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Electric Mobility on Roads, a Boon or a Bane in Case of India

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Abstract:- As per The World Economic Forum Report- India has six out of top ten most polluted cities in the world and Air pollution kills over a million Indians every year. In 1885 when, an Otto four-stroke gas engine modified to run on petroleum vapour by Gottlieb Daimler at this time no one thought that this invention would affect the environment badly one day by emitting the harmful gases in environment by combustion. Rapid growth in urban population and sprawling of cities over a period of time has led to devastating changes in the overall mobility pattern. In addition to this, the wrong notion of social status continuously provides ammunition for owing more personalized vehicles. All these have triggered innumerable environmental and social impacts in terms of air and noise pollution, as per emission inventory for road and transport in India- Globally the transport sector is responsible for 25% of total carbon dioxide (CO_2) emissions from fuel combustion in 2018, India's transportation sector contributes about 10 per cent of total national greenhouse gas (GHG) emissions and road transportation contributes about 87 per cent of the total emissions in the sector.[2], cities/countries have decided to reduce their carbon footprint by going electric. India has also pledged to go completely electric by 2030. With this continuous trend of electrification and declining fuel economy, experts believe that the automobile industry will be continued with the battery used vehicles and by the next decade, almost all the vehicles will be converted into electric vehicles. This paper has tried to explore whether the transformation to electric mobility will be a solution in achieving enhanced mobility options with a green future or another disruption in the transportation sector, future and challenges for E-Vehicles in India. The aim of this paper is to focus on the environmental impacts of the transformation of the mobility pattern to electro- mobility systems.

Keywords:- *E-Mobility, Electronic Vehicles, Indian EVs, Zero Emission, Sustainable Mobility.*

I. INTRODUCTION

Moving towards E-Vehicles are not instant happening actually it is due to major reasons like India is not a country which have petroleum in plenty so for the development, country needs petroleum and for petroleum it is a pressure on India to maintain good relation with gulf countries for which dependency of country on other countries are increased which is not good for country's defence policy this it is necessary to shift on electro vehicles to loose dependency also India is the part of Earth summit/ Rio summit-1992, as this summit is concern for the earth and aimed to maintain earth temperature bellow 2 °C for which UNFCCC make conference every year. In 2021 the COP26 was held in Scotland which aimed to make whole world net zero carbon for which it is necessary to control on emission on greenhouse gases, in India 51% of the pollution is caused by industrial pollution, 27 % by vehicles, 17% by crop burning and 5% by other sources pollution caused by transport sector is major percentage as we know industry is important for development of country's economy so despite industrial sector major focus in given to transport sector to reduce the greenhouse gases in India.

In India, vehicular population has doubled in less than a decade's time (72.7 million in 2004 to 141.8 million in 2011) with an alarming growth rate of 9 percent per annum. This growing trend of automobiles are choking our city roads as well as upper atmosphere. According to the study conducted in 2013, transport sector alone contributed 261 tons of CO_2 emissions in India and of which 94.5 percent was contributed by road transport.[3] About 87 percent of passenger and 60 percent of freight traffic is carried through road in India. Some of the factors which favours road transport includes easy availability, cost savings and adaptability to individual needs. The rapid expansion of the road network, therefore, unable to resolve the issue, in fact invites more traffic on the road. Road transport in India needs to be planned with more energy efficiency, low jam density, and cost savings. Hence, Central Govt. has pushed for electric mobility transformation. As we know transport sector contributes more in Co_2 emission and as per the COP-26 it is aimed by UNFCCC to create net zero carbon emission by 2050 in world, but India demands more time to be net zero carbon emitter and aimed 2070, in this vision to be net zero co2 emitter India decided to shift on e-vehicle by 2030 electro- mobility is seen as a key component of the agenda for sustainable mobility in India which aims to complete shift by 2030. However, with no clear policy, India has been laggard behind in the global race toward electrification of automobiles to reduce dependency on oil imports. Now the million-dollar question is whether this transformation be valuable or amplify existing quandaries in overall transportation system. Without a long-term sustainable approach of handling future mobility need may drag us into a scenario where replacing fuel powered

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vehicle with electric vehicle may not be able to address the present issues. Therefore, whether shifting to electro-mobility would achieve current gaps in mobility or not, will be a talk of this paper. The paper will also come out with various advantages as well as disadvantages of bringing EVs into our automobile industry, particularly with respect to Indian Scenario.

➢ *Aim*

Focusing on electro-mobility transformation and its impacts on environment along with their chances of success and mobility pattern in India.

