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E-MOBILITY IN INDIA – KEY SECTOR TRENDS

Authored by Cassius Castellino

The FAME II scheme of the Indian government has certainly given a big boost to the Indian electric mobility sector. There has been an exponential growth in this sector due to proactive government policies and measures. The government seeks to bring about a transformative change and a gradual adoption of electric vehicles by focusing on demand side incentives. The dynamic Indian mobility sector provides a range of opportunities for foreign ecosystem players both in the short as well as the long term. The government is actively seeking to increase knowledge and technological capacity of the transport sector and it won't stop till it meets its goals of making a zero-emission nation by 2030.

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Evolution of EV's in India

India mobility sector has primarily been driven by the growth of Internal Combustion Engine (ICE) vehicles. Added to this is the fact that India's consumer behaviour gets associated with social mobility and socio-economic factors. If you further include the ease of access to cheaper finances, increased purchasing power and rising aspirations in India, the trickledown effect is

- Rise in private mobility
- Increased production of 2 and 4 wheelers

Production and sales numbers for India (2018-19). Source: SIAM http://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=14			
	2 Wheelers	**4 Wheelers**	**Grand total**
Production	24,503,086	4,026,047	28529133
Sales	2,11,81,390	33,77,436	24558826
Total	**45684476**	**7403483**	**53087959**

Initiatives to promote EVs

The Government of India (GOI) has demonstrated a strong commitment to promote electric vehicles (EV') and has announced an ambitious plan to make India a Zero emission nation by 2030. GOI started on this ambitious undertaking with the creation of a policy framework. The National Electric Mobility Mission Plan (NEMMP) 2020 was unveiled in 2013 which put into motion the concerted efforts for sustainable mobility and electric cars. A scheme for the Faster Adoption and Manufacturing of (hybrid &) Electric Vehicles in India (FAME India) was announced under NEMMP in 2015.

The FAME scheme, when launched, was successful in increasing the sales of Hybrid and electric vehicles (EVs) from 0% in 2012 to 1.6% in 2016 (GOI's) aims to introduce 6–7 million electric /hybrid vehicles on the road by end of 2020). The scheme also provides tax breaks for Battery Electric

Vehicles (BEVs) (the Goods and Services Tax slab for ICE and hybrid vehicles is 28%, whereas for BEVs it is capped at 12%). The tax break will allow the government to procure around 10,000 BEVs for its own use. The Department of Heavy Industries (DHI) whose work entails promoting engineering industry involving machine tools, heavy electrical, industrial machinery and auto industry and administration of 29 operating Central Public Sector Enterprises (CPSEs) along with 4 autonomous organizations has sanctioned subsidies for 5595 e-buses under the Faster Adoption and Manufacturing of Electric & Hybrid Vehicles (FAME)-II scheme. This scheme is applicable across 64 cities and for the Delhi Metro Rail Corporation (DMRC).

The government showed its positive intent towards faster EV adoption when it announced in a report in May 2018, that India could save around USD 60 billion through EV adoption. The Department of Heavy Industries (DHI) invited an Expression of Interest (EOI) from cities having a population of more than a million, proposed smart cities, State/Union Territory (UT) capitals and special category states for deploying e-buses on an Operating Expenditure (OPEX) model in June 2019. Each bus procured under this EOI will receive a demand incentive from DHI up to 40% of the estimated cost of the bus subject to maximum incentive of INR 5.5 million for standard buses, INR 4.5 million for midi (mid-size) buses and INR 3.5 million for mini buses.

The cities were selected based on the recommendations of a screening committee which included representatives from National Institution for Transforming India (NITI) Aayog, Ministry of Road Transport and Highways (MORTH), DHI, Association of State Road Transport Undertakings (ASRTU) and The International Association of Public Transport (UITP) India, a worldwide network to bring together all public transport stakeholders and all sustainable transport modes.

Charging infrastructure is one of the key concern areas for EVs. Recently, the government announced that “the charging of e-vehicles would be a service and not sale of electricity. Thus, all those setting up charging stations would not require a licence”.

Region wise focus

On a nationwide scale, GOI has been ambitious. The government-backed Energy Efficiency Services Ltd (EESL) has issued tenders for 20,000 EVs to be deployed across the country for government use. With this the government aims an EV sales penetration of 30% for private cars, 70% for commercial cars, 40% for buses, and 80% for two- and three-wheelers by 2030.

