AL CONSULTING

INDIA DRIVING TOWARDS ELECTRIC MOBILITY

India: Driving towards electric mobility

In 1970s, the soaring oil prices resulting from the Arab oil embargo and a growing environmental movement resulted in several car manufacturers viewing electric vehicles ("**EVs**")and hybrid vehicles ("**hybrids**") as a better alternative to fuel-based automobiles. The decade saw General Motors and American Motor Company launch some of the earliest commercially available EVs and hybrids, and spurred the development of new technologies including improved batteries, motors, and other components. By the end of the 20th century, Japanese carmakers had successfully launched a few thousand EVs and hybrids such as Toyota's Prius and RAV4 EV, Honda's EV Plus and Nissan's Altra EV. India's venture in the EV segment started with the electricity driven Vikram SAFA 3-wheeler in 1996 followed by REVA -India's first electric 4-wheeer- launched in 2001. Unfortunately, the dearth of technical infrastructure, apprehensive customers and lack of intent from the Indian Government to push the clean mobility revolution led to a premature demise of India's nascent EV and hybrid industry. It is only recently that the Indian Government, while exploring cost effective and viable solutions to the problem of poor air quality and reduction of oil import bills, has provided a new lifeline to the EV and hybrid industry, majorly focusing on EVs. The Indian Government is looking to develop and deploy more EVs on road by 2030.NITI Aayog - India's policy think tank, forecasts India's EV sales penetration to reach 30% for private cars, 70% for commercial cars, 40% for buses and 80% for two and three-wheelers by 2030.[1]

EVs vs Hybrids

EVs come with rechargeable batteries, with the electricity stored in these batteries being their only source of power. Tata Nixon EV and Chevy Spark EV are examples of such EVs in India which run on electricity and have to be charged using external sources. On the other hand, standard hybrids are very much like conventional fuel-powered cars. The only difference is internal - hybrids can recharge their batteries while driving on engine power or by a process called regenerative braking. In such hybrids, the kinetic energy generated from braking is used to run a generator to recharge the on-board battery. Toyota Prius and Cambryare some standard hybrids that need not be externally charged. Some auto

[1] India's Electric Mobility Transformation: Progress to date and Future Opportunities

manufacturers are creating plug-in hybrids such as Audi A7, Maruti Suzuki Ciaz SHVS,that have more powerful batteries which can be recharged by “plugging in” the vehicle to a current source. This allows the vehicle to perform more like a true EV and less like a conventional car while also delivering exceptional fuel mileage.

In 2020, hybrids accounted for only 8% of the global car fleet. By 2030, they are expected to account for 41%, with EVs contributing 18%.[2] However, the emergence of EVs has resulted in tension between the two environment friendly vehicle technology. Experience from US and China shows acceleration in the shift toward EVs, at the cost of hybrids. General Motors and Volkswagen recently closed their hybrid efforts to focus their resources on the EV market only. Citing this, several EV enthusiasts have advocated that India should leap-frog over hybrids to directly focuson Evs. Presently India has preferred a graduated approach, with hybrids being considered a good interim solution before India switches over to only Evs.

Schemes and incentives to boost EV market in India

In 2012, the Indian Government launched the National Electric Mobility Mission Plan 2020, laying down a vision and roadmap for faster adoption of EVs and hybrids, and also promoting domestic manufacture. Subsequently, the Indian Government launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India' (“**FAME**”) scheme in 2015 to be implemented in two phases. Under phase I (“**FAME I**”), INR 8.95 billion was budgeted towards subsidies to generate demand, build infrastructure and technology platforms. Under phase II (“**FAME II**”), launched on 01 April 2019, INR 100 billion has been budgeted towards four key areas i.e. technology development, demand creation, pilot projects and charging infrastructure. FAME II, gives prominence to domestic manufacturing of EVs, batteries and other components, with special emphasis on incentives to reduce battery cost, which was missing in FAME I.

