

# **RIDING THE ELECTRIC VEHICLE WAVE IN INDIA**

JULY 2020



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## I. FOREWORD

In April 2018, we published the white paper titled “Electric Vehicles in India – Prospects and Challenges” in conjunction with IMC Chamber of Commerce. In the past 2 years, much water has flown under the bridge – the auto industry as a whole is in the throes of recession, a new FAME 2 policy has been rolled out, several OEMs have rolled out their EV offerings in the market and EV ride share start-ups have mushroomed across the country.

Globally too, the march of EVs go on undaunted. Range anxiety has reduced, newer and better models continue to be launched across geographies and the EV parc keeps on growing. Tesla has turbo-charged its way through a slew of new models, touched profitability, entered China and achieved a market capitalisation unseen in the auto industry. China continues to be the global leader in EV adoption, although EV sales have taken a hit with the removal of subsidies in July 2019. Reportedly the next push in China would be towards battery swapping, with standards, protocols and business models as the key focus areas. New technology continues to percolate, with Wireless Charging (Fortrum, Oslo), Solar Charging (Lightyear, Netherlands) and Super-Speed Charging (450 KW prototype of Porsche BMW) being the interesting ones.

In India, we have seen the launch of several models from Tata, M&M, MG Motors, and Hyundai in cars. However, more interesting developments have emerged in an India-centric opportunity – in 2 wheelers and in Delivery vans. Conventional 2W heavyweights Bajaj and TVS have signalled their intent to play in the EV space with the launch of their scooter models. Hero Electric continues to maintain its leadership in the E2W space with a successful fund raise. However, with competition from incumbents, this space will undergo significant changes in the next 2-3 years. Several start-ups have launched delivery EVs targeting the e-commerce space. New business models centred around EVs have also evolved in shared mobility (Blu Smart, Yulu, Bounce, Lithium Urban, ebikeGo etc.), Charging (Sun Mobility), Swapping (Sun Mobility, Lithion Power) and Recycling (Tata Chemicals). There are interesting start-ups working on more futuristic technology developments like Carbon ion (Gegadyne).

Policy changes have created short term hiccups but have paved the way for medium term value addition and accelerated domestic opportunities. FAME 2, the umbrella policy to accelerate the adoption of EV has changed the subsidy norms for E2W overnight – raising the minimum bar on range and speed and imposing domestic value addition. This collapsed the market for E2W in the short term (a 90%+ decline in subsidy-led E2W volumes in FY20) and pushed the industry regressively back to Lead Acid battery led products even as the switch to the superior Li-ion products had taken off in Q4 FY19. The lack of economies of scale in India and domestic manufacturing norms have resulted in a sharp increase in prices of E2W using locally assembled components and batteries. In fact, most OEMs have found meeting the requirements to be a challenge. However, pioneers like Hero Electric and others have innovated and launched products outside the subsidy basket and industry volumes have continued to grow.



In the medium term, the emphasis on domestic value addition will result in significant opportunities for manufacturing E2W components as India will emerge as the largest market for this product range with volumes exceeding 5 million. Given the specific needs of the Indian market, design and innovation centred around these market needs will emerge, which can be taken to similar global markets, opening up an international opportunity. On the back of this, ride share business models focused on last mile connectivity, will see huge growth, with allied charging infrastructure growth.

As OEMs strive to meet indigenization requirements, there are opportunities for global leaders in key components to enter India, either alone or in a JV. There are opportunities to invest in the ecosystem and infrastructure. There are also interesting start-ups in the EV space that may require funding for scale-up. Overall, India continues to make firm strides to grow rapidly in EV with the entry of incumbents reinforcing the maturity of the market. Crafting of policy to make local manufacturing a pre-requisite for subsidy will open up investment opportunities and accelerate India-specific design and innovation.





## II. EXECUTIVE SUMMARY

Driven by environmental concerns, technology developments and scale economics in batteries, and aided by subsidies, Electric Vehicles (EVs) are continuing their inevitable march to replace Internal Combustion Engine (ICE) vehicles worldwide.

In India, the adoption of EVs is driven by cost economics. Thus, the market is driven by 2 and 3 wheelers, often unregistered, and lead acid battery models. The Indian EV market is estimated at ~750,000 in FY19 almost exclusively of E3W and E2W. The E3W market in India evolved out of a necessity to provide cheap, last mile connectivity in many urban centres and before FY17 was not even 'recorded' or acknowledged as most of these vehicles are unregistered. Even today, while we have estimated the volumes in India, these are not considered in the global EV volumes – if accounted, India will have a ~8% share of global volumes, even higher than its share in ICE market!

There have been a number of key developments in 2019 which will shape the development of the EV industry in the coming years:

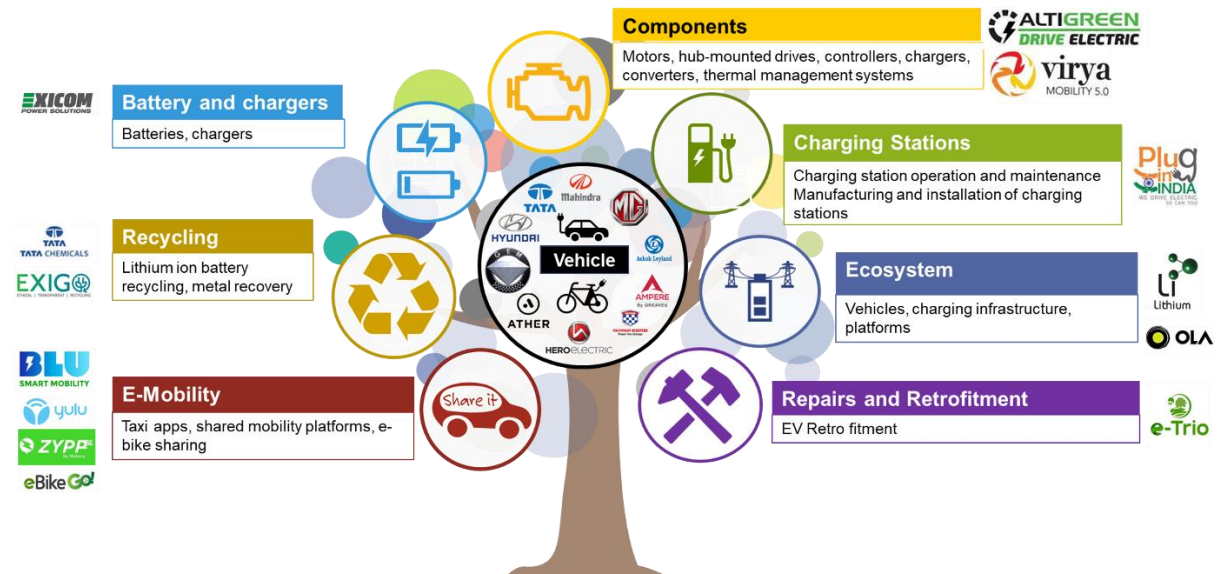
1. Launch of FAME 2 – a commitment to spend INR 10,000 cr. (USD 1.4 Bn) in the next 3 years to develop the EV industry in the long term
2. Launch of a number of E4W and E2W by incumbents
3. Upgradation of the E3W market
4. Component indigenization initiatives
5. Early developments in charging infrastructure
6. Birth of EV-focused ride hailing start-up
7. India-specific innovations

FAME 2, with its focus on higher specification vehicles before the market is quite ready for them, and localization requirements have caused short term pain for the fledgling industry. With the launch of FAME 2 compliant models, the Indian market will see the emergence of a new segment of customers who are switching to EVs driven by environmental considerations, in consonance with the international markets. However, the larger volume sales will be from segments which are driven by cheaper economics of EV vs ICE both in personal and in revenue generating applications across all vehicle categories.

India is also witnessing a large number of new models in the 2 and 4-wheeler segments, upgradation of 3-wheeler models, several initiatives in components, battery and charging ecosystem, ride sharing and myriad other innovations and experimentation in the EV space.