Below are some key highlights for states having a comprehensive EV policy.

Andhra Pradesh

The Andhra Pradesh (AP) government seeks to procure investments of more than INR 30,000 Cr over the next five years with the potential to employ 60,000 people. It also aims to bring in manufacturing units of high-density energy storage of at least 10GWh capacity in the next five years to cater to both domestic as well as export market. The Andhra Pradesh State Road Transport Corporation (APSRTC) has a bus fleet of over 11,000 buses which will be converted into electric buses (BEVs/FCEVs) by 2029. The government has made claims that the first phase of 100% conversion of the bus fleet in top 4 cities will be done by 2024.

Delhi

Delhi's updated EV policy released in late 2019 aims to bring down emissions from the transport sector. The policy aims at pushing rapid adoption of battery electric vehicles (BEVs) with the goal of their constituting 25 percent of all new vehicle registrations by 2023. The government also plans to add 50 percent of e-buses to Public Transport (PT) by 2023. Another unique aspect of Delhi's EV policy is with regards to charging tariffs. It encourages DISCOM's to work with owners of residential and non-residential buildings to ensure adequate power supply infrastructure for the installation of these charging points. Additionally, the policy also promises that the state will have public charging infrastructure every 3 Km.

Karnataka

Karnataka was one of the first states to formulate an EV Policy in September 2017. The policy provides for incentives like interest-free loans on the net State Goods & Services Tax (SGST) for EV manufacturing enterprises. The state plans to attract investments of INR 310 billion and also create employment opportunities for 55,000 people. The government also seeks to make charging infrastructure as a commercially viable business venture that attracts private investment.

Telangana

India's newest state Telangana aims to attract investments worth USD 3 billion and create employment for 50,000 people by 2022 through EVs in charging infrastructure development, shared mobility and EV manufacturing activities. The state has prepared a clear roadmap for developing charging infrastructure in the state and provides incentives related to various components of

ownership cost of EVs. The government has set short term and long-term goals where it seeks to have 25% of its PT fleet electrified by 2022, 50% by 2025 and 100% by 2030.

Key players who drive EV adoption

1. Other equipment manufacturers (OEMs)
2. Charging station manufacturers and installers.

Other equipment manufacturers (OEMs)

OEMs have a role to play in driving the adoption of EVs based on their market offerings. Currently India's 2 biggest EV auto manufacturers are Mahindra & Mahindra and Tata Motors. The Indian EV industry is in its nascent stages with only two 4 wheeler manufacturers, around 10+ players in 2 wheelers and 3 - 4 OEMs in electric buses. Most other auto OEMs are now looking at introducing EV models in India. A major push towards EVs will be led based on the public transport requirements in India - fleet cars, e-buses, 3 wheelers and 2 wheelers. Personal vehicle options for EVs will be a relatively smaller slice in the whole pie. Mahindra & Mahindra and Tata Motors have also invested around INR 1,000 crore each towards transitioning their fleet to Bharat Stage (BS) – VI. A ban on ICEV sales or a dampening of ICEV sales due to EVs could impact the prospects of recouping these investments. So for the time being, the transition is expected to be relatively slow. However, industry experts indicate that around 40-45% EV conversion by 2030 can be a realistic expectation.

Charging station manufacturers and installers

The other major stakeholder for the faster adoption of EVs becomes charging station installers and manufacturers. EVs will proliferate as charging/swapping infrastructure is set up and conducive supporting policies are made. As per the directive of Niti Aayog, the think tank of the Indian government, India would recognize battery swapping and battery charging as addressing different

segments of vehicles and two equally valid options that industry may choose to use. Businesses that provide charging/swapping would be referred to as Energy Operators (EO).

To give a further push to clean mobility in Road Transport Sector, the Department of Heavy Industries has sanctioned 2636 charging stations in 62 cities across 24 States/UTs under FAME India (Faster Adoption and Manufacturing of Electric Vehicles in India) scheme phase II.

