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ELECTRIC VEHICLES IN INDIA – A WAY FORWARD-CHALLENGES & OPPORTUNITIES

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ABSTRACT

The unprecedented growth in the number of vehicles is contributing significantly to Environmental Degradation & Climate Change. Indian Government is seeking solutions to address these issues by encouraging use of alternative fuels and battery operated electric vehicles besides setting up of stringent emission norms for automobiles. For Internal Combustion Vehicles (ICVs), BS VI emission norms are now slated to become mandatory from April 2020.

The Electric Vehicles (EV's) are now gaining the attention across India and Indian Government policies are now aimed at boosting penetration of EVs. Notwithstanding this, there are challenges which need to be addressed for the EV industry to flourish. The requirement of the vehicle buyer with respect to key factors such as Range in Km per Charge, the Charging Infrastructure, the Speed, the Comparable higher Costs of an EV and the life of the batteries are holding the potential EV buyer to opt for an EV instead of ICVs. The technological development two components namely EV Batteries and EV Charging Infrastructure is expected to lead to larger penetration of EVs which in turn would lead to higher production volumes of EVs, bringing the cost reductions for EVs. The Opportunities lies in the technological development of these factors which will not only address India's concern with huge imports of crude oil and balance of payments but also address the Environmental and Climate Change issues.

The role of Technology Driven Supply Chain in addressing these challenges is Critical. While the technological development of EVbattery is critical to address Range, Speed and Life issues, the technological development of EV chargers for fast and quick charging is critical to address the Charging Infrastructure issues. The paper discusses these Challenges and Opportunities, highlights the role of Technology Driven Supply Chain &attempt to project future scenario for EVs in India.

Keywords : Crude Oil Imports, Environment , Electric Vehicles, EV Battery& Charging Infrastructure , Technology Driven Supply Chain , Penetration of EVs

1. INTRODUCTION

The Indian auto industry is one of the largest in the world. The Table below depicts the Automobile sales trends in India over the last five years[1].

Table-1: Automobile Domestic Sales Trends in India (In Lakhs)

Category of Vehicles	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Passenger	26.65	25.03	26.01	27.89	30.47	32.87
Commercial	7.93	6.32	6.14	6.85	7.14	8.56
Three Wheelers	5.38	4.80	5.32	5.38	5.11	6.35
Two Wheelers	137.97	148.06	159.75	164.55	175.89	201.92
Grand Total	**177.93**	**184.23**	**197.24**	**204.68**	**218.62**	**249.72**

Source:http://www.siamindia.com

The growth story is not limited to last five years but has been the case ever since the 90's when India embarked upon the privatisation, liberalisation and globalisation path, breaking the shackles of protectionism and licences raj.The total registered vehicular population which stood at 213 Lakhs in year 1991 has now reached to whopping more than 2300 Lakhs. No wonder India currently imports 219.15 MT of Crude oil for USD 87.725 billion (INR 5.65 lakh crore).

The need for mobility is very large in India. Easier finance options, newer and more fuel-efficient models and rising incomes are helping the demand for vehicles. The massive government spending in rural programmes and large infrastructure projects is leading to a pick-up in volumes in smaller towns and villages.[2] In metros and in second order cities, the sales are also being aided by the lack of public transport and the convenience personalised transport provide for point to point travel. These growth trends would unquestionably continue to grow in coming years.

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As far as share of types of vehicles in the total registered vehicles is concerned, the share of 2 wheelers is dominant. Theshare of two wheelers in total registered motor vehicles in India as of 2016 stands at 73.5 % , followed by the combined share of cars, jeeps and taxis at 13.1 % , Buses at meagre ~ 0.9 % , Goods vehicles at 4.6 % with remaining 8.1 % accounted by other vehicles namely tractors, trailers, three wheelers (passenger)/Light Motor Vehicles (LMVs) and other miscellaneous vehicles[3].