## The EV tree bears many fruits of opportunity in many branches

### EV: Innovation Map



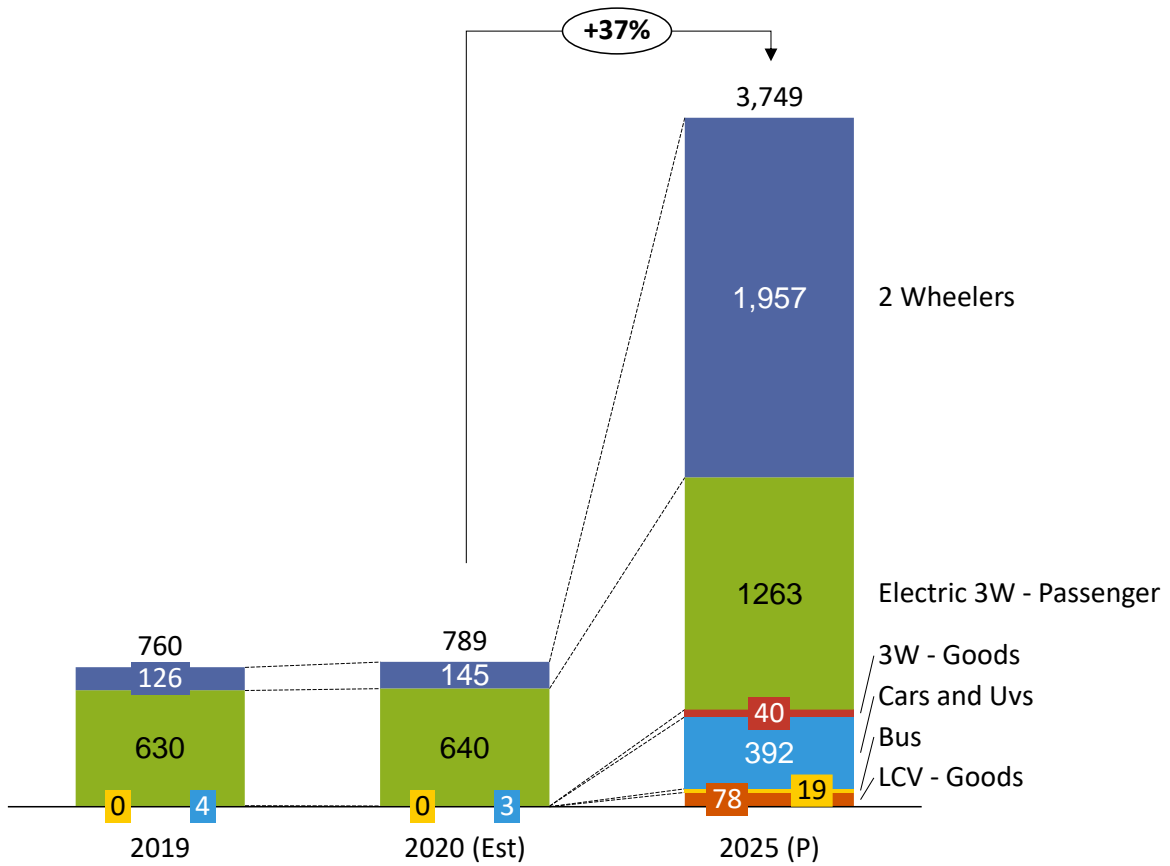
Source: Avalon Consulting Research and Analysis

Thus, the accelerated developments in 2019 have laid a foundation for the future growth of EVs in India. However, various statements made by Government representatives that India will completely switch over to EVs by 2030 and registration of E2W will be stopped by 2025 have been played down subsequently and remain unrealistic as we had indicated in our previous White Paper.

Our analysis leads us to **5 major conclusions** about the future of EV adoption in India.

1. *If both swapping and demand acceleration work as per plan, India may reach an EV sales volume of more than 3.5 Million vehicles in FY25, mainly driven by 2 and 3 wheelers.*
2. *There would be opportunities in various components as indigenization requirements coupled with growing volumes drive local manufacturing*
3. *There would be opportunities to create new business models in the ecosystem. Particularly, the first mover to establish a viable, scalable swapping business model can be a big winner*
4. *There would be opportunities to invest in some innovative companies who are designing efficient components or establishing innovative business models across charging / swapping / recycling / retro-fitment etc.*
5. *There could be consolidation in the Industry as existing OEMs seek to acquire / partner with innovators to leapfrog technology*

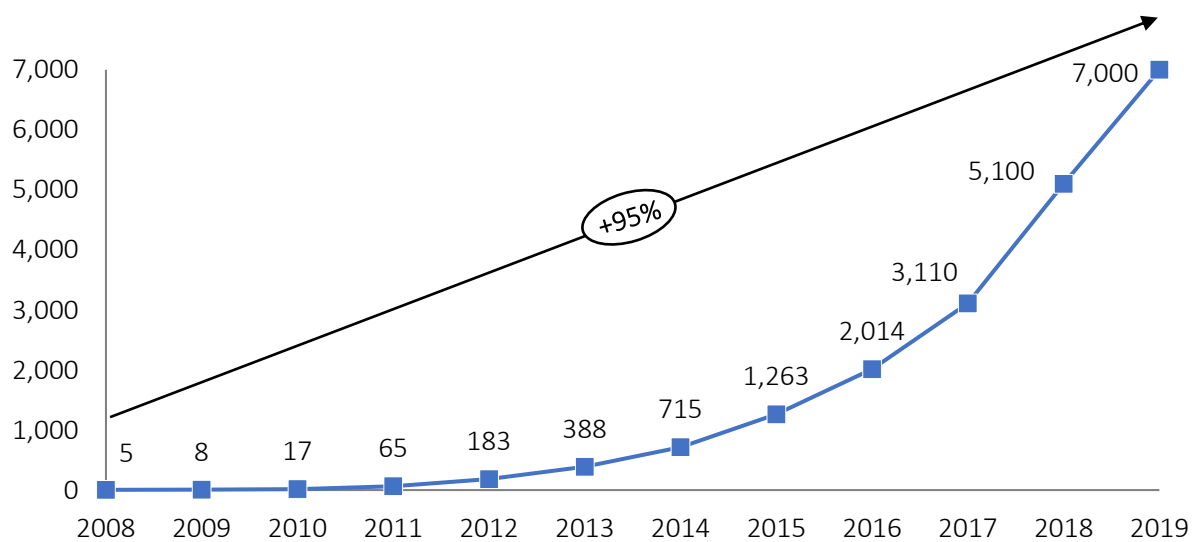
### Electric Vehicles Sale in India, Forecast by Segment ('000 #)



