## 4W

4W OEMs have been modest in their EV ambitions and understandably so, given the high cost difference between an ICE and EV. The 4W market was limited to only 2 domestic OEMs – Tata and Mahindra, and they were primarily catering to government-initiated demand through EESL. Recently, OEMs like Hyundai and MG have taken a bet on premium electric cars, with Hyundai launching Kona and MG launching ZS in 2019. Tata's electric Nexon comes at an attractive price point and can potentially attract a larger portion of the retail market.

EXHIBIT 38 ↘

| OEM | KEY MODELS | PRICE (INR mn^) | BATTERY | RANGE (Km *) | TOP SPEED (Km/hr) | KEY HIGHLIGHTS |
|---|---|---|---|---|---|---|
| **TATA MOTORS** | Tigor EV | 1.1 | Li | 140 | 80 | Launched Tigor for retail buyers in Oct 2019 |
| | Nexon EV | 1.5 | Li | 300 | 120 | Nexon EV launched in Jan 2020 was the highest selling electric car in the month of March 2020 ahead of MG ZS |
| **MAHINDRA ELECTRIC** | E-Verito | 1.2 | Li | 140 | 86 | Oldest EV player in India, having started its EV journey with Reva in 2001<br>Planning to launch e-KUV100 |
| **HYUNDAI** | Kona | 2.4 | Li | 450 | 155 | Launched Kona in Aug 2019 |
| **MG MOTOR** | ZS EV | 2.1 | Li | 340 | 140 | MG received ~3,000 bookings for ZS in the first month of launch - more than cumulative electric car sales in 9 months prior to that |
| **MARUTI SUZUKI** | WagonR EV | | | | | Planned to launch in FY20; Now deferred |

^ **PRICE**
Ex-Showroom Price

* **RANGE**
As reported on companies' websites. Some companies report ARAI range while some companies report range under ideal operating conditions. The practical range however is lower than ARAI and lower than ideal range depending upon usage patterns

## Bus

Bus demand is completely driven by the government and the recent 5,000 bus tender has kindled a lot of activity in this space. There are only a handful of OEMs active in this space with Olectra leading the way.

EXHIBIT 39

| OEM | MODEL | RANGE * (Km/Charge) | LENGTH (Meters) | KEY HIGHLIGHTS |
|---|---|---|---|---|
| OLECTRA | K6 | 200 | 7 | Olectra is owned by Megha Engineering. It has collaborated with BYD for e-buses<br>First company to deploy 100 electric buses in India<br>Has 160+ buses deployed in India and has won a tender for 600 more buses under FAME-II |
| | K7 | 200 | 9 | |
| | K9 | 300 | 12 | |
| TATA MOTORS | Star Bus Ultra Electric 6/9 | 215 | 9 | 60% market share in FAME-I bus deployment.<br>Has won order for 300 e-buses from Ahemdabad Janmarg Limited and 220 bus contract under FAME-II |
| | Star Bus Ultra Electric 9/12 | 151 | 12 | |
| ASHOK LEYLAND | Circuit - S | 50 | 12 | First battery swapping bus project in collaboration with Sun Mobility in Ahmedabad |
| JBM SOLARIS | Ecolife Electric | 150 | 9/12 | JV with Polish bus maker Solaris |
| FOTON PMI | Urban | 144 | 12 | JV between PMI Electro Mobility and Beiqi Foton Motor (China)<br>Won contract for 760 buses under FAME-II |
| | Regio | 168 | 9 | |
| | Lito | NA | 7 | |

* RANGE

As reported on companies' websites. Some companies report ARAI range while some companies report range under ideal operating conditions. The practical range however is lower than ARAI and lower than ideal range depending upon usage patterns

# The battery industry has started shaping up

India has a limited role to play in the electric vehicle battery value chain in the medium-term. In the next 3-5 years, the Indian EV battery industry is largely expected to remain limited to battery pack manufacturing wherein the cells will continue to be imported. Several companies have announced plans to set up cell manufacturing units in India. However, the industry needs to achieve a certain scale for cell manufacturing to be cost competitive with the global market. Critical factors that will define India's role in the battery value chain are cell technology, access to key raw materials and scale of industry.

1 /

## CELL TECHNOLOGY

India has not developed an indigenous cell technology. Globally, cell manufacturing is consolidated amongst 5 players, each of them putting in billions of dollars in cell R&D to develop more cost efficient and scalable cell technologies. Given the competitive landscape and the high entry barriers, both in terms of technology as well as capital, the likelihood of companies investing in existing Li-ion cell technologies is very minimal.

Domestic manufacturers, as and when they foray into cell manufacturing, would prefer to enter into technology partnerships with global battery players (rather than investing in technology).

2 /

## ACCESS TO RAW MATERIALS

India barely has any reserves of Lithium and Cobalt, two of the most critical elements of a Li-ion cell and would be almost completely dependent on imports for manufacturing Li-ion batteries.

The global supply chain for these materials is still not well established and is volatile. All key global battery companies have strategic partnerships to ensure a stable supply. China, in addition to domestic Lithium production, has managed to establish strong control over the global supply chain for these materials and that is one of the primary reasons behind their flourishing battery industry. India will need policy level efforts to ensure stable access to raw materials in order to support domestic cell manufacturing.

3 /

## SCALE OF INDUSTRY

India is largely a light electric vehicle market. Over the next 5 years, a large part of the Indian market will comprise of sub 10 kWh batteries. So, even with the most optimistic penetration scenarios, the battery industry in India would be around 30 GWh by FY25.

This is a too small a market for large scale cell manufacturing to be feasible in India. For demand scale in the battery industry to pick up, large scale adoption in passenger vehicles is critical but that is a remote possibility till FY25.

The first two bottlenecks are less critical if the possibilities of global battery companies setting up manufacturing in India or joint ventures between domestic and global companies are considered. However, the small scale of industry is still a major impediment for the emergence of the battery manufacturing industry in India. In addition to the small scale, the fact that this scale is distributed over a large number of small battery packs that go into the price sensitive 2W and 3W industry, makes a business case in India less attractive for large global battery companies.

It is likely that in the foreseeable future, only ventures that have large underwritten or captive demand will get into cell manufacturing in India. This has already been exemplified through the announced JV between Suzuki, Denso and Toshiba – AEPPL (Automotive Electronics Power Private Ltd.) for battery manufacturing in India.

Even AEPPL is planning to first set up a battery pack assembly plant and then later, by FY25, move into cell manufacturing.

The government has started pushing for localization of cell manufacturing in India. The aim is to set up gigafactories, each having a capacity of 10 GWh. Initial steps are also being taken to gain control over critical minerals such as the formation of Khanji Bidesh – A JV between NalCo, HCL and MECL to acquire Lithium and Cobalt mines abroad.

While cell manufacturing will have to get localized in India as the market gains scale in the long term (>5 years), in the near to medium term (3-5 years), India has a limited role to play in the battery value chain and the same would be restricted to the assembly of battery packs.

# The battery industry in India is going through a formative phase

Till date, a large portion of electric 2W and 3W sold in India are based on Lead Acid batteries. With FAME-II coming into the picture and increased OEM focus towards higher performance vehicles, the shift towards Li-ion batteries is expected to be much faster. 2Ws are expected to shift to Li-ion batteries quickly while 3W e-ricks might take 2-3 years for a complete shift. The shift to Li-ion batteries has started shaping up the domestic Li-ion battery industry.

A large part of the Indian Li-ion battery supply is still made up of batteries imported from China. The need for high-quality reliable batteries and the government's push for localization has led to several domestic companies entering battery pack manufacturing.

Exicom, Bosch, Tata Autocomponents, Phylion, Exide-Leclanche, Greenfuel, Okaya are some of the leading battery pack suppliers in India today. There are several start-ups doing battery pack assembly at a small scale in various regions in India. These include the likes of ChargeDock, Euclion, Octillion, etc. A number of large companies have also indicated potential interest in getting into battery cell manufacturing. RIL, Adani, BHEL, IOCL, Panasonic and Tata Chemicals, have announced plans to enter cell manufacturing but no on-ground action has taken place till now.

EXHIBIT 40

**Automotive Li-ion battery landscape in India**

**MANUFACTURERS**

Total installed capacity = ~2 GWh

**DOMESTIC COMPANIES**

EXICOM POWER SOLUTIONS
AMARA RAJA Gotta be a better way
BOSCH
SUN MOBILITY
GREENFUEL
EXIDE
TATA — TATA AUTOCOMP SYSTEMS LIMITED
OKAYA NEVER STOP INDIA

**GLOBAL COMPANIES**

LG Chem
国轩高科 GUOXUAN HIGH-TECH
PHYLION

**OEMs**

Mahindra
ATHER
BYD

# Differentiators for domestic battery industry

With the role of the battery industry in India being limited to pack manufacturing, the race for differentiation is intense amongst the players.

There are three key sources of differentiation – scale, sourcing, and R&D/technology.

1 /

### SCALE

Scale enables benefit in cell procurement costs. Scale also enables more automated factories that are cost efficient. Large cell manufacturers are less inclined to work with smaller volume battery pack companies.

2 /

### SOURCING

The ability to secure high quality cells from global manufacturers is critical. At a lower scale, the only viable option for a battery pack company is to source cells from Chinese manufacturers. However, to do so effectively, an understanding of cells and the ability to test and validate quality is critical.

3 /

### R & D

Strong R&D is essential for pack companies to drive the cell-pack efficiency via good design, thermal management and a advanced battery management system. A good BMS can create significant differentiation for a battery pack manufacturer.

# Charging Infrastructure is currently lacking, but new business models are coming up to plug the gap

While a lot of initiatives have been taken to encourage the adoption of EVs in India, little has been done to develop public charging infrastructure. Although regular at-home charging remains as one of the great advantages of electric-drive technology, it does not fulfil every charging need. A mix of workplace charging, public charging and fast charging is needed to extend range and increase charging access to those customers with no home charging.

