution for Transforming India (NITI Aayog) have envisaged that India can save 64% of anticipated passenger road-based mobility-related energy demand and 37% of carbon emissions in 2030 by pursuing a shared, electric, and connected mobility future (NITI Aayog, 2017).

## 2. Recent policy initiatives for e-mobility in India

As already stated, India is on the ambitious goals of having 6-7 million EVs by 2020 and converting all the vehicles into electric vehicles by 2030. In this direction, there were many initiatives like clean fuel policy, Bharat Stage Emission Standards (BSES) etc., however no concrete steps were taken especially for electric vehicles. The recent initiatives started somewhere in 2012 with launch of National Electric Mobility Mission Plan (NEMMP) 2020 which set the targets of achieving around 6-7 million EVs by 2020. The main purpose of the NEMMP was to address the issue of energy security, vehicular emission and domestic manufacturing of such e-vehicles. This led to the launch of Faster Adoption and Manufacturing of Electric vehicles (FAME) scheme in 2015. The scheme provide subsidy on purchase of different type of electric vehicles (NEMMP 2013; FAME, 2015). With this policy background, there have been many experiments for exploring the electric vehicles. As a result there was an increase in number of electric vehicles. For instance, number of cars has increased nearly 16 times from only 370 in 2008 to around 6000 in 2015 (Global EV Outlook, 2017). This shows a growth of around 1500 percent. On the same lines, only around 4,50,000 electric two wheelers have been sold in past 8 years till 2016 (Economic times, 2017). However, as a share of total vehicle population, this doesn't even make 1%.

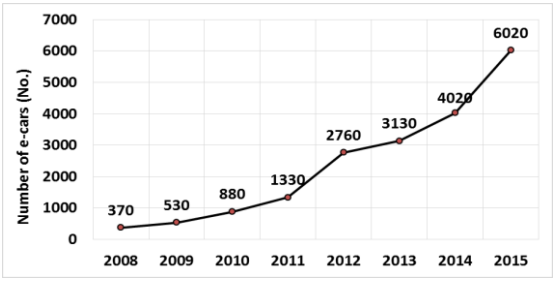


**Figure 1:** Electric cars stock in India, 2008-15
Source: Global EV Outlook, 2016

## 3. Global Trends of e-mobility

According to IHS, electric and hybrid vehicles accounting for just 3% of global auto sales. Some of the countries like U.S., China, Japan and Norway etc. are pioneering in the field of adoption of these vehicles; however some countries are still in the initial stages of adoption. New registrations of electric cars reached over 750 thousand sales worldwide in 2016. Norway is leading this mass deployment of electric vehicle with a 29% market share. (fig. 4) It is followed by the Netherlands, with a 6.4% electric car market share, and Sweden with 3.4%. The China, France and the United Kingdom all have electric car market shares close to 1.5%. In 2016, China was by far the largest electric car market, accounting for more than 40% of the electric cars sold in the world and more than double the amount sold in the United States. The global electric car stock surpassed 2 million vehicles in 2016 after crossing the 1 million thresholds in 2015 as shown in Figure 2 (Global EV Outlook, 2017).

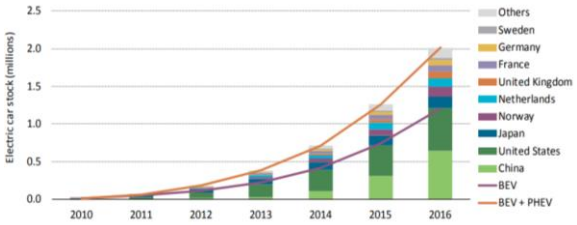


**Figure 2:** Evolution of the global electric car stock, 2010-16

Source: Global EV Outlook, 2016

Until 2015, the United States accounted for the largest portion of the global electric car stock. In 2016, China became the country with the largest electric car stock, with about a third of the global total (fig. 3) With more than 200 million electric two-wheelers, 3. 3 to 4 million low-speed electric vehicles (LSEVs) and more than 300 thousand electric buses, China is also by far the global leader in the electrification of other transport modes (Global EV Outlook, 2017).