### III. ELECTRIC VEHICLES MARCH ON

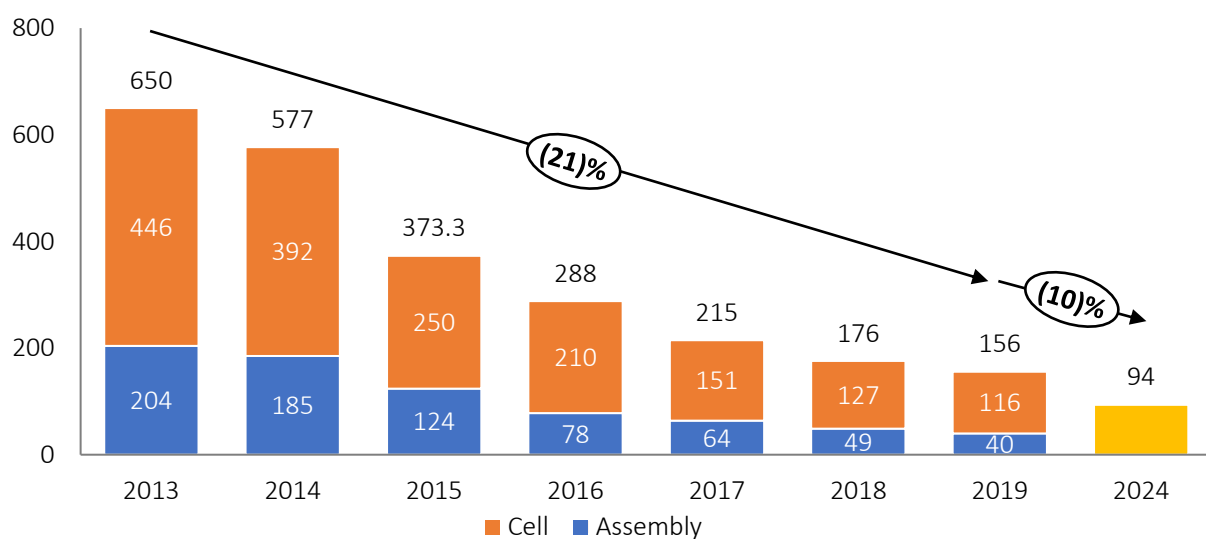
While the earliest adopters of EVs were only five thousand globally in the year 2008, the number of EVs on road has grown to over seven million in eleven years. Clearly, there must be significant drivers of a growth this steep. Environmental concerns around greenhouse gas (GHG) emissions have contributed to a societal acceptance of EVs. Worsening air quality and noise pollution across cities have turned the people’s attention to the need for eco-friendly solutions. This has further led countries around the world to consider phasing out Internal Combustion Engine (ICE) cars in the next decade, making way for EVs. Subsidies for EVs have also enabled this growth.

**Global Electric Car PARC**  
(‘000 #)



Source: IEA EV Outlook Report 2019, Avalon Consulting Research and Analysis  
Note: Includes Battery and Plug-in Hybrid Electric Vehicles

**Lithium Ion Battery Price Trends: Cell and Pack Split**  
(2018 USD / Kwh)

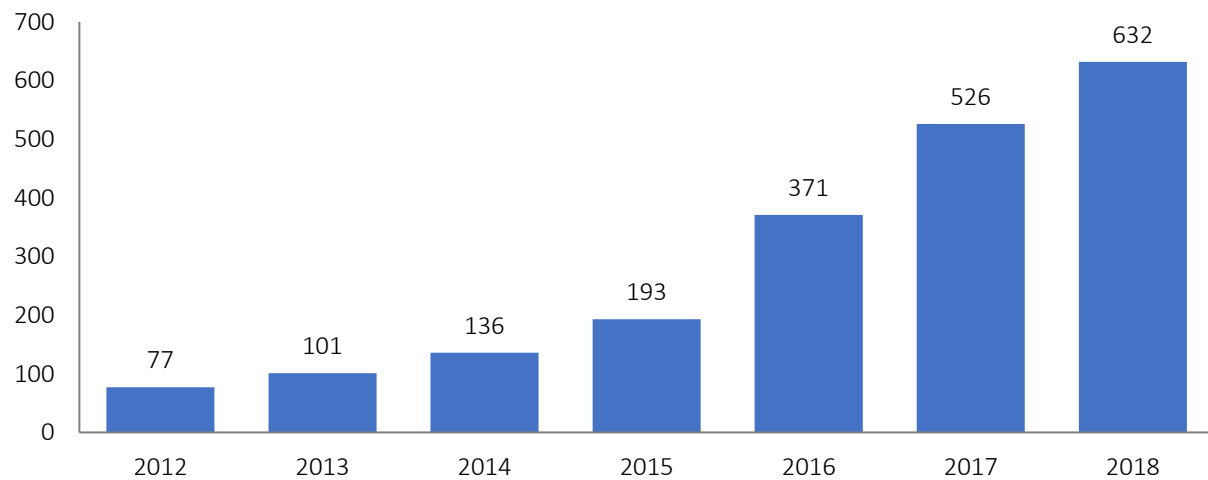


Source: Bloomberg NEF Report, Avalon Consulting Research and Analysis  
Note: Evidence of 18% reduction in prices with doubling of volumes



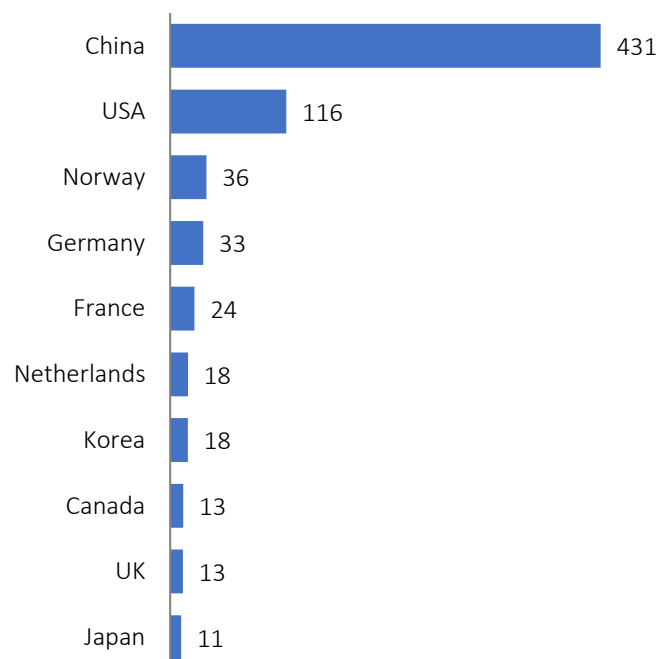
The consistent decline in the average battery pack price and a steady increase in publicly accessible slow charger and fast charger stock has been a key driver of this growth. In many countries, policy initiatives support the development of charging infrastructure. For example, local administrators in France are involved in EV infrastructure projects, the German government supports R&D activities for inductive and quick charging technologies, Netherlands has introduced tax incentives to support the creation of charging infrastructure.

### Global EV Charging Slot PARC (‘000 #)

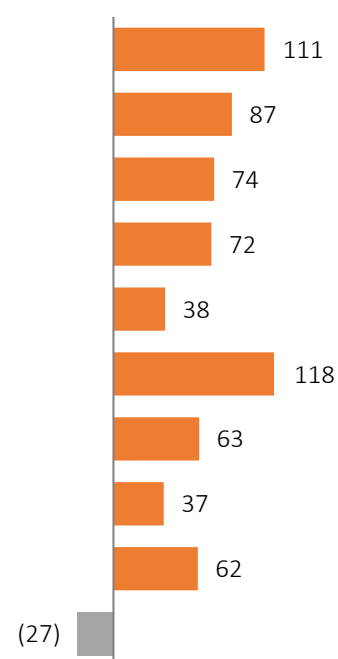


Source: Bloomberg NEF Report, IEA EV Outlook Reports, Avalon Consulting Research and Analysis