A key factor towards increased proliferation of EVs is consumer behaviour and the Indian Government has responded with incentives in order to attract consumers for EVs. In 2019, the Goods and Services Tax (“**GST**”) on EVs was slashed from 12% to 5%, while that on EV chargers was reduced from 18% to 5%. This will significantly influence consumer behaviour in favour of EVs as conventional vehicles (and hybrids) are charged higher GST at 28% rate and an additional cess up to 22%. Several States have exempted EV owners from paying road tax. Waiver of this compulsory tax, ranging from 4% to 10% of the vehicle cost, will bring down the acquisition cost of EVs. The Indian Government had also announced tax benefits for EV purchasers, and individuals who avail loans for purchasing EVs can now claim deduction of the interest paid by them, from their total taxable income. This is expected to provide an impetus to adoption of EVs in India. However, by allowing deduction only on interest paid on loans, the benefit has been restricted to individuals opting for a loan from financial institutions. India's electric mobility mission would have been better served by a tax benefit on EV procurement by any individual irrespective of the mode of finance.

[2] Driving into 2025: The Future of Electric Vehicles

Driving the battery charging infrastructure growth

A conventional car takes less than 5 minutes to be completely refuelled at a fuel station. In contrast, it takes an EV anywhere between three to four hours to get completely charged. Additionally, while India has over 69,000 fuel stations, only a few hundred EV charging stations have been made available. This lack of battery charging stations is a major roadblock to large scale EV adoption in India. To remedy this, the Indian Government legislated the 'Model building bye-laws for EV charging infrastructure, 2016' ("**EV bye-laws**"). The EV bye-laws lays down the framework to an affordable charging infrastructure and encourages preparedness of India's electricity distribution system to adopt for EV use. It specifies that a charging station should be present every 25 km along a highway and in every 3km x 3km grid in the cities. As the EV bye-laws have de-licensed public charging stations business for EVs, several companies like ABB, Acme Industries, Fortum India and cab-hailing giants Ola and Uber have shown interest in setting up charging stations. Additionally, under FAME II, an amount of INR 10 billion is earmarked for setting up over 2,500 charging stations in 62 cities across 24 states. In December 2019, Rajasthan Electronics & Instruments Ltd and Energy Efficiency Services Ltd. were awarded tenders for setting up bulk of these charging stations. By providing a 'basic minimum infrastructure', the Indian Government has succeeded in boosting confidence of EV consumers in an EV supportive charging infrastructure.

Additionally, several States have either proposed or adopted EV policies providing incentives to consumers, auto makers, battery manufacturers and charging/swapping infrastructure firms. The policies vary from state to state with Karnataka, Maharashtra and Telangana focusing on incentives for development of EV charging stations while Kerala, Bihar and Uttarakhand focusing largely on electrification of their public transport. However, this lack of consensus between individual state policies and their poor implementation has undermined Indian Government's objectives. For example, Pondicherry has restricted new registration of conventional 3-wheelers for plying on roads while electric 3-wheelers have been exempted from road tax and incentivised with easy availability of road permits. Lucknow, amongst the biggest 3-wheeler market in India, is yet to introduce electric 3-wheelers on a large scale in its public transport system. As policies will greatly influence the success of EV adoption, there is a need for a uniform and effective policy to build confidence of auto manufacturers.

Nevertheless, existing automakers have responded to the opportunity in this nascent sector. MG Motors and Jaguar Land Rover are installing charging points at their showrooms and workshops, as well as at private vehicle parking locations such as homes and offices. Panasonic plans to set up 100,000 charging stations across 25 major Indian cities by 2024. Also, private firms like Magenta Power are working on EV charging corridor on Mumbai - Pune highway besides other projects to usher an EV supportive infrastructure boom in India.