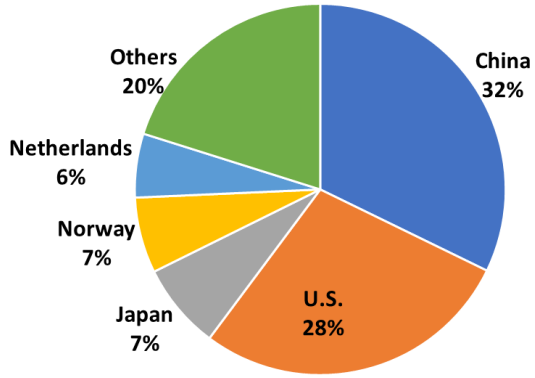


**Figure 3: Global Electric Car Stock, 2016**

Source: Global EV Outlook

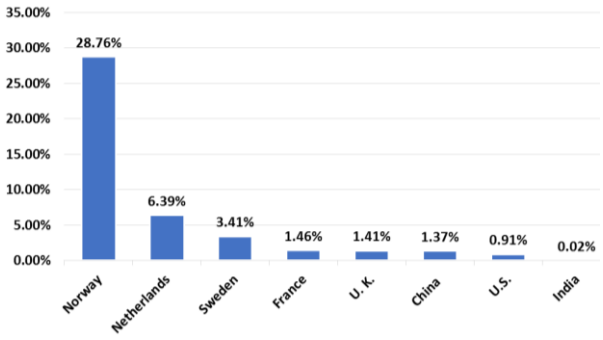


**Figure 4: Electric Car Market Share, 2016**

Source: Global EV Outlook

## 4. Global best practices of e-mobility planning

Countries like Norway, Netherlands, Sweden, China, France and U.K. have highest market share of electric vehicles. The policies, programmes and initiatives adopted by these are discussed below:

### *4.1 Norway*

Norway is leading the global mass deployment of electric vehicles with highest market share (Global EV Outlook, 2017). This is obviously due to the reason that Norway has one of the world's best incentives schemes for EVs. As seen in the figure 5 Norway adopted a number of incentives and programme along with global policies and initiatives.

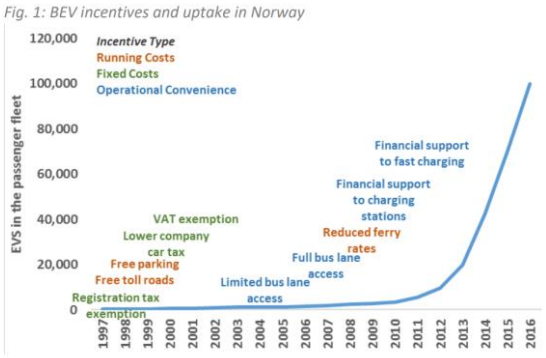


**Figure 5: BEV incentives and uptake in Norway**

Source: Electric Vehicle Policy in Norway, Peter Zeniewski, 2017

Establishment of Norwegian EV Association has promoted the electric vehicles drive a lot. The efforts lead to exemption of e-vehicles from registration tax and toll tax. In the following years more e-vehicles were launched by local manufacturers even at international levels. This further made government to reduce company car tax and VAT and incentives to drive in public lanes. These initiatives were followed by launch of EV charging infrastructure programme. The government launched various other programmes like TRANSNOVA, Gronn Bill project, CHAdeMO platform, Zero Emission Resource Organization (ZERO), ZEROcat Battery electric ferry, Taxi Trondheim project and The Norwegian charging

station database for Electromobiltiy (Tariq Muneer at. el., 2017).

