

# Rise of Electric Vehicles

And The Impact Created By Changing  
Consumer Preferences



2017



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## FOREWORD

This knowledge paper advocates the incremental transition to electric mobility in India. TechSci Research is of strong view that this revolution in Indian transportation space will open-up vast business avenues for international as well as domestic manufacturers. The paper highlights issues pertaining to long term energy security and environmental impact caused by fossil fuel based vehicles. However, there are some ground realities in India and globally that continue to remain long term challenges for extensive uptake and penetration of electric vehicles. These challenges eventually form vast business opportunities for some of the companies who plan to get benefitted by rising electric vehicle demand. Also technology improvements in battery

capacity, fast charging facilities, vehicle range, etc. are rapid and dynamic with most of the OEMs and companies in the value chain making huge investments in research and development activities. With increased government focus on vehicle electrification, OEMs have great opportunity to backward integrate, secure raw materials, component sourcing and create better and affordable products for the consumers.

I firmly believe that contents of this knowledge paper will provide vital insights to OEMs, Mobility Service Companies, EV component manufacturers and policy makers in achieving a smooth transition into electric vehicle ecosystem.

**Karan Chechi**

Director – Research

TechSci Research



# Executive Summary



# EXECUTIVE SUMMARY

The paper aims at identifying global best practices, OEMs and government initiatives, which are instrumental in faster adoption of electric vehicle in different countries.

In India, recent government announcements and thrust for electric vehicles have opened a plethora of opportunities for international and domestic players.

The Indian government is exploring possible investments across the electric vehicle value chain, and therefore opening a large automobile segment for manufacturers to cater to.

Battery is the most important part of an electric vehicle. Globally Lithium Ion batteries are used to power all kind of electric vehicles. Therefore, it is very important to

understand the current global scenario of Lithium-ion capacities, production and applications. Indian government and OEMs understand the criticality of this subject, so there is an increasing focus towards manufacturing and bringing down the cost of batteries so that electric vehicle becomes affordable for the masses.

The paper also highlights current state of electric vehicle users and prospective buyers taking about issues, challenges and factors, which will eventually help customers in taking buying decision.

The paper is concluded by showcasing key challenges and opportunities in electric vehicle ecosystem.

**Neeraj Singal**  
CEO – Semco India,  
Director – Lightyear  
Infratech



“Convenient charging is key to EVs being seen as a viable alternative to conventional vehicles.

There can be no widespread adoption of Electric Vehicles in India without first developing the required charging infrastructure.”

**Christie Fernandez**  
Founder – SOOORYA EV  
PTE LTD



“India, with its strengths in small car manufacturing, frugal engineering & innovative mindset, has an opportunity to become the leader in affordable electric vehicles...”

While the west is focused on Speed, Range & Charging Time, India can design & manufacture vehicles to suit the needs of the emerging markets in Asia, Africa & South America for affordable transportation... Countries in the southern hemisphere are blessed with abundant sunshine, so integrating solar based solutions in electric vehicles will help to strengthen India’s leadership in these fast-growing markets...”



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# Electric Vehicles Global Scenario



# 1 ELECTRIC VEHICLES Global Overview

## 1.1. Faster Adoption of EVs in Developed Economies

The rising air pollution levels and global warming has been consistently pressurizing the countries to come up with ways to curb pollution levels. The automotive industry has been on receiving end of the criticism. With rising regulatory pressure, the automotive industry is evolving, and the trend is moving from adoption of Electric vehicles to banning of fossil fuel vehicles.

Developed economies such as France, Britain, Norway, Scotland, Germany announced ban on fossil fuel vehicles latest by 2040. Developing economies such as China and India followed the suit. Small economies such as Norway were early adopters of EVs, and currently have highest penetration amongst the European countries with penetration of almost 30%.

Hence, a 'Electric vehicles' has moved from just being a buzzword to the mainstream business. When there is such a huge policy push across the globe, the market players must take note of it.

Volkswagen, one of the largest automobile companies, has declared publicly that Tesla is its biggest competitor and it has announced that it would attempt to bring 30 or more BEVs by 2025 and EVs would account roughly 25% of its total sales. Jaguar Land Rover announced that all its models would be electric from 2020 onwards. Similarly, other European car makers Daimler, Volvo, BMW have announced their plans.

While European automakers have made concrete plans for the next phase of revolution, traditional US auto majors such as Ford, GM and Chrysler are lagging behind as they did not foresee the potential EVs have to offer. To correct their mistake and cover up on a lost ground, they have moved towards China and increasingly establishing JVs with Chinese players.

Japanese manufacturers with models such as Nissan Leaf and Toyota Prius have made their presence felt in the electric vehicle industry, globally.

The discussion about electric vehicles would not be complete without mention of Tesla. While we agree Tesla leads the electric vehicles sales in BEV category, BYD is the market leader in BEV+PHEV category and beats Tesla.

While the auto majors are ramping up for big change, needless to say, the automotive component manufacturers are also feeling the heat.

### Key Announcements for EV market

Company	EV announcements
Volkswagen	30 or more BEVs by 2025 and EVs would account roughly 25% of its total sales
Jaguar Land Rover	All its models would be electric from 2020 onwards
Mercedes Benz	Will spend 1 Billion USD to build electric cars
Daimler	To spend 755 Million USD in China for electric car and battery production
Volvo	All New models would be electric or hybrid from 2019 onwards
BMW	25 all electric and hybrid vehicles by 2025
Ford	Exploring JV with little known Chinese firm Anhui Zotye Automobile Co., to build electric passenger vehicles in China under a new brand

Bosch, the world's largest auto component supplier, has divested its starter and generator business to a large Chinese firm. The starter and generator business of Bosch enjoys leading business position with presence in more than 14 countries

While the developed regions of Europe and US were getting ready for the next revolution, Asian markets were contemplating on their path forward. China, as always, has taken the lead and established ecosystem for EVs, and currently, leads the EV market in the APAC region.

**The Seattle area's buses, manufactured by Proterra Inc., have batteries that can be recharged in less than 10 minutes.**

### Toshiba SCiB battery cells in Proterra electric bus



Source: Inside EVs



While the electric automobile market is buzzing with product innovations and market investments, automakers race to put battery-powered cars on the road, other industries like aviation are not lagging and are continuously exploring and introducing products using alternate power source.

Boeing backed Zunum Aero’s 12-seat plane will carry battery packs and a small fuel reserve for a back-up engine. The first model will fly about 700 miles, far enough to ferry travelers from Boston to Washington or Silicon Valley to Los Angeles. On similar lines, another start up Vimana has developed an electric air taxi prototype to carry passenger over short distances.

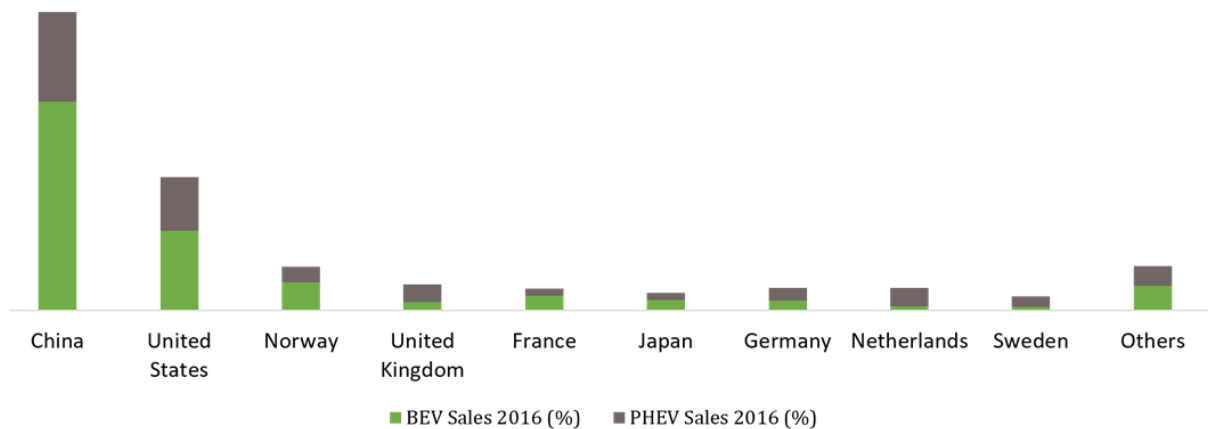
Few of the developed nations enjoy a greater penetration of electric vehicles in their countries due to the faster adoption of electric vehicles, and also the industry is backed by the countries’ strong infrastructure, which further supports the electric vehicle industry in these countries.



