Arthur D Little

Viewpoint

When will the electric vehicle dream in the Indian passenger vehicle market become a reality?

Insight on the inflection point

Ever since the Government of India made public its intention to electrify all new vehicles by 2030, a sudden wave of excitement has gripped the global automotive industry. Several global and local OEMs in India have begun work on their respective India electric vehicle (EV) strategies. Arthur D. Little has interacted with various stakeholders, such as OEMs, government entities and EV ecosystem players, to understand their perspectives. After having analyzed this insight, we believe 2020 could be the watershed year for the EV revolution in the passenger vehicle (PV) segment in India. Progressive efforts in charging infrastructure and localized battery production could reap dividends, encouraging OEMs to launch EVs for Indian consumers. For India to make the EV dream a reality, it is important that enablers such as the charging infrastructure network, localized battery and product availability move in tandem, given their complementary nature. While the government and the other players in the ecosystem are making the appropriate moves in battery and charging infrastructure, we hope OEMs will also begin to think beyond institutional customers such as government entities and fleet operators, and focus on the needs of retail consumers in order to create sustained momentum and make the EV dream a reality.

Introduction

India has embarked on an ambitious plan for going all-electric by 2030. The International Energy Agency (IEA) has estimated that the ambitious target would mean selling 10 million EVs, a figure equivalent to more than five times the number of EVs globally today. While there are key drivers for EVs in India, the goal cannot be achieved without a thriving EV ecosystem such as charging infrastructure and the battery landscape. Arthur D. Little has investigated these enabling factors to conclude that the major take-off point for EV revolution in the Indian PV market will be around 2020.

Demand drivers for electric vehicles

Oil bill	India's current oil bill is pegged at 3 percent of GPD: Government of India plans to reduce its oil bill by 10 percent by 2022. Transportation sector is the largest contributor to the oil bill at 37 percent
Leveraging renewables	Current renewable share is 16 percent in the energy mix, whereas as per the Paris agreement, government plans to increase the renewable mix to 40 percent by 2030
Carbon emissions	India must reduce its carbon emission per unit of GDP by 33–35 percent from 2005 levels by 2030: share of transport in greenhouse gas emissions is 9 percent
Grid efficiency improvement	Government is targeting 15 percent reduction in transmission and distribution losses through smart grids, thereby making electricity cheaper

Source: Arthur D. Little

From a global perspective, India's targets are overly ambitious given the current charging density and existing market acceptability for EVs.

Comparative mapping of factors

Comparative factors					
Global EV market share	33%	28%	6%	<0.5%	5%
Regulatory targets	7 MN NEVs by 2025	No central-level target: targets adopted individually by state	50% market penetration for EVs by 2020	100% electric by 2030 *(proposed)*	2 MN EVs by 2020
Demand incentives	State and central governme nt subsidy of USD 7,500 and USD 6,700 (max level)	Tax credits for EVs worth USD 2500+ USD 417 per kwh for battery	USD 1,100 for small cars and USD 550 for mini vehicles, along with reduction in automobile tax	USD 2,000 by central government and additional USD 1,500–2,000 by state government	Exemption from registration tax bonus of USD12K on disposal of diesel vehicle
Charging infrastructure	210K	16K	40K	Only 230	15K

Source: Arthur D. Little

Charging infrastructure in India is clearly lacking, but even local battery production is a key enabler, as 40–50 percent of an EV's cost is dependent upon the battery. From the standpoint

of government incentives, India needs to take some major steps beyond a mere "subsidy" program. We expect some of these announcements to be made in the short term. As a late entrant to the EV revolution, India has the benefit of hindsight to design a robust policy framework and environment. We expect consensus to be attained across these incentives by the end of 2019. We also expect various state governments to make decisions immediately around dedicated EV car parking, lower or zero registration charges for EVs, and green number plates.

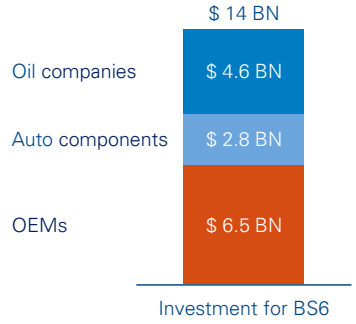
Incentives and policy intervention

Action and intervention					
R&D support, tax breaks, depreciation allowance for OEMs	×	×	×	×	
Declared EV sales goals or targets	×	×	×	×	×
EV production subsidy	×	×		×	×
EV purchase subsidy	×	×	×	×	×
Lowered tax implication for consumer	×		×		×
Discounted/free electric charging					×
Preferential lane and parking spaces		×			
Low carbon fuel incentive for electricity providers	×	×			
Publicly funded charging infrastructure		×	×		×
Home-charging equipment tax incentive		×			

Source: Arthur D. Little

Besides enablers such as charging infrastructure, battery production and government incentives, product availability is a key factor to boost demand. In this regard, most competitors in India do not have plans to launch EVs before 2020, given the increased pressure of meeting BS6 emission norms in ICE vehicles. As per industry estimates, OEMs have incurred expenses worth USD 6.5 BN to meet BS6 compliance. Clearly, ROI concern would be a limiting factor in launching quality EV products, as companies would not want EVs to cannibalize sales of ICEs.

