BACKGROUND NOTE
ON
E-vehicles: Issues, Promises, and Challenges

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E-vehicles: Issues, Promises, and Challenges

Abbreviations:
- ICE : Internal Combustion Engine
- EVs : Electric Vehicles
- FY : Fiscal Year
- E2Ws : Electric Two Wheelers such as scooters
- E3Ws : Electric Three Wheelers such as electric-autos
- E4Ws : Electric Four Wheelers such as electric cars, buses
- FAME : Faster Adoption and Manufacturing of (Hybrid and) E-vehicles
- NEMMP : National Electric Mobility Mission Plan 2020 (launched in 2013)
- NEMP : National E-Mobility Programme (launched in 2018)
- PCS : Public Charging Stations
- BCS : Battery Charging Stations
- EVSEs : Electric Vehicle Supply Equipment (or charging stations)
- PLI : Production linked incentives
- MORTH,GoI : Ministry of Road Transport & Highways, Government of India

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I. Background and Introduction
II. Issues related to E-vehicle and government measures
III. Aftermath/Conclusion

I. Background and Introduction

With the shift in global automotive industry and in accordance with SDG commitments and to reduce carbon emissions, Indian automotive industry is also significantly developing in the sector of E-vehicles and is expected to become third largest by 2030 from the current position of fifth largest today time. In April 2022, Minister of Transport & Parliamentary Affairs, Govt. of Maharashtra organized India’s one of the biggest EV rallies in Pune with the objective to increase awareness about the E-vehicles among the consumers, and increase the sales of EVs in contrast to ICE (Internal combustion engine) vehicles. This is done in accordance with the aim of the government to reduce carbon emission by one million tons and improve India’s ranking as fourth largest carbon emitter. However, rapid rise in population and urbanization has also created huge rise in demand of private and commercial vehicles, substantial proportion of which is still dominated by ICE vehicles. A report published in the India Electric Vehicle Opportunity (2021), states that sales of electric vehicles (EVs) currently account for only around 1% of total vehicles sales. However, it is
supposed to increase to around at least Rs. 475 billion by 2025, out of which around 37% is to be captured by three-wheelers and major section of around 62% is to be captured by two-wheelers. There is also a difference across different states in terms of types of sales. For Ex: Uttar Pradesh, with lowest level of urbanization is observing more rapid rise in electric-two wheelers as compared to the electric three-wheelers, whereas Maharashtra observed more rapid rise in electric three-wheelers, and thus the share of two-wheelers and three-wheelers is dependent upon several underlying factors such as income distribution, urbanization rate, regulations, demographics and landscape among others.

Chart 1: Regional registered EV sales in Q4 2020 and in Q4 2021

Source: Made by Author from reports by JMK Research and analytics, India

Government policy and economic incentives such as states subsidies and tax rebate, along with allowing 100% FDI, new manufacturing hubs, policy push for technically advanced and to improve the availability charging stations, as well as push for made-in-India batteries and other EV drivers, among others is acting as statistically significant determinants for growth in E-vehicle sector, as India reported sales of over 3,00,000 E-vehicle units in 2021.
Indian government has also approved Rs. 76,000 crores in 2021 through the production linked incentive (PLI) scheme, for semiconductors and chip making, which is in addition to Rs. 50,000 crores PLI scheme approved in 2020 to attract electronics manufacturers in India. Government have also introduced FAME-I (Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles-I), FAME-II along with its amendments, PLI scheme, among several other schemes to attract investment and increase sales through investment incentives, tax rebate, subsidies etc., have played a significant role in order to raise the growth of e-vehicles industries, for both commercial and private consumption.
II. Issues related to E-vehicle and government measures

India has set an ambitious target to electrify 70% of all commercial vehicles, 30% of all private cars, 40% of all buses, 80% of all two-wheelers and all three-wheelers sales by 2030. However, according to a report published by Global EV Outlook report in 2020 only 0.07% of the total cars in 2019 are EVs in India. The growth of EV sector in India is highly dependent on the supply side and trends in demand side, which in turn is dependent upon several underlying factors. Supply factors such as tax exemptions, appropriate eco-system for designing and manufacturing microchips and other EV components, as well as demand factors such as charging time, acceleration and top speed, battery cost and adequate charging facilities, availability of trained personals and maintenance cost are some of the primary concerns that have constrained EV sector in India in its developing stage. In a report published in journal Consumer Perspective toward E-mobility, Arya Market research, the primary determinants of EVs are:
In this study, we analyze some primary concerns, challenges and their impact on the growth of EV sector in India as well as the initiatives taken by the government to alleviate these issues.

i) Charging time, range and stations

The primary concern with E-vehicles is their infrastructure and range limitations such as acceleration and speed limit; range of distance before requiring the battery to recharge; as well as the lifespan of the components and battery and replacement cost. However, the most prominent concern among households regarding EVs is charging time, range, and charging infrastructure. The charging infrastructure includes charging stations (EVSEs/PCS/BCS), central management system, and software applications. The charging time required by different cars is specifically dependent upon two factors- battery capacity and charging station power.