The EV adoption and charging infrastructure is a bit of a chicken and egg problem. On one hand, without good infrastructure, owning and operating an EV is not convenient for users, hence, they would want to wait till such infrastructure is available. On the other hand, low adoption of EVs drastically impacts the economic viability of any public charging infrastructure project. A majority of existing charging stations are catering to either captive demand or large commercial fleets like e-ricks.

| Current DC charging points | Current AC charging points |
|---|---|
| 700 | 1,500 |

**2,600** Charging station projects announced as of January, 2020

While the commercial business models are struggling on account of demand, the government is trying to deploy infrastructure through bodies like EESL. In Jan 2020, the government approved 2,600 charging stations to be set up under FAME-II.

Players like Lithium Urban – India's largest 4W EV fleet, have been able to successfully develop infrastructure leveraging their captive demand. Currently, all players developing infrastructure for captive usage are also treating it as a business differentiator and not sharing it for public use.

Another key problem with creating fast charging infrastructure is that there are almost no vehicles on the road at the moment that can handle high-power DC charging like 120 kW. For DC fast charging to become feasible, vehicles need to be equipped with batteries that can handle rapid charging.

EXHIBIT 41

**Key players in the EV charging market**

## Battery Swapping

3W is by far the largest adopter of EVs in India at the moment. The number of 3W EVs in India make a good case for developing charging infrastructure. One of the key business models that has emerged for charging EVs is battery swapping.

Battery swapping enables e-rick drivers to avoid 3-4 hours of down time thus, increasing their earning potential. It also enables a business model wherein the battery cost is delinked from the vehicle, reducing the upfront cost pressure on a vehicle owner and they can use the battery as a service from the charging station operators.

EXHIBIT 39

**Battery swap station at an Ola charging station**


EXHIBIT 42

**Key EV charger manufacturers in India**

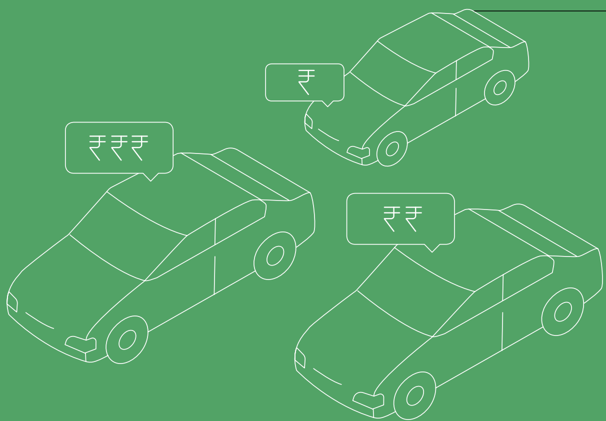
The need for charging infrastructure is an opportunity for charger manufacturers themselves. Many of these are companies that have significant experience in power electronic products. Exicom is currently leading the EV battery charger market, followed by Delta in India.

SIEMENS
EXICOM POWER SOLUTIONS
DELTA
Raychem
ABB
MASS-TECH CONTROLS PRIVATE LIMITED

05

# TCO Equation in India





## Different segments lie on different parts of the TCO spectrum

Electric vehicles have a significantly higher upfront cost, as compared to ICE vehicles, largely on account of battery costs. On the other hand, the operating costs for an EV are much lower. Thus, Total Cost of Ownership (TCO) is an important and more correct assessment of economic comparison between ICE vehicles and EVs.

A TCO comparison across different vehicle categories and use cases within them has been presented below. The TCO analysis has been done for a 5 year period and takes into account maintenance cost, salvage value, new battery cost, if needed, and inflation. Details of TCO assumptions are presented at the end of this section.

1 / ELECTRIC - 2W

## At parity for retail and a no-brainer for commercial use

Electric 2W are at TCO parity with ICE 2W for multiple scenarios. Depending upon the vehicle specification, TCO parity is achieved at different usage levels. Low/medium speed e-2W would achieve TCO parity at less than 10Km of daily usage.

The TCO for high speed 2Ws is not yet attractive and TCO parity is achieved at 40+ Km daily usage. While the upfront cost (without subsidy) in the case of a medium–high performance electric 2W is 50-75% higher than the ICE equivalent, the operational cost per Km is almost 1/6th that of an ICE 2W.

A comparison of Hero Electric Optima E2 (Low Speed e-2W) and Ampere Zeal (Medium Speed e-2W) with TVS XL-100 (Moped) and TVS Pep indicates a ~25% lower TCO. Ather 450x TCO is about 20% higher than Activa BS VI. Commercial use for electric 2W seems highly favourable with 33% TCO advantage.

EXHIBIT 43

## TCO Analysis

ELECTRIC VEHICLES: Capex / Opex
ICE VEHICLES: Capex / Opex
*TCO with subsidy benefit

### 2W

**Low Speed 2W - Retail**

| | HERO OPTIMA E2 | TVS XL-100 |
|---|---|---|
| TCO | INR 93,724 | INR 120,982 |
| Capex | 55% | 34% |
| Opex | 45% | 66% |

**Medium Speed 2W - Retail**

| | AMPERE ZEAL | TVS PEP |
|---|---|---|
| TCO | INR 116,456 | INR 126,223 |
| Capex | 70% | 40% |
| Opex | 30% | 60% |
| *TCO with subsidy | *INR 94,557 | |

**High Speed 2W - Retail**

| | ATHER 450X | HONDA ACTIVA BSVI |
|---|---|---|
| TCO | INR 219,974 | INR 156,353 |
| Capex | 72% | 60% |
| Opex | 28% | 40% |
| *TCO with subsidy | *INR 187,124 | |

**Medium Speed 2W - Commercial**

| | HERO OPTIMA ER | HONDA ACTIVA BSVI |
|---|---|---|
| TCO | INR 212,425 | INR 290,824 |
| Capex | 38% | 23% |
| Opex | 62% | 77% |
| *TCO with subsidy | *INR 190,526 | |

### 3W

**E-Rickshaw (Li-ion)**

| | KINETIC SAFAR SAMRT |
|---|---|
| TCO | INR 501,241 |
| Capex | 42% |
| Opex | 58% |
| *TCO with subsidy | *INR 456,225 |

**E-Rickshaw (Lead Acid)**

| | KINETIC DX |
|---|---|
| TCO | INR 500,415 |
| Capex | 27% |
| Opex | 73% |

**Auto Rickshaw**

| | MAHINDRA TREO | BAJAJ COMPACT |
|---|---|---|
| TCO | INR 561,081 | INR 580,361 |
| Capex | 54% | 39% |
| Opex | 46% | 61% |
| *TCO with subsidy | *INR 479,502 | |

### 4W

**Car- Retail Medium**

| | TATA NEXON EV | TATA NEXON PETROL |
|---|---|---|
| TCO | INR 1,800,049 | INR 1,757,940 |
| Capex | 70% | 58% |
| Opex | 30% | 42% |

**Car- Retail Premium**

| | HYUNDAI KONA | HYUNDAI CRETA |
|---|---|---|
| TCO | INR 2,763,033 | INR 2,548,536 |
| Capex | 70% | 62% |
| Opex | 30% | 38% |

**Car- Commercial**

| | MAHINDRA E-VERITO D6 | MAHINDRA VERITO D6 |
|---|---|---|
| TCO | INR 2,162,449 | INR 2,126,378 |
| Capex | 53% | 45% |
| Opex | 47% | 55% |
| *TCO with subsidy | *INR 1,871,201 | |

### CV

**Light Commercial Vehicle**

| | CONCEPT LCV | TATA ACE |
|---|---|---|
| TCO | INR 2,195,770 | INR 1,855,196 |
| Capex | 38% | 31% |
| Opex | 62% | 69% |
| *TCO with subsidy | *INR 1,852,316 | |

**Bus**

| | E-BUS | ICE CITY BUS |
|---|---|---|
| TCO | INR 22,609,090 | INR 16,105,243 |
| Capex | 62% | 42% |
| Opex | 38% | 58% |
| *TCO with subsidy | *INR 15,740,026 | |

2 / ELECTRIC - 3W

## At parity – must go electric

The TCO comparison between Lead Acid battery-based e-rick (Kinetic DX) and Li-ion battery-based e-rick (Kinetic Safar Smart) indicates that Li-ion is at TCO parity with Lead Acid. The Li-ion e-ricks have a lower total cost of ownership without considering subsidy benefits, if daily running is more than 120 km. The benefit of lower charging time with Li-ion, which is a reduction in the down time for drivers during the day, has not been considered for this analysis and if considered, would further improve the TCO for Li-ion.

A comparison in the 3W-Auto category between Mahindra Treo and Bajaj Compact indicates lower TCO for Mahindra Treo.

For an average daily usage case of 100 km, the TCO of Mahindra Treo is 16% lower than Bajaj Compact. Even in absence of subsidy benefit on Treo the electric variant breaks even with CNG variant.

3 / ELECTRIC - 4W

## TCO parity for personal use is still distant; fleet applications are very close

A retail use case comparison in the premium 4W category between Hyundai Kona and Hyundai Creta highlights that there is a wide gap between the TCO of an electric car and an ICE car. Kona is not only 33% more expensive in terms of upfront cost but on a TCO basis, Kona is about 8% more expensive than Creta.

A comparison between Tata Nexon EV and Nexon ICE in the mid-price segment indicates 2% higher TCO for electric variants.

The commercial use case, however, comes much closer to TCO parity. A comparison between Mahindra e-Verito and ICE Verito for fleet operators indicates a 12% lower TCO for EV when compared to Diesel car and 2% lower TCO when compared to CNG car. Even without the subsidies, which are available on commercial e-4W applications, electric cars are close to TCO parity for a commercial use case. The threshold km/day for a cost parity is about 120 km.