The zero emissions incentives mainly include (NEVA):

- No purchase/import taxes (1990)
- Exemption from 25% VAT on purchase (2001)
- Low annual road tax (1996)
- No charges on toll roads or ferries (1997 and 2009)
- Free municipal parking (1999)
- Access to bus lanes (2005)
- 50 % reduced company car tax (2000)
- Exemption from 25% VAT on leasing (2015)

### *4.2 Netherlands*

Netherlands currently holds around 6.39% market share for electric vehicles (Global EV Outlook, 2017). In Netherlands, EVs are exempt from the registration tax and from the annual road tax. Electric and hybrid Leased cars are also given some tax concession on income tax. Tax relief regulations exist for purchasing commercial electric vehicles. The city of Amsterdam grants subsidies up to 5.000 Euros to purchase EVs which are being used for business and up to 10.000 Euros for purchasing electric taxis and courier cars. Through the MIA and VAMIL regulation of the central government, entrepreneurs can receive a subsidy for installing charging infrastructure (Martijn van der Steen al. el., 2015; Clean Technica, 2017).

### *4.3 Sweden*

Sweden currently holds around 6.39% market share for electric vehicles (Global EV Outlook, 2017). In Sweden, taxation is based on the amount of CO2 emission. This tax has been raised with 33 % in 2011 to stimulate the use of EVs. Hybrid vehicles with CO2 emissions of 12 G/KM or less and EVs with an energy consumption of 37 kwh per 100 km or less are exempt from the annual circulation tax for a period of 5 years from the date of their first registration starting on 1 January 2010. For EVs and Hybrid vehicles, the taxable value of the car for the purposes of company car taxation is reduced by 40 % compared with the corresponding or comparable petrol or diesel car (Martijn van der Steen al. el., 2015; EAMA).

A clean vehicle premium of 40,000 SEK (approximately €4.500) has been introduced (from January 2012) for vehicles emitting less than 50 g CO2 per km Local benefits (‘non-fiscal incentives’). EVs get a discount or can park for free. Exemption from toll was also there for some limited time period. EVs and PHEVs are expected from congestion charging fee to be paid to ply in central Stockholm (Martijn van der Steen al. el., 2015; EAMA).

### *4.4 France*

France currently holds around 1.46% market share for electric vehicles (Global EV Outlook, 2017). France made tremendous gains in electric-car numbers over the past few years. Going from less than 10,000 registered electric vehicles in 2012, to over 100,000 in 2016. User are eligible for €6. and €4.000 as a “thank-you for switching to electric” if they swap their diesel car (bought before 2016) by fully electric model. In the case of replacing by a plug-in hybrid, you’re eligible for €1.000 and €2.500 as a “thank-you for switching to electric” (Clean Technica, 2017).

Both fully-electric vehicles and plug-in hybrids are eligible for either a 50% discount or are exempt from the license plate tax depending on the province. Fully-electric vehicles are exempt from this company car tax. Plug-in hybrids are exempt from this tax for two years (Clean Technica, 2017).

### *4.5 United Kingdom*

United Kingdom currently holds around 1.41% market share for electric vehicles (Global EV Outlook, 2017). In U.K., EVs are exempted from vehicle excise duty or VED (the UK's circulation tax). Employees and employers exempt from company car tax. Along with this, exemption for electric vans from income and national insurance contributions (maximum of £3.000). Electric Vehicles also exempted from fuel benefit charge (Martijn van der Steen al. el., 2015; Clean Technica, 2017).

Some local authorities in U.K. provide exemptions or a reduced parking charge for electric cars. Many of the EV types (not all) gets 100% discount in London Congestion Charging. Other incentives like Plug-in-car grant and plug-in-van grant were also introduced to provide subsidy to electric cars and light truck vehicles respectively (Martijn van der Steen al. el., 2015; Clean Technica, 2017).

### *4.6 China*

China currently holds around 1.37% market share for electric vehicles (Global EV Outlook, 2017). Chinese government provide purchase subsidies and incentives depending upon their vehicle type and technical specifications. Typically, tax incentives are given to local automakers, which are based in the city itself or its province. As BYD is one of major EV manufactures, various local governments in different localities offer incentives for those purchasing the company's BEV and PHEV models. In 2009, China initiated Ten Cities, Thousand vehicles programme to take large scale pilots to address technology and safety issues. Each participating city was challenged to roll out at least 1000 vehicles (Gilmar Masiero at. el., 2016).