![Chart 5: Charging Time required by EVs of different kWh](source)

Source: Daze Technology
On a typical full charge of 8 hours (with 7kW charger), a 60kWh battery can usually drive for around 200 miles. However, during their regular use, even consumers of hybrid cars tend to recharge their batteries before complete discharge, which in turn requires a substantial number of charging stations near to each other, especially on highways. Lack of trained personals for batteries and other components, as well as lack of charging stations (or EVSEs) also plays another significant deterrent in EV sales. On other hand, due to low number of EVs on road, the established EVSEs (electric vehicle supply equipment), or charging stations, do not observe enough footfalls to be considered self-sustainable, let alone profitable. Thus, government needs to intervene to bring economy out of this bottleneck by incurring the cost of construction and maintaining EVSEs, at least during the initial period, as well as buying EVs for their consumption in various ministries. EVSEs are the relatively more efficient high-powered charging stations, with mode-3 or mode-4 multiple charging guns. Accordingly, government has proposed to set up EV charging stations in several schemes to encourage growth in EV sales.

Chart 6: EV Charging Stations Established under FAME-I and FAME-II Schemes

Source: Department of Heavy industries, JMK Research and analytics, India
FAME-II also requires that at least 2 chargers of ~100kW each on every PCS (public charging stations) which, in face of low EVs on road, creates a substantial burden on PCS/EVSEs and thus makes it non-feasible, especially in non-metropolitan areas as it may lead to substantial power consumption in such areas. However, strong government thrust for EV transition, and its supporting infrastructure, as well as state policies in conjunction with central initiatives such as low GST rates, NEMMP and FAME schemes have encouraged the key stakeholders to drive market growth through regulatory mechanisms and industry initiatives. Hero Electronics has proposed to set up around 1,00,000 charging stations in India among others.

Chart 7: Planned Charging Stations/Charge Points

<table>
<thead>
<tr>
<th>Company</th>
<th>Number of Charge Points (Planned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hero Electric-Charzer</td>
<td>1,00,000</td>
</tr>
<tr>
<td>Kazam</td>
<td>1,00,000</td>
</tr>
<tr>
<td>Raft Motors</td>
<td>1,00,000</td>
</tr>
<tr>
<td>CHARGE+ ZONE</td>
<td>50,000</td>
</tr>
<tr>
<td>Omega Seiki-Charzer</td>
<td>20,000</td>
</tr>
<tr>
<td>IOCL</td>
<td>10,000</td>
</tr>
<tr>
<td>BPCL</td>
<td>7,000</td>
</tr>
<tr>
<td>HPCL</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Source: JMK research and analytics, India

ii) Battery

Another significant issue with EVs is the lifespan of batteries, and the aids provided by the government for replacement. Government schemes only provide aid for specific vehicles and only up to a certain period, after which the earlier lucrative buy becomes unaffordable. Without aid, the battery alone becomes expansive which needs to be replaced every 5-7 years, costing around 60-70% of total cost of vehicle. Batteries that have high density gives more power per atom, proving to be more cost-effective when compared with alternatives such as sodium-ion or aluminum air batteries. In April 2022, one of the world’s most energy dense batteries at 54MWh, developed by a Bengaluru-based battery startup – Pravaig, was acquired by a European renewable energy company, Eren Groupe, for its storage
applications. The developers of the battery have also informed that it takes just 30 minutes to fully charge a battery. This new acquisition by a European company is expected to give boost to domestic manufacturing of batteries as well as it is also anticipated to pave way for making EVs more economical, considering batteries usually account for 35-40 percent of the total cost. Further responding to the opportunity that India’s EV industry presents, many leading industry players like OLA Electric Mobility Pvt, Ather Energy, and Mahindra Electrics are rapidly growing their market presence. Moreover, certain states like Karnataka and Tamil Nadu are rolling out innovative and timely investor-friendly policies besides building necessary infrastructure. However, India’s EV sector is still in its nascent stage and maintenance or replacement of old batteries cost sufficiently high amount. The most commonly used Li-ion batteries in electric vehicles ordinarily last for 6-8 years, afterwards EV-user remains with no other choice than to buy a newer battery which costs nearly 3/4th of the whole vehicle cost.