### BEV Sales by Country, H1 of 2019 (#’000)



### % Growth over H1 2018

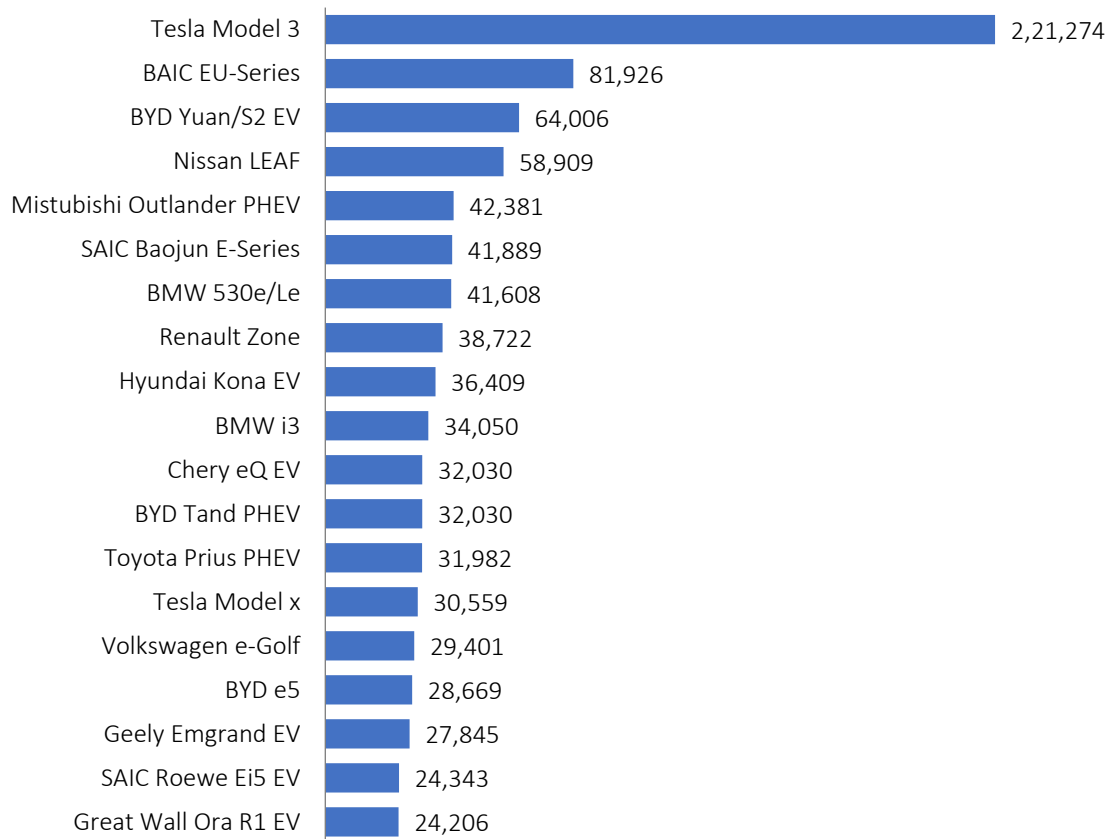


Source: JATO, Avalon Consulting Research and Analysis

China continues to be the dominant player in EVs. However, the withdrawal of subsidies in July 2019 created a dip in EV sales. But the Chinese Government is said to be preparing a revised policy, with public charging and battery swapping as the key drivers.

It is expected that by 2022 the cost and range of EVs will rival the Internal Combustion Engine vehicles in the sedan segment in the US, without subsidy. This could prove as the inflection point for EVs to potentially replace ICE vehicles in the next ten to fifteen years. Some estimates suggest that 2024 would be the year of peak ICE in the automotive industry of the OECD countries.

### Top 20 Electric Vehicles in the World [Jan-Oct 2019]



Source: IEA, OPEC, BP, BNEF, Avalon Consulting Research and Analysis

While Tesla Model 3 continues to be the global leader, Nissan Leaf, Renault Zoe and various BMW models also have found customer acceptance. Various Chinese manufacturers like BAIC, BYD, SAIC, Chery, Geely and Great Wall also have proven EV models, which are now going global. Thus, a wide range of vehicles are set to give customers greater choice, which will further the EV adoption globally.

New technology continues to percolate, with Wireless Charging (Fortrum, Oslo), Solar Charging (Lightyear, Netherlands) and Super-Speed Charging (450 KW prototype of Porsche BMW) being the interesting ones.

Thus, several aspects have contributed to the growth of EVs. This growth is expected to be exponential as per predictions by organizations such as the International Energy Agency (IEA), Organization of the Petroleum Exporting Countries (OPEC), British Petroleum (BP) and Bloomberg New Energy Finance (BNEP). While each of them differs in their projection of the EV adoption, there is a unanimous agreement that there will be a steep growth.

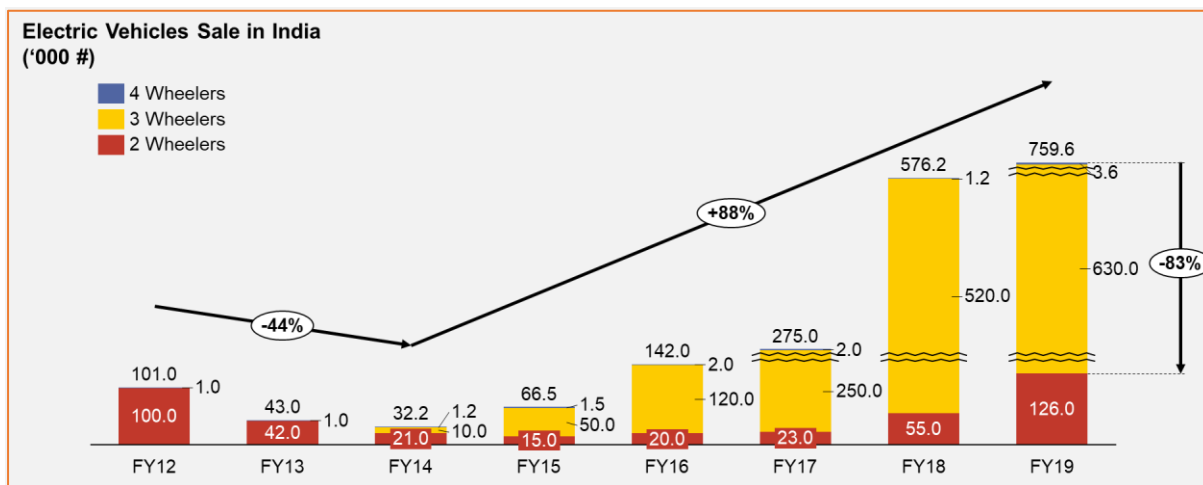
## IV. THE INDIAN EV MARKET: A UNIQUE AND DISTINCT OPPORTUNITY

### A. PAST TRENDS AND EVOLUTION

Unlike international markets, the Indian market has some unique characteristics – it is the only market dominated by E3W and E2W. The E3W market in India evolved out of a necessity to provide cheap, last mile connectivity in many urban centres and before FY17, was not even ‘recorded’ or acknowledged, as most of these vehicles are unregistered. Even today, while we have estimated the volumes in India, these are not considered in the global EV volumes – if accounted, India will have a ~8% share of global volumes, even higher than its share in ICE market!

The Indian EV market is estimated at ~750,000 in FY19 almost exclusively of E3W and E2W. There has been a revival of E2W volumes since FY17 as a result of the Faster Adoption & Manufacturing of Electric Vehicles in India (FAME) in 2015, with an outlay of INR 895 Cr. (~USD 128 Mn), primarily towards subsidy. E3W volumes have been estimated since FY17, though sales existed even in prior years.

**Electric Vehicles Sale in India**  
(‘000 #)



Source: Society of Manufacturers of Electric Vehicles, Avalon Consulting Research and Analysis

The Indian market is unique in another way – most of the EVs (E2W and E3W) use lead acid batteries and adoption of Li-ion batteries has started in E2W in FY19. Hence, these are also much cheaper than the rest of the world with bulk of the 2 and 3 wheelers sold falling below the USD 1,700 (INR 120,000) price band. Hence, unlike other geographies, the adoption of EVs in this range in India is driven by them being an economic alternative to ICE rather than environmental considerations, confirming India being a uniquely value conscious market in EVs.



## B. DEVELOPMENTS IN 2019

There have been a number of key developments in 2019 which will shape the development of the EV industry in the coming years but have also caused short term pain for the fledgling industry:

1. Launch of FAME 2 – a commitment to spend INR 10,000 cr. (USD 1.4 Bn) in the next 3 years to develop the EV industry in the long term
2. Launch of several E4W and E2W by incumbents
3. Upgradation of the E3W market
4. Component indigenization initiatives
5. Early developments in charging infrastructure
6. Birth of EV focused ride hailing start-ups
7. India specific innovations



### 1. Launch of FAME 2

FAME 2 was launched in April 2019 with the policy expanding beyond providing subsidies to a broader development of the EV industry covering investments towards charging infrastructure and an aggressive road map to indigenise manufacturing of EV and components in India. This move to develop local manufacturing has been driven by the need to prevent the repeat of the mobile phone experience wherein dramatic growth in usage resulted in a sharp increase in the trade deficit with China.