4 / ELECTRIC - BUSES

## TCO parity is distant but government driven demand + subsidies delink the adoption from the TCO equation

Buses have a very high upfront cost differential (>100%) due to the large size of the battery. In terms of the TCO, the gap is very wide and electric buses are about 40% more expensive at a daily use case of 200 km. However, it is expected that the adoption in buses would be based on government push and not on TCO parity.

EXHIBIT 44

## Detailed working for TCO estimation

ELECTRIC VEHICLES: HERO OPTIMA E2, AMPERE ZEAL, ATHER 450X, HERO OPTIMA ER

ICE VEHICLES: TVS XL-100, TVS PEP, HONDA ACTIVA BSVI

All numbers are in **thousand INR** unless otherwise stated

* Range **per charge** or **per liter fuel**

### 2W

| | | 2W-LOW SPEED | | 2W-MEDIUM SPEED | |
|---|---|---|---|---|---|
| | | HERO OPTIMA E2 | TVS XL-100 | AMPERE ZEAL | TVS PEP |
| Vehicle Ex-Showroom Price | | 58 | 45 | 69 | 56 |
| Interest Cost On Loan | | - | - | - | - |
| Additional Battery Cost | | 17 | - | - | - |
| Total Fuel Cost | | 7 | 56 | 8 | 51 |
| Total Maintenance Cost | | 11 | 22 | 11 | 22 |
| Salvage Value | | 12 | 11 | 8 | 14 |
| Total Cost Of Ownership With Subsidy | | 94 | 121 | 95 | 126 |
| Total Cost Of Ownership w/o Subsidy | | 94 | 121 | 116 | 126 |
| Average Running/Day | (Km) | 20 | 20 | 20 | 20 |
| Battery Pack Size | (kWh) | 1.3 | - | 1.8 | - |
| Range* | (Km) | 50 | 50 | 65 | 55 |
| Charging Cycles | (#) | 650 | - | 650 | - |
| Subsidy Available | | - | - | 18 | - |
| Additional Battery | (#) | 1 | - | - | - |

| | | 2W-HIGH SPEED | | 2W-COMMERCIAL USE | |
|---|---|---|---|---|---|
| | | ATHER 450X | HONDA ACTIVA BSVI | HERO OPTIMA ER | HONDA ACTIVA BSVI |
| Vehicle Ex-Showroom Price | | 148 | 70 | 69 | 70 |
| Interest Cost On Loan | | - | - | - | - |
| Additional Battery Cost | | - | - | 73 | - |
| Total Fuel Cost | | 13 | 63 | 30 | 188 |
| Total Maintenance Cost | | 17 | 28 | 22 | 33 |
| Salvage Value | | 23 | 18 | 18 | 14 |
| Total Cost Of Ownership With Subsidy | | 187 | 156 | 191 | 291 |
| Total Cost Of Ownership w/o Subsidy | | 220 | 156 | 212 | 291 |
| Average Running/Day | (Km) | 20 | 20 | 60 | 60 |
| Battery Pack Size | (kWh) | 2.9 | - | 2.7 | - |
| Range* | (Km) | 65 | 45 | 75 | 45 |
| Charging Cycles | (#) | 1,000 | - | 650 | - |
| Subsidy Available | | 27 | - | 18 | - |
| Additional Battery | (#) | - | - | 2 | - |

## 3W

| | | E-RICKSHAW | | 3W-AUTO | |
|---|---|---|---|---|---|
| | | KINETIC SAFAR SMART | KINETIC DX | MAHINDRA TREO | BAJAJ COMPACT |
| Vehicle Ex-Showroom Price | | 191 | 144 | 270 | 240 |
| Interest Cost On Loan | | - | - | - | - |
| Additional Battery Cost | | 154 | 199 | 96 | - |
| Total Fuel Cost | | 89 | 135 | 104 | 302 |
| Total Maintenance Cost | | 17 | 17 | 17 | 28 |
| Salvage Value | | 36 | 26 | 66 | 36 |
| Total Cost Of Ownership With Subsidy | | 456 | 500 | 480 | 580 |
| Total Cost Of Ownership w/o Subsidy | | 501 | 500 | 561 | 580 |
| Average Running/Day | (Km) | 100 | 100 | 100 | 100 |
| Battery Pack Size | (kWh) | 3.8 | 6.7 | 7.4 | - |
| Range* | (Km) | 60 | 70 | 100 | 30 |
| Charging Cycles | (#) | 1,000 | 250 | 1.500 | - |
| Subsidy Available | | 37 | - | 67 | - |
| Additional Battery | (#) | 3 | 10 | 1 | - |

## LCV and Bus

| | | LIGHT COMMERCIAL VEHICLE | | CITY BUS | |
|---|---|---|---|---|---|
| | | CONCEPT LCV | TATA ACE | E-BUS | ICE-BUS |
| Vehicle Ex-Showroom Price | | 625 | 600 | 10,000 | 7,000 |
| Interest Cost On Loan | | 153 | 147 | 2,455 | 1,719 |
| Additional Battery Cost | | 328 | - | - | - |
| Total Fuel Cost | | 706 | 1,008 | 3,528 | 6,912 |
| Total Maintenance Cost | | 55 | 83 | 166 | 276 |
| Salvage Value | | 95 | 60 | 1,629 | 700 |
| Total Cost Of Ownership With Subsidy | | 1,852 | 1,855 | 15,740 | 16,105 |
| Total Cost Of Ownership w/o Subsidy | | 2,196 | 1,855 | 22,609 | 16,105 |
| Average Running/Day | (Km) | 150 | 150 | 200 | 200 |
| Battery Pack Size | (kWh) | 25 | - | 250 | - |
| Range* | (Km) | 75 | 18 | 200 | 3.5 |
| Charging Cycles | (#) | 2,000 | - | 2,500 | - |
| Subsidy Available | | 250 | - | 5,000 | - |
| Additional Battery | (#) | 1 | - | - | - |

## 4W

| | | 4W-MID SEGMENT | | 4W-PREMIUM SEGMENT | | 4W-COMMERCIAL USE | |
|---|---|---|---|---|---|---|---|
| | | TATA NEXON EV | TATA NEXON PETROL | HYUNDAI KONA | HYUNDAI CRETA | MAHINDRA E-VERITO D6 | MAHINDRA VERITO D6 |
| Vehicle Ex-Showroom Price | | 1,550 | 1,150 | 2,388 | 1,800 | 1,005 | 1,000 |
| Interest Cost On Loan | | 381 | 282 | 586 | 442 | 247 | 246 |
| Additional Battery Cost | | - | - | - | - | 273 | - |
| Total Fuel Cost | | 64 | 353 | 75 | 353 | 323 | 786 |
| Total Maintenance Cost | | 33 | 55 | 55 | 83 | 39 | 66 |
| Salvage Value | | 426 | 230 | 648 | 360 | 144 | 100 |
| Total Cost Of Ownership With Subsidy | | 1,800 | 1,758 | 2,763 | 2,549 | 1,871 | 2,126 |
| Total Cost Of Ownership w/o Subsidy | | 1,800 | 1,758 | 2,763 | 2,549 | 2,162 | 2,126 |
| Average Running/Day | (Km) | 30 | 30 | 30 | 30 | 130 | 130 |
| Battery Pack Size | (kWh) | 30 | - | 39 | - | 21 | - |
| Range* | (Km) | 200 | 12 | 220 | 12 | 120 | 20 |
| Charging Cycles | (#) | 1,500 | - | 2,000 | - | 1,200 | - |
| Subsidy Available | | - | - | - | - | 212 | - |
| Additional Battery | (#) | - | - | - | - | 1 | - |

1 / TCO analysis is done basis ex-showroom price as the registration costs vary from state to state with several states having favourable policies towards EVs

2 / Only 4Ws and higher vehicles have been assumed to be purchased through vehicle financing

3 / Cost of additional batteries is assumed at a 20% discount considering exchange benefit and decrease in their price in market

4 / Fuel cost has been estimated basis efficiency assumptions as specified and fuel rate of INR 70/litre for petrol, INR 60/litre for diesel, INR 45/Kg for CNG and INR 7/kWh for Electricity

5 / Maintenance cost has been estimated considering the total utilization of vehicle in Km

6 / Salvage value for ICE and ex-battery EV are considered as a % of upfront cost. The salvage value for battery has been estimated basis the life remaining in battery

7 / Inflation @4% has been assumed for all costs

8 / Subsidy available is taken as per FAME-II portal or as per the criteria specified under FAME-II guidelines

