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# Shifting Towards Electric Mobility

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**ABSTRACT:** Alternative solutions to decrease the impact of vehicles on the environment are the Electric Vehicles (EV's). Recent trends indicate that people's interest is increasing towards electric mobility. On the other hand, we also need to understand the impact of this technology on the environment as there would be a rapid increase in the amount of electricity needed. If we see in the context of India, certain central and state government policies are coming up to increase the adoption of Electric Vehicles over their petroleum counterpart. This paper talks about the various government policies and what is the cost analysis between a petroleum and electric vehicle and talks about long term monetary benefits after owning an EV. Besides, there are still certain constraints that need to be figured out. To name them, lower number of charging stations, higher on road price of EV's with respect to the petrol version etc. Analysis shows that there is decrease in operational cost for an EV and as the technology is growing every second, we are hopeful of a better future in the industry of EV's.

**KEYWORDS:** Electric Mobility, Electric Vehicles, EV, Shift

## I. INTRODUCTION

There has been a lot of talk and discussion regarding the importance of EVs and how the landscape should change especially the transportation landscape and we are aware of how EVs are useful in reducing pollution and greenhouse gases. Due to climatic change, advances in renewable energy, rapid urbanization, advancements in batteries, energy insecurities have led to establishment of a policy framework to increase the adoption of electrical vehicles. While every country has taken this into account, but their responses have varied significantly based upon the technological capabilities, economic developments, what is currently at the priority for the country and energy resources. In the context of India, we have few things in our favor which can lead to the desired goals. To name them we have an abundance of renewable energy sources that can be exploited, availability of skilled manpower and technology in the manufacturing and IT sector, consumers' willingness to transition and all of this are sufficient enough for India to have a systematic EV policy that can keep the pace with global scale. Larger and developed economies have already taken significant steps in this regard but there is not an iota of doubt that India's growth prospects are strong and significant enough to become a leader in this space and EV policies have a significant role to play in it. But it is surely not as simple as it sounds, the EV policy needs to be tailor made with the Indian context with respect to ownership of vehicles and the kind of vehicles that are there on roads in India. For instance, most of the advanced technologies available globally are in the premium category segment of 4-wheelers but that comprises only 2% of the total number of vehicles.

EV policies: The national government has sped up the introduction of electric vehicles by enacting several policies. Manufacturers have jumped in with a variety of devices, and start-ups are working on practical solutions for battery systems, charging networks, and other issues. However, the uptake of electric vehicles has been slow due to the high upfront cost and range anxiety. The government's position in accelerating the introduction, proliferation, and implementation of electric mobility is critical. In India's price-sensitive economy, the national policy should be based on electric (clean) kilometers driven versus electric vehicles purchased.

The value chain framework of EV pays attention to the multistakeholder aspects of EV policies, divided into three different value chains:

- Electric vehicles
- Charging infrastructure
- The surrounding network.

## II. PROBLEMS OF ELECTRIC MOBILITY IN INDIA

India has launched a variety of electric mobility initiatives and regulatory interventions to get on the global stage of sustainable growth, including a recent budgetary allotment of INR 10,000 crore (\$1.4 billion) to facilitate the rapid adoption and production of EVs around the country. India has a lot of potential for electric mobility. It would reduce emissions while also reducing dependence on imported fossil fuels. It would also encourage creativity in the manufacture of electric vehicles and their parts, as well as provide an economic boost by fostering entrepreneurship and specialized employment opportunities. The Indian automobile industry is one of the global Big Four – the others are China, the USA and Japan – in terms of the manufacture and sale of passenger and commercial vehicles. Due to its promising scale, EVs present India with the opportunity to change the global automobile and energy landscape.

In May 2017, India witnessed its first multimodal electric mobility project in Nagpur, in the state of Maharashtra. The electric fleet in Nagpur is a combination of e-rickshaws and e-cabs operated by the ride-hailing and rideshare platform Ola. As of January 2019,

- It had served more than 350,000 customers.
- Clocked more than 7.5 million clean kilometers.
- Saved more than 5.7 lakh liters of import-dependent fossil fuel
- Reduced CO2 emission by more than 1,230 tons since its inception.

This initiative along with new-age EV enterprises partnering to offer sustainable connectivity to public transit, as well as the introduction of e-buses by several state governments, are all measures geared towards increasing the clean kilometers travelled by India's vehicular fleet.

## III. ANALYSIS OF STATE EV POLICY

### III.I. DELHI

#### III.I.I. OBJECTIVES

- To improve Delhi's air quality by bring down emissions from transport industry.
- Goal to reach adoption percentage of Battery Electric Vehicle to ~25% of all new vehicle registrations by 2023.
- Ultimately the end goal is to create jobs in driving, financing, servicing and charging EVs in an eco-friendly way.
- By 2023, Delhi wants to see 50% of its public transportation be electric buses.