The scheme will be implemented through three verticals:

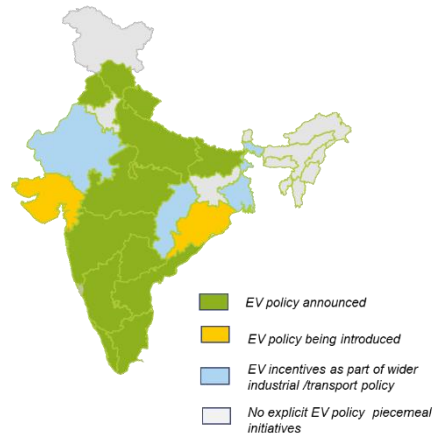
- Demand Incentives – a budget of INR 8600 cr. (~USD 1.2 Bn) over 3 years
- Establishment of network of Charging Stations with a budget of INR 1000 cr. (~USD 140 Mn) over 3 years
- Administration of scheme including publicity & IEC (Information, Education & Communication) activities with a budget of INR 38 cr. (~USD 5 Mn) over 3 years

Demand Incentives for Buses, 4 wheelers, 3 wheelers and 2 wheelers are based on their battery capacity, since the cost of batteries is one of the major reasons for the difference in the acquisition price of EVs & ICE vehicles. Public vehicles (buses) have been granted an incentive of INR 20,000 (~USD280) / KWh while all other vehicles have been extended an incentive of INR 10,000 (~USD 140) / KWh. For electric buses, demand incentives on operational expenditure will be delivered through State/City Transport Corporation (STUs); 3W and 4W segment incentives will be applicable mainly to vehicles used for public transport or to those that are registered for commercial purposes. In the 2W segment, focus will be on private vehicles.

The charging station infrastructure will be created through active involvement of various stakeholders including government agencies, industries and public sector enterprises with flexibility in funding up to 100% of the project cost.

Many states have also set up procurement plans for the State Transport Corporations, some of whom are going even beyond the FAME 2 Allocations (e.g. TN, AP, WB). Thus, there are a plethora of policy initiatives at various levels to create an environment where EVs can bloom.

## EV Policy Across States



| Initiative  | Andhra Pradesh | Bihar | Delhi | Himachal Pradesh | Karnataka | Kerala | Madhya Pradesh | Maharashtra | Punjab | Tamil Nadu | Telangana | Uttar Pradesh | Uttarakhand |
|---|----------------|-------|-------|------------------|-----------|--------|----------------|-------------|--------|------------|-----------|---------------|-------------|
| Subsidy top-up over FAME 2                          | X              | X     | ✓     | X                | X         | X      | X              | X           | X      | X          | X         | X             | X           |
| Road Tax Exemption                                  | ✓              | ✓     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | ✓      | ✓          | ✓         | ✓             | ✓           |
| Open permit for Commercial Vehicles                 | ✓              | ✓     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | ✓      | ✓          | ✓         | ✓             | ✓           |
| Govt. Land for Charging Stations/Hubs               | X              | X     | ✓     | X                | X         | X      | ✓              | X           | X      | ✓          | X         | ✓             | X           |
| Govt. Procurement Plans (beyond FAME 2)             | X              | X     | ✓     | X                | X         | X      | ✓              | X           | X      | X          | X         | ✓             | X           |
| Goal set for EV use/stopping ICE in public vehicles | ✓              | ✓     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | ✓      | ✓          | ✓         | ✓             | ✓           |
| Free Parking  | X              | X     | ✓     | X                | X         | X      | ✓              | X           | X      | X          | X         | ✓             | X           |
| Mandatory EV charging Facility in New Buildings     | X              | X     | X     | X                | ✓         | X      | X              | X           | X      | X          | X         | ✓             | ✓           |
| Manufacturing Incentives                            | ✓              | ✓     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | ✓      | ✓          | ✓         | ✓             | ✓           |
| R&D Incentives & Investments                        | ✓              | X     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | X      | X          | ✓         | ✓             | ✓           |
| Training Incentives                                 | ✓              | X     | ✓     | ✓                | ✓         | ✓      | ✓              | ✓           | X      | X          | ✓         | ✓             | ✓           |

Electric & hybrid vehicle manufacturers are expected to indigenize a significant portion of the EV components for availing subsidy. Detailed localization draft guidelines have been issued by DHI and it has put out a list of key components for EV manufacturers to localize, with respective deadlines across all vehicle categories.

## Revised Phased manufacturing program for xEV parts for eligibility under FAME India Scheme (Phase-II)

| S. No | Category   | e-2W    | e-3W                 | e-3W | e-3W | e-4W | e-Buses |
|-------|--|---------|----------------------|------|------|------|---------|
|       | Item Description   | L1 & L2 | E-Rickshaw/ & E-Cart | L5   | M1   | N1   | M2/M3   |
| 1     | HVAC   | NA      | NA                   | NA   | B    | B    | C       |
| 2     | Electric compressor  | NA      | NA                   | NA   | D    | D    | D       |
| 3     | Wheel rim  | A*      | A*                   | A*   | A*   | A*   | A       |
| 4     | Power and Control Wiring harness along with connectors   | A       | A                    | A    | B    | B    | B       |
| 5     | MCB / circuit breakers / electric safety device  | A       | A                    | A    | C    | C    | C       |
| 6     | AC Charging inlet Type -2  | NA      | NA                   | NA   | C    | C    | C       |
| 7     | DC Charging inlet CCS2/CHAdeMO   | NA      | NA                   | NA   | D    | D    | D       |
| 8     | DC Charging inlet BEVC DC 001  | NA      | NA                   | NA   | D    | D    | NA      |
| 9     | Traction battery pack  | A*      | A*                   | A*   | A*   | A*   | A*      |
| 10    | Wheel rim integrated with Hub motor  | B       | B                    | B    | B    | B    | B       |
| 11    | DC – DC converter  | B       | B                    | B    | C    | C    | C       |
| 12    | Electronic Throttle  | C       | C                    | C    | C    | C    | C       |
| 13    | Vehicle control unit   | C       | B                    | C    | C    | C    | C       |
| 14    | On Board Charger   | C       | B                    | C    | C    | C    | C       |
| 15    | Traction Motor   | C       | B                    | C    | E    | E    | E       |
| 16    | Integrated rear axle including, motor, motor Controller, transmission system & rear braking system | NA      | B                    | C    | NA   | NA   | NA      |
| 17    | Traction Motor controller / inverter   | C       | B                    | C    | E    | E    | E       |
| 18    | Instrumental Panel   | A*      | A*                   | A*   | A*   | A*   | A       |
| 19    | Windscreen Wiping System   | NA      | A*                   | A*   | A    | A    | A       |
| 20    | Chassis (For e2W and e3W – allowable imported Content @ 20%)                                       | A*      | A*                   | A*   | A    | A    | A       |

### Definitions:

| Code | Effective date of indigenisation of parts |
|------|---|
| A    | w.e.f. 1 <sup>st</sup> April 2019         |
| A*   | w.e.f. 1 <sup>st</sup> July 2019          |
| B    | w.e.f. 1 <sup>st</sup> October 2019       |
| C    | w.e.f. 1 <sup>st</sup> April 2020         |
| D    | w.e.f. 1 <sup>st</sup> October 2020       |
| E    | w.e.f. 1 <sup>st</sup> April 2021         |

Source: DHI

Note: Traction battery pack to be assembled domestically, for which battery cells and associated thermal and battery management system may be imported



The above aggressive indigenisation norms had a huge short-term impact, especially on E2W sales. From sales of ~10,000 vehicles per month in March 2019, sales dropped to zero in April as all vehicles required recertification. Sales continued to limp along in Q1. For the period April to December 2019, subsidy-led vehicle sales fell ~90% from >70,000 in FY19 to <7000 in FY20. The market downgraded from significant sales of high-speed Li-ion batteries to low speed Lead Acid batteries, given the need to meet price points to continue to deliver an economic value proposition vs. ICE vehicles. However, OEMs have adapted and launched mid speed Li-ion battery products. Thus, with this agility of the E2W players to adapt, overall sales in FY20 will still witness a growth to ~145,000 vehicles from ~125,000 in FY19 but most of these will be outside the subsidy regime with a larger share of Lead Acid vehicles.