The following visual will illustrate the number of allocated EV charging stations across states:

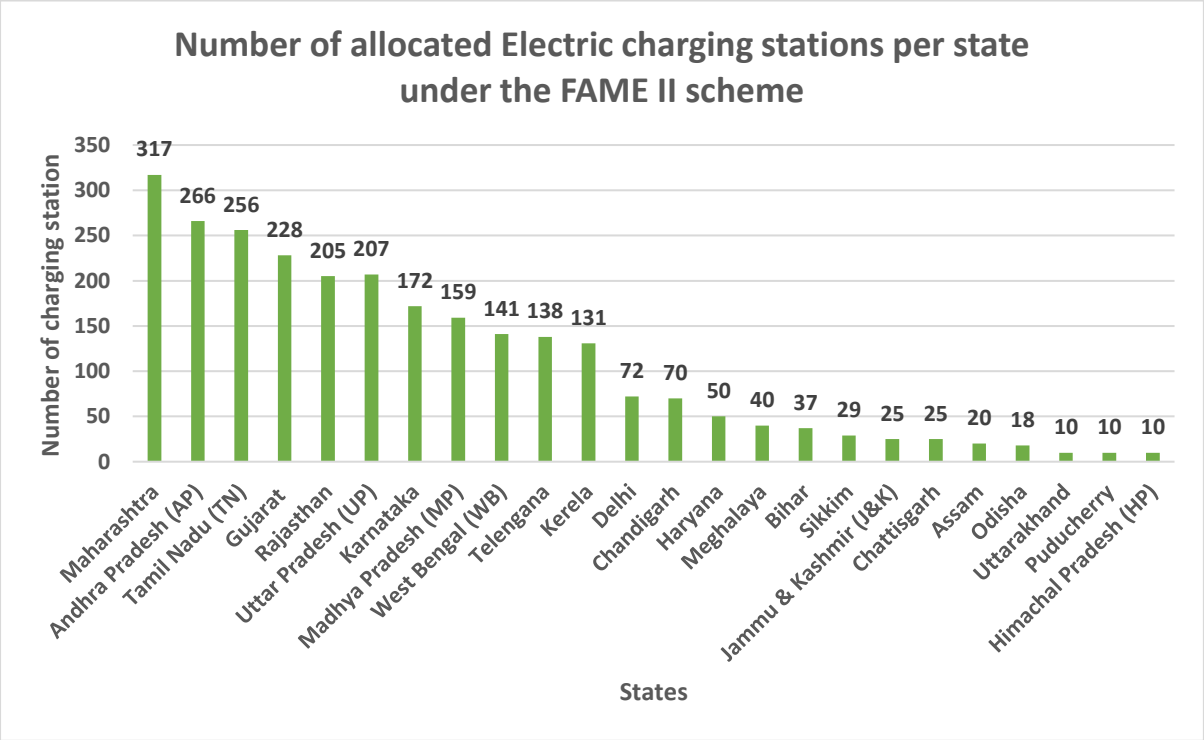

Figure 1 – Number of EV charging stations - https://www.businesstoday.in/sectors/auto/centre-sanctions-2636-ev-charging-stations-to-62-cities-prakash-javadekar/story/393123.html

Under the FAME II scheme, DHI had invited the EOI from 'million-plus' cities to avail of subsidies to set up charging stations. The DHI has thus far received about 106 proposals from Public/Private Entities for the deployment of about 7000 EV charging stations. The EOI under FAME II so far has sanctioned 2636 charging stations to 62 cities submitted by 19 public entities for 24 states. Of these 2636 charging stations, 1633 charging stations will be fast charging stations and 1003 will be slow charging stations. With this, about 14,000 charging stations will be installed across the selected cities. The EoI will be operated under the guidance of the Project Implementation and Sanctioning Committee (PISC) which is an inter-ministerial committee and headed by the heavy industries secretary.

To give an example, State-run Energy Efficiency Service Ltd (EESL), in collaboration with South Delhi Municipal Corporation (SDMC), on December 14, inaugurated the first electric vehicle public charging station in South Delhi. This charging station is the first one of the 75 charging stations the bodies are planning to install in Delhi. With this move, EESL and SDMC plans to boost the adoption of electric vehicles (EVs) in the national capital.

Challenges and opportunities of the EV sector

There are a number of barriers which exist for the stakeholders involved, especially the manufacturers. Below is an analysis of the various opportunities and gaps which exist in the current Indian EV ecosystem.