➢ *Objective*

- Economic analysis of both conventional and e-vehicles in India.
- Impacts of electric vehicle transformation on travel pattern and environment.
- Electro-mobility solutions in Indian context
- Challenges in adaptation of e-vehicles in India.
- Future of e vehicles in Indian automobile industry.

II. ENABLERS OF ELECTRO MOBILITY DRIVER

A. *FAME India Scheme*

During the Launch of scheme Prime minister Mr. Narendra Modi states- "Clean Mobility powered by clean energy is our most powerful weapon in our fight against Climate change". FAME (Faster Adoption and manufacturing of (Hybrid &) Electric vehicles in India is part of NEMMP (The National Electric Mobility Mission Plan)-2020. This scheme was launched in 2015 for the promotion of electric and hybrid vehicle technology and ensure better sustainable growth for the same in India. FAME India has two phases FAME I and FAMEII

FAME-I was launched at 1st April 2015 for the period of two years but due to extensions last extension of first phase was up to 31st March 2019. In first phase 280987 electric and hybrid vehicles are subsidies worth IRs 359 Crore, total 425 electric and hybrid buses are commissioned in various cities of India worth 280 Crore, 520 charging stations are constructed worth 43 crore rupees in cities like Delhi NCR, Chandigarh, Bengaluru & Jaipur.

FAME-II was launched at 1st April 2019 for the period of 3 years, up to November 2021 as per GOI records- 6315 e-buses sanctioned across India, 2877 charging stations in various cities have been sanctioned, 1576 charging stations are approved on Highways.

These schemes are key pusher of e-vehicles on Indian roads.

B. *Charging Stations as a service factor in buildings:*

For the promotion of e-vehicles, Union Power Ministry have been allocated charging stations as a service category and for the establishment of charging station there is no need of license.

Model building byelaws amendments-2016, for electric vehicles charging infrastructure, chapter 10 clearly says that charging infrastructure is mandatory for all building types whether it is residential or, non-residential.

Table 1: Charging Infrastructure requirements for Individual house/Self use

Building Type	Plotted House
Ownership of Station	Private (Owner)
Connection and Metering	Domestic meter
Type of Charger	Slow chargers as per owner's specific requirements
Modes of Charging	AC (Single charging gun)
Norms of Provisions	Min. 1 SC and additional provisions as per the owner individual.

Table 2: Charging Infrastructure requirements for PCS (Commercial Use)

(Source: Amendments in Model Building Bye-Laws (MBBL - 2016) for Electric Vehicle Charging Infrastructure)

Building Type	Any building type			
Ownership of Station	Service provider			
Connection and Metering	Commercial Metering and Payment			
Types of Charger	as per min. requirements specified in MoP Guidelines (refer Annexure IV)			
Additional chargers	PCS service providers shall install additional number of kiosk/chargers beyond the minimum specified requirements to meet the ratio of charging points as prescribed below (by the type of vehicles).			
Norms of Provisions for charging points	**4Ws** 1 SC - each 3 EVs 1 FC - each 10EVs	**3Ws** 1 SC - each 2 EVs	**2Ws** 1 SC - each 2 EVs	**PV (Buses)** 1 FC - each 10 EVs

C. *Purchase, running and Fuel cost compression with respect to Indian Car users:*

In Indian market it can be observed that the prices of E-Vehicles are in higher side, electric cars are 25-30% costly with respect to petrol cars but on the analysis of all costs of purchase, running, maintenance, and subsidy by governments it is find that in long term e-vehicles are cheaper with respect to conventional petrol cars.

An average life of a conventional petrol based car is 12 years or 2 lakh miles whereas an electric car life span is about 3 lakh miles[4]. Here by we analyse the total expense of conventional and e-vehicles for 10 years.

Table 3 TCO (Total Cost of Ownership) Analysis of petroleum running vehicles and E-vehicles for 10 Years

Compression basis	Conventional vehicles (petrol based)	E-vehicles	Remark
Initial cost of purchase	800000 IRs	1200000 IRs	Prices based on market analysis
Fuel cost	1621414 IRs (approx.)	138805 IRs (approx.)	• Considering petrol price is IRs 96.72/letter. • Conventional car mileage 16KM/Letter • Considering electric cost6.9 IRs/Unit • Mileage 200Km/Charge • Required 15 Unites per full charge of Vehicles.
Maintenance cost	200000 IRs (approx.)	400000 IRs (approx.)	• Conventional cars maintenance prices based on market analysis. • E-vehicles Battery replacement based on Market Analysis
Total cost	2621414 IRs	1738805 IRs	

(Note: Petrol cost Per Letter & Electricity cost per unit is considered constant for all projected 10 years for analysis above.)