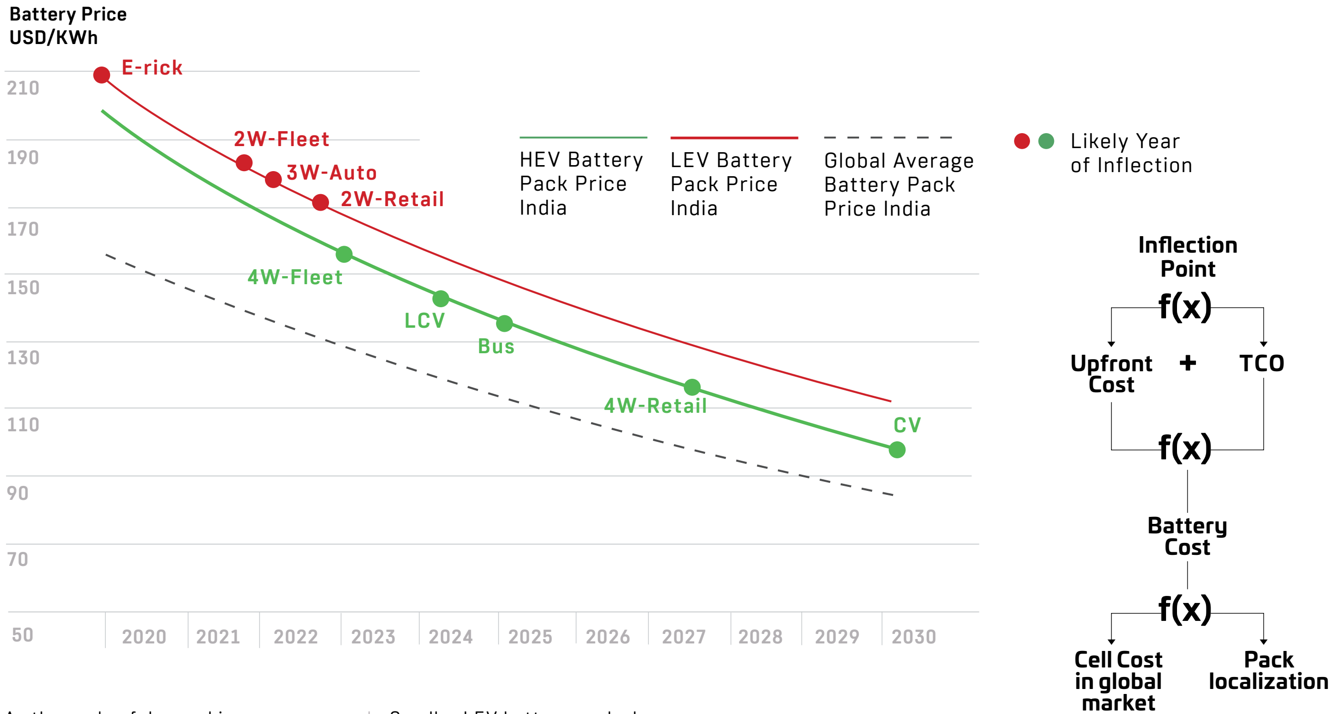
## TCO implications for large scale adoption

While the policy incentives and a general buzz in the market can create momentum for EV adoption, the eventual large-scale adoption will only happen when EVs make economic sense to the end-user. The inflection point for EV adoption in India will be contingent not only on the TCO, but also on the upfront cost. Retail users and individual buyers are especially sensitive to the upfront cost.

The largest driver for the upfront cost and hence the TCO, is the cost of the battery. As the cost of battery reduces, the TCO of the EVs would become lesser than the ICE equivalent models and that would determine the inflection point for rapid adoption of EVs. Higher capital expenditure but lower operating expenses for EVs also makes the asset utilization a critical factor. Commercial applications – where vehicles run for larger distances over their lifetimes are already at or are very close to parity (considering the benefit of subsidies in the case of buses).

EXHIBIT 45

**EV adoption inflection point for different vehicle segments**




As the scale of demand increases and pack manufacturing gets localized, cost differential vs global pack prices will reduce

Smaller LEV battery packs have higher per pack cost as non-cell components do not decrease linearly with pack size

## Early adopters and laggards

Fleet operators understand the logic of TCO and going electric is an inevitable shift for them to stay competitive. They also benefit from a tighter control over the ecosystem and hence, are better positioned to create captive charging infrastructure. They understand the importance of a good battery and are trying to keep closer control over its sourcing by dictating the battery procurement process to OEMs. 2W and 3W fleets must go electric and most of them are already working towards it. 4W fleets face bigger challenges due to charging infrastructure needs and non-availability of good quality entry segment electric cars and so, a transition there will take longer.

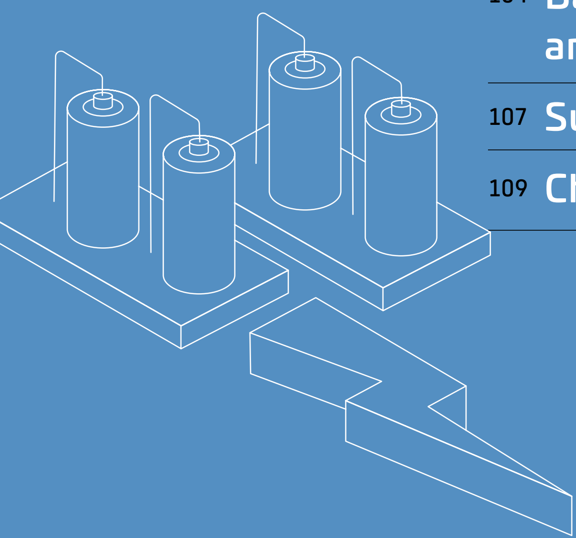
The 3W-auto market has been a laggard in going electric. The primary reason is that the owners of 3W autos are largely individuals and so the demand side drivers are weak. Also, key manufacturers like Bajaj and Piaggio have not yet gone big on electric variants. Both companies are expected to launch their EVs soon and that will create a shift in this segment.

Light commercial vehicle use cases, especially the ones running on a fixed route or with a fixed schedule, are extremely amenable to electrification – e.g. LPG cylinder delivery, e-commerce last mile delivery, etc. While some pilot tests have come up in that segment, it has not seen participation from any meaningful player. The key bottleneck here is a lack of electric LCVs in the market. Key OEMs like Tata and Mahindra as well as a few interesting start-ups are working on electric LCV platforms that should create a positive impact in this segment.

06

# Factors that will determine EV adoption in India





## Key Drivers of EV Adoption in India

The rate and degree of EV penetration in India is not an easy question to answer. However, the drivers of this adoption are clear.

There are four critical factors that will drive this in India over the next decade – policy, battery cost, charging infrastructure and supply chain localization.

The first two factors are the most critical ones and the next two are essential conditions to support large scale adoption.

As part of the analysis, the impact of these factors on the overall adoption has been considered in order to arrive at a reasonable range for EV adoption by FY25.

1 /

# Policy

+ **Mandate** – **Support**

A / Policy support through subsidies alone might not be the most effective tool for large scale adoption

B / A mandated policy guideline, that is in sync with projected EV economic parity can fast-track the adoption significantly

2 /

# Battery Cost

In global market

+ **USD <100/kWh** FY25 – **USD 130+/kWh** FY25

A / Battery cost is the single largest constraint for EV economic parity, thus, preventing large scale adoption

B / The decline in battery prices is fairly certain, but slower decline will affect adoption, especially, in the 4W category

3 /

# Charging Infrastructure

+ **1 Fast Charger** for every 20 EVs – **1 Fast Charger** for every 100 EVs

A / Good public charging infrastructure is essential for retail adoption of EVs especially 4W

B / The chicken and egg situation in charging infrastructure and EV adoption requires an initial push from the government

4 /

# Supply Chain Localization

+ **80%** – **50%**

A / Currently high import dependency for key components

B / Battery packs, motors, controllers, key electronics need to get localized in the country to augment the growth of local players in the EV supply chain

# Policy push vs policy support

India's EV policy ambitions are directionally clear and policy makers have extended reasonable amount of support to the ecosystem. Yet, the penetration of EVs has not reached the level that one would have expected. One of the key reasons behind the lower EV adoption is the economic parity. EVs are significantly more expensive than ICE vehicles in terms of the upfront cost and the TCO argument is slightly difficult to appreciate for a retail customer. Hence, the primary route that the policy has adopted to promote EVs is to subsidize the vehicles.

## 1 / Policy intent is good but execution can be better

The idea behind subsidizing EVs makes sense as the objective is to create momentum in the market. FAME-I was a success in that aspect and FAME-II will hopefully take the industry to a scale where sustainable EV adoption can happen. However, subsidies can't be the driver for large scale adoption – that will happen only when economic parity is considerably in favour of EVs. The FAME-II pool of benefits for 2W is equivalent to 1.3% of the 2W market in India, which clearly underlines the limitations of subsidy driven adoption.

The localization of the supply chain is being promoted through the Phased Manufacturing Program (PMP). The early deadlines for localization have already passed and some of the critical deadlines (e.g. battery, motor) were set for April 2020.

Yet the extent of localization achieved is very low. A strict implementation of such a program is essential but the existing industry traction should also not be derailed in the quest for localization. This is a delicate challenge for the policy to address.

Tax incentives, GST benefits and other measures at the central government level to drive consumer interest are a welcome sign. The state EV policies can complement this effort better. Policy makers are also trying to address some difficult aspects of the EV industry like the reliable supply of key battery raw materials, establishing public charging infrastructure, setting up battery gigafactories in India.

In short, there is basic policy support offered through subsidies with the hope that EV adoption picks up and there are a host of measures to make this adoption sustainable. Making EVs sustainable through localization, supply chain security, etc. can only succeed if adoption picks up. To understand this let us take the example of supply chain. For the battery cell industry to get localized in India, the industry needs to reach a scale where the demand for batteries is at least a 100 gigawatts a year. For domestically manufactured components like motors to be cost competitive, there needs to be a large volume of demand.

The current policy measures have significant limitations. A few bolder steps by the government can do a lot of good for the EV industry in India.

2 /

## The Industry needs policy push and not just policy support

While large scale subsidy driven EV adoption is not feasible, the slow adoption of EVs (once the economic parity is favourable) is also not ideal for the industry. There is reasonable visibility on battery prices and correspondingly on the EV economics vs ICE vehicles. For certain categories, the parity is already achieved and for others it will come as the battery prices decline. One of the key objectives that the policy should drive is to push EV adoption in line with economic feasibility, ensuring that the industry does not lag behind in the EV transition vis-à-vis the rest of the world.

A clearly mandated adoption target is a must for the Indian industry. The scope, nature and timelines for the mandate can be debated with the industry participants and set accordingly, keeping in mind the best interests of the ecosystem as a whole. Mandating EVs has been considered at the policy level and the recent rumours around 100% electrification of 2W/3W attracted fierce criticism from the industry, especially from the ICE OEMs. Before debating the kind of mandate that should come, it is important to understand why a mandated target provide significant impetus to the industry.

A clear mandate achieves three objectives –

A / It removes uncertainty over whether the industry will grow or not

B / Gives a timebound roadmap for stakeholders to prepare themselves for an EV shift

C / Creates confidence within the ecosystem and encourages investments in supporting infrastructure which are essential for large scale EV adoption

The objective of the mandate should be less about expediting the EV adoption and more about streamlining the transition. A large target adoption has massive ramifications for the industry. The 100% 2W/3W mandate which was in the news is extremely difficult to implement and is a potential threat to the overall auto industry.