This trend is expected to persist in FY21 – a larger share of E2W will be outside the subsidy regime but the share of Li-ion bikes will increase. The launch of models by incumbents like Bajaj and TVS will be eligible for subsidy but the price point of these models will not make the economics cheaper compared to ICE and hence will cater to a more premium segment which is concerned about the environment. Thus, the Indian market will see the emergence of a new segment in consonance with the international markets. However, the larger volume sales will be from segments which are driven by cheaper economics of EV vs ICE both in personal and in revenue generating applications across all vehicle categories.



## 2. Launch of a number of E4W and E2W by incumbents

Recent years have seen interesting launches of more capable vehicles in electric 2W and 4W segments.

In the 2-wheeler segment, Ather has launched the 450X with 2.4 kWh Li-ion battery, 3.3 kW power, 80 kmph top speed and 75 km range. Bajaj brought back its iconic Chetak brand of scooter in an electric avatar, priced between INR 1.07-1.23 Lakh (~USD 1500), ex-showroom Bangalore. TVS Motors launched the iQube e-scooter, priced similarly. Honda Activa electric is expected in 2020. Other performance bikes from start-ups like Tork Motors, Emflux motors are expected in 2020.

In 4 wheelers, Hyundai has launched the Kona, with 39.2 kWh 327 V lithium polymer batteries, 100 kW power and 452 km rated range. MG Motors is launching ZS EV SUV with 105 kW power and 340 km rated range. Tata Motors has launched the Nexon EV SUV with 30.2 kWh battery and more than 300 km range. Mahindra is complementing its e2O hatch and eVerito sedan with an electric KUV model.

Ashok Leyland is already in the e-bus segment with 3-minute battery swap technology and is collaborating with ABB to incorporate TOSA flash charging. BYD, Tata, JBM are also present in the e-bus segment.



*Ather 450 X*  
Source: Company Website



*Ashok Leyland Circuit eBus*  
Source: Company Website



*Mahindra e-Alfa Mini 3 Wheeler*  
Source: Company Website



### 3. Upgradation of the e-3W market

In electric 3 wheelers, much of the market remains unorganized and driven by unregistered lead acid battery powered vehicles. DMRC is trying to bring in organized players with a phone app / other easy to use processes which enable auto debit from the Metro smart card. In late 2019, Khati and Jangid have introduced 200 rickshaws at Vaishali metro station (NCR) and plan to scale this to >1000 in 2020. Oye Rickshaw has launched and started scaling up these and other e ricks across multiple metro stations through a ride sharing app. Similarly, Smart e has introduced 1000 Metro linked 3 wheelers (mainly Mahindra Treo) and has plans to scale up to 10,000 by 2022. Smart e along with Sun Mobility is piloting 3 wheelers with swappable Lithium Ion batteries in Gurgaon. Swedish company Clean Motion has launched its advanced Lithium ion electric vehicle, 'Zbee' in India. Zbee is already running successfully across Europe and Indonesia; and would be used as last mile connectivity in the CyberHub area of Gurgaon.

Incumbents Bajaj RE, TVS King and Piaggio Ape have all launched E3W autos, as had Mahindra with Treo and Alfa. While current price points would typically make these less competitive than ICEs, if swapping and fast charging is able to eliminate idle time then this can really take off. Kinetic Green and Gayam Motors had auto-like Lithium powered 3 wheelers. Low cost E-Rickshaw manufacturers like Thukral, Mayuri, Yatri have also launched lithium variants.

All these initiatives will result in an upgrade in the E3W segment – both e-ricks and autos – in the future.



### 4. Component indigenization initiatives

Firms like Altigreen technologies were already present in EV components, developing technologies suitable for India and developing countries. Several traditional auto component firms have ramped up investments and capabilities for EVs – Sona Comstar in motors and drive train, Lumax has signed an MoU with a Chinese company New Ananda Drive Techniques to locally manufacture electric vehicle motors and controllers. In 2019, there is growing interest among incumbent auto component firms to ride the EV trend.



## 5. Early developments in charging infrastructure

The Ministry of Power has already undertaken several leads in 2019 in pushing the EV Infrastructure initiatives through its various PSU companies, such as:

- National Thermal Power Corporation (NTPC) – plans to set up 100,000 EV charging stations in India
- Energy Efficiency Services Ltd (EESL – a national ESCO company, experienced in large tendering process) has already issued tenders to source about 4,000 EV chargers
- Rajasthan Electronics (I) Ltd, (REIL) – plans to set up 200 charging stations in Delhi, Jaipur and Chandigarh

Similarly, 2019 has also seen moves in charging infrastructure by various private players.

- Tata Power has set up a pilot project of EV charging and is likely to install more in the future
- Mahindra along with Ola has been setting up EV charging stations so far and will continue to be aggressive about this
- Fortum India, owned by Finland's utility firm, plans to enter and set up nationwide EV Charging stations
- Lithium Urban, an EV fleet firm has plans to set up 60 charging stations



## 6. Birth of EV-focused ride hailing start-ups

India has seen maximum innovation in the e-mobility space. Ola and Uber have experimented with EVs, with OLA running an EV pilot in Nagpur. Companies like Lithium Urban and Ola are looking to set up a complete ecosystem to provide e-Mobility solutions including charging stations, vehicles, fleet operating and balancing technology. BluSmart in Delhi is getting traction as an exclusive EV ride hailing app.

There are a large number of start-ups in the e-bike sharing space. Delhi Metro Rail Corporation (DMRC) offers e-bikes out of its stations in partnership with Yulu. Zypp from Mobycy, Hexi, Smartbike, eBikeGo are other bike sharing models being experimented with. The larger bike sharing start-ups, Bounce and Vogo are predominantly using ICE 2W for their ride sharing business. However, they have realised that the path to profitability will be faster with E2W. They have experimented with many of the available E2W in India but did not find them robust enough. Bounce plans to raise \$30 million exclusively for its electric vehicles subsidiary Zuink Smart Mobility Solutions and is developing its own robust e-bike for the same. Bounce, which is running a pilot with nearly 30 kirana (small retail shop) owners in the Bengaluru, plans to connect them with banks and other lenders to finance charging units and EV batteries. The cost per station works out to ₹1,00,000.





## 7. India Specific Innovations

2019 also saw the start and scaling up of a number of India specific innovations connected with the EV ecosystem.

### Retro-fitment of Electric Drive

India has set up standards governing retro-fitment of electric / hybrid drives into ICE vehicles in 2018. Hyderabad based e-Trio offers retro fitment of electric drives into cars. Autobot offers retro-fitment training courses – aiming to create MSMEs and individuals capable of retro-fitment and repairs. Niti Aayog is coordinating to offer EV related courses in Engineering Colleges and ITIs. Many state governments are also planning funding for training in EVs.

### Recycling

Recycling alone is estimated to become a USD 1 Bn opportunity in India by 2030. Tata Chemicals has set up a pilot plant for lithium ion battery recycling near Mumbai with a plan to scale up operations to recycle 500 tons of spent Li-ion batteries in the pipeline.