**EHang 184 – self flying air taxi (prototype)**

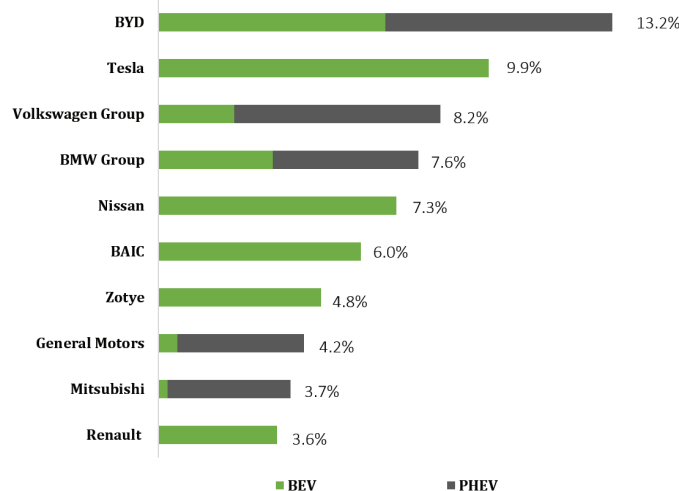


**Global Electric Vehicle Market Share, By Country, By Volume, 2016**



Source: International Energy Agency, MarkLines, ACEA, EEA

**Global Electric Vehicle Market Share, By Company, By Volume, 2016**



Source: International Energy Agency, MarkLines, ACEA, EEA



## 1.2. Case Studies

The electric vehicle industry has gradually picked up pace across the globe. The biggest example of the adoption of electric vehicles is China. The country has a severe air pollution problem and to curb the prevailing pollution levels, the country is promoting the use of electric vehicles. Today, China is the biggest market for electric vehicles, volume wise, The country achieved this through various governments incentive schemes backed by the government's push towards electric vehicles.

Another example about increasing adoption of electric vehicles is Norway. The country adopted the electric vehicle concept in the early stages and the electric vehicle industry majorly benefitted from the strong infrastructure of the country. Today, Norway has the highest penetration of electric vehicles across the globe, and electric vehicles accounts for roughly 30% of the total automobile market.

US has an existing regulation in place for California and 9 other states. **The Zero Emission Vehicle (ZEV) program** is a California state regulation that requires automakers to sell electric cars and trucks in California and 9 other states. The exact number of vehicles is linked to the automaker's overall sales within the state. The program's objective is to ensure that automakers research, develop and market electric vehicles (EVs), which generate lesser emissions than gas-powered cars, and which don't produce tailpipe pollution (hence the term: "zero emission vehicle")

Furthermore, in Norway, electric cars are exempted from acquisition tax, representing around NOK1,00,000 (USD11,600) (OECD, 2015).

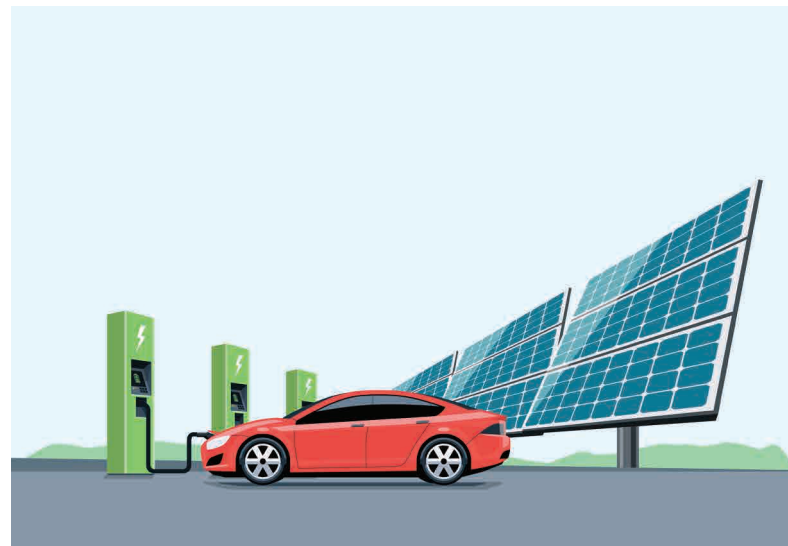
On the other hand, Japan introduced a new subsidy scheme in 2016 which provides higher subsidies as the running range of the model increases and the maximum subsidy is set at JPY8,50,000 (USD7700).



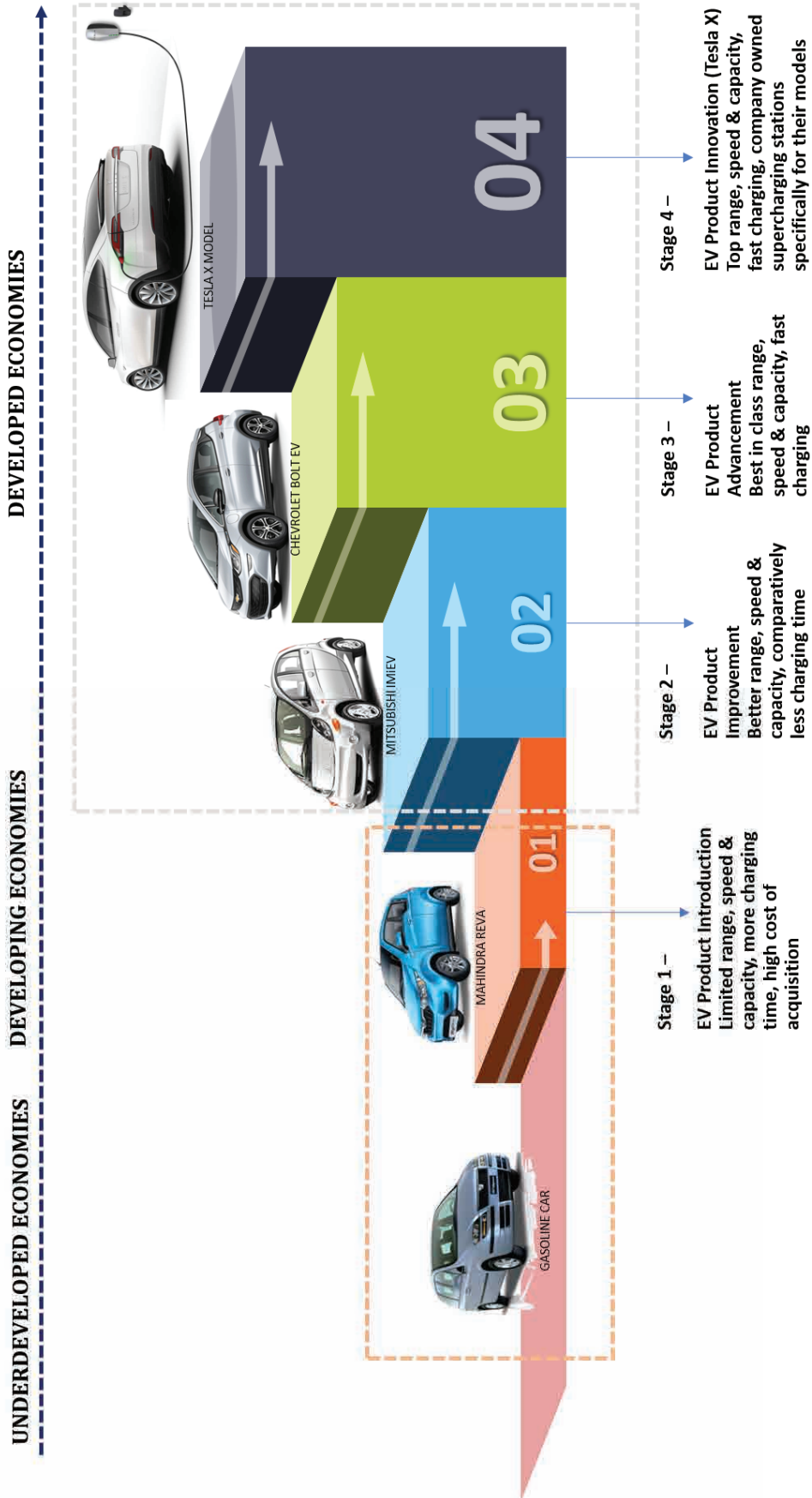
## 1.3. Policies & Regulations around the world