Huge capital investments would need to be incurred by OEMs; the battery industry would need at least an INR 100 billion of investments towards local manufacturing of batteries. Key new components like motors and controllers would not only need large investments but a hasty mandate could mean that the industry could become over reliant on the global industry for technology.

At the end of this, the important question is whether the customer would prefer to buy an electric vehicle that is either high in cost or low on performance. If not, then there would be massive repercussions on the established auto industry. Some important considerations while mandating EVs are –

I / The extent of the mandate needs to be in sync with the level of demand that makes economic sense for EVs. Otherwise, OEMs will find it difficult to meet their targets.

II / The timing of the mandate must consider the economic parity of EVs vs ICE vehicles. The objective of mandating adoption is not to sell EVs when they are not economically viable but to ensure that as soon as economic parity is achieved the adoption picks up rapidly.

III / Supply chain is virtually non-existent today in India, mandated adoption should not come by relying on imports. Enough time must be given for the domestic industry to prepare itself for supporting EV production.

Fleets are one of the first segments where a mandate could come in effect. Fleets have favourable economics for EV adoption and they can appreciate the higher capital expenditure for lower operational expenses. Such a mandate would also need minimal subsidization from the government as EVs are at or close to economic parity already for fleet usage. Such a mandate could act as a pilot experiment for a larger, more long-term mandate for OEMs. For larger mandates, flexibility can be built into the method of implementation. China is good example in this context. Starting from 2019, China introduced EV credit policy by which automakers have to earn credit points from NEVs equivalent to a certain percentage of the total vehicles produced. The credit points required increase every following year starting at 10% in 2019 and there are penalties for not completing the credit requirements.

To conclude, the mandated EV adoption target must be set in India. Policy support keeps the onus of implementation on the government, while a mandated target shifts the onus of implementation on the stakeholders in the ecosystem. The latter is a more rational and practical approach, assuming that the nature of the mandate is carefully drafted.

# Battery cost reduction a key enabler

Battery cost reduction is an important driver for EV adoption as it significantly impacts the upfront cost and TCO parity of the EVs. How battery costs pan out over the next five years is perhaps the biggest determinant of EV adoption in India.

Battery costs have fallen by around 85% in the last decade. The prices are further expected to decline rapidly. The elements driving the price decline are as follows –

1 /

## Changes in cell chemistries

New cell chemistries are being aimed at reducing consumption of expensive raw materials and offering higher performance in terms of energy density.

E.g.

NCM 811 chemistry uses 50% less Cobalt and Manganese than NCM 622. Chemistry upgrade of the electrodes is the key to a high energy battery but the trade-off with structural stability must be managed.

2 /

## Scale of operation

Large capacity creation in cell and battery manufacturing is enabling economies of scale. In addition, production lines are running at higher speeds.

E.g.

One of SDI's lines increased from an original capacity of 300K cell / month to 500K cell / month. Surplus capacity in the market is also creating pricing pressure on manufacturers.

3 /

## Developments in other components

Improvements in other critical cost components like electrolytes and separators are further reducing the cost of batteries.

E.g.

In 2016, a research group including Toyota discovered the conductor LiSiPSCl, which has ionic conductivity around 2.5x the performance of existing electrolytes.

## Global price projections

Battery prices vary between chemistries. Different companies and OEMs have chosen different chemistries. NCM, NCA, LFP are the key chemistries in the market today. The price expectations for different battery chemistries are mapped in the chart below.

The mix of battery chemistries is also expected to change over a period of time. LFP and NCM 111 are expected to phase out slowly. Nickel rich NCM chemistries are expected to take a larger share of the market. Average battery prices are expected to demonstrate a falling trend till 2025. Overall, the prices are expected to fall to 110 - 120 USD/kWh by 2025.

EXHIBIT 46

**Global average battery pack price projection**

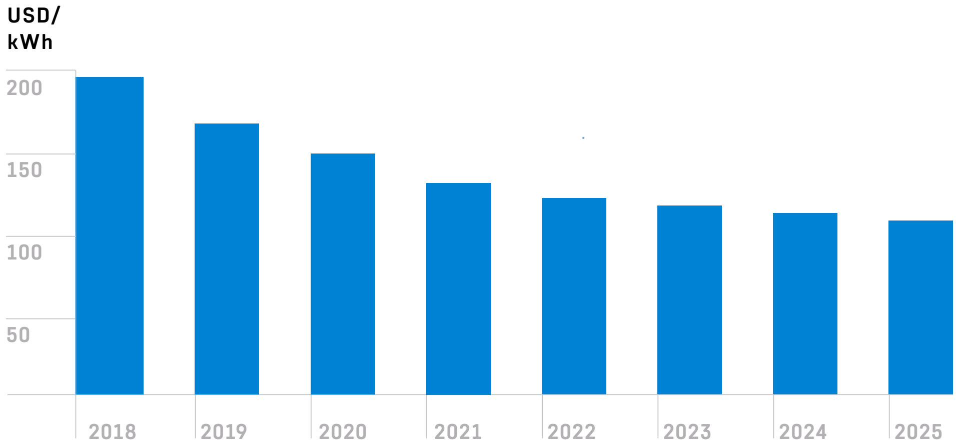
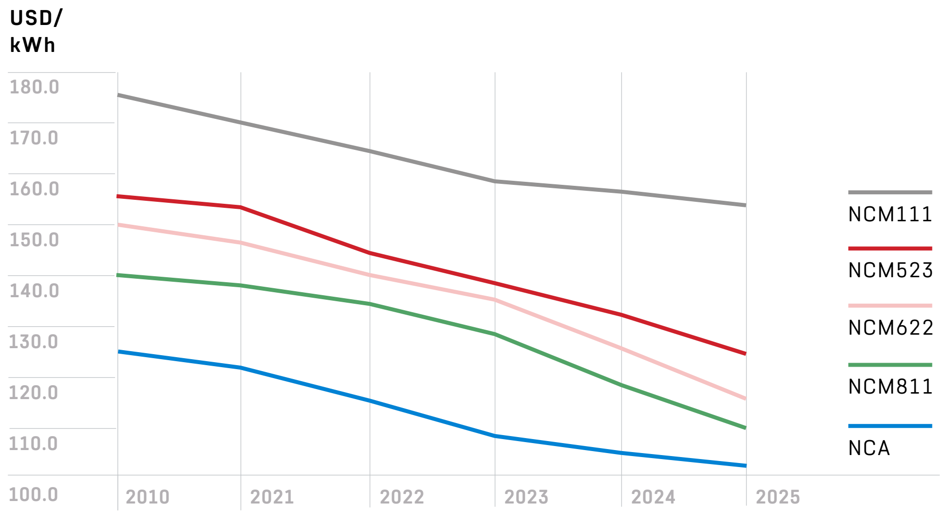



EXHIBIT 47

**Average pack price expected by chemistry type**



## Battery price implications for the Indian market

Price points in the Indian battery market are significantly different when compared to the global market and a direct comparison with global price average does not portray the ground reality of the Indian market. A number of factors are responsible for such contrasting market dynamics in India.

I /

### Lower bargaining power over cell manufacturers

The demand scale in India is minuscule at the moment. Thus, the cell prices that Indian battery pack manufacturers get are significantly higher than what a large global OEM with much higher volumes has to pay.

II /

### Market composition

The Indian market is largely concentrated towards small batteries like 1-10 kWh. Currently, even the locally manufactured passenger vehicles operate with very small batteries of <30 kWh. The ex-cell cost of a battery pack does not move linearly with the pack size. The global data represents an average battery pack size of 60 kWh. Smaller batteries have higher per kWh price on account of increased costs in terms of balance of pack.

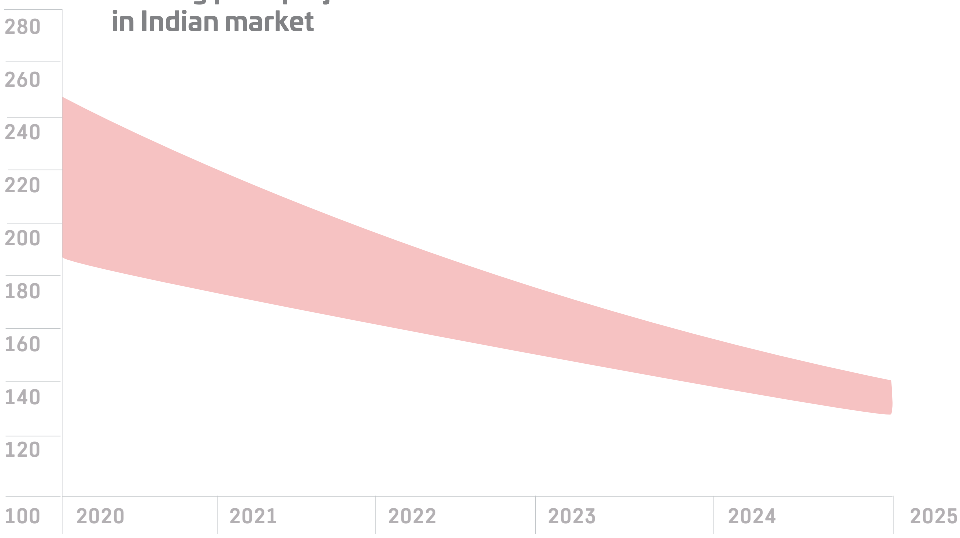
III /

### Chemistry choice

India is largely using LFP and NCM 1:1:1 at the moment. Going forward, most Indian players are expected to rely on NCM chemistry with a gradual shift towards Nickel rich variants. NCM 6:2:2 and NCM 7:4:3 are already being used by 4W and bus OEMs in the domestic market.