D. Safety assessment:

NCAP (New Car Assessment Programme), done safety assessment of Cars in this process on the basis of 5 Star rating system vehicles are rated. Due to the placement of Batteries at bottom of cars, it is hard to crash of cars while accident so electric cars get 5 Star rating whereas in other cars it is difficult to get 5 Star rating.[5] Chances of catching fire in Petroleum vehicles are one in 2 Cr. Vehicles whereas in E-vehicles the chances of catching fire are one in 12 Cr. Vehicles.[6]

E. Green number plates:

For the promotion of EVs, Ministry of Road Transport & Highways announced to give Green number plates to all e-vehicles (private and commercial both), benefits are provided to green number plate holders such as Exemption on road tax, Exemption on registration fee, Reduced toll charges on highways, etc.

F. Transfer of Technology:

ISRO has selected 10 Indian companies through "Request for Qualification (RFQ)" for transfer of its indigenously developed space grade lithium-ion battery technology which will bring the technology in the hands of EV manufactures. With given time and research, the manufacturing cost of lithium ion battery will come down making EV's more affordable for the general public.

G. Reduce dependency on Gulf Countries for Petroleum:

India is a developing nation and one of the largest Petroleum consumer, an analysis of Observer Research Foundation in April 2022 reveals that more than 84% of petroleum and crude oil demand is fulfilled by Gulf countries it is another consideration that Gulf countries also depends on India for their food consumption, more than 85% of food product of gulf countries fulfil by India7 but equation of import and export of countries can change any time wither India's relation with Gulf countries are good now but conflicts in relation can also be seen in past some experiences (Noopur Sharma conflicts, etc.).

Less dependency of India on gulf countries will empower the vision of "Aatma Nirbhar Bharat".

H. Willing of foreign automobile companies to target Indian market:

As per 2021 statistics, India is the fourth largest automotive industry in the world & in 2020 India is the fifth largest market of automobile industry so it is seen that globally big fishes of the automobile sector are willing to target Indian market for their E-vehicles for which they are in continuous contact with Indian Government. Craze of these companies are high in Indian buyer especially in youth and when these global companies established their production units in India these cars will available in cheaper price due to removal of excise duties, which can be key driver of E-vehicles in India. Government of India will definitely want to invites these companies, because establishment of production units in India will generate employment, increase technical advancement & empower the ongoing "Make in India".

I. Reducing vehicular pollution:

Vehicular pollution is major concern, as per ICCT (International Council for Clean Transport) report- in 2015, 74000 people die due to pollution caused by vehicles. India account for 55% of the global deaths caused by air[8] and transport account 27% of total air pollution in India. Country needs electric vehicles to reduce vehicular pollution.

J. Indirect pushes to sale EVs by GOI:

Union Transport Minister, Mr. Nitin Gadkari states in his speech (dated 08 Nov 2021)- "There is no need of artificial push for the sale of electric vehicles in India, the economics is so good that the low per kilometre cost, consumer will naturally shape towards buying electric vehicles. The per kilometre running cost for petrol based vehicles are 10 IRS, for diesel it is 7 IRs, and for electric vehicles it is 1 IRs only. The government intent to have an electric vehicle sales penetration of 30% for private cars, 70% for commercial cars, 40% for buses & 80% for two and three wheelers."

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K. Low CO2 Emission:

Various, previous debates misguide people with the concept of "Carbon shifting", which states that the amount of electricity that needs for charging electric vehicles are also using coal to generate electricity so, EVs will not reduce carbon emission but just shift the carbon emission from road power plants. To analyse carbon emission of EVs and Conventional fuel vehicles it is assumed that a car rune 50 km daily thus annual journey of the car is 18250 km. through analysis of on market it is find EVs mileage is 200 km per full charge and one full charge takes 15 kwh. Electricity at this rate an electric vehicle consumes 1368.75 kwh power annually. To generate one Kwh electricity in thermal power plants, 0.91 to 0.95 kg of CO2 emission is done9 at this rate, to generate 1368.75 Kwh power 1.3 ton CO2 emission is done, hence an electric vehicle emits 1.3-ton carbon die oxide annually. In conventional petrol vehicles, 132g per kilometre emission CO_2 is done10 at this rate a combustion engine vehicle emits 2.4 tone CO_2 annually. Through the above calculation it is proved that carbon emission through EVs are 54% less than combustion engine vehicles so it is good with respect to emission of CO_2. It is notable that embedded carbon footprints of both vehicles and carbon footprint of conventional fuel is not considered here.