Automotive R&D worldwide is driven by increasingly stringent emission norms, improving safety standards, highly complex digital technologies, shortening product lifecycle, and emergence of connected and autonomous cars. With the auto R&D expected to undergo significant overhaul due to the continuous investment in new technologies, India may very well become the next global EV R&D hub with the continuously evolving policies and support through investments by the stakeholders. Let us look the challenges, opportunities and recommendations for the Indian e-mobility landscape:

Challenges	Opportunities	Recommendations
Lack of technical skills: Although the cost of hiring a researcher in India is only 20% of that of the US, finding technically skilled personnel requirement remains a challenge.	**New materials:** Advances in battery technology have been tremendous with 80 percent cost reduction between 2010 and 2017.	**Specialised centres** India needs more centers like the National Automotive Testing and R&D Infrastructure Project (NATRiP) centres in an effort to boost auto R&D in the country. Automotive companies use the NATRiP facilities not just for their product development, but also for pushing their global R&D capabilities.

Price sensitive market: According to research by Deloitte, Indian consumers are least inclined to pay a premium of INR 25,000 for alternative engine solutions and more towards infotainment, safety and autonomy.	**Platform sharing:** Companies are seeking out cost optimising methods by sharing their platforms. Global companies are not only looking to share platforms within the local companies, but local OEMs too are trying to share a platform with companies with whom they have a global association with.	**Flexibility in solutions:** Swappable batteries for 2 wheelers and slow charging solutions at home to alleviate range anxiety and bring down costs. In addition, leasing batteries and treating them as a separate component from the vehicle, can enable in having lower upfront costs and eventually a higher uptake of EVs.
Vehicular emissions High vehicular emissions are a major issue in India due to lacuna in norms, especially in the National Capital Region (NCR) in Delhi. PM 2.5 levels have gone up from 25.4 percent in 2010 to 41 percent in 2018 in the NCR region.	**Shared mobility:** Connected mobility and ride sharing has the potential to revolutionise the future of mobility in India. With the cab aggregators having grown in popularity, there is potential for electric vehicle fleets to be deployed to meet the growing demand and work towards the goal of achieving multimodal transport.	**Easing regulations:** Government policies such as the National Urban Transport Policy (2014) promote the concept of shared mobility, given its vision to move people and not vehicles. Such policies in combination with easing the access to these EV's will ease congestion and reduce CO2 emissions.
EV roadmap: No clear roadmap for EV deployment from the government and lack of policy implementation following announcement.	**Collaboration** Opportunities for manufacturers and policy makers to work in collaboration to take things forward.	**Incentives and economics:** A combination of mandates and incentives are required on both, the demand and supply sides and a strict timeline to come out with better EV products (strict guidelines) must be imposed on EV manufacturers.

Financial reluctance	Return on investment	Loans
Banks and microfinance institutes are reluctant to fund EVs due to their lack of confidence in the technology. There is also a clear lack of long-term investment in R&D of new technologies and products for EVs.	Microfinance institutes and banks stand a chance to make a substantial return on the resources invested in the EV ecosystem.	EV specific loans with lower interest rates are essential to meet this goal.

Some more observation about the EV ecosystem

- Jobs in ICEV manufacturing will continue to grow as many manufacturers continue to improve the efficiency of engines (Bharat Stage 6) for the next 20 to 30 years . However, hiring skilled manpower is a major barrier today as most companies are only training their employees in-house, leading to an information and resource gap.
- Mobility services and 'EV as a service' is likely to emerge as a market. Car refurbishing business will find sustenance as the life of the EVs are longer due to lower wear and tear and the fact that the drivetrain in an ICE vehicle contains 2,000+ moving parts typically, whereas an EV contains around 20.
- Digital technologies such as telematics for battery and vehicle diagnostics will develop further, which will help in improving their performance. Optimisation solutions such as these have the potential to spur the growth of business in the EV ecosystem as it continues to evolve.
- Engine retrofitting technologies for conventional ICEVs have potential to scale up. Industry and researchers who have interests in the field of battery cells, packs and materials can aid in the mobility transformation of India and gain access to the third largest automotive market in the world.
- The electric mobility landscape offers opportunities to companies who specialise in the 'second life' of batteries. There is potential revenue in supporting load balancing, time-of-day charging, energy banking and other uses after the usage of batteries in the automobiles. Since, disposing lithium ion batteries has high environmental costs, second use of batteries has a market in the Indian EV landscape, considering the scale of batteries which will reach their end-of-life cycles in the near future.