iii) Chip Shortage and EV components

Naveen Munjal, MD of Hero Electric (E2W market segment), as well as Nagesh Basavanhalli, MD & group CEO of Greaves Cotton (Indian Engineering co.), while mentioning the hockey stick growth in EV sector also pointed out the significant shortage of chipset, especially for semiconductors, in India as well as rest of the world. Metals including lithium, cobalt, nickel, manganese, among others, are used in battery and other components of E-vehicles. However, due to lack of natural endowment, ecosystem and capital for such resources in India, it is highly dependent on imports from US, China, Taiwan and Korea, along with other MNCs, to fulfill the domestic demand of chipsets and other electrical components. In 2018-2019, India imported $1.23 billion worth of lithium batteries only. However, the worldwide shortage of chipset since 2019 has significantly affected the growth of EV sector in India, specifically E2W (electric two-wheeler) and E3W (electric three-wheeler) as the proportion of E4Win EV segment is still significantly low.
Though India has achieved significant expertise for designing of chipsets and technical services, however manufacturing of chips in the domestic economy is negligible. In order to reduce its reliance on China and other economies for manufacturing of microchips, GoI has announced a $10 billion incentive plan to attract the global chipmakers to manufacture microchips and semiconductors in India. However, India is still yet to see any significant growth in production of chipsets and the domestic economy is suffering from shortage of chips. Rating agency ICRA Ltd. (formerly Investment information and Credit Rating Agency) has estimated the loss of around 5,00,000 units in sales just on account of shortage of chips and semiconductors, which is expected be around Rs. 1,800-2,000 crores in lost sales opportunity. With seriously hindered supply chain and waiting period going as long as 12 months, the government needs to rejuvenate the policies and ecosystem to increase the investment and speed in developing and maintaining better supply chains for e-vehicles.

iv) Price and Demand factors for influencing E-vehicles

Due to high cost of battery and components used in EVs, a significant concern for households in India while taking decision for purchase of E-vehicles is the huge overall cost of the on-road price and maintenance of e-vehicles, especially in case of E4W (electric four-wheelers), as compared to ICEs. As per a report published in 2020, the average cost of buying electric car is around Rs.13-15 lakh as compared to an average of Rs. 6-8 Lakhs. Moreover, with the increase in size of the vehicle, the price bracket increases too. For Ex: a report published by Economic Times in 2021 suggests that while E2W will breakeven with the IC counterpart at approximately 15000 kms, however E4W needs approximately 1 lakh
kms to breakeven. This high upfront cost as well as low resale value of EVs compel Indian consumers to prefer a cheaper ICE vehicle. Thus, Government of India along with state governments has introduced several condition-based subsidies and incentives for purchase of EVs, however the common obscurity with most of the conditional subsidies are the time frame and number of vehicles, beyond which EVs becomes significantly expensive.

Chart 9: Impact of FAME-I and FAME-II subsidies on EVs prices

Source: Barkha Mathur April 2019, NDTV, India

v) Environmental Concerns

As India is ranked 5th world’s most polluted nation in 2019, with 6 of the world’s top 10 polluted cities located in India, the economy is looking for the ways to reduce pollution level. Increasing the consumption of EVs has always been observed as an apparent solution for sustainable growth. In a study conducted by Mishra, M., and Malhotra, G., in 2019 (before Covid-19) to understand e-vehicles purchase intentions, the authors concluded that environmental concerns and performance features of EVS are one of the important factors influencing Indian consumers’ behavior towards EVs. While metropolitan areas such as Delhi, Mumbai, Chennai, etc., are observing an increasing demand for EVs due to environmental concerns, however the major part of India where awareness and education about pollution and its remedies in the form EVs is limited to an extent. Thus, the government also needs to play a significant role in spreading the awareness about EVs and its effect on environment, along with reducing the cost of EVs. Furthermore, if the electricity consumed to charge EVs is generated through burning fossil fuels, then this may lead to net negative impact on environment depending upon the efficiency in production and distribution of electricity. Thus, government needs to play a significant role in estimating
the net impact of using EVs as well as doing investment in technological advancements to generate and distribute electricity and running pumps.

III. State Demographics:

EV sector is observing a fast and increasing adoption across India for the last couple of years, especially for E2Ws and E3Ws, which holds market share of around 90% of total EVs. In India, around 1,57,712 units of High speed E2W were sold whereas 1,46,336 units of L-3 category E3Ws were sold. High speed L-5 E3Ws were sold around 8,689 in 2021 which increased from 4,642 units in 2020.