### Innovations in EV Battery Business Models

Hero Electric has launched E2W models where the Li-ion battery can be removed from its case and connected to charge using a conventional charging point. In order to popularize this, they have tied up with kirana (small retail) shops around their dealers and provided them with Hero Electric branded electrical switch boards as charging points at a small fee, where the E2W owner can plug in the battery for charging. This can significantly address range anxiety.

Experiments in business models which involve selling the E2W without the battery and renting batteries which can be swapped, have been conceptualised and will be launched shortly in specific geographies. India is also pushing for battery swapping to decrease upfront costs and accelerate adoption in certain categories of EVs. The model is likely to be adopted for E3W and E2W segments. Adoption by e-rickshaws also stems from the fact that their routes are more standardized, making it easier to identify locations where swapping stations would see sufficient demand.

Since buses ply on fixed routes, existing bus depots can be used as battery swapping stations. High upfront cost of electric buses makes the battery swapping model ideal, provided that the operators can overcome certain technological challenges. However, it is possible to have an operator focused swapping model for buses centred around depots. The O&M model proposed under FAME 2 also would result in investments in swapping of bus batteries.

*Thus, the accelerated developments in 2019 have laid a foundation for the future growth of EVs in India. However, various statements made by Government representatives that India will completely switch over to EVs by 2030 and registration of E2W will be stopped by 2025 have been played down subsequently and remain unrealistic as we had indicated in our previous White Paper.*

*Let's look at what the future holds.*

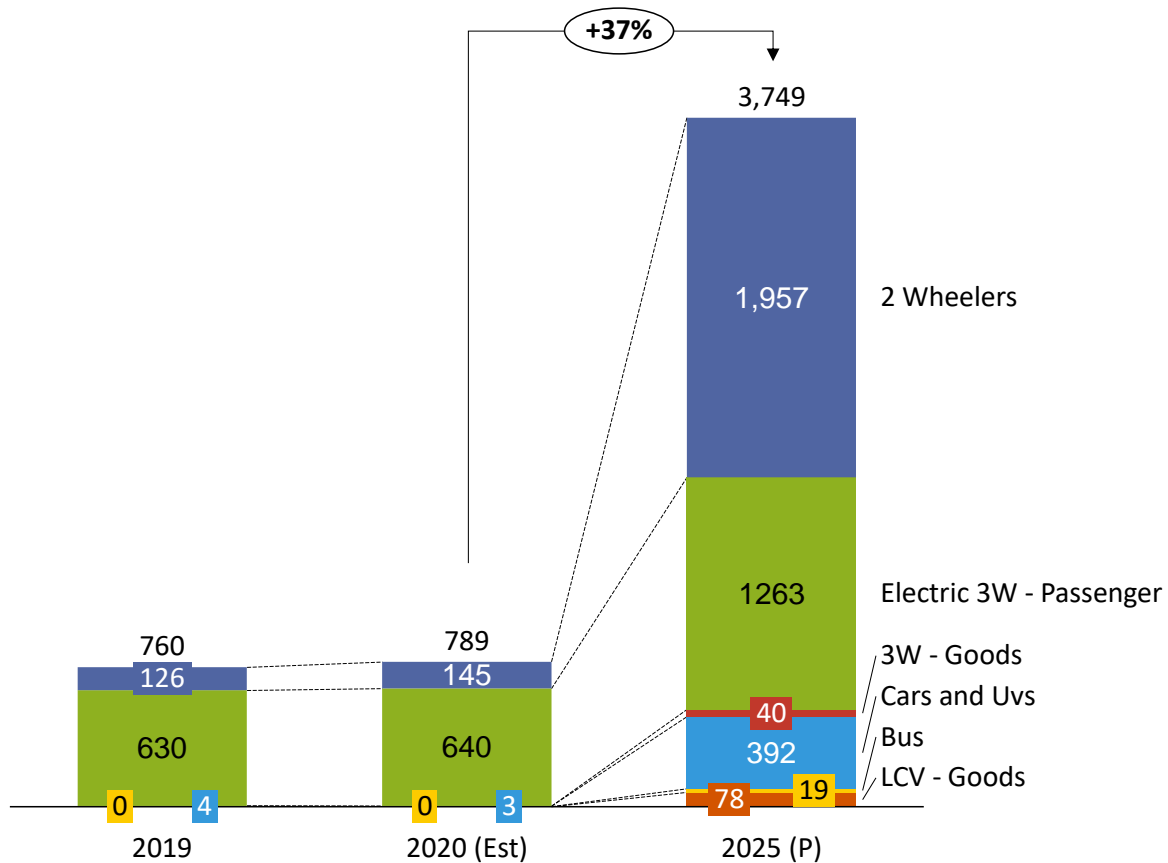


### C. FUTURE OF ELECTRIC VEHICLES ADOPTION IN INDIA

Our analysis leads us to **5 major conclusions** about the future of EV adoption in India.

**1** If both swapping and demand acceleration work as per plan, **India may reach an EV sales volume of more than 3.5 Million vehicles in FY25**, mainly driven by 2 and 3 wheelers. We analyse the impact by each segment below:

Electric Vehicles Sale in India, Forecast by Segment ('000 #)



Source: Avalon Consulting Research and Analysis

The Indian EV market volumes will continue to be driven by cheaper economics than ICE vehicles in the short term, in all vehicle categories. The private owner customer segment which buys EVs due to environmental considerations or as an early adopter of a new technology, which involves a spend higher than ICE (either as an upfront cost and / or higher running costs due to low km usage), will be small. We expect the private owner customer segment to also be value driven in a market like India and inflection point for their adoption of EVs will be beyond 2025 when battery costs come down sufficiently to make EV use cheaper than ICE vehicles.

The customer mix and drivers for each category is expected to be as follows:



## Cars

This will be largely driven by fleet operators and government procurement. While Government signalled an intent to accelerate adoption through tender led procurement of 10,000 cars and started with an initial offtake of 2000 cars, the actual deployment across departments has been low. We estimate Government procurement to be 30,000 vehicles till 2025. Bulk of the demand for EVs will be driven by fleet operators - traditional ones like Ola and Uber along with new start-ups like BluSmart, Lithium Urban, etc. Private vehicle adoption will be mainly in the higher end vehicles which are not economy driven.



## Two-wheelers

The E2W market will be driven by private owners, ride sharing app led businesses and for last mile delivery. Each of these segments will be catered to by specific models suited for the segment. Some of the ride share app businesses will develop their own models. Across these segments, economic advantage over ICE will drive adoption.

In the short term, a larger share of E2W will be outside the subsidy regime but the share of Lithium-ion bikes will increase with the launch of mid speed bikes, some of which will be eligible for subsidy. The launch of models by incumbents like Bajaj and TVS will be also eligible for subsidy but the price point of these models will not make the economics cheaper compared to ICE and hence will cater to a more premium segment which is concerned about the environment. Thus, the Indian market will see the emergence of a new segment in consonance with the international markets. However, the larger volume sales will be from segments which are driven by cheaper economics of EV vs ICE both in personal and in revenue generating applications across all customer segments.



## Passenger 3-wheelers

E-rickshaws are likely to be the fastest growing segment. With the upgradation in models seen in 2019, the trend towards registration of vehicles and app-based business models and the launch of models by organized players like Mahindra, Kinetic Green, etc. this will become a more attractive market. E-Auto sales are also expected to grow through the entry of OEMs like Bajaj and TVS, though will still account for a relatively smaller share of the overall electric 3-wheeler category. Demand aggregation through public procurement and battery swapping is expected to play an important role in driving adoption.



## Buses

Major OEMs like Ashok Leyland, Tata and BYD-Olectra, will continue to pilot and test in the coming years. Battery swapping will reduce upfront cost and spur greater procurement from EESL and STUs. This is clearly identified as a focus area in FAME 2 and there are indications that many STUs would procure EVs over and beyond FAME 2 quotas. While intra-city buses (stagecoaches, school and office buses) would convert first, we are also witnessing experimentation with EVs in short inter-city routes like Mumbai-Pune. We expect this segment to gain traction after 2025.