### *4.7 U.S.*

U.S. currently holds around 0.91% market share for electric vehicles (Global EV Outlook, 2017). To encourage manufacturing and R&D development investments, government initiated advanced technology vehicle Manufacturing Incentive Programme to develop technology achieving 25% higher fuel economy. Tax credits are provided on infrastructure investment like charging infrastructure. Along with this, consumer tax credit and purchase incentives also exist. Other than these, EVs and PHEVs are free to enjoy HOV lanes, designated parking space etc. (Michael Schneider, 2017)

## 5. Trends of e-mobility in India and associated issues

The review of global best practices in electric mobility in earlier section reveals that mass adoption resulting in high share of electric vehicles in cities is possible if it si supported by programme and incentives in order to promote and achieve ambitious targets electric vehicles in cities (Michael Schneider, 2017)

In contrast to the cities with successful electric vehicles adoption there have been very less success in terms of adoption of electric vehicles in India. In 2016, 336,000 electric vehicles were sold in China and 160,000 in the U.S while in India it was just 450. Currently, electric vehicle sales are low in India and rose 37.5% to 22,000 units in the year ended 31 March 2016 from 16,000 in 2014-15; only 2,000 of these were cars and other four-wheelers, according to Society of Indian Automobile Manufacturers (SIAM). The government wants six million EVs on Indian roads by 2020 and converting all vehicles in India to electric vehicles by 2030 (NEMMP, 2013; NITI Aayog, 2017).

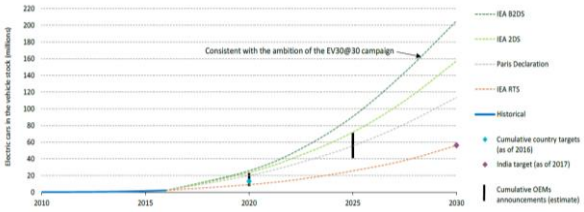


**Figure 6: Development scenario for the stock of electric cars to 2030 with Indian targets**

Source: Global EV Outlook

India is also set to go on the way of electrification of vehicles to achieve a target of having 6–7 million xEVs by 2020 and 175 GW of renewable energy by 2022 and also converting all vehicles in to electric vehicles by 2030 (NEMMP, 2013; NITI Aayog, 2017). In this context, to scale this new technology it will be important to bring down battery costs and provision for charging infrastructure in the background of strong political will, which currently doesn't exist in India. Some similar kind of issues and challenges that exist in front of India for achieving the ambitious targets of e-mobility by 2030 are as described in the following section.

### *5.1 New technology and Indigenous manufacturing*

Electric vehicles are comparative new and less mature technology for India, which create uncertainty about the adoption of such vehicles. In present situation, as most of the electric vehicles are imported or partially imported and then assembled, which makes it quite costly due to different type of taxes levied on these. If manufactured locally, the costs can be under control and comparatively lower and also it will benefit the overall economy of the country. This will promote mass adoption due to economies of scale. Hence, indigenous manufacturing which is presently at very low scale is a very big challenge (GGGI &CSTEP, 2015; NITI Aayog, 2017).

### *5.2 Regulation and encouragement*

In order to adopt such a new technology to a great extent, government regulations are always required. Presently, there have been few initiatives by Indian government to promote electric vehicles. However, there have been very less efforts related to regulation of foreign manufacturers into Indian market, local manufacturing and taxes levied etc. Incentives to be given to electric vehicle buyers are also very less as compared to other countries which are accommodating the most of such vehicle (NITI Aayog, 2017). Lack of regulatory mechanisms and efforts for incentivizing such vehicle at present is also one of the biggest issues.