- Companies making smaller battery packs and offering battery swapping solutions have opportunities in India. By 2022, Sales of Electric 2 & 3 wheelers are expected to reach 1.6 million in India. In addition to these, treating batteries as a separate component of a vehicle is hindering the faster uptake of EV's due to the high upfront costs.
- Lastly, companies which are offering battery optimisation and management systems have the opportunity to tap into the large volume being offered by the Indian market and opportunities to collaborate with Indian OEMs. Companies which offer end-to-end solutions such as charging solutions, grid optimisation, battery management and digital payment solutions as per government norms and guidelines too have tremendous opportunities in India.

The OLA case

India's first multimodal electric mobility pilot by was done by Indian cab aggregator company, Ola, in the city of Nagpur. The pilot consisted of a fleet of 100 cars, 100 e-rickshaws and 2-3 buses. The Nagpur pilot helped bring to light the various crucial operational issues and lacuna with respect to running an EV fleet. The economics of operating the required charging infrastructure was one of the main concerns that came up. The limited availability of EV charging infrastructure led to longer waiting times for drivers, and a considerable share of their working hours was spent off-road for charging. While setting up more charging stations reduced the waiting time from 3–4 hours to 15–20 minutes, it significantly increased the costs for land lease rent (INR 23-28 per sq. feet), which was 31% of the overall OPEX, affected the overall economic viability of the project.

The high electricity tariffs coupled with limited fleet size led to underutilised charging infrastructure. The average utilisation was 40 percent for fast chargers and 5 percent for slow chargers respectively. The commercial electricity tariff of INR 17.7 per kWh made electricity expenses the second biggest contributor at over 30 percent of the total OPEX. Thus, the lessons learnt from the OLA experience was that battery swapping infrastructure needs to be considered and installed in parking zones, bus depots, metro stations and bus terminals. Since, EV users prefer faster charging, more faster charging options were needed. The need for faster charging was further seen due to the current vehicle range being around 100 km for passenger cars, while the desired range as seen with interviews was around 200 km. High ambient temperatures, in Nagpur, further reduced the range to 85-90 km per charge.

Another lesson learned was that a faster Homologation process for EV's is needed. This process needs to include performance-oriented test requirements as well as administrative guidelines. These guidelines need to address the approval type of vehicle systems, parts and equipment, the conformity of production capability to prove the reliability of the manufacturer to produce a line of products which will exactly match the approved specifications. The Nagpur pilot is a good example of a collaborative effort between the GOI and industry to facilitate the commercial deployment of EVs in India. The government should replicate this in other clusters to help develop the EV ecosystem

The Indian EV ecosystem and opportunities

One major area to be worked on in India as highlighted by the Ola case study is the charging ecosystem. To have the installed charging infrastructure working at full or near full capacity calls for a robust and resilient grid. A good grid calls for a dedicated transformer and transmission line and grid optimisation software solutions which can help predict fluctuations and power cuts to ensure that the gird does not collapse and continuous charging (fast and slow) is always on offer for EV users.

The opportunities for foreign players within the current EV ecosystem, based on the policy guidelines, are as follows:

- Aid India to quickly develop strong Research and Development (R&D) capacity leading to commercialization of the EV subsystems. GOI will has plans to give R&D grants through challenges and product-development for products that could commercialize within one to three years. Short-term R&D would enable the development of electric motor controllers, DC-DC converters, EV chargers, electric power-steering, electric power-brakes, electrical air-conditioners, vehicle control and management and communication protocols.
- All such R&D proposals would ab-initio figure out target volume costs of EV subsystems in India. Another area that will require R&D is in understanding the impact of large-scale charging on the electric grid.
- Last-Mile Connectivity (LMC) is another area where electric micro-mobility solutions can be offered to meet the demands for short-distance commute. The STAMP Challenge run by WRI India is a great example of a collaboration between different stakeholder, both public and private to address the LMC mobility gap.