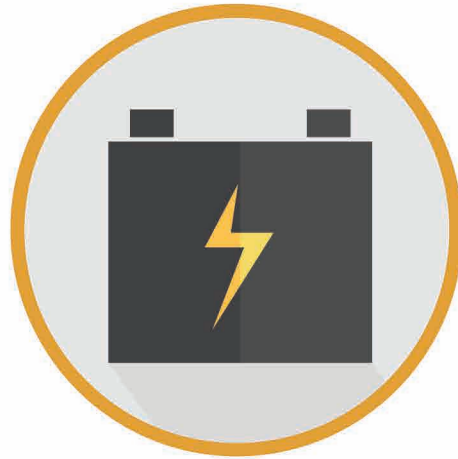
All the countries around the world have their own rules and regulations which have been set by their respective governments. China, the biggest market for electric vehicles, is driving the sales of electric vehicles on the back of various strong financial and non-financial incentives for faster adoption of electric vehicles. In 2016, exemptions from acquisition and excise taxes ranged from CNY35,000 to CNY60,000 (USD5000 to USD8500) in China.

Moreover, the regional and local authorities can also compliment these exemptions within the limit of 50% of the central subsidies.



**EV Development Stages in Different Economies**





# Electric Vehicles Indian Scenario





# 2 ELECTRIC VEHICLES Indian Overview

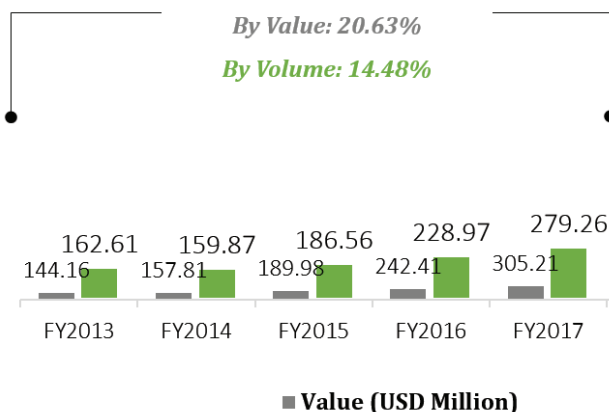
## 2.1. Electric Vehicle Scenario

Electric vehicle industry is still at a very nascent stage in India with less than 2,000 electric cars sold in the country and a little less than 23,000 electric two-wheelers sold in the last year. The government of India is aggressively pushing the sales of electric vehicles on the back of various incentives through the government's schemes. Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) in India is the government's latest initiative to boost the sale of electric vehicles within the country. Under the FAME India initiative, the government is providing subsidies on several

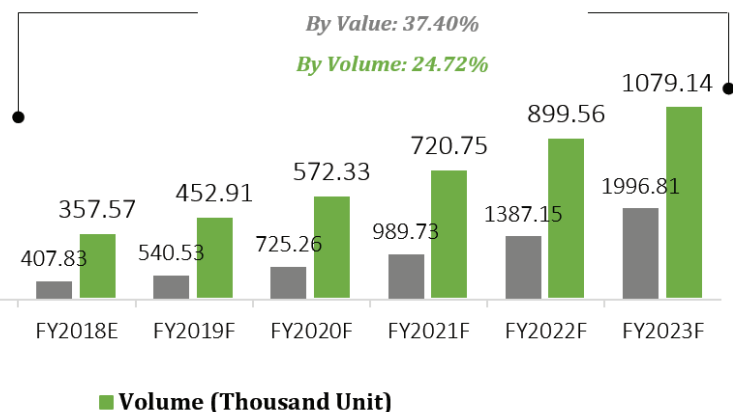
electric vehicles manufactured in India ranging from two-wheeler, three-wheeler, buses to passenger cars. The government is also exempting these vehicles from various taxes and is providing the important incentives needed for the expansion of electric vehicles in the country. Moreover, several state governments are themselves purchasing a prominent number of three-wheelers, passenger cars and buses in order to replace their existing vehicle fleet with electric vehicles.

### India Electric Vehicles Market Size

CAGR FY2013-FY2017

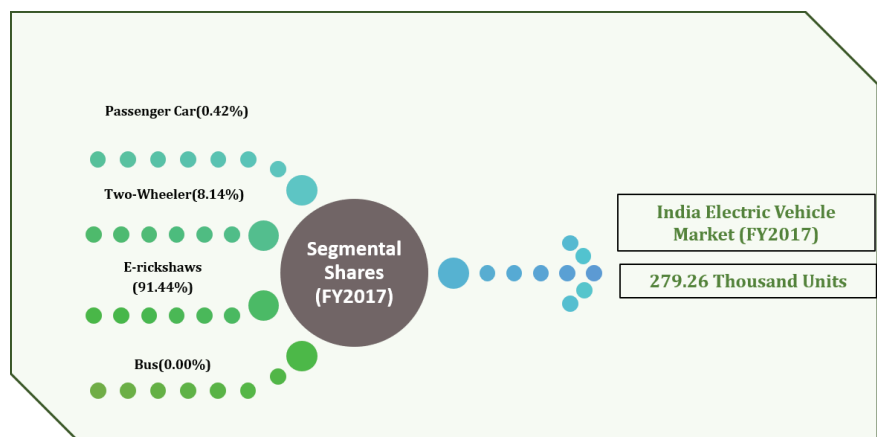


CAGR FY2018E-FY2023F



USD 305.21 Million

India Electric Vehicle Market,  
By Value, FY2017







## 2.2. Charging Infrastructure Scenario

Charging infrastructure is still at a miniscule level in the country which is majorly hindering the sales of electric vehicles in India. The country lacks a proper charging infrastructure to support the electric vehicles market, which majorly keeps the customer away from buying such vehicles.

However, the government is increasingly focusing on developing the charging infrastructure in the country. Recently, TATA launched its commercial charging station for electric vehicles in Vikhroli, Mumbai. As per some industry sources, power utility firms like BEST, Reliance Energy and MSEDCL are also exploring the option of setting up their charging points.

In addition to that Finland's Fortum has installed an AC 22KW charger for electric vehicles in New Delhi on a pilot basis, which will be maintained by NBCC.

Furthermore, the Indian government is looking to invite bids for the construction of 4,000 charging stations in Delhi NCR region.

## 2.3. Government Tenders – A Thrust for EVs

The Indian government is aggressively promoting the use of electric vehicles in the country. To support the electric vehicle industry of the country, the government has passed several tenders to procure electric vehicles from several manufacturers.

Energy Efficiency Services Limited (EESL) released a tender to procure 10,000 electric cars. TATA Motors and Mahindra & Mahindra have bagged an offer to supply 500 electric cars in the phase 1 of the tender. 350 electric cars will be supplied by Tata and 150 by Mahindra & Mahindra. The time frame for phase 2 has not been announced. The purchase order for supply of 9500 electric vehicles in phase 2 will only be initiated once phase 1 deliveries are completed.

Several state governments are also procuring electric buses to promote the use of electric buses in the country. For example, Mumbai Metropolitan Region Development Authority has procured 25 Hybrid buses from TATA Motors and Himachal Road Transport Corporation has placed an order to procure 25 electric busses from Goldstone BYD, etc.

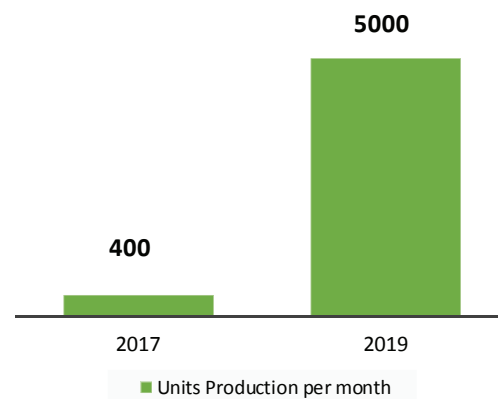
Kinetic Green, which had launched its electric rickshaw in 2016, has won an offer to deliver an upward of 25,000 electric rickshaws to the Uttar Pradesh government.