Significance of BS6



Source: Society of Indian Automobile Manufacturers

Charging infrastructure: The immediate challenge

Currently, India has 200–250 charging stations, with the majority being slow chargers. Slow AC chargers typically give outputs of 3–5 kwh, taking five to eight hours to fully charge an EV. To make EVs a mainstream offering, more chargers, with a good share of fast chargers, are needed. **To achieve this, cost is the major issue.** Moreover, as Tier 1 cities will be early adopters for EVs, space for charging infrastructure is a constraint. While existing dealerships of OEMs can be a possible alternative, response from dealers has been **lukewarm**. Mechanics for the commercial models are a challenge, along with issues around revenue sharing, ownership, security and safety.

To address the challenges of charging infrastructure, India has already opted to go for a nationwide charging standard, an approach similar to the one followed in China. Opting for a single standard would reduce the overall cost, given the scale benefits. We expect future standards to be GB/T for DC charging and CCS for AC charging. In the interim period, India has developed its own Bharat charging standard; however, we do not expect this to be a permanent standard, given that it is not backed by international protocols.

Cost of EV chargers and subsequent deployment is a key challenge. The government has initiated work to localize manufacturing chargers in India that would result in cost savings of 40–50 percent. We anticipate that locally made chargers will happen around 2020, with the state of Maharashtra taking the lead in production and manufacturing of chargers.

For deployment, the government will be creating a public-private partnership (PPP) model, inviting major business houses and enterprises to deploy chargers on a commercial basis. To develop the framework of the PPP network, special initiatives have already been taken.

1. An amendment to the National Electricity Act 2003 that will allow private operators to sell electricity is expected to be completed by 2019.
2. Framing of the Intelligent Transportation Systems policy will be completed by the end of 2018.
3. A policy for accepting M-payment as standard for vehicle charging has started.
4. The government think tank, NITI Aayog, has plans to set up India's first smart mobility solution, called "Lighthouse City", a pilot to install 135 chargers in 55 locations.
5. Under the PPP, the government is expected to install chargers in 90 cities in a phased approach: the number of chargers will be set up based on a capacity of 10 vehicles per charger.

Local battery manufacturing a medium-term necessity

India's ambitious plan for EVs would not be feasible without addressing the issue of higher TCO. At present, EVs are 40 percent more expensive than ICEs from a TCO perspective, a gap that could be reduced by increasing vehicle range with the same battery or localizing battery production. For instance, local battery production can provide a price advantage to the tune of 25–40 percent. At present, since India lacks domestic cell-

manufacturing capacity, it has been importing LiB cells, mainly from China and the US. Low volumes and limited reserves of raw materials mean domestic manufacturing won't happen any time soon. At the core, there are three fundamental reasons for the absence of domestic production of LiB cells.

Firstly, a standard battery technology has yet to stabilize. Companies such as IBM and Tesla are working on different cell chemistries that may offer advantages over existing technologies.

Battery technologies

New technologies	
Lithium-air batteries	■ IBM has been working on lithium air batteries since 2012 ■ Advocates believe the technology can offer thousands of miles without a single charge ■ Technology is 7 years away from commercial use
Duel carbon batteries	■ Charge time for lithium ion batteries is an issue ■ Lithium batteries aren't particularly energy dense and lose power after repeated charges ■ Dual carbon technology substitutes lithium oxide terminals with plain carbon ■ Technology is 8 years away from commercial use
Graphene ultra capacitors	■ Tesla is pioneering this: no timeline is available ■ Charged plates are separated by resistors and utilized in lieu of batteries ■ Cells can be developed with massive capacities; however, discharge rate is an issue
Lithium imide batteries	■ Leyden Energy is pioneering this development ■ Lithium imide batteries are known to limit thermal expansion at high temperatures ■ Leyden has been making silicon-based anodes that facilitate greater energy density than carbon-based anodes
Super polymer lithium 2.0 batteries	■ Super polymer 2.0 is reputed to have improved fire resistance and can operate within wide temperature parameters
Solid-state electrolyte	■ Solid-state conductor that has the potential to become electrolyte is far more fire resistant ■ Different companies are working on identifying various classes of solid conductors; however, none have been fully established ■ Toyota is aiming to commercialize the first such chemistry by 2022

Source: Arthur D. Little

This would discourage companies from committing to a cell chemistry; moreover, battery manufacturing is a complex process requiring new capabilities and knowledge. Challenges around technical know-how and lack of a broad-based technology could deter OEMs from entering the segment.

Secondly, the fringe benefits associated with being technology agnostic are attractive. Relying on third-party vendors for cells and packs is convenient, as it allows OEMs to enjoy benefits such as volume discount, warranty, cost and lead time.