It should be noted that, unlike fuel stations, which have a single standardized nozzle for all types of vehicles, EV charging stations need different types of chargers for various types of vehicles. The EV bye-laws approve the following chargers:

- Bharat AC/DC-001 chargers: entry level slow chargers used by electric 2 and 3-wheelers;
- Type 2 AC chargers: moderately fast chargers. Used as private (home/office) chargers by EV owners especially in Europe, as they are also compatible with Combined Charging System ("**CCS**") plugs;
- CCS chargers: a versatile fast charger capable of being used at home-charging stations and also commercial charging stations. They are the standard chargers for European and US EVs; and
- Charge De Move ("**CHAdeMO**") chargers: Fast chargers which were initially almost exclusively used by Asian car makers such as Toyota, Nissan and Mitsubishi.

A standard charger would have enabled charging of any vehicle at any charging station across the country. While the Indian Government has understandably, in an attempt to attract investment from all international EV makers, pushed to include all charging models in its charging stations network, this lack of standardisation is a big infrastructural challenge for setting up multiple charging kiosk at EV charging stations. In the long run, a single uniform standard charger would be the key to mass scale adoption of EVs by the public.

Battery Swapping – alternative to battery charging

Tesla and Porsche recently deployed 250-Kw public charging stations in Germany and Europe which are capable of completely charging an EV battery within 45 minutes. However, this is still a lot longer than getting completely refuelled at a fuel station. Also, the super-fast charging options is only available for a handful of new, high-end EVs. Given the price sensitivity of the Indian consumer, large scale EV adoption will be contingent on affordable EV batteries that can be charged even faster. A substitute to this is battery swapping. A battery swapping station can easily pack in multiple replacement batteries effectively working as a battery bunker. As compared to a charging station, a significantly higher number of vehicles can be effectively "charged" at a swapping station in the same time. Also, as batteries for 2 or 3 wheelers are in the 7-15 kg range, less physical space is required for storing and swapping them, making battery swapping convenient. Revolt Intellicorp, which recently launched its electric bikes in India, has dedicated dealerships for swapping of batteries.

On 12 August 2020, the Ministry of Road Transport and Highways ("**MoRTH**") issued directions to all States and Union Territories to permit the sale and registration of EVs without batteries. As the battery pack accounts for 30-40% of an EV's cost, this move should help lower the upfront cost of EVs, making them more affordable. MoRTH is hopeful that this will boost the uptake of EVs and also help the niche battery swapping market to expand into a much bigger industry It is worth mentioning that electric 2 and 3-wheeler manufacturerslike Ather Energy are already experimenting with models where the vehicle cost does not include the battery. Customers pay for the battery based on the number of kilometres they run the vehicle, or on a monthly subscription basis or simply lease it.

Unfortunately, though battery swapping has been a part of most state EV policies, it hasn't received the same importance as battery charging. Influenced by the Society of Indian Automobile manufacturers' ("**SIAM**") recommendation on EVs,[3] Karnataka, Madhya Pradesh, Kerala and Maharashtra drafted policies which limited swappable batteries for public transport - electric 3-wheelers and buses only. Even the EV bye-laws pushed for a battery charging infrastructure while making battery swapping optional. A big reason for this initial withdrawn approach towards battery swaps was the unsuccessful attempt of Tesla and Better Place in US and Israel, respectively. However, while these companies focused on battery swapping in electric 4-wheelers and failed, Gogoro, a Taiwanese company that launched its battery swappable electric scooters in 2015, has succeeded and now expanded its operations to Japan, Germany, France and US. India can take Gogoro's success story as a model and focus on battery swappable electric 2 and 3-wheelers to initially develop a supportive battery swappable ecosystem. However, for large scale swapping adoption, interoperability of batteries between different manufacturers is important which can only be achieved by standardisation. It should be noted that Sun Mobility - a Bangalore start-up, has tied up with Indian Oil Corporation and created a standard battery swapping platform for all 3 wheelers. This venture has created its own smart batteries which can be adapted to different vehicles, effectively overcoming the problem of battery standardisation. Delhi government's sturdy push for battery swap infrastructure has enabled EV start-ups such as Zyppto set up around 20 battery swapping stations in Delhi – NCR, while ChargeUp is in process of creating 50 swapping hubs.