### *5.3 High cost of vehicles along with range and performance*

As this technology is comparatively new for India, there has not been much choice of vehicle models. One of the issues is the high purchase cost of the vehicle which is the biggest hindrance in the way of adoption of these vehicles. Other barriers are vehicle travel range and performance of these vehicles. As these vehicles operate on battery, these can only go for certain kilometer depending upon the battery charge (GGGI & CSTEP, 2015; EVI, 2014). This factor makes the users to go for conventional vehicle over electric vehicle as former do not have any travel range constrain. The overall performance of these vehicles and battery safety is also very important issue.

### *5.4 Charging infrastructure*

This is another very important factor. As these vehicles have limited range over certain hours of charge, there will a requirement of charging options like on the way or community charging or charging while driving etc. due to limited range, charging infrastructure has to be spread all over the city space

so that people can charge their vehicles anywhere their want (EVI, 2014). This at present is missing in Indian cities; this is another hindrance in the way of adoption of such vehicles (GGGI & CSTEP, 2015; Praveen Kumar et. al., 2013).

### *5.5 Consumer attitudes*

Consumer's attitude towards these vehicles is a very important factor and one of the biggest issues in front of Indian vehicle market. There are various constrains related to these vehicles like high purchase cost, limited travel range, new technology (not proven) etc. which is somewhere stopping the users to go for electric vehicles as they opt for conventional vehicles. Changing these attitude and the mindsets of consumers is one very important issue. This can only be done by regulatory and fiscal measures/incentives to consumers, which are presently lacking in Indian markets (NITI Aayog, 2017; Fanchao Liao at. el., 2016).

## 6. Policy imperatives for enabling e-mobility environment

In order to adopt the electric vehicle at a mass scale and to achieve the ambitious targets set by various bodies, it is very essential to take care of the issues and challenges discussed above. Each of these issues have to be tackled with proper polices, programme and other fiscal/non-fiscal initiatives. In order to achieve the successful adoption of electric vehicles, some of the policy imperatives can be as follows:

### *6.1 Policies and Regulations and incentives*

#### 6.1.1 Enabling Policies

Present NITI Aayog policy and National Electric Mobility Mission Plan (NEMMP) 2020 have laid down the principle and strategies needed to move toward electric mobility. These have been supported by various other schemes like Faster Adoption of Manufacturing of electric vehicles (FAME) by providing subsidies. These polices have set the targets of achieving certain number of vehicles by 2020 and 2030 (NEMMP, 2013; NITI Aayog, 2017). As these policies have not been able provide a detailed roadmap of how to move towards electric vehicles, there is a need to incorporate following points:

- There have to be phased targets may be for each 5 years and at the end of each phase Targeted vehicles and achieved vehicles have to be compared.
- Each phase period has to be supported with detailed strategies which will vary in each phase.
- Each strategy laid out for different phases should talk about level of implementation and authorities responsible.
- Phased monitoring and evaluation of all the strategies has to be done which can be feedback for strategies for next phases.

#### 6.1.2 Prioritization

The present policies have set the targets to achieve certain number of vehicles by end of 2020 and 2030. This seems very ambitious and is quite difficult to achieve. However, this can be quite simplified and organized if done in a prioritized manner. There can be a priority for different type of vehicles. The priority can be set on the basis of various factors like vehicle population of that specific mode, emissions from that mode, public, hired and private modes, duration required and possibilities of conversion etc.

#### 6.1.3 Regulations for local manufacturing and import

There has to be clear and specific regulations for adoption of electric vehicles. In order to promote these vehicles, there has to be lenient regulation for import of these vehicles and local manufacturing. As importing these vehicles or parts cannot be a lifetime

solution, there has to be regulation for regulating local manufacturing of these vehicles especially batteries which is mainly not happening now (NITI Aayog, 2017). The strong regulation and incentives scheme for battery manufacturer with assistance from research bodies, industry partners and foreign collaborations has to be achieved. This will lead to exploring battery manufacturing with flexible ranges and will produce economies of scale. These efforts can completely transform the Indian EV market manufacturing.