EXHIBIT 48

**Battery price projection in Indian market**




Taking into consideration the decrease in battery prices at a global level and the increasing scale of the Indian market, battery prices are expected to fall to USD 130-150 /kWh by FY25.

## Supply chain reinvention and its localization

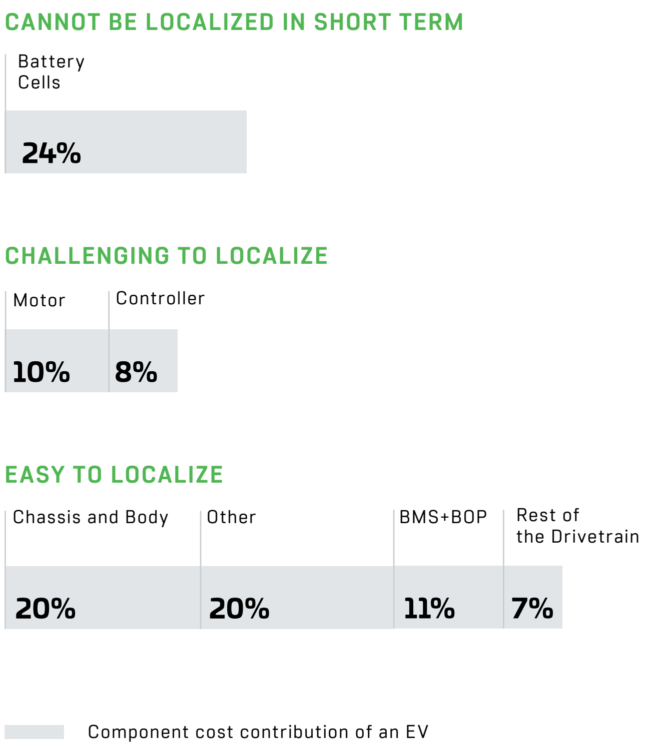
EV manufacturing in India, currently, is largely supported by imported components. While the small scale doesn't justify the localization of critical components, a roadmap to do so as the industry gains scale, would be imperative. Electric vehicle components present an INR 200 bn market opportunity by FY25 in India. As a country, India has been historically very good at cost engineering in manufacturing set ups. However, a large portion of EV components need deep technological capabilities.

Time, effort and large amounts of capital is needed to make sure that when the EV dream is actually realized in India, it is supported by a vibrant domestic supply chain rather than an import dependent supply chain.

Localization of the supply chain is also critical from the perspective of bridging the cost differential between EVs and ICE vehicles. A well-established local supply chain can help reduce the cost of electric vehicles.

EXHIBIT 49

**Ease of localization for different components**

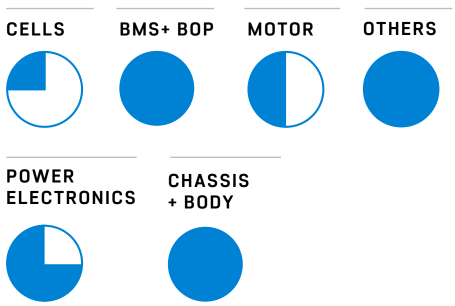


There are two key stakeholders that influence the supply chain localization in India – the first is the government and the second are the incumbent auto component companies. The government has taken policy measures to support component localization in India. Phased Manufacturing Program is an important step in this direction. Incumbent auto component companies have vast experience in the automobile industry in India. They are excellent at cost engineering and have the muscle to deploy capital for new components for EVs.

While a well established supply chain is not a direct determinant of EV adoption, whether or not the supply chain can get localized is an important question that needs to be addressed.

This localization has its own challenges, and it will take time, but the country needs to invest in it, starting from now.

EXHIBIT 50
**Potential for localization**




## Key challenges in localization

Cells, which are the largest cost component in EVs, are also the most difficult to indigenize. Even in the best case, a large majority of cells are expected to be imported into India.

BMS and BOP technology, on the other hand, are relatively easier to master. Field experience is critical for fine-tuning BMSs and that will only come with a learning curve of the Indian market.

A lack of availability of rare earth magnets is a key bottleneck for the domestic motor industry. Small motors for light electric vehicles should be easier to manufacture locally. Large motors need sophisticated technology and could take a longer time to be localized in India. The market for larger motors is also expected to be limited as adoption in the PV and CV segments will be low until FY25.

Controllers are technologically intensive and can be developed locally if investments are made in technology. There are already companies that are focussing on EV controllers, specially, for the 2W and 3W markets, where there is a large void, as global players are more focussed on PV and CV segments.

Other components and bodies are closer to the core strength of Indian manufacturers and there is a high likelihood that their manufacturing will get localized rather quickly.

EXHIBIT 51
**Localization opportunity for EV components**

| COMPONENT | CELLS | BMS+BOP | MOTOR | POWER ELECTRONICS | CHASSIS & BODY | OTHERS |
|---|---|---|---|---|---|---|
| FY25 MARKET SIZE (INR bn) | 80 | 35 | 25 | 35 | 75 | |
| CURRENT LOCALIZATION | None | Low | Very Low | Very Low | High | Low |
| OPTIMISTIC CASE | 30% | 100% | 70% | 100% | 100% | 75% |
| PESSIMISTIC CASE | <5% | 40% | 30% | 50% | 80% | 50% |

## Charging infrastructure for India's unique needs

The Indian EV market has multiple unique requirements. 2W and 3W make up for over 80% of the overall market and are likely to be the first adopters of electric vehicles.

Low and medium speed 2Ws can be easily charged at home and most of them run less km/day than what the battery capacity allows, making range anxiety a lesser of a problem. A large portion of the urban population lives in high-rise buildings, where parking facilities are either poor or non-existent.

3W typically require an additional charge during the day given that they run for longer distances. This additional charging has critical implications for the driver as the time it takes is the opportunity cost for not running the vehicle.

In passenger cars globally, 70% of the charging is done at home on slow AC chargers and the rest is supported by the public charging infrastructure. Home charging in India, especially, in urban areas is tricky due to the lack of proper parking arrangements. Also, the miniscule levels of 4W EV uptake is not encouraging the development of public charging infrastructure.

Buses have very large batteries that need DC fast chargers to charge them in 5-6 hours during the night. While depots are perfect places to charge these buses at night, each depot has hundreds of buses and if a significant number of them need to be charged together, the capability of the grid is an important aspect to be considered.

EXHIBIT 52
**EV charging requirements**

| | 2W | 3W | PV | BUS |
|---|---|---|---|---|
| TYPICAL BATTERY | 2 kWh | 4-8 kWh | 40 kWh | 200 kWh |
| CHARGING TIME | AC – 3-4 hrs | AC - 4/5 hours<br>DC - 30 mins | AC - 7/8 hours<br>DC - 1 hour | DC – 3-4 hrs |
| MOST SUITABLE PLACE | Home | Home/Station | Home/Station | Depot |
| POTENTIAL SOLUTIONS | Infrastructure development at residential complexes<br>Business models to charge 2W through regular plug points at various commercials places | Battery swapping<br>Infrastructure development by fleets | Infrastructure development by/ or for fleets<br>Public charging stations with business models that attract customers | Distributed pantograph charging |

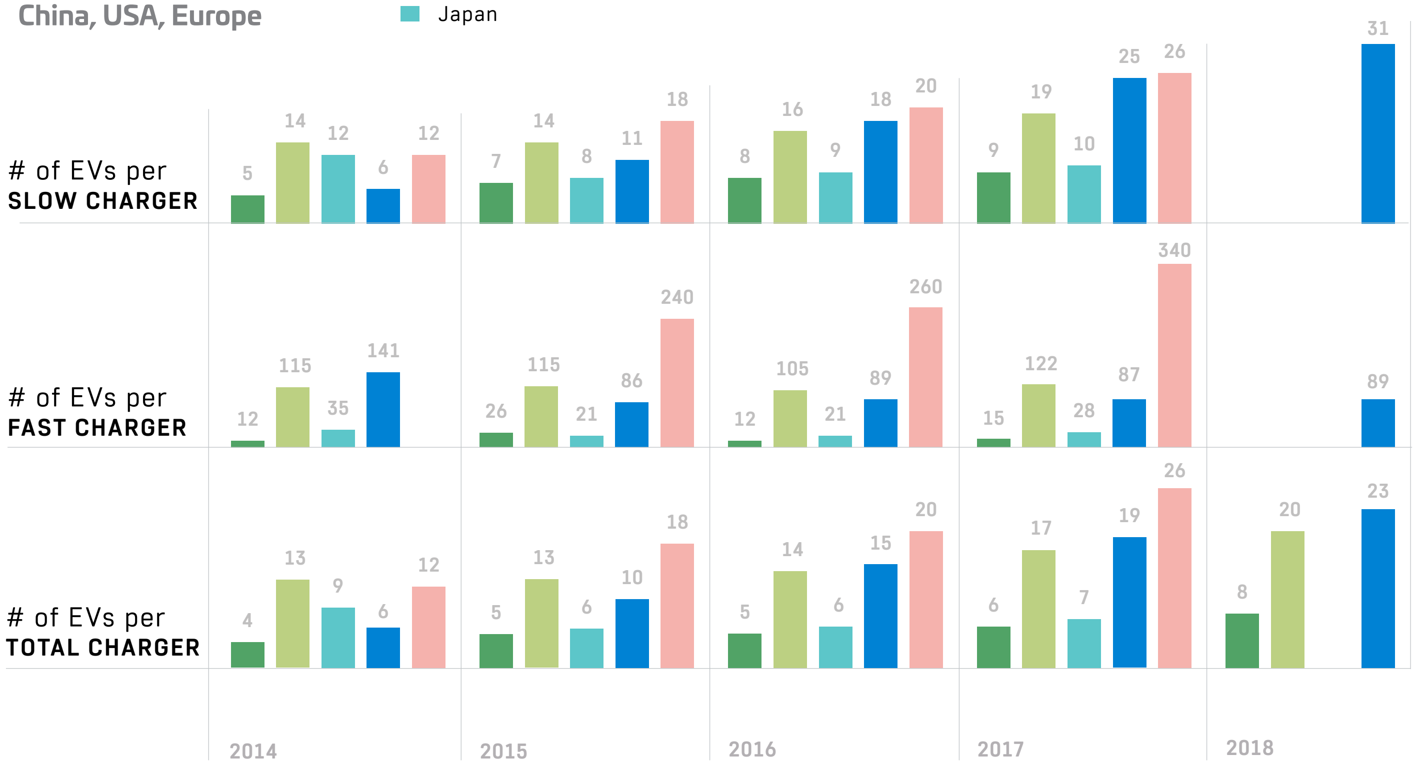
Public charging infrastructure has not been conducive for initial adoption in the Indian market. The country is witnessing almost non-existent infrastructure, despite all the buzz around EVs in the market today. While the initial EV adoption was not aided by public charging infrastructure, creation of the same is a necessary condition for large scale adoption in the country. Both EV adoption and charging infrastructure will need to be developed simultaneously. Development of residential/private/commercial infrastructure will need creation of awareness, municipal level policy support and some innovative business models.