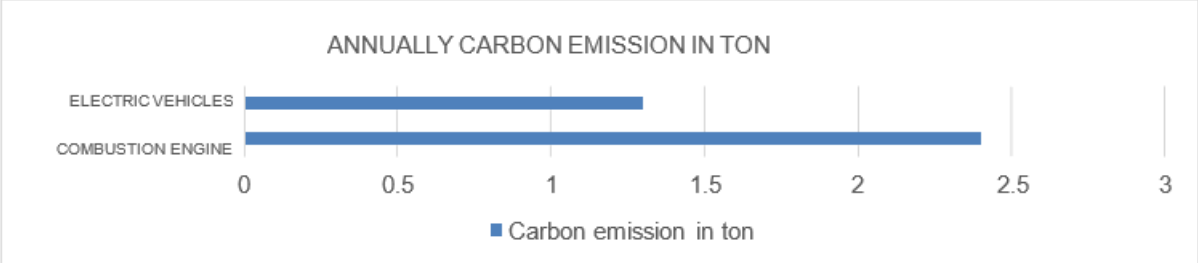

Fig 1: Annually Carbon Emission in Ton
(Source: Author analysis on the basis of assumptions and market statics.)

III. CHALLENGES IN INDIA'S ELECTRO-MOBILITY FUTURE

Although various initiatives have been taken in both Central as well as State level to create EV demand and to create EV ecosystem, but electric vehicle (EV) policy at central level is still need of the hour. A few states have already begun developing their own policies in accordance with their needs, but due to the absence of a centralised policy framework, EV is not receiving the necessary support to realise the Indian Government's Vision 2030. Since more than 50% of electricity is still produced from polluting sources like coal, one of India's main EV goals is to reduce emissions. The credibility of India's emission-reduction targets will be damaged since additional thermal electricity, which currently serves as the primary source, will be required in order to seamlessly charge the batteries for electric vehicles. Despite this, the plan is for 30% of EVs to be on Indian roads by 2030. It's difficult to imagine how this shift will occur in around ten years given that there are currently over 210 million vehicles on the road and that number is rising. Comparing it to nations like Britain, which is also competing for similar results, Britain intends to cut the number of fossil fuel vehicles in half by 2030 but only has approximately 38 million vehicles on the road, has a surplus of electricity, and will phase out coal-fired power by 2025. Everything puts some credence in its green objectives.

On the other side, India's projected EV trip has a lot of dead ends. India's automakers are recalibrating automobiles to satisfy Bharat Standard-VI (BS-VI) pollution standards rather than creating electric vehicles (EVs). By 2020, the cost of typical lithium-ion batteries will have increased due to the use of costly components like cobalt. Power might be spotty in rural places. Moreover, electricity in large portions of rural India consists of a supply line and one hour of daily power. The government of India would have to restrict EV use to areas close to charging stations due to infrastructural limitations, which is unlikely to be acceptable to most consumers.

A. Cost of Electric Vehicles in India

Indian market is very sensitive towards pricing, limited manufacturing unit of electric vehicles, dependency for Lithium ion batteries on other countries & high excise duties on import of EVs in India increases the cost of electric vehicles in country. In India petrol segment cars start from 6 to 7 lakhs whereas electric segment cars have starting price of approx. 14.24 lakhs which is almost more than 50% extra from Petrol segment cars, this huge pricing variation makes electric vehicles unfordable. GOI also subsidizing EVs but these Subsidies are up to some extent.12. Site analysis.

During the visit in Dharavi, it was observed that their living style and construction techniques are quiet slandered. With respect to other slums these shelters are neither permanent nor temporary, the weight of structure gets lighter when they grew vertically. Here are a few pictures sharing my observations about Dharavi. Some of them are positive and some of them are negative.

B. Lack of Service Infrastructure & Battery Life

After sale service is the major concern for each new product, in case a person bought an electric vehicle and after some time he faces problem to run it then the only option is to concern with manufacturing companies wither in conventional vehicles he has more than sufficient option of mechanics who are specialized in these vehicles to look after it. So the lack of Service infrastructure is also a challenge for adoption of electric vehicles in India. It is another concern that electric vehicles are coastally due to the Li-ion batteries, cost of batteries accounts 25 to 30% of total cost of the

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electric vehicle,11 so after the life of battery which is hardly 7 to 8-year customer have to pay a big amount for replacement of batteries which is not affordable.