There has to be a supportive ecosystem which will regulate both direct and indirect factor for adoption of E-vehicles. It has to regulate promotion of electric vehicles through various mechanisms. However, there has to be a regulation on indirect factors like emission standards of vehicles, regulating oil demand etc. These indirectly prompt the adoption of such vehicle (McKinsey & Company, 2017). This supportive system only can bring the revolutionary adoption.

### *6.2 Incentives for encouragement and promotion*

Most of the countries that are lading the mass deployment of electric vehicles have provided various types of incentives to different stakeholder to promote electric vehicle adoption. Similar incentives as shown below can be adopted for Indian cities along with already existing incentives.

- registration tax
- road tax
- insurance benefits
- income tax benefits
- free parking
- toll benefits

### *6.3 Charging Infrastructure*

#### 6.3.1 Demand assessment for charging infrastructure

China is the clear leader in public charging infrastructure; with a particularly great number of public fast chargers (more than 80 percent of the global fast chargers are located in China) (Global EV Outlook, 2017). As per the reports, numbers of community charging stations in India are only 206 (CSTEP, 2017). One of the main reasons for the low sales of electric vehicles in India is the charging infrastructure which is needed to support it. This includes increasing the number of electric vehicle charging stations in India in order to remove the fear among consumers regarding the vehicle's limited range. For an-all-electric-car target, India needs to ramp up infrastructure at a very large scale.

#### 6.3.2 Provision Standards

At present, there are no standards for provision of charging infrastructure in Indian cities. In order to provide mass infrastructure, there is a need to make provision of these charging stations like any other social or physical infrastructure. Current master plans, zonal and layout plans, smart city plans, mobility plans etc. have to incorporate provision for charging infrastructure at three levels along with their area requirements. Some of the factors to be considered for developing charging infrastructure provision standards can be:

- Population distribution or population density distribution
- Type of land uses; e.g. residential, commercial, institutional, transportation etc.
- Type of activity/hierarchy of facility; e.g. local market, district center, malls etc. (CSTEP, 2017)

- On the basis of building typologies; plotted, group housing etc.
- Area requirements based on above factors

6.3.3 Typology of charging infrastructure based on land use and activities

There will be a requirement of massive charging infrastructure for electric vehicles stretched all over the cities or regions. The type of charging systems available are fast charging which takes around 30 minutes for full charge, medium charge taking around 3-4 hours and long time charge taking around 8 hours to charge a vehicle fully (CSTEP, 2017). There has to be clear cut regulation related to provision of mix of chargers. For example, long term chargers may be suitable for residential areas, offices, bus depots for buses and transport nodes where people park their vehicle in the morning and take back in evening. However, medium charging based system will be suitable for large scale markets like malls, movie theatres and also in residential areas based on consumer's preferences. However, fast charging systems will be required in small scale markets and government offices where people visit for shorter durations.

### *6.4 Consumer Attitudes*

Consumers are one of the main players in the whole game of adoption of electric vehicles. In order to make consumer to buy electric vehicles, there will be a requirement of incentivizing consumer as already stated. The incentives can be in terms of exemptions from purchase tax, road tax, registration charges, concession in income tax, parking charges, toll charges, insurance charges etc. This has to be supported with various workshop and other initiatives to make aware and encourage consumers about the recent vehicle models, their benefits and incentives etc. This can prompt the users to buy electric vehicles.

## 7. Summing Up

The achievement of Indian government vision of electrification of vehicles by 2030 , though welcome, would depend on how the entire ecosystem develops in the country for supplier base of various components, batteries as well as how the charging infrastructure develops. However there would be lot of challenges to be overcome with onset of electric vehicles such as limited driving range low speed capabilities, high battery costs, lack of adequate electric charging infrastructure and high cost of electric drive train systems. The vehicle manufacturers too would have to craft roadmap entailing specific short –terms and long term goals and make timely investment to enable electric vehicle manufacturing ecosystem develops in time for scaling up electric vehicles manufacturing and availability in the country Finally city planners would have to evolve appropriate planning norms, standards and building bylaws which would facilitate development of charging infrastructure both at city, zonal and neighbourhood level particularly in residential developments for slow charging demand .