Such initiatives are anticipated to boost the overall electric vehicle industry in the country.

## 2.4. Major Companies Supplying EVs

Lohia, Yobykes and Avon are few of the key players manufacturing electric two-wheelers in the country, and currently, Hero enjoys a healthy share in the electric two-wheeler segment of the country.

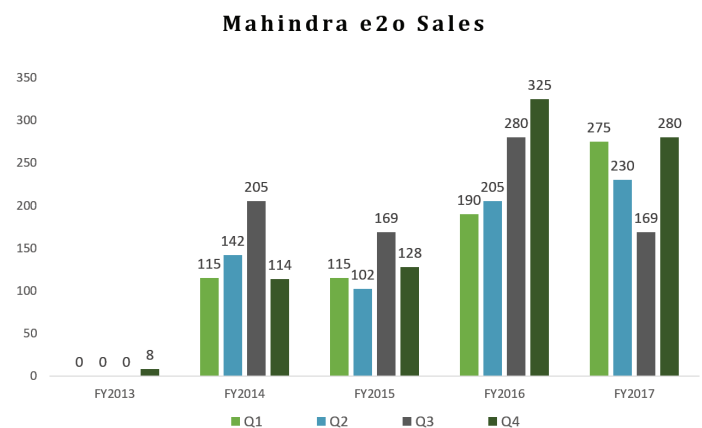
### Mahindra & Mahindra capacity expansion plan.



Source: Company Spokesperson

### Passenger car sales

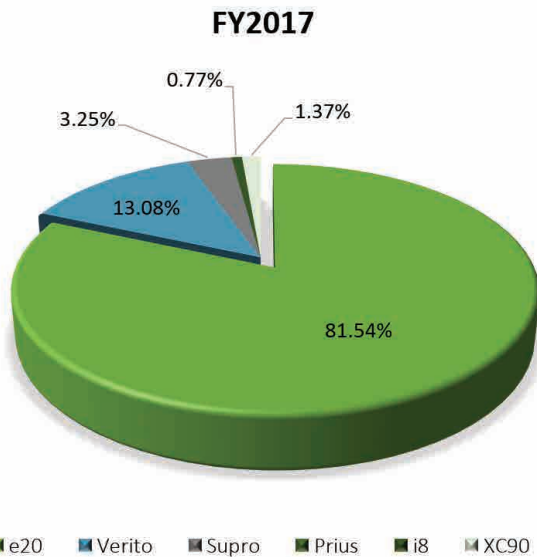
#### Mahindra e20 sales (no. of units) in last five years



Source: Economic Times



### Passenger car share by Models sold



Electric three-wheeler segment is prominently dominated by the e-rickshaws in the country, which is largely catered by the small and unorganized players that which are located in the same city. Hero, Lohia and Kinetic Green are few of the organized players currently selling electric rickshaws in India.

Electric buses market is still at a nascent stage in the country with only a handful of sales of electric buses in the country. State governments have been the key buyers of electric buses in the country. Various incentives on electric buses have made it possible for the state governments to purchase such electric buses as these buses generally cost twice or thrice the value of the traditional buses which run on either CNG or on diesel.

### Comparison between diesel, CNG, hybrid & electric buses

	Diesel Buses		CNG	Hybrid Electric Bus Pure	Electric Bus
<b>Model</b>	Volvo 8400 (AC)	Tata STARBUS SLF 44 (AC/non-AC)	Tata STARBUS 18 LE CNG (AC/non-AC)	Tata Starbus Hybrid (AC/non-AC)	BYD K9 (AC)
<b>Seats</b>	32	44	18	32	31
<b>Length</b>	12.3m	12m	12m	12m	12m
<b>Costs (INR)</b>	88 lakhs	33 lakhs	30 lakhs	1.2-1.4 crores	2-3 crores
<b>Fuel efficiency</b>	2.2 km/L	3.5 km/L	2-3 km/kg	2.2-4km/kg	1.5 kWh/km
<b>Fuel cost</b>	INR 23/km	INR 15/km	INR 13-19/km	INR 10-17/km	INR 10/km
<b>Range (km)</b>	484	560	260-390	286-520	249
<b>Max power</b>	290 BHP	177 BHP	230 BHP	230 BHP engine 44 kW battery	180 kW

Source:UITP





In the electric passenger car segment, Mahindra is the only company currently dominating the market with its e2o and e-Verito models being sold in the Indian market. BMW, Toyota and Volvo are also selling their plug-in hybrid cars in the Indian market. BMW is currently selling its plug-in hybrid i8 model, Toyota is selling its widely popular Prius Hybrid in the country, followed by Volvo's XC 90 plug-in hybrid model. Government doesn't seem currently focused on Hybrid, as GST on such vehicles is set higher than pure electric vehicles.

Hero's Optima series along with the Wave series are among the prominent electric two-wheeler models. Lohia's Omastar range of electric two-wheelers are also well received by the customers in the country. In the three-wheeler, segment Hero's Rahi, Lohia's Narain passenger and Kinetic Green's Safar electric three-wheelers are among the popular electric three-wheelers in India.

Companies like Clean Motion have introduced Zbee electric three wheelers in India and have started commercial operations of their products strategically in prime locations, which has not only created a buzz but also helped the electric vehicle ecosystem in terms of creating awareness.

All electric taxi fleet operators like Lithium Urban Technology (LUT) operating in Bengaluru, Delhi NCR, etc., have corporates as their customers. Business model runs around assigning a fleet of electric passenger vehicles to corporates, and these corporates will also share some space within the company complex to charge these vehicles. Until now, LUT has some of the major IT companies as its clients.

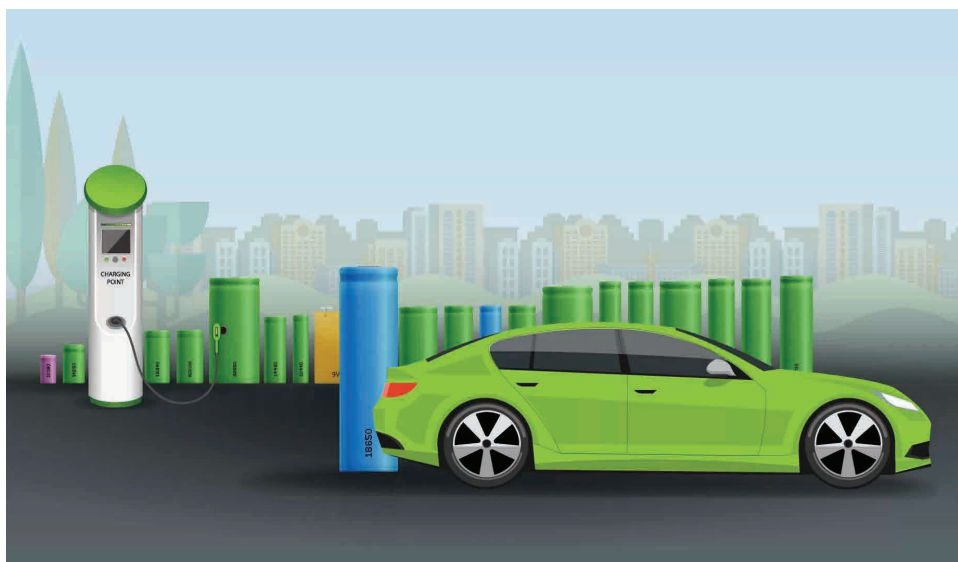
## 2.5. Case Studies

### Mobility Solution Provider and their preference for EVs

Key domestic "On demand mobility provider" Ola recently purchased a fleet of electric vehicles ranging from three-wheelers, buses to passenger cars in the state of Maharashtra in order to promote the use of electric vehicles. All the vehicles bought by Ola were waived off their VAT, road tax and registration in Maharashtra. Ola has also invested more than USD7.69 million towards electric vehicles and charging infrastructure. A push from such mobility providers is also anticipated to buoy the electric vehicle industry in the country.

## 2.6. Policy & Regulation

The government provides several incentives on electric vehicles in the country. Incentives under the FAME India range from USD115-USD335 for electric two-wheelers and USD200-USD2880 for four wheelers. There is no Electric Vehicle Policy yet, but a panel has been formed to decide on the policy structure, which will be finalized by December 2017.