Delhi's policy mainly focuses on 3 aspects - Discouragement, Adoption, and Infrastructure value chain.

#### III.I.II. TO DISCOURAGE USE OF ICE VEHICLE

- An emissions surcharge, an air-quality parking surcharge, and a climate reimbursement charge for existing ICE vehicles as well as new ones
- Scrappage and deregistration discounts for a few ICE vehicle categories if an EV is purchased during the same fiscal year.

#### III.I.III. TO INCREASE ADOPTION OF EV VEHICLE

- Raising consumer understanding of the benefits of EV adoption and establishing customer trust.
- Collaboration with original equipment manufacturers (OEM), energy operators (EO), and battery-swapping operators to develop vocational courses (BSO)

- Based on their proportion in the market, 2Ws, 3Ws, public transportation (bus) and taxi fleets have been prioritized to benefit from government incentives.

#### III.I.IV. INFRASTRUCTURE VALUE CHAIN

- Enable dealers and charging facility providers to make long-term investments to establish enabling conditions for private and public charging infrastructure.
- The state will have public charging infrastructure at least every 3 kilometers.
- To make the system more end user-friendly the state is planning to provide real-time information on charging infrastructure.

### III.II. UTTAR PRADESH

#### III.II.I. OBJECTIVES

- Promote adoption to create green UP and Establish it as a favored location for attracting EV manufacturing investments.
- Create employment opportunities both on the supply and demand sides of EVs.
- Develop a strong and sustainable environment for battery management, from the production to the disposal stage.
- Target 2024: 2 lakh (200,000) charging (fast, slow and swapping) stations.
- Target 2030: 10 lakh (1 million) EVs on the road in all categories and 70% of public transport to be electric.

#### III.II.II. EV VALUE CHAIN

- For EV manufacturing units, various incentives are offered such as capital interest subsidy, infrastructure interest subsidy, exemption from stamp duty.
- For EV and battery production, reimbursement of up to 25% of the land cost at the current circle rate.
- Provide a subsidy of 50% on annual interest on loans taken in the form of reimbursement to set up waste treatment plants.

#### III.II.III. R&D

- Collaboration with universities and colleges to create electric vehicle testing centers with 24/7 power back-up which will be accessible to manufacturers and service providers.
- Collaboration with universities and engineering colleges to encourage research and development in the e-mobility space, with the aim of developing low-cost technology, smart vehicle design, battery technologies, and charging infrastructure.

#### III.II.IV. INFRASTRUCTURE VALUE CHAIN

- The government would allow developers to provide EV charging infrastructure in new apartments, high-rise towers, and technology parks.
- The state will assist PSUs in acquiring land to construct charging facilities on their premises.
- From manufacturing to disposal, UP intends to create a management environment for electric vehicle batteries. The state would allow electric vehicle producers to set up shop in the state.



### III.III. MAHARASHTRA

#### III.III.I. OBJECTIVES

- Develop Maharashtra as a leader in EV manufacturing and use of EVs.
- Create new employment opportunities.
- Promote export of EV, components, battery and charging equipment.
- Encourage R&D, innovation, and skill development in the EV sector.
- Establish a sustainable transport system.

#### III.III.II. EV VALUE CHAIN

- Introduction of an EV-based curriculum in technical and skill development boards, setting up of R&D centers, centers of excellence, etc.
- Incentives for micro, small and medium enterprises (MSMEs) and large manufacturing units
- Incentives for the purchase of e-buses and for electric 2Ws, 3Ws and 4Ws
- Exemption of EVs from road tax and registration fees

#### III.III.III. INFRASTRUCTURE VALUE CHAIN

- Legal provisions for charging points in residential and commercial properties
- Property rules to be modified to establish a robust public charging infrastructure.
- Fuel stations policies to be amended to set up charging points.
- 25% capital subsidy for commercial public charging stations

### IV. EV COST ANALYSIS

There is no denying to the fact that Electric Mobility is the future. People have certainly bought on to this value proposition of using cleaner fuels with low carbon emissions. Consistent increase in fuel prices were running a vehicle with a fuel tank full up to its capacity is becoming a dream to many has made people look positively towards adoption of EV. But in a developing country like India what matters is how many bucks will I have to spend? Now this is one thing that is not in favor of EVs where the initial buying cost for a 2-wheeler is significantly higher as compared to its gasoline counterpart. But the future looks promising and since the running costs of EV is declining the adoption of EV would soon look lucrative. Mentioned below is our analysis:

#### Comparing the running cost:

Particulars	Electric 2-wheelers	Petrol 2-wheelers
Vehicle price	Rs. 1,15,000	Rs. 83,893
Life	10 years	10 years
Amortised annual cost	Rs 11,500	Rs. 8,389
Annual electricity/fuel cost	Rs 2,127	Rs 12,483
Annual maintenance + insurance	Rs 3,000	Rs 4,300
Amortised annual battery cost	Rs 7,500	0
Total annual cost of operation	Rs 24,127	Rs 25,173
Total annual cost of operation (per KM)	Rs 3.4/Km	Rs 3.5/Km



Particulars	Mahindra E2o plus P4 (Electric 4-wheeler)	Maruti Ignis Zeta Petrol AMT (Petrol 4-wheeler)
Price	Rs 6.26 lakh	Rs 6.30 lakh
Mileage	0.12 unit/km	15 km/litre
Electricity/fuel cost	Rs 6.5 per unit	Rs 77 per litre
Electricity/fuel used per day (assuming 50km travel)	6 units	3.33 litre
Cost of running per day	Rs 39	Rs 254.1
Fuel expenditure per month (24 days working)	Rs 936	Rs 6098.4
Fuel cost in 5 years	Rs 56,160	Rs 3,65,904
Service cost per year	Rs 1500	Rs 8000
Service cost in 5 years	Rs 7500	Rs 40000
Battery replacement cost in 5 years	Rs 2,84,500	Rs 3000
Total running cost in 5 years	Rs 3,48,150	Rs 4,08,904

In the hindsight the upfront cost of owning an electric vehicle is higher but if we look at the total cost of ownership of the vehicles for an increased time duration the price comes at par with its petroleum counterparts. The main factors which need to be compared in this case are the petroleum cost for petroleum based vehicles and battery cost of electric vehicles, and we know that the price of petrol and diesel are rising with time while the price of batteries are coming down. Hence even though the immediate cost benefits are either not visible right now or are minor at best, they are an excellent long term product and will save money over time.

**Price Parity Comparison:**

- Two Wheelers: A price parity comparison between Ather 340 and Honda Activa 5G, showsthat after 6 years of operation total ownership cost would be at par
- Three Wheelers: The situation is much better here where a comparison made between Piaggio Ape Elektrik and Mahindra Alfa DX showed the breakeven point at around 2-2.5 years in tier 1 cities due to better infrastructure for a projected run of around 25000 km a year.
- Four Wheelers: A price parity comparison between Tata Nexon EV and Maruti Suzuki Swift Dzire shows that price parity of conventional and EV will come in the 7th or 8th year of purchase.
- Commercial Vehicles: A price parity comparison between Tata Starbus Ultra Electric and SML Isuzu S7 in the commercial vehicle category with an yearly run of 70,000km will approximately take 9 years to match the conventional vehicle currently available.

Source: Datalabs Inc 42 media

These figures mentioned above certainly do not look promising because breakeven point comes after a long period of time. So, what do we have then? Well, the situation is not that bad as it seems. R&D & Infrastructure development has a role to play here. With better batteries available and with the falling prices the breakeven point is set to lower low.

Since the fuel prices are also not looking to drop from here this will again make the break even point loosen up.

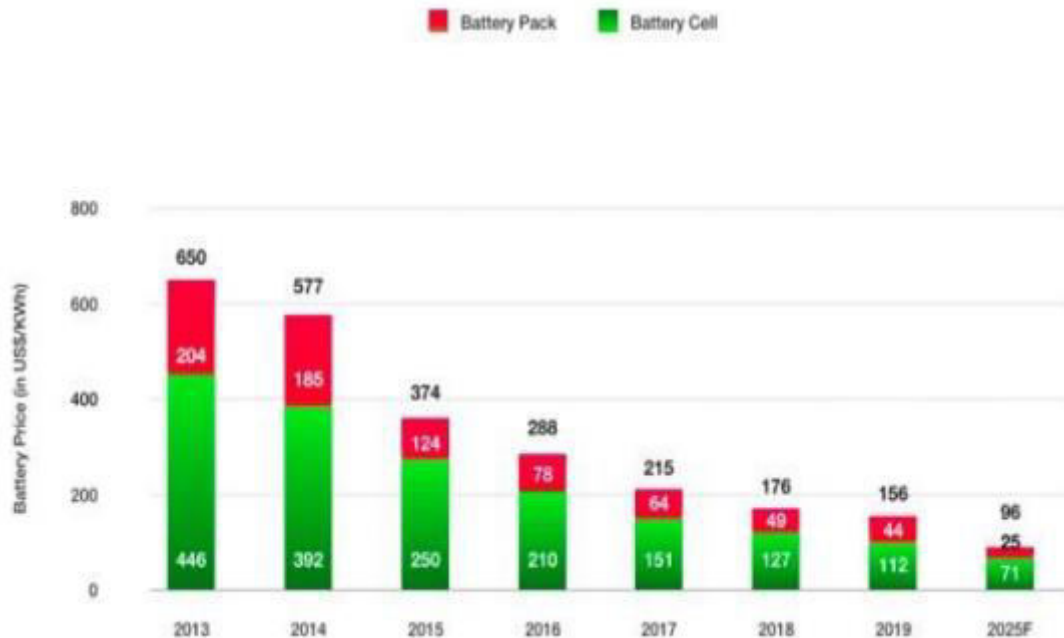


Figure 1 :Falling battery price over the years Battery price reduced by 21% from the period 2013-19