## References

1. Clean Technica (2017), Electric Car Incentives In Norway, UK, France, Germany, Netherlands, & Belgium.
2. European Automobile Manufacturing Association, *Electric Vehicle Incentives Overview.*
3. Electric Vehicle Initiative (2014), Assessing and Accelerating Electric Vehicle Deployment in India. *Clean Energy Ministerial.*
4. Faster Adoption and Manufacturing of Electric Vehicles (FAME), 2015.
5. Fanchao Liao, Eric Molin & Bert van Wee (2016), Consumer preferences for electric

vehicles: a literature review, *Transport Review*, VOL. 37, NO. 3, 252–275.

6. Gilmar Masiero, Mario Henrique Ogasavara,, Ailton Conde Jussani and Marcelo Luiz Risso (2016), *Electric vehicles in china: BYD strategies and government subsidies.*
7. Global Green Growth Institute and Center for Study of Science, Technology and Policy (2015). Electric Buses in India: Technology, Policy and Benefits, GGGI, Seoul, Republic of Korea
8. IUT and CSTEP. 2014. "Review of Urban Transport in India." Bangalore. http://cstep.in/uploads/default/files/publications/stuff/0038b8f5daffde935c12f955c6ea994e.pdf.
9. Martijn van der Steen, R.M. Van Schelven, R. Kotter, M.J.W. van Twist and Peter van Deventer MPA, 2015, EV Policy Compared: An International Comparison of Governments' Policy Strategy towards E-Mobility, *Springer.*
10. Michael Schneider *(2017),* The road ahead for electric vehicles, ICCG.
11. McKinsey & Company (2017), The future of mobility in India: Challenges and opportunities for the auto component industry.
12. National Electric Mobility Mission Plan 2020.
13. NITI Aayog & Rocky Mountain Institute (2017), India leaps ahead: Transformative mobility Solutions for all.
14. Norwegian Electric Vehicle Association https://elbil.no/english/norwegian-ev-policy/
15. Patankar, P., (1991). Urban Transport in India in Distress. Central Institute of Road Transport, Pune, India.
16. Peter Slowik and Nic Lutsey (2017), Expanding the electric vehicle market in U.S. cities, *International Council on Clean Transportation.*
17. Praveen Kumar and Kalyan Dash (2013), Potential Need for Electric Vehicles, Charging Station Infrastructure and its Challenges for the Indian Market, A*dvance in Electronic and Electric Engineering*. ISSN 2231-1297, Volume 3, Number 4 (2013), pp. 471-476.
18. Ramachandra, T.V., Shwetmala, Emissions from India's transport sector: State wise synthesis, *Atmospheric Environment* (2009), doi:10.1016/ j.atmosenv.2009.07.015
19. Rameshwar Dayal Sharma, S. J. (2011). Growth rate of Motor Vehicles in India -Impact of Demographic and Economic Development. *Journal of Economic and Social Studies, Vol. 1*, pp. 137-150
20. Singh, S. K. (2012). Urban Transport in India: Issues, Challenges, and the Way Forward. European Transport \ *Trasporti Europei* (Issue. 52).
21. Tariq Muneer, Mohan Kolhe & Aisling Doyle (2017), *Electric Vehicles: Prospects and Challenges*, Joe Hayton.
22. TEDDY, 2006. Teri Energy Data Directory and Yearbook, 2005–06. Tata Energy Research Institute, New Delhi.
23. The Economic Times, Two wheelers to lead electric vehicle market in India, https://economictimes.indiatimes.com/industry/auto/news/industry/two-wheelers-to-lead-electric-vehicle-market-in-india/articleshow/60739035.cms retrieved on 19 Jan 2018.