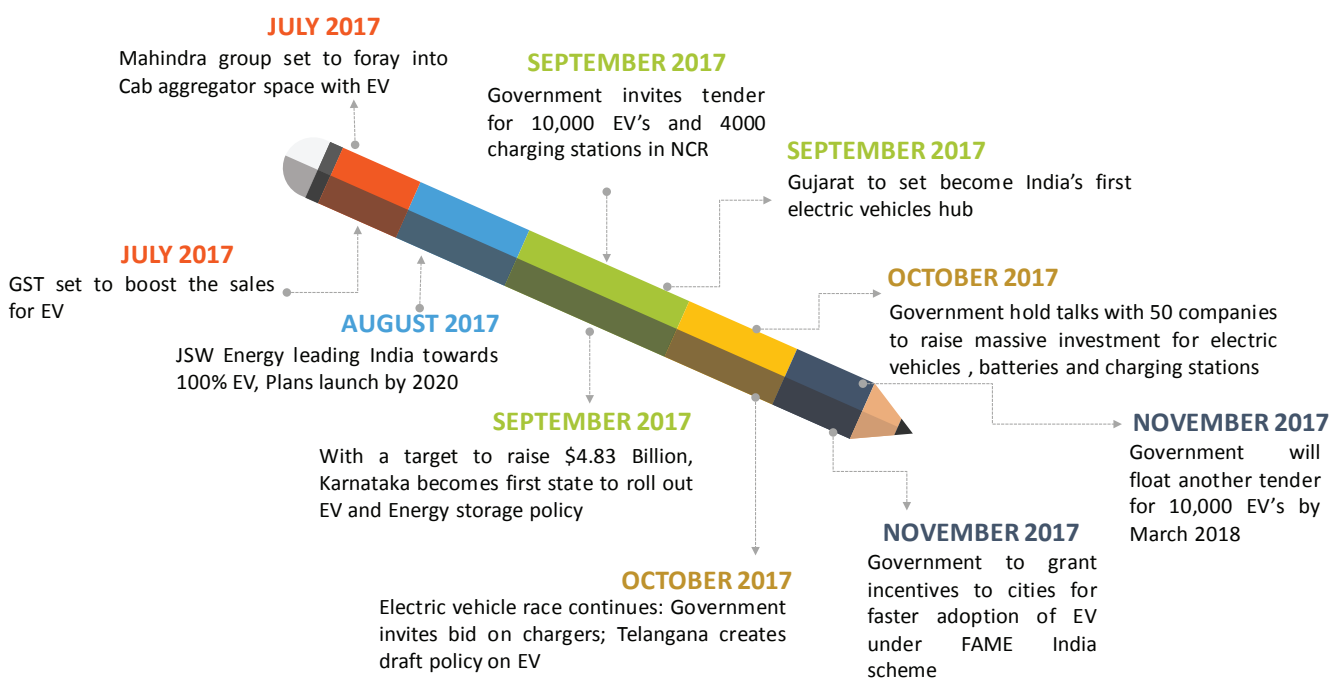
### Incentives for Different Electric Vehicle Categories

Vehicle Segment	Mild Hybrid INR (USD)	Strong Hybrid INR (USD)	Plug-In Hybrid INR (USD)	Battery-Operated Electric INR (USD)
Two-Wheeler	USD 27-93	-	USD 195-270	USD 112.5-435
Three-Wheeler	USD 49.5-117	-	USD 375-690	USD 165-915
Passenger Cars	USD 165-360	USD 885-1065	USD 1470-1770	USD 1140-2070
Light Commercial Vehicle	USD 255-315	USD 780-930	USD 1095-1875	USD 1530-2805

### Components and Outlay Under FAME Scheme3

Component under FAME Scheme	FY2015-16 Million INR (Million USD)	FY 2016-17 Million INR (Million USD)
Technology Platform	700 (10.5)	1200 (18)
Demand Incentives	1550 (23.25)	3400 (51)
Charging Infrastructure	100 (1.5)	200 (3)
Pilot Projects	200 (3)	500 (7.5)
IEC/Operation	50 (0.75)	50 (0.75)
<b>Total</b>	<b>2600 (39)</b>	<b>5350 (80.25)</b>

### Key Development Initiatives Taken by Indian Government in 2017



# Lithium Ion Batteries Overview



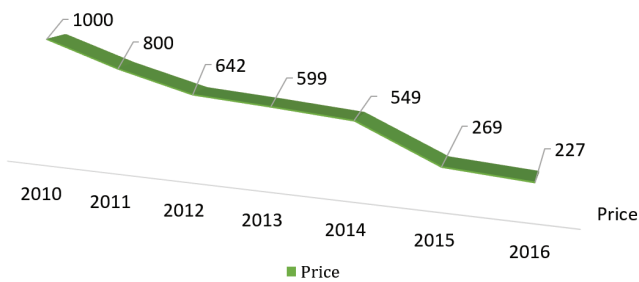


# 3 LITHIUM ION BATTERIES Overview

## 3.1 Lithium Ion Battery Scenario

The steep decrease in prices over the past few years is in part due to technology improvements and economies of scale. However, fierce competition between the major manufacturers has been instrumental in bringing down the prices.

### Average Battery Pack Price (\$/kWh)

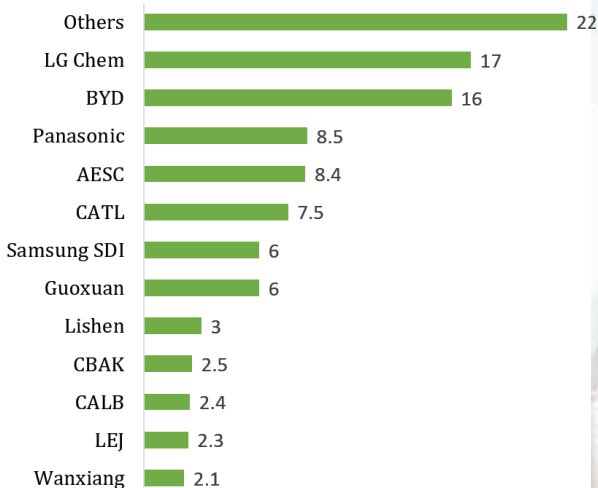


Source: Forbes

From USD 1000/kwh in 2010 to USD 227/kwh, the prices have witnessed drop at almost negative 21% CAGR. Declining prices are expected to have a huge positive influence on the production of electric vehicles across the globe.

LG Chem and BYD are the biggest players in terms of Li-Ion battery production capacity. These players are catering to different industries with their product offerings. Country analysis shows that China has a lion's share of the overall Li-ion battery production capacity which is only going to increase magnanimously to reach 107 Gwh by 2020.

### Installed Li-Ion Battery Capacity Q1- 2017, in GWh

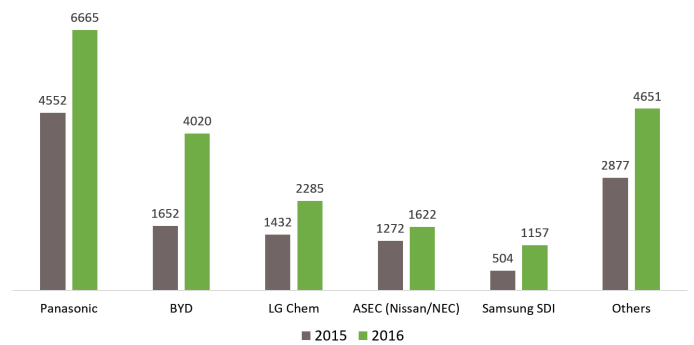


Source: Benchmark Mineral Intelligence

Li-Ion Capacity, By Country		
Countries	2016 Capacity (Gwh)	2020 Capacity (Gwh)
United States	1.0	38.0
China	16.4	107.5
South Korea	10.5	23.0
Poland	0.0	5.0
India (battery assembly capacity)	More than 1 Gwh	n/a

Source: Benchmark Mineral Intelligence

### MWh of EV Li-Ion batteries producers for electric cars in 2015 & 2016



Source: Benchmark Mineral Intelligence

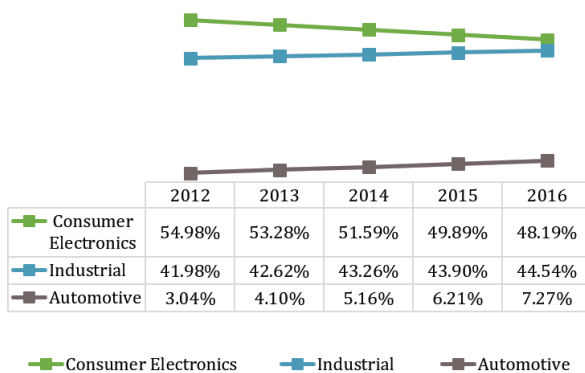
Currently Li-ion battery industry is growing faster than the EVs because of rising battery capacities and increasing battery & plug-ins vehicle sales.