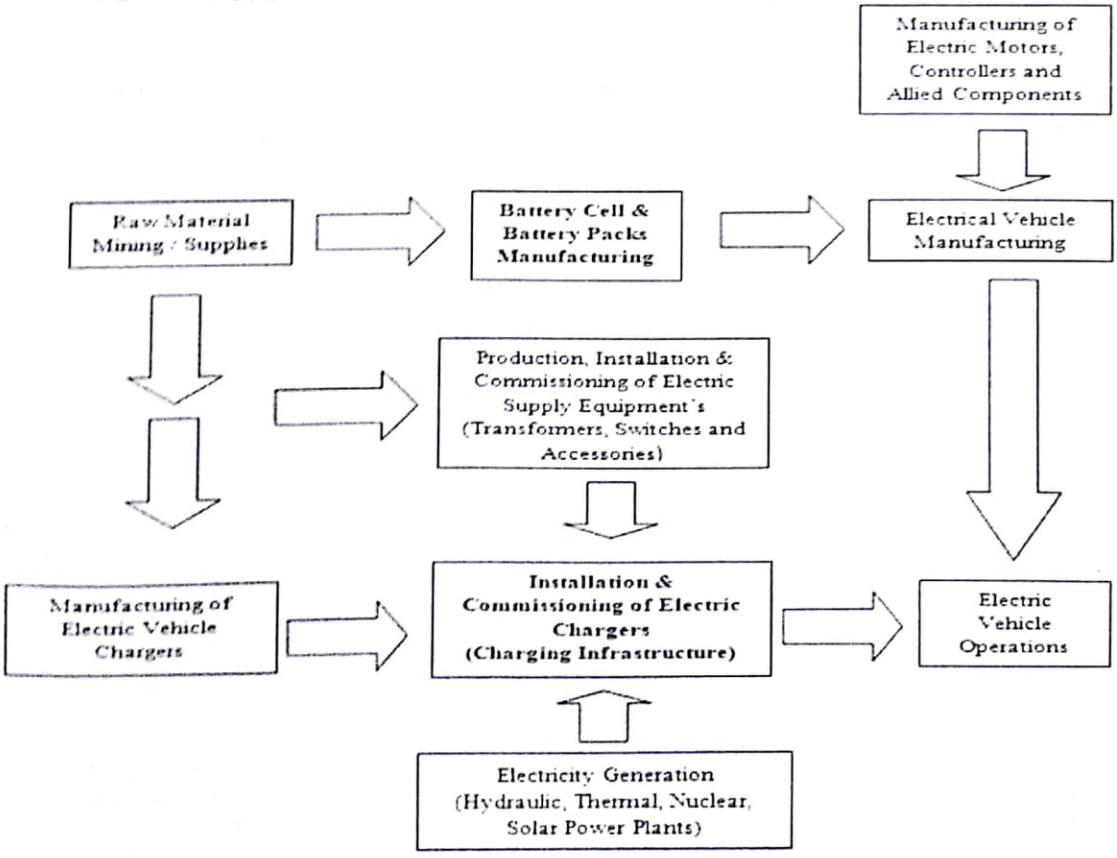
The unprecedented growth in the number of vehicles is raising certain serious issues about India's balance of payments and environmental degradation. Indian Government is seeking solutions in this regard by encouraging use of alternative fuels and battery operated electric vehicles and setting up of stringent emission norms for automobiles. BS VI norms are now slated to become mandatory for Internal Combustion engines from April 2020.

Current share of Electric Vehicles in total Vehicles in India is at less than 1 per cent[4]. This share is bound to increase with the encouraging policies of Government of India and State Governments. When compared with Conventional IC Engine Vehicles, Electrical Vehicles are primarily facing challenges with respect to two key critical factors. These two critical factors are EV Batteries and EV Charging Infrastructure. These challenges are also opening up Opportunities which will address these challenges to help larger and deeper penetration of EVs in India. The opportunity mainly lies in the sustainable technological development of supply chain for electrical vehicles particularly with respect to electrical vehicle batteries and electrical vehicle charging infrastructure as discussed below.

2. SUPPLY CHAIN FOR ELECTRICAL VEHICLES – CHALLENGES & OPPORTUNITIES

The typical supply chain for Electric Vehicles manufacturing and its operations is depicted in figure-1. The main challenges for making the above supply chain sustainable lies in Technology Development of two Critical factors in above supply Chain. These two Critical factors are EV Batteries and EV Charging Infrastructure. Development of Batteries is critical to address the key issues relating to Range in Km per Charge, the Speed, the charging duration, comparable higher capital costs of an EV and the life of the batteries. On the other hand development of the robust battery charging infrastructure backed up with robust information systems across homes , housing colonies , city roads, parking centers, malls , schools and colleges , offices , inter -city roads, State & National highways is critical for removing the range anxiety and charging duration issues .

Figure-1: supply chain for Electric Vehicles manufacturing and its operations



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The technological development of these two critical factors is expected to lead to larger penetration of EVs which in turn would lead to higher production volumes of EVs, bringing the cost reductions for EVs. The Opportunities lies in the technological development of these factors which will not only address India's concern with huge imports of crude oil and balance of payments but also address the Environmental and Climate Change issues.