C. India is not Prepared for Quick Shift to Electric Vehicles

It is estimated that over 600 sewer workers die every year because of the lethal fumes inside the sewer which is more than 10 times the Indian soldiers killed by terrorist. Here, in Dharavi people live round the year breathing in the venom which is blatant self-harm. Being adjacent to Mitthi River, sewer lines run through the area and a lot of open drains are also present in which people throw their garbage making it extremely filthy and unhygienic thereby providing solid proofs of lack of proper disposal system in Dharavi. The concerned authorities clean the drains once every year during the onset of the rainy season. There are some people who segregate the hard sludge using a sieve in the drains which run close to the gold smith workshops, in an attempt to find some gold crush which, they can convert into money to aid their survival.

D. Lack of Academic Infrastructure for EVS:

It is well known thought that "If you want to change in profession, Start it with Education". Electric vehicles industry can have pushed up only with the help of best academic infrastructure where students are trained to make parts of EVs which will Leeds to invention of new technologies and advancements in making low cost batteries which will combindly makes electric vehicles affordable in India.

E. Increases Electricity Demand:

Country like India, where the electricity thefts happens in major parts and in warm months between April to August due to over loading power cut is major problem, it is not feasible to impose more load through charging of EVs. It is assumed that by 2030, EVs will add up to 50% of the peak demand in electricity, as per data released by GOI Ministry of Power, 58.6% of total production of electricity is based on burning on fossil fuels which emits pollutants. So if we further depend upon fossil fuels for charging EVs, the electric vehicle revolution will be of no use.

F. Increases Traffic Contestation on Road:

Government data shows that nearly 90% people don't have Private vehicle12 but still roads are very highly congested as per the graph bellow it can be seen that between 1961-2011, percentage growth of vehicles are growing day by day but roads are not growing in such amount thus the vehicular holding capacity of roads are reducing day by day hence the roads are choked out. As per surveys it is found that majority of Indians do not buy personal vehicles due to high cost of fuel, road tax and parking problems if EVs will be successful in India than more people will buy their own vehicles due to low ownership cost which results over contestation on roads.

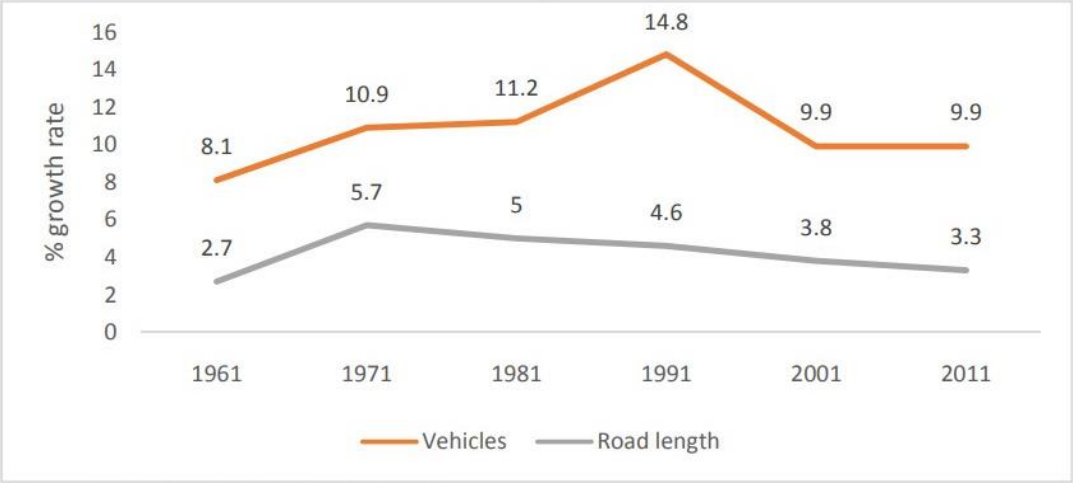

Fig 2: Growth Rate of vehicles and road Length in India
(Source: RTO India, MoRTH 1961-2011.)

G. Lack of Charging Infra Structure, Consume More Time for Charging And Less Mileage:

Even after so much focus of government on establishment of charging stations for electric vehicles, no sufficient charging points are in country, here petrol pumps can be easily seen but charging stations are rare, if charging points are available then the charging time is a major problem to fully charge an EV more time is required which not good and last but not the least less mileage of EVs are major problems.