Globally, EV adoption has been supported by extensive charging infrastructure development. China invested huge amounts of money in creation of charging infrastructure. Today, China has close to 50% of the global infrastructure and also has 50% of the global EV market.

EXHIBIT 53

**EV charging infrastructure — China, USA, Europe**

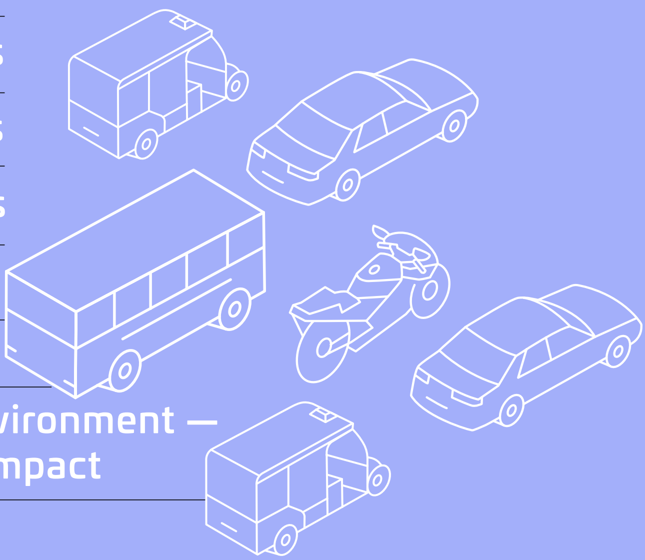
A lower EV/Charger ratio indicates denser charging infrastructure



07

# EV Penetration in India





# Scenarios over the next 5 years

Battery price reduction is the most important driver for mass scale adoption of EVs. As prices fall, the role of policy would be critical in ensuring that India doesn't lag in EV adoption. Policy and battery cost are the two main drivers that will decide how adoption takes place in India over the next 5 years. Development of local supply chain and public charging infrastructure are two supporting conditions that will have a further impact on the extent of EV adoption in the country.

3W, 2W Fleet, 2W Retail, Buses, 4W Fleet, 4W Retail would be the pecking order of electrification in India. 2W/3W present an attractive TCO argument. A controlled mandated adoption target could make a significant difference to the growth in this category. E-bus adoption is driven by the government and will continue to be the case given the lack of TCO parity. 4W adoption is largely expected to be restricted to 4W fleets, with retail penetration being driven by the OEMs, push to launch new variants in the market and the development of public charging infrastructure.

EXHIBIT 54
**Rate of EV adoption**

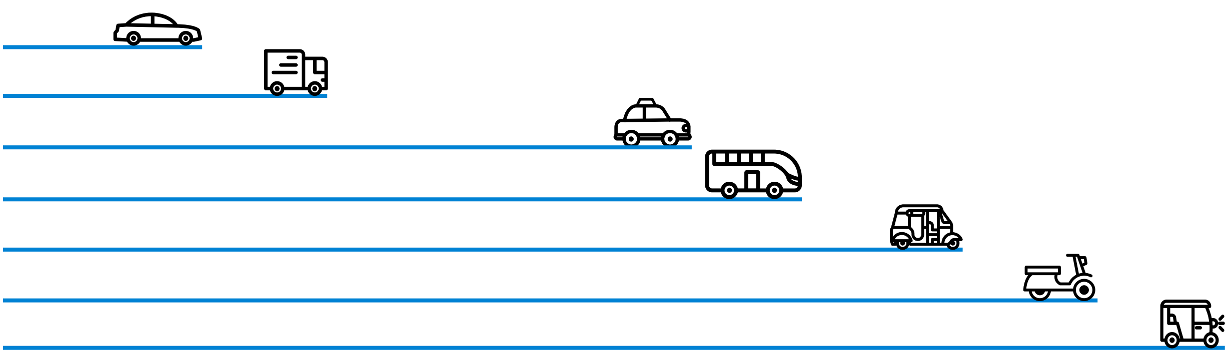
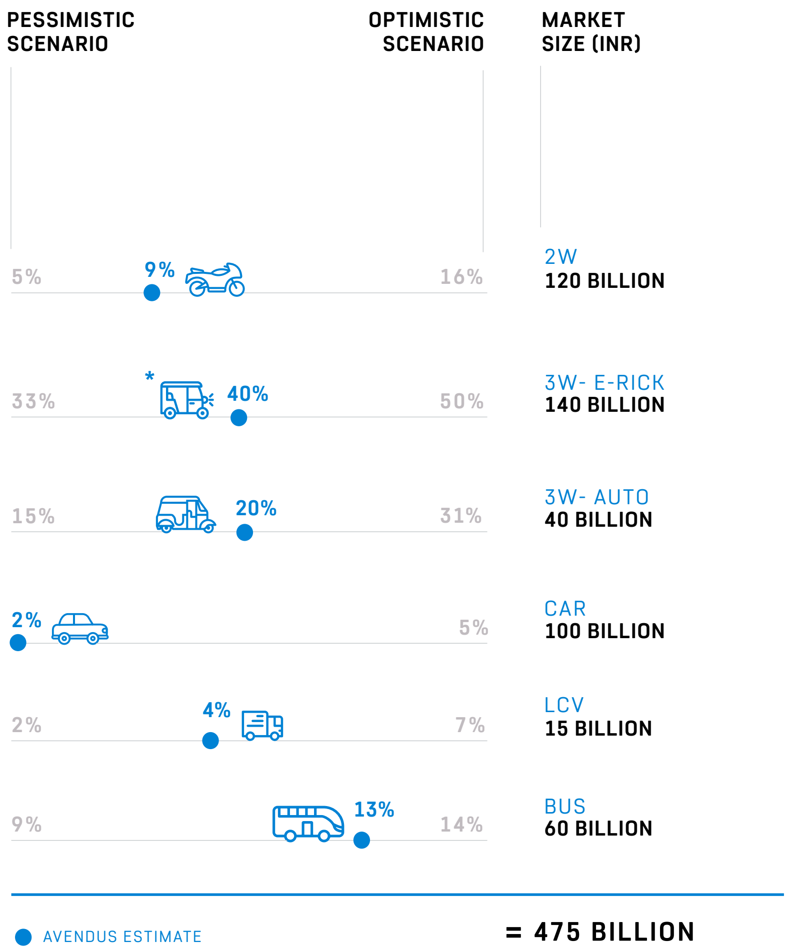


EXHIBIT 55

## Electric Vehicle adoption in India

| DRIVERS FOR ADOPTION | POLICY | + BATTERY PRICE | + CHARGING INFRASTRUCTURE | + SUPPLY CHAIN EVOLUTION |
|---|---|---|---|---|
| SCENARIOS | + Mandated adoption target | + USD 120-130/kWh by FY25 | + Easy access to high voltage DC fast charging | + 80%+ components localized |
| | - Clear policy framework and support through incentives | - USD 140-150/kWh by FY25 | - Poor public charging infrastructure | - <50% components localized |

## = FY25 EV adoption scenarios




* Penetration represents the adoption of Li-ion batteries in this segment. Market Opportunity represents the total market size

## 2W — Upfront cost expected to be a major dampener, despite favourable TCO

The total cost of ownership of low to medium specification electric 2W is lower than ICE vehicle equivalents. The operating costs which are almost 1/6$^{th}$ in case of electric vehicles, is the major driver for TCO parity despite the upfront cost being high. 2W is largely a retail market and is highly sensitive to pricing. Thus, in addition to favorable TCO, lower upfront cost is essential for mass adoption of e-2Ws.

However, as the battery prices reduce, it is expected that a reduction in upfront cost will drive interest among retail customers. The point of inflection for mass adoption of electric 2W is expected to be reached by around FY23 with battery prices falling to USD 160-170/kWh. By that time, a successful implementation of FAME-II would put 1 million electric 2W on road, giving a vital learning curve for the whole ecosystem.

Customers need access to good financing options to buy EVs, availability of which is limited currently. General awareness around EVs could attract the higher usage customers to shift to EVs. Customers also need better purchase options in the market. EVs are easy to make and customize. If OEMs were focused on scale and cost for ICE vehicles, they need to focus on customization and the value proposition for EVs. A typical large ICE vehicle 2W OEM has 5-6 models in its portfolio whereas a typical large OEM of the future would have 15-20 EV models offering a wide choice of specifications for the customer.

The role that top incumbent 2W ICE vehicle companies in India assume during this transition would define not only how the industry transforms but also how these companies endure the EV shift. One of the key impacts that EVs are likely to have on the 2W OEM industry is that it will become more fragmented than what the current ICE market is. It is more likely that the industry will have 6-8 large players accounting for the majority of the market along with a number of small players operating in niche market segments.