All the top battery suppliers are witnessing an increase in sales. Panasonic remains the top player, with more than one-third share of the market, but in terms of growth, BYD is second to none moving up by more than 300%.

Interestingly, Nissan's AESC is back ahead of LG Chem, which is now gearing up for a strong run at 3rd in 2017, with the Chevrolet Bolt EVs (60 kWh), which arrives in Q4 for the United States.

## 3.2. India Lithium Ion Battery Scenario

### India Lithium-ion Battery Market Share, By Application, By Value



Lithium Ion batteries find wide range of usages in consumer electronics, industrial & automotive segments. Rising EV focus by government has increased prospects for global as well as domestic players to increase their footprints in India. In 2017, Suzuki, Toshiba & Denso announced an investment of USD190 million for the manufacturing of electric vehicles in India. Suzuki will account for 50% of total investment, while 40% & 10% will be borne by Toshiba and Denso, respectively.

Under the National Electric Mobility Mission Plan, the Indian government plans to invest around USD4 billion during 2013-2020 for the development of infrastructure needed for the growth of electric vehicles in India.

As a result of this plan, the sales of electric vehicles in the country is expected to reach 0.57 million units by 2020.

Other than automotive, there is immense opportunity in consumer electronics and industrial applications. In consumer electronics segment, Li-ion batteries find wide applications in smartphones, cameras, laptops, electric tools, and other handheld devices. Lithium-ion batteries are widely used in industrial applications comprising medical, renewable energies, telecommunications, robotics, industry equipment, solar, energy storage system and dyeing machines.

## 3.3 Current Developments in EV & Lithium Ion Batteries

▶ In September 2017, Energy Efficiency Services Ltd (EESL) has ordered 10,000 electric vehicles. Tata Motors & Mahindra jointly will supply the electric vehicles (EVs) in two phases with 500 e-cars in the first phase in November 2017 and the remaining 9,500 EVs in the second phase timelines for which will be shared once phase 1 deliveries are completed.

▶ In November 2017, EESL has announced plans to float another tender for 10,000 e- cars between March April 2018.

### Lithium Battery Import Scenario

▶ India currently imports 100% of lithium-ion batteries and only assembly is being done in the country with most of the companies dependent on import of Li-ion cells (predominantly LFP Chemistry) from China and making battery packs in India.

▶ While both Government of India and private players are trying to ramp up battery manufacturing in India, it's imperative to have a quick understanding on Upstream Battery Value Chain as well, since globally there are potential supply chain risks especially for rare earth metals like Cobalt, which is essential element for most of the lithium-ion battery chemistries (e.g. LCO, NCM, NCA). According to the latest news, Ministry of Mineral & Mines is considering potential partnerships with Argentina, Bolivia and Chile, popularly known as "Lithium Triangle" since India does not have substantial reserves for both Lithium & Cobalt and other raw materials like Manganese, Permanent magnet, etc. This will certainly help boost the battery manufacturing plans of domestic players.

▶ Owing to lack of core-technology in India, a slew of partnerships both in battery & EV manufacturing were announced by Indian companies with technology players planning several billion dollars of investment over next decade.

## Tesla to invest in China, not in India

- ▶ A great opportunity got lost, in spite of the fact that Tesla has shown interest on multiple occasions to set up its first manufacturing plant outside the US, in India.
- ▶ China is implementing new incentives for EV adoption to replace expiring subsidies and push automakers onto more aggressive EV investment and production schedules.
- ▶ Tesla plans to invest in China as it stands a chance to gain even more sales in China, where Tesla has been growing quickly. But Chinese government-subsidized local electric-carmakers also are rapidly advancing. The major global auto companies — including Ford and GM — will also push further into the Chinese market and EVs as the government clarifies its support for these efforts.

## Charging Infrastructure

- ▶ Indian government is seeking investments from a number of companies, both domestic and foreign. They are planning to raise capital that will be spent on purchasing electric vehicles, three wheelers, batteries and charging stations for deployment across the country.
- ▶ Director of Tata Power Delhi Distribution revealed plans to team up with Delhi Metro Rail Corp (DMRC) and the Municipal Corporation of Delhi to erect charging stations at metro stations

and other locations across the country.

- ▶ According to Director of Tata Power Delhi Distribution, for electric vehicles become more mainstream, an area of 3 km will need nearly 300 charging stations with four to five charging slots each. The cost of setting up a rapid-charging outlet is around \$38,245 (INR 25 Lakh), while that of a slow charging station will be around \$1,529 (INR 1 Lakh).

## Lithium Ion Battery Manufacturing Set Up

- ▶ Octillion Power Systems, a US based manufacturer of advanced energy storage systems for EVs and power grids is planning to set up a plant in Pune Maharashtra. The new EV battery facility will have a production capacity of over 250-Megawatt Hour (MWH).
- ▶ Suzuki has embarked on a journey that has the potential to kickstart the electrification revolution in the Indian automotive industry. The company, in a collaboration with tech giants Toshiba and Denso, will be setting up India's first lithium-ion battery production facility purely dedicated to automobiles. The plant is expected to be up and running by the end of this decade and will be constructed in a supplier park close to the carmaker's production facility in Hansalpur, Gujarat.

## Key Partnership Announcement in India EV & Lithium Ion Battery Landscape

Recent Slew of Key Partnership Announcement in India EV & Lithium Ion Battery Landscape

Lithium Ion Battery Localization			EV Manufacturing		
Companies	Technology Partners	Investment Pledged	Companies	Technology Partners	Investment Pledged
Suzuki Motors	Toshiba & Denso	173 Million USD	JSW Energy	Geeley Motors, China	600 Million USD
BK Modi Spice Group	BYD	100 Million USD	Mahindra & Mahindra		525 Million USD
ISRO	BHEL	15 Million USD	Hero MotoCorp	Ather Energy	30 Million USD
Reliance Industries	BP Plc.	3.5 Billion USD (25 Gwh)	Zuhai Yinlong (Punjab)		NA
Octilon Power Systems		15 Million USD	MG Motors (SAIC)	Taken over GM Motors Plant	300 Million USD
Sun Mobility	Leclanche SA	NA			
Hero Future Energy	Under Evaluation stage	NA			
Exide Industries	Chaowei Power, China	NA			
Foxconn		5*Billion USD (Total, part for batteries)			
CERI Tamil Nadu		NA			
Adani		NA			