3. WAY FORWARD

a) Way Forward for EV Batteries

The types of EV batteries currently being considered by Industry are predominantly Lithium Ion based Batteries. The most prominent technologies are Lithium ion–Phosphate (LFP), Lithium- Nickel- Cobalt - Aluminum (NCA), Lithium-Nickel- Manganese Cobalt (NMC), Lithium-Manganese-Spinal (LMO) and Lithium Titanate (LTO) Batteries.The six key parameters[5] around which the Technology Development of Batteries will evolve are **Safety**, **Life** (Number of Cycles & Age) , **Performance** (Peak Power , State of Charge {SOC} and Thermal Management), **Specific Energy**(Energy Stored per kg of weight), **Specific Power** (the power battery delivers per kg of mass) and **Cost**. Among all the six key parameters, the most critical parameter which would require elaborate attention with regard to range per charge is the Specific Energy. This factor limits the driving range of Electric Vehicle. This opens the significant opportunity for development of batteries with higher specific energy duly taking into consideration its trade off with remaining five parameters. This tradeoff is elaborated below.

NCA, NMC and LMO offer higher Specific Energy but are less safe than LFP and LTO and require more specific efficient cooling systems, SOC monitoring and cell discharge balancing. With respect to Specific Power, all battery technologies mentioned above perform equally except NCA, whose performance is still better among remaining four battery technologies. As regards, the Cost aspects while LFP, LMO and NMC are cheaper, the chemistries such as NCA and LTO are costlier. Although NCA, LTO and LFP are expected to have higher life span then NMC and LMO, it is yet not clear as to how fast these battery types will age across a range of temperature conditions.[6]

Currently the Lithium-ion Phosphate (LFP) batteries are predominantly used by Electric Vehicle Manufactures considering its advantages with respect to Safety, Life Span, Performance and Specific Power. However, considering the Specific Energy & Range issues, the remaining battery technologies, particularly NCA and NMC are expected to develop further as we move forward.

b) Way Forward for EV Charging Infrastructure:

A robust charging infrastructure is the key in encouraging the adoption of electric vehicles. In general, there is broad agreement that public charging infrastructure is important to the growth of the electric vehicle market, among other factors related to electrical vehicle cost and awareness[7]. Besides the electric vehicle, the availability of user friendly charging infrastructure is of utmost importance to make the supply chain for EV operation sustainable.

The types of charging are Level 1 charging, Level 2 charging and DC fast Charging. Level 1 Charging uses the same power supply and standard outlets available in the households using power cord and equipment that two wheelers and cars come with. This is a simple charging facility which can be made available in the household or business property parking by installing a dedicated electric outlet in the parking lot of the premises. The cost of installation for Level 1 Charging is low and has low impact on the grid. The disadvantage is that it provides slow charging. This kind of Charging is typically suitable for private 2 wheelers and cars for night charging (6-8 Hours charging).

Level 2 Charging requires installation of an Electric Vehicle Supply Equipment to enable faster charging. It is more efficient than Level 1 Charging and may provide charge of 80 kms within 2-3 hours. Level 2 charging have a higher impact on peak power than Level 1 Charging. This could be one of the best options for public charging infrastructure at Parking Spaces, Malls, Office Parking lots and Schools& Colleges.

DC Fast charging provides compatible vehicles with an 80 per cent charge in 20-30 minutes by converting high voltage AC power to DC power for direct storage in EV batteries. This provides a charge of 90 to 130 Km in 20 minutes. It is significantly more expensive than Level 1 or Level 2 equipment and will require a high voltage 3 phase power connection. It has higher impact on peak power than Level 2 Charging.

When it comes to Public EV charging facilities, the relevant benchmarks could be the Level 2 and DC fast charging, with Level 2 charging stations being established at Parking Spaces , Malls, Office Parking lots and Schools & Colleges and DC Fast Charging being established at dedicated battery charging stations besides city

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town and village roads, state highways , major district roads and national highways[7] on the lines of petrol & diesel dispensing stations.

The establishment of electrical vehicle charging infrastructure on the above lines is the Way Forward for making the EV penetration in India larger and deeper.

4. CONCLUSION

With the burgeoning vehicular population, it is critical and imperative for India to seek alternative propulsion means to curtail the import of crude oil and address the environmental degradation and climate change. The battery operated electrical vehicles offer solutions to address these two issues. There are challenges though.These challenges open up opportunities. These opportunities mainly lie in the Sustainable Technological Development of Electrical Vehicle Batteries and Electrical Vehicle Charging Infrastructure.

Currently the development of battery technologies such as Lithium-ion Phosphate (LFP), Lithium- Nickel-Cobalt –Aluminum (NCA), Lithium-Nickel- Manganese Cobalt (NMC) appears to be the Way Forward. The establishment of robust and penetrative infrastructure for Electric Vehicle Charging stations will also be key factor in making the technology driven supply chain for Electric Vehicles sustainable and a Way Forward.

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