[3] SIAM: Adopting Pure Electric Vehicles: Key Policy Enablers

Adoption of battery swapping is also relevant as most states are pushing to achieve 100% electrification of their public transport rickshaws. Battery swapping will enable electric rickshaw drivers to reduce the dwell time for charging the batteries and thus be back on the road, looking for the next fare within minutes. Instantaneous charging of public transport vehicles which travel longer distance per day as compared to a personal vehicle, can propel EV penetration in the market. Therefore, state EV policies should consider an optimal infrastructure for swapping batteries with charging facilities as a back-up.

Localizing the EV and hybrid chain

Localising the EV and hybrid chain is critical for India's electric mobility transition as it would help savings on oil import, boost industrial growth and facilitate job creation. To achieve this, the EV policies of various states provide up to 15-20% capital subsidy on intermediate products used in EV manufacturing,100% stamp duty exemption, complete reimbursement of state GST, and other subsidies. To supplement their efforts, Indian Government has approved the 'National Mission on Transfor mative Mobility and Energy Storage' ("**Mission**"). The key highlight of the Mission is to set up a few large-scale, export-competitive, integrated batteries and cell-manufacturing giga factories i.e. huge battery manufacturing centre where lithium ion ("**Li-ion**") batteries - the building blocks of EV batteries - are crafted. Recently, NITI Aayog proposed incentives worth INR 300 billion for setting up at least 4 giga factories by 2030.[4] This includes initial capital assistance and infrastructure incentives worth INR 9 billion in 2021, which can be escalated annually. Amara Raja Batteries Ltd., which is India's second-biggest traditional battery maker, is in talks to build a Li-ion assembly plant in Andhra Pradesh while Suzuki Motor Corp. along with Toshiba Corp. and Denso Corp. are setting up India's first Li-ion battery manufacturing plant in Gujarat. On the technology front, Indian EV manufacturers are being ably supported by EV technology leader Japan In July 2019. Japan's largest conglomerate Mitsui Group, partnered with Indian electric 3-wheeler start-up SmartE for pushing forward the growth of EVs in India. The Indian Institute of Technology, Hyderabad has collaborated with Japan-based its EV for developing superior Li-ion batteries, as compared to the existing batteries in India. The Japan International Cooperation Agency ("**JICA**") has also shown willingness to collaborate jointly with India's private sector to promote Japanese technologies for manufacture of zero emission EVs.[5]

However, India's ambitious 'self-reliant' EV industry plan faces a major hurdle – its lack of Lithium reserves. Lithium is the preferred choice of EV batteries as it is lighter yet has higher energy density than lead acid batteries or other rechargeable batteries; meaning it can store more energy compared to it alternatives. Li-ion batteries also have excellent performance and long battery life and have therefore become the choice of power source for most portable electronics, ranging from handheld mobiles to on road vehicles. China currently occupies a major share of the global Li-ion battery market due to its large natural reserves, forcing India to heavily rely on imports from China. To reduce this dependency, three Government-run companies, National Aluminium Co. Ltd., Hindustan Copper Ltd. and Mineral Exploration Corp. Ltd., have formed a joint venture called Khanij Bidesh India Ltd. to acquire lithium and cobalt mines, especially from Australia and South America.

[4] ET AUTO: India plans for $4 billion Tesla-scale battery storage plants, says report

[5] JICA Supports Creating New Lithium Ion Battery for High Temperature Areas to Promote Pollution free substitutes in India

It should be noted that most EV batteries typically have an 8-year life or a 160,000 km drive limit. However, the EV battery pack life can be impacted by the operating temperature of the battery packs. A temperature range of 15-35 degrees celsius is considered optimal; with lower temperature translating to power fade and low driving ranges, while higher temperature accelerates battery degradation.[6] Therefore, India with its hot climate would require sufficiently larger batteries with significantly excess power as against comparatively colder countries. Presently, EV manufacturers employ liquid gels as in Volt EV, or air ventilation as in Prius for thermal control of batteries. While India eyes to kick start its domestic EV manufacturing industry, R&D in battery technology should also be promoted to reduce India's technological dependence.