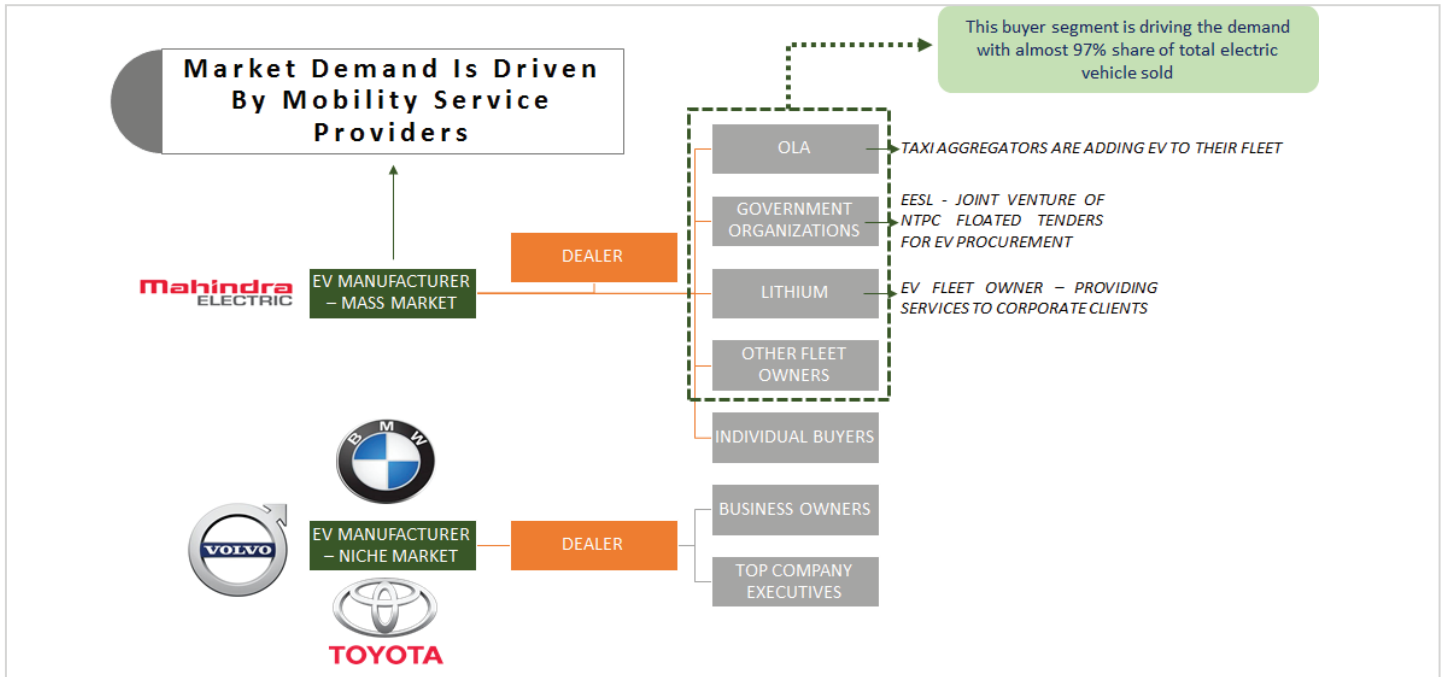
4

Demand  
Drivers  
Indian  
Perspective



# 4 DEMAND DRIVERS Indian Perspective

## EV Supply-Demand Scenario for Passenger Vehicles



The biggest beneficiary due to government thrust for EVs is Mahindra & Mahindra. The company have been getting repeat orders for e20s and e-Veritos. Ola has recently ordered 100 EVs. EESL has already procured 4 E-Veritos for initial testing (part of 10,000 EV order tender). Lithium, India's first EV taxi fleet company, has procured 45 e20s and 11 E-Veritos and plans to

procure more E-Veritos in the future. From the current scenario, it is understood that the mobility solution service providers are driving the market and not individual buyers. In Delhi NCR, almost 97% sales of electric car sales were made to fleet owners or taxi aggregators rest 2-3% were individual buyers.

## User Analysis

### Electric Passenger Vehicle



e-20

- FAST CHARGE - 1.5 HOUR (80-90%)
- NORMAL CHARGE - 6-7 HOURS



DRIVERS



PASSENGERS

#### Drivers feedback

- Car does 80-100 Km instead of claimed 140 Km
- Avg Speed - 60-70Km/Hr
- Low Maintenance cost.
- Avg Running Cost : Rs. 1000-1500/month
- Issues during rainy season (no covers for battery under the car. The issue though is rectified now)
- Charging stations in the company premises

#### Passengers feedback

- Less Space
- Less Comfort
- Suspension system not good enough for carrying more than 2 people
- Long distance travelers experience patchy drive



## Electric Two-Wheelers



e-Bike  
CHARGING TIME- 6-7 HOURS FOR FULL CHARGE



DEALERS



OWNERS

**Dealers feedback**

- Good demand due to no license requirement
- Vehicle cost: 20-30k INR
- Low Maintenance cost.: Approximately INR 1000/year
- Avg Running Cost : Rs. 500-600/month
- Average km run per charge: 60-70 km

**Owners feedback**

- Very less maintenance
- Used for household activities/student purpose
- Usually the coverage is 4 to 5 kms
- People have bought it for spouse and children to support their routine tasks

## Electric Three-Wheelers



e-Rickshaws  
CHARGING TIME- 4-5 HOURS FOR FULL CHARGE



e-Three Wheeler  
CHARGING TIME- 3-4 HOURS FOR FULL CHARGE

**Drivers feedback**

- 1.Price ranges from 60 to 140k INR
- 2.Last mile connectivity – metro station, markets, shopping malls
- 3.Usually the coverage is 4 to 5 kms
- 4.Driving range – 50-60km

**Drivers feedback**

- 1.Price – More than 500k INR
- 2.Last mile/first mile service connecting fixed points like Metro stations to malls, colleges, hospitals, markets and other key congregation points.
- 3.Usually the coverage is 4 to 5 kms
- 4.Range per charge – 40-45 km
- 5.Top speed – 50 km/Hr

**Passenger feedback**

- 1.Overloading
- 2.Slow commute
- 3.Value for money

**Passenger feedback**

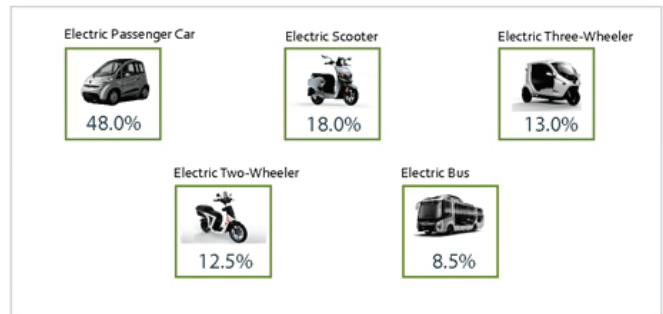
- 1.Comfortable
- 2.Premium feel
- 3.Smooth ride without jolts
- 4.No vibrations

## Non-User Analysis

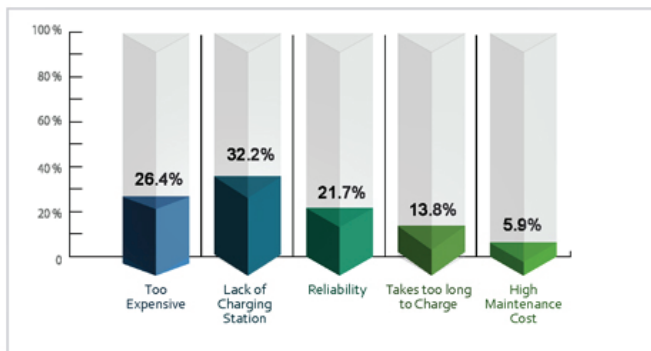
### Respondents Considering Buying Electric Vehicles



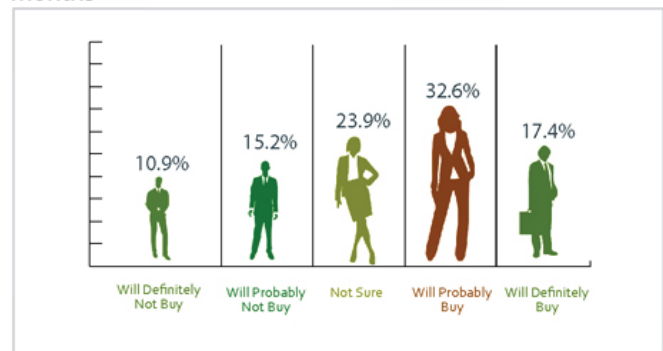
### Types of Electric Vehicles Respondents are Willing to Purchase



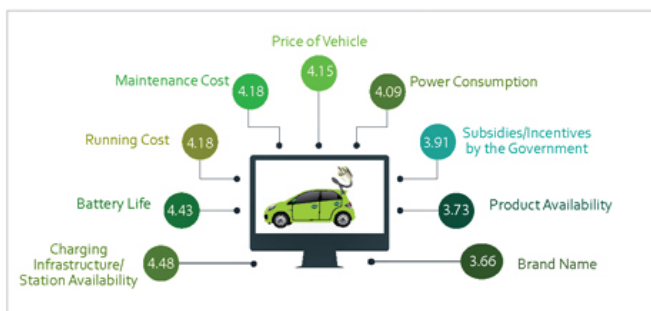
### Factors Affecting the Sales of Electric Vehicles