## SCVs

The small commercial vehicles (e.g. Tata Ace, Mahindra Jeeto, Suzuki Super Carry) and 3-wheeler goods vehicles (Piaggio Ape, Bajaj Maximo) are primarily used in last mile logistics and delivery. E-commerce is a key driver of this vehicle segment. E-commerce companies are increasingly looking to reduce their carbon footprint. Additionally, these are predominantly intra-city vehicles with high vehicle usage and single journey rarely more than 100 km. Hence, in our view this segment is ripe for electrification. Additionally, this is a segment which has evolved in India with a lot of frugal engineering. We envisage this as a segment where India can establish global leadership in both products and business models, with potential to export to other developing countries.

Despite the rapid growth across vehicle categories, the penetration of EVs into the auto market till FY25 will still be in single digits at an overall level. However, in specific vehicle segments like E3W auto, buses and SCVs, the share will be reasonable.

| All in '000 | Category         | FY19   | FY25   |
|-------------|------------------|--------|--------|
| 4 Wheelers  | Total Sales      | 3,415  | 4,969  |
|             | EV Sales         | 3.6    | 204    |
|             | EV Penetration % | 0.11%  | 4.11%  |
| 2 Wheelers  | Total Sales      | 21,307 | 33,167 |
|             | EV Sales         | 126    | 1,957  |
|             | EV Penetration % | 0.59%  | 5.90%  |
| E-Autos     | Total Sales      | 1,202  | 1,272  |
|             | EV Sales         | 5      | 363    |
|             | EV Penetration % | 0.42%  | 28.57% |
| E-Rickshaws | Total Sales      | 625    | 900    |
|             | EV Sales         | 625    | 900    |
|             | EV Penetration % | 100%   | 100%   |
| Buses       | Total Sales      | 92     | 119    |
|             | EV Sales         | 0.4    | 19     |
|             | EV Penetration % | 0.44%  | 15.98% |
| SCVs        | Total Sales      | 644    | 1,022  |
|             | EV Sales         | 0      | 119    |
|             | EV Penetration % | 0.0%   | 11.6%  |
| Total       | Total Sales      | 27,555 | 40,671 |
|             | EV Sales         | 760    | 3,562  |
|             | EV Penetration % | 2.8%   | 8.8%   |

Source: Avalon Consulting Research and Analysis



**2*****There would be opportunities in various components as indigenization requirements coupled with growing volumes drive local manufacturing***

With the indigenization drive under FAME 2, we expect substantial investments in key EV components like motors, controllers, batteries and BMS as well as charging infrastructure. There would be 3 main paths to investment:







- I. **Inward investment by global leaders:** This can either be standalone investment or JV. Hence in order to ride the Indian EV wave, we envisage global leaders across components to contemplate investments in India. This will include Chinese companies coming in on their own or through JVs with Indian companies. This will include ecosystem suppliers of MG Motors (SAIC) and Great Wall.
- II. **EV foray by technology leaders:** Crompton Greaves has developed an electric motor, Tata Power is setting up charging stations, Tata Chemicals is setting up a battery plant as well as a Li-ion recycling unit, BHEL is planning investments in Solar Chargers. Thus, investment will be driven by large Indian private companies and PSUs from outside the conventional auto supply chain.
- III. **Proactive technology acquisition by auto component players organically or inorganically:** Some such initiatives are already in place. For example:
  - a. Sona Comstar has developed EV drive technology, with axle mounted drive being co-developed with Sona BLW
  - b. Lumax Auto Technologies Limited signed a Memorandum of Understanding with Ananda Drive Techniques, China for manufacturing and sale of various powertrain products for electric vehicles
  - c. Sandhar Technologies set up a JV with Korea's Hanshin to make high-end data cables for EVs and PVs

**3*****There would be opportunities to create new business models in the ecosystem. Particularly, the first mover to establish a viable, scalable swapping business model can be a big winner***

Planned investments in battery swapping have not materialized. Initiatives by ACME Power, Sun Microsystems etc. have been largely localized. We believe that it is possible to create a viable, scalable swapping business model and companies who get this right could be big winners in the EV revolution in the Indian context.

**4*****There would be opportunities to invest in some innovative companies who are designing efficient components or establishing innovative business models across charging / swapping / recycling / retro-fitment etc.***

There are innovative companies pioneering new technologies and business concepts at a local or regional level. Some of these are likely to scale up and go national or global and would need growth capital for the same. Some examples are outlined below:

| Company  | Business Concept   | Footprint   |
|--|--|-------------|
|                           | EV Retro Fitment   | Hyderabad   |
| <br>Convenience Innovated | Smart and affordable vehicle charging platform. Has solutions for residential, parking lot, office and commercial segments. Also supports swapping | Bangalore   |
|                           | Designing motors and controllers for EVs   | NCR         |
|                           | E Rickshaw Design and Manufacturing  | NCR         |
|                           | Power Train and charging solution design. Power train, charger, DC-DC converter are key products   | Bangalore   |
|                           | Charging Infrastructure focusing on apartments, business owners, office complexes  | NCR, Mumbai |

There are other interesting start-ups working on more futuristic technology developments like Carbon ion (Gegadyne).

5

*There could be consolidation in the Industry as existing OEMs seek to acquire / partner with innovators to leapfrog technology*

The global EV ecosystem is flush with start-ups trying out new technologies and business models. We expect a few of these to become unicorns and drive consolidation in the industry.

Existing OEMs would also be on the lookout for acquisitions to obtain relevant technology. Thus, at a global as well as India level, the sector would be flush with M&A activity in the next decade.

*These future trends clearly highlight that the EV related opportunities in India are real and have distinctly different characteristic compared to other developed markets. Better economics delivered by EVs in various vehicle categories will be the driver of these opportunities in India and successful entrepreneurs will create significant value in the coming years*



**Avalon Consulting** is an international management consulting firm that advises clients across the world on Strategy, Business Transformation and Transactions. It is part of the 30 year old, 200-plus people strong Avalon Group with offerings across the knowledge value chain including Market Research, Social Media Research and Marketing Analytics. As a member of Cordence Worldwide, Avalon Consulting has a global presence across 25 countries.

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Chamber of Commerce and Industry

#### **IMC Chamber of Commerce and Industry**

The IMC Chamber of Commerce and Industry, popularly known as The IMC, is a legendary organization which has relentlessly pursued the agenda of identifying opportunities, addressing critical issues and driving Indian businesses with the single-minded focus of sustainable growth.

IMC’s members and its network have been instrumental in Influencing policy frameworks and changes towards this goal and continually strengthening sectors that are critical to India’s new phase of flourish.

IMC seeks out thought leaders and Industry spearheads to identify today’s needs and catalyse the achievement of tomorrow’s vision. Set up in 1907, in the wake of the ‘Swadeshi Movement’ to represent Indian businesses. IMC is a premier Chamber of trade, commerce and industry in India.

Headquartered in Mumbai and a strong presence in Delhi, the Chamber has more than 3000 members, comprising a cross section of the business community. It plays an advocacy role on a wide range of matters and acting as an impetus to growth and development of businesses, on policy and implementation matters. It represents the interests of a variety of sectors like banking and financial services, environment, energy, water resources, geographic indications and protection of interests of artisans, tourism, information technology, education, construction, etc. IMC organizes interactive meetings with ministers, senior bureaucrats and others to express and drive home its views. Ladies Wing of IMC gives special focus to entrepreneurial development for women and IMC’s Young Leaders Forum provides interactive platform to young entrepreneurs and professionals.

IMC hosts foreign delegations visiting India and provides a platform for interaction to expand business ties and address issues affecting growth of business between the visiting country’s environment and India for doing business.

IMC’s vibrant Economic Research and Training Foundation carries out research in a variety of areas and supports various initiatives of expert committees.

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**IMC**

Chamber of Commerce and Industry