Looking forward to positive policy applications

Under FAME II the government plans to deploy 10 lakh two-wheelers, 5 lakh three-wheelers, 55,000 four-wheelers and 7,000 buses by 2022. According to Rocky Mountain Institute (RMI), this equates to 3.8 billion vehicle kilometres over their lifetime. These are significant figures and the policy seeks to lay a comprehensive foundation for the e-mobility ecosystem and more importantly establish a supportive infrastructure for it to thrive. There are some market assumptions we can make to understand the uptake of EVs by 2030 if the policy objectives have a catalytic effect. India's fast EV acceleration is further driven by global market trends where research shows that EVs are the economical choice. To drive this catalysation, there needs to be active participation from the industry. The industry will have to channelize its resources to build an efficient supply chain by building a robust ecosystem and improving access to the charging ecosystem.

A level playing field, where healthy competition and co-operation co-exist, needs to be created. While the Make in India initiative encourages manufacturers to manufacture cells and assemble battery packs suited to local conditions such as factoring humidity and heat, it gives opportunities to Swiss companies who specialise in battery chemistries to collaborate with Indian OEMs by means of technology transfer and Research & Development. These collaborations can especially be sought-after to reduce, recycle and even nullify the use of materials for batteries which are not readily available in India. A way to do this would be to put the onus on carmakers responsible for recycling batteries. This is already being practiced in China and has led to the creation of a circular economic model where, post usage, a battery's carbon footprint can be minimised.

Business models for faster uptake of EV's

The EV industry will have to think out-of-the-box if it wants to ensure that the FAME II targets are met. Batteries account for 40 percent of the costs of the EV. In the year 2018-19, India imported $1.23 billion worth of lithium ion batteries. India currently lacks an authorised lithium battery recycling facility for used lithium-ion batteries generated from electric mobility. Adoption of new business models will give the opportunity to Swiss players, both in academia and industry, and provide for an entry into the Indian market in the following ways -

1. The Swiss academia can address the gap of grid maintenance once smart grids becomes a reality and come up with solutions which can address peak power demand and optimise power to prevent the grid from collapsing.

2. OEMs need to get into business collaborations with foreign entities having expertise so that India is not over-dependent on the global supply chain for EV technologies. Commercial vehicles across all spectrums – Public Transport to micro-mobility solutions will be first adopters and having a Joint Venture (JV) with foreign players will make it easier for Indian OEMs to manufacture locally. For context, Chennai-based Munoth Industries has set-up a Li-ion cell manufacturing unit with the help of Better Power Company, a China-based firm in Tirupati, Andhra Pradesh. With an investment of INR 799 crore, it is the first of its kind in the country and will generate employment for approximately 1,700 people. Under the first phase, targeted capacity is of 250 MW amounting to 2 million 3AH lithium batteries, with an expected increase of five times under phase two in 3 years. This will also bring down the total ownership cost of an EV.
3. The Federation of Indian Chambers of Commerce & Industry (FICCI) has suggested business models at three levels, namely:
   - ✓ Utility-scale business models
   - ✓ Consumer & Industry (C&I) model
   - ✓ Residential ESS business models

Utility scale business models

Merchant Model: Storage plant owners and operators can participate in competitive electricity market, thus, unlocking new revenue streams. The Independent Power Producer (IPP) often owning multiple generation power generation facilities can arrive at a power purchase agreement with a utility company or directly with other electricity end users, to provide services at specific times.

Utility Owned: Utilities can be at the forefront of the energy storage solutions to offset the cost of electrical Transmission and Distribution (T&D) upgrades which are required to meet growing electricity demand. Energy saving specialist (ESS) companies can help improve grid reliability by managing T&D congestion and improving T&D performance. This will enable utilities to increase the lifespan of infrastructure assets and not create additional infrastructure and increase in costs.

Capacity Contract: Capacity contracts would involve utilities to acquire services from companies based on an energy storage-as-a-service model that can offer reliable load increase or reduction, at a set location which typically faces lack of capacity in infrastructure.

Consumer & Industry (C&I) business model

Vendor/Third-Party Owned: The vendor/third-party owned model can include a wide range of agreements between vendors and their customers. The two leading third-party owned business models are power purchase and power efficiency agreements. In a power efficiency agreement, the customer can get a set power efficiency project implemented by the vendor through a contract. On a global scale, these models have allowed a growing number of customers to benefit from energy storage without incurring significant upfront expenses. China and USA are pioneers of this model where the Energy Saving Companies (ESCO's) grew by 11% to USD 16.8 billion and 8% to USD 28.6 billion in 2017.