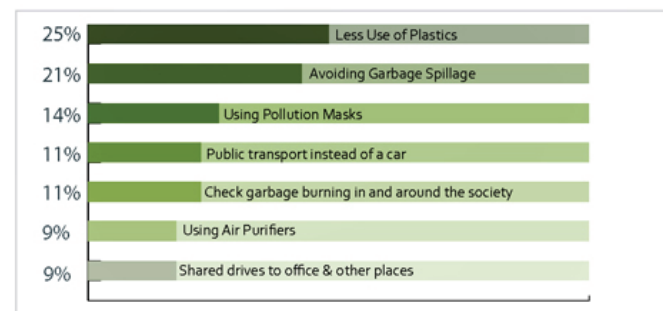
### Respondents Willingness to Buy Electric Vehicles in Next 12 Months



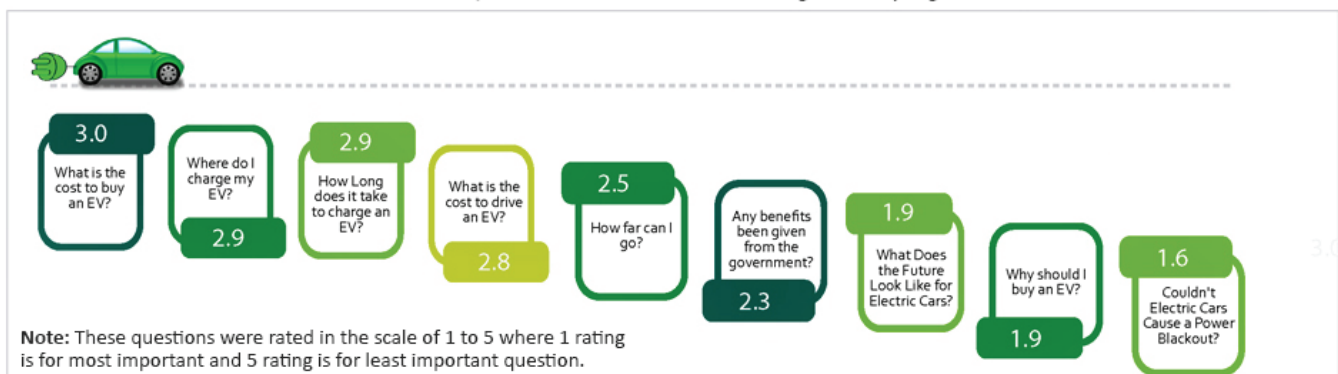
### Factors Considered while Making a Purchase Decision of the Electric Vehicle



### Steps taken by Respondents to Check Pollution and Promote Green Environment



### Questions Which Come to Mind When Respondents Think of Considering and Buying an Electric Vehicle



Challenges  
&  
Opportunities



# 5 CHALLENGES & OPPORTUNITIES



## Large pool of auto component manufacturers will witness business cessation period

India has a large pool of auto component manufacturers, which are organized as well as unorganized. An electric vehicle has 20 moving parts compared to 2000 parts of an ICV. Hence, the component requirement for electric vehicles is very less, and consequently, many of these manufacturers will be out of business owing to no demand.

## Battery Recycling

Industry experts are more concerned about the battery recycling process as it is learned that without using advanced recycling process the defunct battery will have huge environmental impact.

## Electric cars aren't green

The charging infrastructure will highly depend on coal based power generation. It is learned that coal based power production emits more green house gases than diesel/petrol or CNG.



## New avenue for OEMs to backward integrate

Auto component business closure will also create great opportunity for OEMs to backward integrate and create their own set of components and batteries to power their vehicles.

## A turnkey business opportunity – Battery Recycling

While recycling of batteries will turn to be a challenge, it is also a great business opportunities for those who can employ advanced processing technologies and support EV ecosystem. In China, the electric vehicle battery recycling is expected to be US\$ 5.5 billion market by 2023.

## Switch to other alternate power sources

Other alternate power sources like solar, wind , fuel cells etc. possess great prospects. The next big race will be from these sources to power future electric vehicles.



6



**Way  
Forward**





## 6 WAY FORWARD

- Government should focus on integration rather than faster introduction of electric vehicle.
- Charging Infrastructure development is the key to successful penetration of electric vehicle in the country
- Lithium Ion production within the country will eventually bring down the cost of electric vehicle significantly. Current government initiative of “Make in India” provides immense opportunity for manufacturers to develop battery production base in India and reap cost benefits.
- Furthermore, it will be very important to understand Indian consumers unmet needs, challenges, etc., as that will be key determinants shaping the future of EV industry in India.
- National Retail Supply Licence Prerequisite - Under The Electricity Act of 2003, the sale of electric power is an activity that can only be performed by licensed distribution companies (DISCOMs), and their licensees or franchisees. Therefore a common national license will be required which could help firms set up charging stations at increased pace.
- Currently the incentive structure for EV in India is comparatively less than other countries focusing on EV expansion. The government will need to work out a better incentive structure which will eventually encourage customer to buy an EV.
- The country’s transition to a shared, electric and connected mobility system can save USD 330 billion (Rs 20 lakh crore) by 2030 on avoided oil imports alone.
- Even under a shared mobility paradigm, over 46,000,000 vehicles (two, three, and four wheelers) could be sold by 2030
- This annual market size would present an opportunity for Indian companies to become leaders in EV (electric vehicle) technology on a global scale.
- India can leapfrog the western mobility paradigm of private-vehicle ownership and create a shared, electric and connected mobility system, saving 876 million metric tons of oil equivalent, worth USD 330 billion and 1 giga-tonne of carbon-dioxide emissions by 2030.



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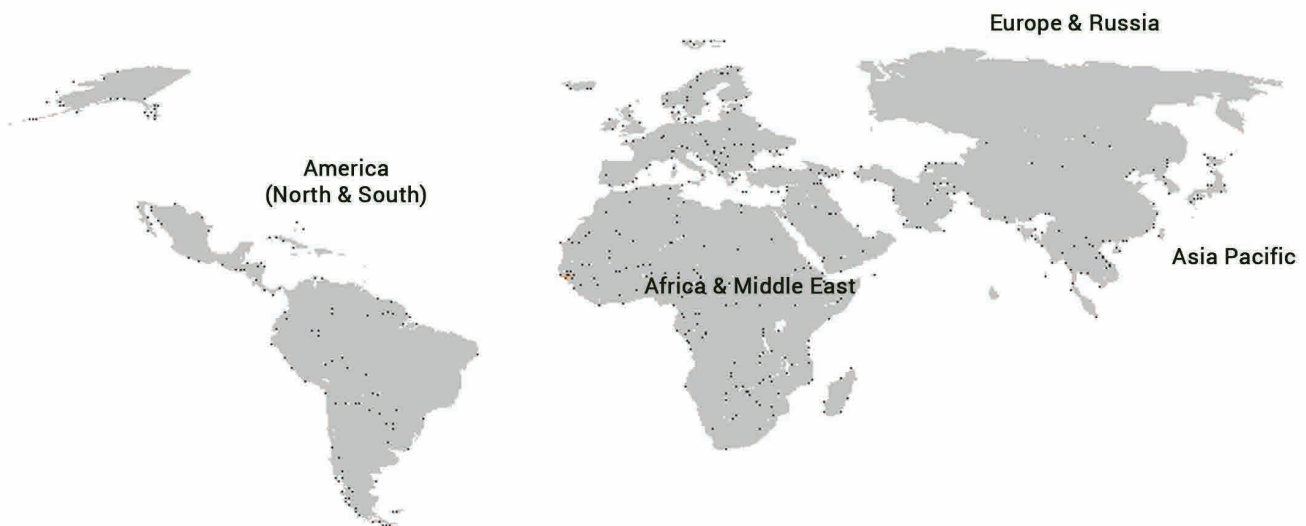
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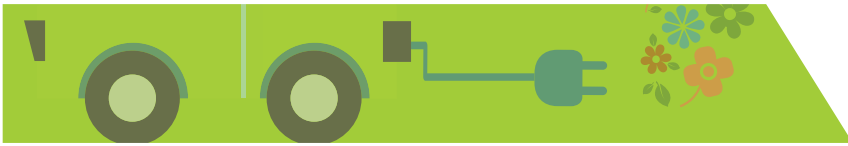
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