Source : Bloomberg NEF and Datalabs Analysis

After 2025 with the improved battery density and better charging infrastructure the penetration of EVs will see a rise.

## V. CONCLUSION

But the war is not won yet. Three factors responsible for less EV penetration in India of 0.12% in comparison to 3% in other countries is lack of these crucial factors:

- The initial capital cost required for purchase
- Lack of charging infrastructure
- Driving range anxiety
- Limited choice

Though the government has introduced various policy incentives and non-fiscal measures, numerous barriers highlighted above prevent widespread adoption of EVs.

While analysing the State policies based upon Value chain framework a lot of them have laid emphasis on production of EV value chain, becoming a manufacturing hub for EV and its components. Clearly the objective resonated well with the “Make in India” campaign that lays the foundation for boosting the manufacturing industry within the country. Another common factor identified in the policies was the production of clean fuel batteries, battery recycling, and storage. Well this is definitely a crucial juncture where the overall cost of batteries can come down if implemented well.

With the context of infrastructure value chain, the thought process is right to create a link between consumer demand and manufacturing supply. State policies have definitely considered one of the crucial factors like range anxiety (listed above) by providing for the installation of charging infrastructure. Fiscal and non fiscal initiatives are equally being carried forward like public awareness, skilling programs, pollution tax, payment facilities, etc.

Our economic analysis in the 4 wheeler category does show very fruitful outcomes where the operational cost of electric vehicles are significantly lower. The research has some different statistics to be shown where in the 2-wheeler and 4-wheeler category the break even point lies a bit ahead where the total cost of ownership becomes equal with

respect to petrol vehicles. However with battery costs coming down considerably, the future does look a lot more hopeful.

Even if we look at the global commercial EV market, there does not seem to be a default choice available for customers. As stated above in one of the examples above in the commercial EV segment that price parity comes after nine years of operation with an yearly run of 70,000 km. the 3-wheeler category has shown better outcomes where the price parity comes within 2 years in Tier-1 cities.

It is estimated that in India the penetration will be more in the light commercial vehicle space due to more EV being used by e-commerce players in their delivery fleet/logistics fleet.

## V. DISCUSSION

Since the operational cost of EV is significantly less in comparison to owning a conventional vehicle the only part left is the initial buying cost. Government's policy framework should include financial support to be given more weight to encourage consumers to purchase EV.

This also highlights an important point to consider while designing the policy framework for a country currently in the process of transitioning to electric mobility. Prioritising more cleaner kilometers in comparison to electric vehicles could also be a solution. As proven above where the total cost of ownership significantly comes down with higher usage vehicles. The government has definitely included these points in mind while designing the policy framework as discussed above but better implementation is always a checkpoint the government should look to target.

India's national and state policies and regulations prioritize the electrification of high-use vehicles. The Transformative Mobility Mission for India by NITI Aayog and the National Electric Mobility Mission Plan 2020 have laid down the principles and strategies for the transition to e-mobility. These are supported by policies such as the Faster Adoption and Manufacture of Electric Vehicles (FAME) and others. Overall, these policies outline strategies for demand creation, technology development, robust charging infrastructure and pilot projects.

In the vehicle value chain analysis and after going through state policies developed for Electric Mobility it is concluded that the focus is more downstream and limited on R&D. Though there has been some boost as listed above with some states but not a very clear path has yet been put forward. Creating a manufacturing base will help drive sustainable growth because manufacturing has already been put forward with a lot of focus. Similarly another missing element we feel is fiscal incentives for the production of charging infrastructure and the required services as part of value chain framework. Leading geographies have already put forward policies that legally mandate this and we can also see through it.

Lack of guaranteed domestic demand could be a barrier in the sustainability of manufacturing units, this has been addressed currently by mandating the automotive manufacturers about certain percentage of shares in the sales has to be from Electric Vehicles. This does not sound much convincing and more like transferring the responsibilities because ultimately if there is no infrastructure in place there will be lack of demand and this has to be taken care by the government

High usage vehicles could be the go to strategy initially as highlighted above and this can be implemented through taxi cab aggregators Uber, Olacabs to be done synchronously with the automakers

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