2W fleets are likely to shift to EVs much more rapidly. Dock-less ride sharing companies, delivery fleets like Swiggy or Domino's are already charting out plans to go electric. For fleets, considering massively low operating costs, not going electric would be a costly mistake.

## 3W —
## E-ricks to rapidly shift to Li-ion, and Autos to benefit from a strong TCO rationale

E-ricks has been a surprise category and has grown rapidly in the last 5 years. Currently, a majority of the market is based on Lead Acid batteries. The e-rick market is around 0.7 million units a year. Close to 50% of this market is completely unorganized and unregulated. The cost of an e-rick from an unorganized-unregulated market to a fully organized-regulated market changes from INR 80K to about INR 130K.

Li-ion is a superior battery choice as compared to Lead Acid. Li-ion batteries have a longer life, higher depth of discharge, do not result in massive deterioration in range over the life of the battery, and can be charged quickly as compared to Lead Acid batteries. A shift from Lead Acid to Lithium makes complete sense right now. Fleet based 3W operations have already started to use Li-ion. However, the problem of higher upfront costs is dampening Li-ion adoption in the e-rick market at a larger scale. The good quality, regulation compliant e-ricks with Lead Acid batteries cost around INR 130K. The same would cost around INR 190K with Li-ion batteries.

Li-ion based e-ricks are expected to get up to 25% market share by FY23 and after that, the shift could become very rapid. The market is expected to shift away from unorganized-unregulated to at least semi-organized and regulated.

The auto market is concentrated between 3 OEMs and is almost entirely retail in nature. So far, there has been no push from OEMs nor any pull from the demand side. However, several factors are prompting auto makers to shift to electric. With e-ricks growing, the traditional auto market has the pressure of staying relevant. Even though e-ricks and autos operate in mutually exclusive segments right now, the line between these two categories is thin and might vanish in the future as bigger batteries become cheaper. On a TCO argument, e-autos make sense even against CNG 3W vehicles. This, along with additional benefits like no permit cost, will drive the adoption of electric autos in the near term. Key OEMs are in the final phase of their product development. Bajaj and Piaggio are expected to come out with e-autos soon.

A 20% penetration in the 3W-auto category is expected by FY25.

## 4W— Adoption to largely remain restricted to fleets. OEMs will be key in driving retail penetration

India is a relatively difficult market for electric cars. 78% of Indian car sales are at price points of sub INR 1 million. An electric car with the same price tag cannot match the performance of an ICE car. ICE equivalent cars have a much bigger battery. While the Indian market is less likely to go for super big battery packs like the 100 kWh used in Tesla, even a 40 kWh battery pack creates a huge difference in the upfront cost for cars. Plus, retail use case of cars have lower running over their lifetime and so, the TCO argument does not hold true for retail customers. A good electric car, however, provides a driving experience that cannot even remotely be matched by an ICE vehicle. That has to be the key retail sales pitch for electric cars.

Electric cars in the retail category are expected to make up 2% of the market by FY25. The tipping point for electric cars is expected to come around FY27 at battery prices of around USD 120/kWh.

Fleet operators on the other hand are incentivized to go electric. On a TCO basis, electric cars are cheaper for average daily running in excess of 120 km. Fleets also benefit from the fact that they can set up their own captive charging infrastructure to manage the charging demand. They also have a complete understanding of the pattern of demand for charging, usage of battery, etc. and can create a more economical fleet ecosystem as compared to ICE. Several successful cases have been seen in India. Lithium Urban is operating a 1,000+ strong fleet of electric cars. An electric car is a high capital investment and any use case that can assure a high asset utilization is fully incentivized to go electric.

20% of the 4W fleet market in India is expected to shift to electric by FY25.

## Bus — Will continue to be driven by public transport demand, led by the government

The electrification of buses in India is primarily being driven by the objective of reducing pollution in cities. In that context, the factors that were identified as critical for electrification have lesser impact on bus electrification. DHI is in the process of deploying 5,000+ buses under FAME-II. Various state governments have laid down plans for pubic transport bus electrification.

At current battery prices, the cost differential between an electric bus and diesel/CNG bus is huge and even on a TCO basis, electric buses are significantly more expensive. Thus, without subsidies, bus sales are not expected to happen. FAME-II covers for 7,090 buses by FY22; there are additional efforts by the state governments to promote electric buses.

Electric buses are expected to come at TCO parity with ICE equivalents at batteries prices of USD <100/kWh. By FY25, electric buses will contribute to about 13% of total sales.

## Interesting opportunities in the LCV space and freight applications

High capital expenditure, low operating expense – that summarizes the EV economic viability decision. Hence, any business model that can ensure high utilization of vehicles has an advantage in going electric. In that perspective, light commercial vehicles segment is an interesting opportunity for EVs. For both goods carriers as well as last mile public transport, electric LCVs make economic sense. Key CV OEMs – Tata Motors, M&M and Ashok Leyland are working on e-LCV models.

Trucks suffer from the same capital cost dilemma as buses. However, freight operations can offer very high asset utilization levels and have the potential to go electric. Electric mobility as a service for freight operators, is a business model that is being closely evaluated by OEMs and investors, and is likely to come to fruition soon.

EVs are likely to penetrate up to 4% in the LCV segment. Penetration in the truck segment is not likely to pick up outside mobility-as-a-service business models.

## Current Environment

# Current Environment — COVID-19 Impact

**Expect a relatively rapid revival of the EV industry in India**

COVID-19 has hit the Indian auto industry at a time when it was already grappling with the dual challenge of slower demand and recent BS-VI transition. In FY20, ICE auto sales declined by 18%. Given the COVID-19 situation, Q1FY21 is expected to be a washout for most OEMs even though most of them are resuming production at some scale. FY21 is expected to be a tough year for the auto industry and sales are expected to show a double digit decline across vehicle categories.

EV sales increased by 20% in FY20 – a slower than expected growth as there was a FAME-II transition impact on the e-2W market (as discussed earlier in the report). A significant portion of the EV industry in India is represented by SMEs and start-ups. The COVID-19 lockdown is expected to affect this part of the industry the most. EV plans for most ICE OEMs are likely to be on the backburner as these companies will be busy restoring their "bread-and-butter" ICE products. The EV industry, in the short term, will have to fight for survival given that most of the EV players have been focussed on growth and and have been generating limited cash.

COVID-19 is expected to be a part of our lives for the next 12-18 months. The auto sector, in general, might be on a slow revival trajectory post COVID-19 but the revival of the EV industry is expected to be faster. The EV consumer of today is significantly different as compared to an ICE vehicle consumer. EV purchase decision is influenced more by the value proposition rather than only on comfort or leisure. To that extent, the impact of reduction in discretionary consumer expenditure is less likely to affect EVs than ICE vehicles.

97% of EV sales in India are in the 2W segment and within 2Ws, 90%+ sales are in the low-medium speed segment. The low-medium speed e-2Ws are marginally cheaper than ICE vehicles in terms of upfront cost and significantly cheaper in terms of TCO. Hence, while the overall 2W market will degrow in FY21, EVs as a percentage of 2W sales could very well increase. The need for affordable personal mobility will increase in a COVID-19 world. E-2Ws make a strong case for such mobility demand.

In other segments, the COVID-19 impact could be more significant. e-auto launches by major auto OEMs are likely to get deferred. The growth of e-ricks will slow down as the use of public transport by people reduces. Shared mobility presented a compelling use case for e-4W but that segment will now be dented significantly in the near term. The retail demand for e-4W can get heavily impacted as the value-for-money proposition here is not as strong as e-2W and e-3Ws. Buses are relatively neutral and the electric bus market is expected to show strong growth on account of e-bus deployment project under FAME-II.

In summary, while the short-term negative impact on EV growth is certain, the EV industry is likely to revive faster and penetrate deeper into the overall auto sales in India.

While it is too early to draw parallels, the trends in the global EV market indicate a lower impact of COVID-19 on EVs. Sales in worse affected countries in Europe and China were impacted lesser than ICE vehicles in the months of February and March 2020. The revival of EV sales has been rather encouraging in China. Electric car sales in China grew more than 3X in March-20 as compared to February-20, ending up with a 5.7% penetration for the month – higher than the 2019 number.

## COVID-19 to expedite the ICE-EV shift in the long term

In the longer term, COVID-19 is expected to accelerate the ICE-EV shift at a global scale.

Multiple structural changes are expected to take shape in the post COVID-19 world —

**Aspiration for clean mobility**

**Need for affordable personal mobility**

**Growth of online delivery**

**Value driven purchase**

The aspiration for shifting to a cleaner mobility will get fresh impetus at a policy level as well as at a personal level. The otherwise price sensitive Indian customer is much more likely to appreciate the value of cleaner mobility – a shift that in the normal course of life would have been difficult. The policy's focus on EVs will get slightly distracted in the short term but is likely to become firmer in the long term.

The demand for affordable personal mobility will go up. Auto sales in China, post SARS-2002, went up due to an increased demand for personal mobility. The poor state of public transport in India means that the need for affordable personal mobility can increase even faster in a post COVID-19 India. The e-2Ws are most likely to cater to this mobility need, as the e-4Ws still do not make an equally meritorious case for retail use.

The online delivery market is expected to grow faster post COVID-19. These companies are highly incentivized to go electric due to a lower TCO.

Consumer purchase decisions are expected to be more value driven rather than leisure, feature or performance driven. The shift from ICE 2W to e-2W would be much faster in such purchase decisions. The shift from ICE to EV in commercial (especially fleets) use cases in 3Ws, 4Ws and LCVs will become faster in the long term.

FY22 was expected to be the inflection year for the Indian EV industry. In the context of COVID-19, the inflection point is likely to get delayed by a year. But the EV transition post the inflection point will be faster and the industry is expected to stay on track to achieve the FY25 penetration levels that it would have achieved in the absence of COVID-19.