For instance, warranty is possible with LG and Samsung after a threshold volume, which, at present, is unfeasible for OEMs in India, given the low EV sales. However, pack vendors and aggregators can pass on the same benefits with lower volumes; hence, an outsourced battery is preferable. Similarly, pack aggregators are able to club the purchase requirement of various OEMs to negotiate more competitive prices from cell suppliers. Thirdly, cell- and pack-making require considerable investment in safety testing and compliance with regulatory norms, resulting in an increased burden in terms of transaction costs. OEMs would prefer to focus on developing attractive products rather than meeting regulatory norms. In India, regulatory norms with respect to battery manufacturing are evolving, causing regulatory burden. Besides this, limited local talent in areas of cell making and BMS reinforces the same point.

Benefits of in-house vs. outsourced for battery

Comparison: Bought vs. in-house	
Volume requirement for warranty	
X (bought out)	3X (in-house)
Landed cost	
X (bought out)	1.5X (in-house)
Lead time	
X (bought out)	2–3X (in-house)

Source: Arthur D. Little

As a result, OEMs active in the EV market in India mostly outsource battery packs. However, the government realizes the importance of localized battery production for accelerated adoption of EVs.

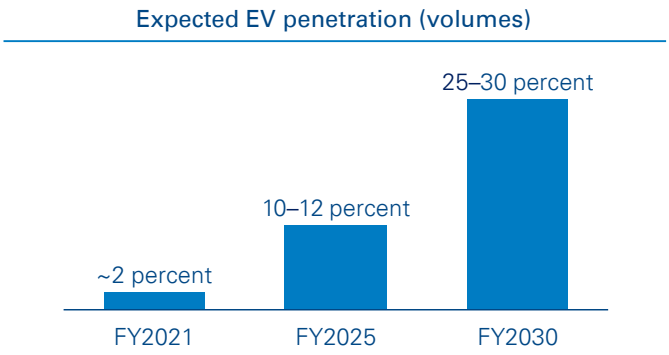
Public sector entity to spearhead localized battery production

We expect a nodal agency or public sector enterprise (PSU) to undertake the battery localization efforts. This nodal agency could tie up with two or three vendors in the category of cell making, with a view to introducing cell-manufacturing facilities in India after a certain threshold industry volume is achieved. Services offered by the enterprise would be open to all OEMs as a key commercial offering. The focus would be to increase the volume of EVs in India to leverage the learning rate effect in battery production. In fact, we also expect that the nodal agency may not restrict itself to batteries alone, but even enter the charging infrastructure and motor controller segments in 2019–2020.

2020: A tipping point – We estimate the penetration rate for EVs (in volume terms) in four wheelers in 2020 at 1.5–2 percent, 10–12 percent for 2025 and 25–30 percent for 2030. Fleet operators and government transport unions will drive the initial adoption. The draft of the recent national automotive policy is a credible indicator. Post 2020, as enablers related to charging infrastructure and battery production fall into place, we expect the penetration to be much higher. A key point worth noting is that while the penetration rate for 2030 is considerably high, there is strong reason to expect reduced overall sales in passenger vehicles, as the expansion of services of mobility providers (such as Ola and Uber) would deter individuals from purchasing personal vehicles. Based on our internal analysis, addition of one vehicle to a mobility provider fleet deters the retail sale of passenger vehicles by two. Several start-ups are also expected to launch EV products with disruptive pricing offerings that may contribute to an overall reduced market in

total volumes. Given this, the penetration rate could be as high as 35 percent, but with a reduced total market.

Indian EV market penetration (volumes)



Source: Arthur D. Little primary interviews

Conclusion

While the tipping point is 2020, a couple of years from now, OEMs serious about penetrating the Indian EV market must look at some immediate-action steps as part of their EV strategies. Such steps would enable OEMs to draw out robust market penetration strategies, while keeping in mind the Indian EV ecosystem.

1. Develop localized understanding of customer needs and preferences. Typical driving distances in India are much shorter than in the west, a factor that needs to be internalized at the product development stage.
2. A lower range requirement can be a lever to design batteries with lower kwh, resulting in reduced prices. Various pack aggregators are present in the Indian market; however, an assessment of their technical expertise and pricing needs to be done.
3. Entering into strategic partnerships with charging infrastructure players is important. Commercial sites can be leased from the respective local bodies and players, giving movers an early advantage. While OEMs present in India would offer such facilities through dealerships, for new or recent entrants, this is an important criterion. Various business models can be designed depending upon the ownership of charging equipment or the real estate.
4. Deploying chargers requires studying local traffic patterns and understanding the local grid preparedness, which calls for on-the-ground knowledge.
5. For high-end EVs, home-charging equipment is a differentiator, as customers of these products may prefer charging their EVs at home. Offering home-charging services is a value add that OEMs may consider for overcoming anxiety issues.

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