Cost parity and technological advancement

Over the last decade, improvement in battery technology and decline in battery packs cost have sustainably reduced the cost of acquiring EVs. A further decrease in prices would definitely result in EVs becoming cost competitive to conventional vehicles. However, as the price of Li-ion batteries nears the cost of its raw materials, any further price decline is expected to be slow and limited. As things stand, EVs may not be able to achieve cost parity with conventional vehicles and the higher upfront price of the EV will play on the mind of the cost conscious Indian customers. Therefore, the Indian Government must focus on creating customer awareness in order to build interest in EVs. Emphasis must be on explaining social and long term benefits of EVs while also addressing public anxiety on the twin issues of EV charging and range. Needless to say, this goes hand in hand with development of supportive infrastructure.

Avendus recently studied the total cost of ownership of vehicles across various segments for a 5-year period taking into account maintenance cost, salvage value, new battery cost, if needed, and inflation. The research concludes that the total cost of ownership of electric 2-wheelers and 3-wheelers is lower than that of their conventional counterparts, while that of electric 4-wheelers is comparable to that of a conventional 4-wheeler.[7]

[6] National Renewable Energy laboratory: Electric Vehicle Battery Thermal Issues and Thermal Management Techniques

[7] Electric Vehicle: Charging towards a better future

The rising fuel cost and the decreasing electricity tariff could help EVs achieve near parity on a first-cost basis with conventional vehicles while charging convenience, savings on fuel and maintenance expenses, tax and other incentives will help consumers look at EVs more favourably.

Our thoughts

India's recent EV push is part of its clean energy future frame work, which is in harmony with its obligation under the Paris climate agreement. As EVs are only as green as their energy sources, India's electricity grid will have get cleaner too, with higher dependence on renewable energy and less on polluting thermal plants. India has already taken appropriate measures in this direction by substantially increasing its renewable energy installed capacity. If India's 2030 EV targets are achieved, EV's load on India's power grid will also have to be factored in the National Electricity Policy and the tariff slabs. India needs to make its power grid more adaptable while also framing a practical plan to meet the increased energy demands while mitigating any fallout risk with regard to charging EVs.

India's giga factory plans will also need to factor in the high emission generally associated with Li-ion battery and Li-ion waste which can off-set any environmental gains of EV. In February 2020, Indian Government published the draft Battery Waste Management Rules, providing a blueprint of a cohesive set of rules tailor made for recycling and safe disposal of EV batteries. Speedy enactment and stringent enforcement of the Rules, coupled with establishment of large scale recycling plants is essential for gaining optimal benefits of pollution free EVs. Given India's lack of lithium reserves, the Indian Government should focus on urban mining - extraction of minerals from waste - as a possible alternative source for this rare mineral. It would also be prudent for India to focus on other components of the battery pack especially the battery management operation system, where India can leverage its software expertise. Considering that manufacturing Li-ion batteries is a capital-intensive endeavour, India needs a predictable ecosystem with a growing demand of EVs and a gradual phase out of fossil fuel based vehicles, before committing huge corpus for setting up ambitious giga factory. India may also consider employing the benefits of proven hybrids technology to bridge the gap between EVs and conventional vehicles.

Un doubt ably, India's EV ecosystem has gained pace thanks to push policies of the Indian Government, but the aspect of Indian customers willing to participate in the change is something that needs work. As India's population continues to grow and incomes rise, EV ownership is within the reach of millions additional consumers. A common framework is needed which pays equal attention to this multi sectoral and multi-stakeholder industry. Equal consideration should be given to EV manufacturers, developing supportive infrastructure, and customer awareness and service. Notwithstanding the battery charging and driving range challenges, in the near future EVs are going to define mobility.