H. High Carbon Foot Print of Electric Vehicles:

Carbon footprint of a vehicle is the total amount of carbon released through the life cycle of car, which is categories in three stages production, use and scraped. Scraping of cars will emits almost same amount of carbon wither it is an ICE-Car or EV.13 A study by the Massachusetts Institute of Technology estimates that production of a conventional ICE-Car emits 2 Metric tons of carbon in atmosphere, and an Electric vehicle produces approx. 50% more emission in environment, so manufacturing of an electronic vehicle emits 3 Metric tons of carbon. In this Way manufacturing of an electric vehicle emits more carbon than ICE-cars. In use phase, according to

the United States Department of Energy, an ICE-Vehicle commute distance of 19,300 km annually & emits 5.2 tons of carbon yearly, whereas a study done by the Alternative Fuel Data Centre of the US reveals that an electric car produces 2.2 metric tons of carbon dioxide for the same distance.

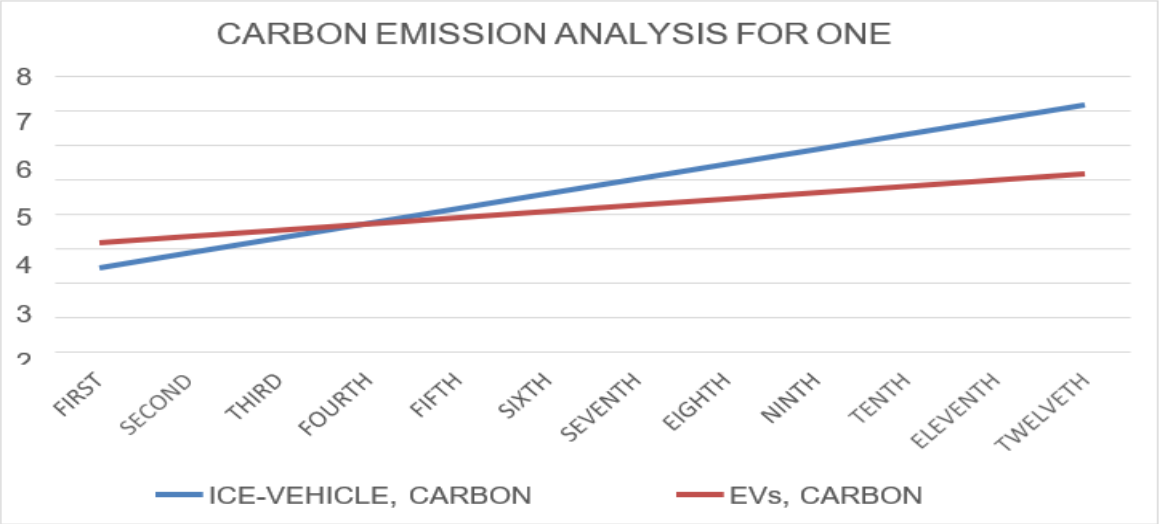

Fig 3: Carbon Emission Analysis for a vehicle
(Source: Author analysis based on RESEARCH DATA.)

I. Lack of E-Waste Disposal System

In India only 40% of the e waste are made available for recycling process whereas 60% of E-waste remains the part of warehouses or storage14. Total E-waste that comes for recycling, 95% are refurbishment & and only 5% needs process of disposal so E-Waste disposal capacity and techniques of India is not so good, if electric vehicles acquires automotive industry, production of E-waste will increase so it will create a load on disposal units which is also a major concern for GOI.

IV. CONCLUSION

Government of India is hoping consumers will overcome cost hurdles through the subsidies it offers. But it's not possible to race past inadequate infrastructure. India will need a reliable excess power supply that can be fed to charging stations across the nation in order for EVs to operate properly, and for that reason, the country has to rely more on hydro or green energy sources. Gridlocks and air pollution won't be eliminated by electric automobiles, but carbon footprints could be reduced by giving preference to mass transportation, bicyclists, and pedestrians. To reduce the use of private vehicles for commuting, the government must develop and strengthen shared mobility and public transportation in the interim. Cities should be made smaller to cut down on commute time, and the government should build wide, shaded NMT infrastructure so that people can bike and walk. Together with financial and non-financial measures, the government should establish regulations to manage parking in crowded city centres. We all want our cities to be faster, smarter and greener – and the car is not the only answer. We must use technology and entrepreneurship to ensure that our urban future is fair, inclusive and aligned with the common good. India's shift to EVs should be kick-started by converting intra- city public transport to green, and by generating enough surplus power through clean energy.

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