Transactional Sale: The transactional sale business model is a more traditional sale of an ESS to end-use customers. This model can be popular among customers with more building systems that have a dedicated infrastructure for charging solutions.

Residential ESS business model

Full Utility Ownership and Control: The full utility ownership and control model will have no upfront cost, and customers will pay monthly fees for backup power. The utility will manage the ESS remotely, and the need of the grid will be prioritised over customer needs.

Full Customer Ownership and Control: In the full customer ownership and control model, the customer pays the full cost of the system with no utility control. The responsibility of managing the system onsite is given to a third party, and the software prioritises the needs of the customer over the grid.

Hybrid: The utility may control the system during certain periods, and priorities can vary based on the way the programming of the software is done. Upfront costs of the installed system will be shared between the customer and the utility.

Real world usability of the above business models:

The above-mentioned business models have application and relevance to drive the e-mobility sector. To build capacity for storage, Energy Saving Specialists (ESS) can get into an agreement with charging station manufacturers to create a grid management and storage system, and that way, create a comprehensive ecosystem between the Indian OEM charging station manufacturers and ESS.

Energy Saving Companies (ESCOs) will have a major role to play as India strives to step up its electric mobility drive. ESCOs along with the OEMs and charging station manufactures (with their innovative business models) will be responsible for a cumulative growth of EVs, energy savings and lesser CO2 emissions. For this, different permutations and combinations of the aforementioned business models will have to be tried and tested. These business models can be utilised and further worked upon by the Energy Efficiency Services Limited (EESL) – a Joint Venture (JV) of Public Sector Undertakings (PSU's) of the Ministry of Power and the Government of India. EESL is already using demand aggregation model for bulk EV procurement and the price is arrived upon through an International Competitive Bidding (ICB) process (public procurement process) to ensure that competition is created and competitive prices are ensured to drive the EV landscape.

EESL has already been a major enabler in India as it has also floated a tender to procure 750 air-conditioned four-wheeler electric sedan cars. Once the tenders are allocated to the manufacturer, they are responsible for the designing, manufacturing, supplying, and maintenance of the cars. The rationale of this bid was to:

- Create an uptake of EV's for government staff across offices in India. The goal is to replace 500,000 ICEVs with EVs over a 3-4 year period, which will lead to fuel savings of about 83.2 crore litres per year and 2.23 million tonnes of CO2 reduction.
- Encourage car manufacturers, charging infrastructure companies, fleet operators, service providers, and the industry to gain efficiencies of scale by driving down costs, create local manufacturing facilities and develop technical competencies for the long-term growth of the EV industry in India.

With EESLs progressive initiatives, it is seeking to create aggregational demand in the EV sector which will push the OEMs to invest in manufacturing capabilities. The OEMs, through innovative business models, can then get into collaborations with EESL, or they can collaborate directly with charging and energy service solutions. This is where Swiss innovation can be plugged in to enable in the creation of a robust EV ecosystem in India.

Plug-ins still required for India:

In conclusion, the trends and stakeholder table will provide a streamlined perspective of where the Indian EV ecosystem support and how foreign players can look at them as market opportunities:

Sector trends	Stakeholders	CH plug in
Smart charging solutions	Government, OEMs, utilities	Smart grid and optimisation solutions - opportunities for CH university spinoffs and startups
Requirement of fast chargers for public transport fleets	Government, OEMs, Public Transport Operators	Standardised fast chargers as per India standards, engine retrofitting solutions and top-up charging for public transport fleets
Growth in the rise of electric 2 and 3 wheelers	Intermediate Public Transport (IPT) operators, cab aggregators, micro-mobility solutions for Last Mile and individual vehicle owners	Battery swapping solution - charging stations for fleet operators, home AC charging solutions and smart plug-ins for optimising electric 2 and 3 wheelers and Battery Mangaement Systems (BMS)
Emergence of corporate electric 4W opertors and electric 2W bike rentals	Indian startups / SMEs, Indian corporates	Charging solutions at source (corporate parks), battery swapping solutions for 2W fleets and Battery Mangaement Systems (BMS)
Large scale deployment of public chargers by government	OEMs, utilities, Public sector companies, parking lot operators, Indian corporates	End to charging and optimisation solutions and grid management solutions to handle upsurge in power demand