In December 2021, Sh. Nitin Gadkari (Road, Transport and Highways Union minister) highlighted the list of top Indian states in EV sales. With central initiatives such as budgetary support of Rs. 10,000 crores, reduction in GST bracket from 12% to 5%, tax relaxation on ESEVs, etc., Uttar Pradesh, Maharashtra, Karnataka, Delhi, Bihar, have observed highest sales of EVs during the fy 2021. Out of total 8.7 lakh EVs registered in India in 2021, Uttar Pradesh has registered around 2,55,700 units, followed by Delhi at 1,25,347 units and Karnataka at 72,544 EVs. Bihar with 58,014 EVs and Maharashtra with 52,506 EVs have taken the fourth and fifth places respectively. Between the overall sale of EVs in India, share

![Chart 11: State Wise EV Sales Trend in 2021](source: Vahan Website, MoRTH, GoI, and Telangana regional transport data portal.)
of E2W, E3W and E4W have been 17%, 79%, 4% respectively during the year of 2021, with total sales of around 3.29 lakh sold EVs sold in India.

Chart 11: State Wise EV Sales Trend in 2021

Source: Vahan Website, MoRTH, GoI, and Telangana regional transport data portal.

Karnataka, Tamil Nadu, Maharashtra, Telangana and Rajasthan have registered highest sales of all high-speed E2Ws, with proportion of around 67% in 2021. Whereas Uttar Pradesh, Delhi, Bihar and Assam have sold highest L3 category E3Ws, with 75% of total sales, and Delhi, Karnataka, and Telangana have sold the highest number of high-speed L5 category E3Ws. On the other hand, Maharashtra have sold highest number of E4Ws in India in 2021, with a proportion of around 26% of total sales, followed by Delhi and Telangana each with proportion of around 13% vehicles sold. Maharashtra with proportion of 47% and Gujarat with proportion of around 18% have sold highest E-Bus in 2021.

IV. Aftermath/Conclusion:

In September 2021, OLA electric sold around Rs.1,100 crores worth of e-scooters in just two days, which roughly translates to around 85,000 units at an average cost of around Rs. 1.3 lakh per e-scooter. During fy 2019-2020, total EV sales stood at around 1,68,300 units. With Tata Motors and MG Motor India grabbing the top two position in 2020 and 2021 with a market share of around 85.37% and 11.49% respectively in 2020-2021 fiscal, India observed a tremendous growth in EV sector during recent periods. This was significantly helped by
government push to create ecosystem, attract investment and to boost demand. However, EV sector is still in nascent stage and the Indian economy needs to make a significant transition for the economy to move from ICEs to EVs, which requires a lot of planning, research and development, as well as estimations for the net impact on environment. To achieve the goal of national fuel security and promotion of sales of hybrid and EVs, the government has launched several schemes such as FAME-I, FAME-II (2019-2022), National Electric Mobility Mission Plan (NEMMP), 2020, among others. However, empirical evidence considering the time-lag between implementation of government policies and their resulting definite impacts, as well as concerns related to EV purchase, economic response to new technologies, and financial conditions of people, among other factors, suggests that economic transformation towards EVs requires time and significant government intervention (K. Gujarathi et al). The Indian government focuses on EVs with an ambitious aim of substantially reducing ICE vehicles on India’s roads by 2030 as part of its climate change and net-zero carbon emission commitments as well as to reduce dependency on oil imports. India should focus on improving the energy-efficiency of EVs. To achieve this target, economy needs to adopt ways to mitigate significant issues such as shortage of microchips and semiconductors, charging time and range, battery and maintenance cost, resale value, environmental concerns etc., discussed earlier. Charging infrastructure needs to be adequately build to address range anxiety. It is also important to create eco-system in India for investment in manufacturing of semiconductors and other components that requires microchips. Indian economy also needs to increase reserves for lithium, cobalt and silicon. The advantage for India over the world is its strong emerging market, with increasing disposable income in the hands of more vibrant, risk-taking young generation. By 2026, the Indian automobile industry has the potential to raise up to $300 billion in annual revenue, generating additional employment by 65 million and contribute over 12% to the GDP. The government also needs to generate supply and demand by increasing proportion of government electric-buses on roads as well as offer economic incentives such as tax exemptions or subsidies etc., for private EV owners.

References


EV Monthly updates, *JMK research and analytics*, India