When Are We Bringing EV Home?

Industry Update on Electric Vehicle

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Foreword

This report is a result of the collaborative effort of ET Government and Felix Advisory Private Limited. In the recent years, the Electric Vehicle has witnessed a phenomenal rise in interest from governments as well as investors globally. We were intrigued to understand different facets of this industry which holds key to finding solution towards a greener tomorrow. In this report, we have delved into the details of the Electric Vehicles ecosystem and factors which are expected to drive the quicker adoption.

During this exercise, we researched and spoke to a lot of key players including industry experts and investors to answer the most intriguing question "When are we bringing EV Home?". We would like to express our deepest appreciation to

- **Mr. Pushkar Jauhari**, Director – Investments at Oman India Joint Investment Fund
- **Mr. Satish Mugulavalli**, Venture Partner at Yournest Venture Capital
- **Mr. Ashwin Swaminathan**, Investments at Chiratae Ventures
- A few more whose names cannot be mentioned due to various limitations

for their support that made this report possible. Speaking with them was a great learning experience for us.

A Special thanks to **Mr. Mohd Ujaley** , Senior Correspondent at ET - Government, and **Mr. Swetabh Pareek**, Partner - Investment Banking at Felix Advisory for spearheading this exercise and providing extensive cooperation in publishing the report.

We hope this report accelerates the EV's journey to our homes.

Thanks

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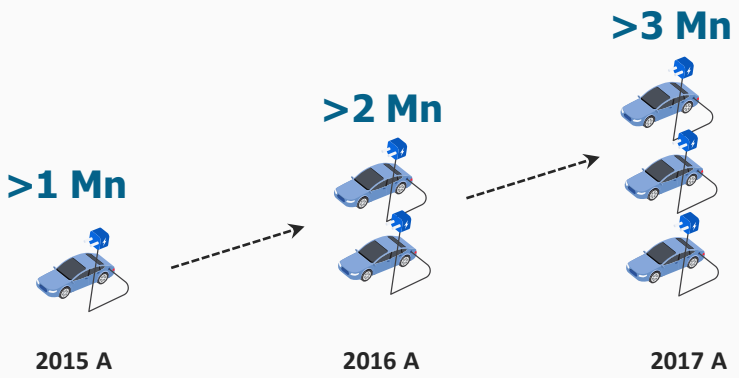
The next decade is set to witness a radical transformation in EV market space

Past and Present

Trend in Global Stock of Electric Cars



In 2017, the global EV market was valued at **~$ 49 Bn.**

A record volume of **~2 Mn** EVs added to global fleet in 2018.

China led the space & accounted for **>50%** of global electric car sales.

Private chargers worldwide numbered at **~3 Mn** in 2017.

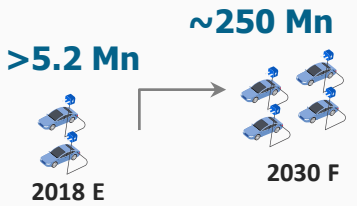
Charging infrastructure market was valued at **~$8.87 Bn** in 2018.

Source - [1],[3],[4]

Vis-a-Vis

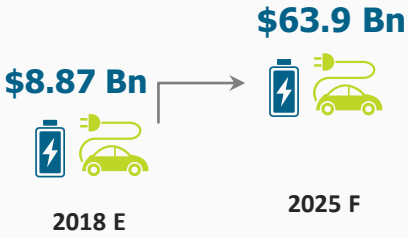
What to expect in the next decade

Massive Growth in Global EV fleet…



48x growth is expected as governments around the globe endeavor to make EVs take-up 30% of new vehicle sales by 2030.

…backed with considerable investments in charging infrastructure

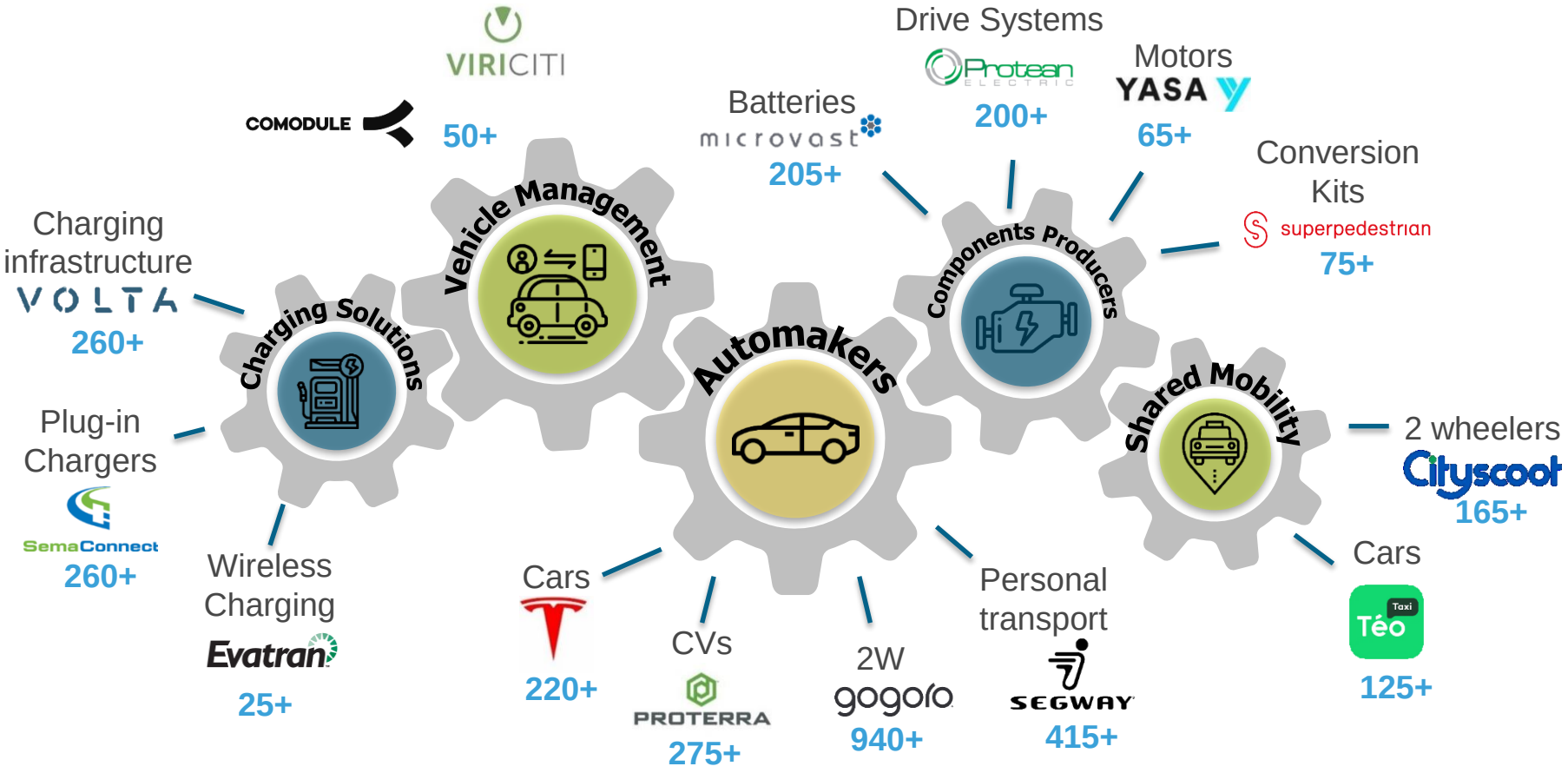


Market size of EV charging infrastructure to grow at **32.6% CAGR** and is estimated to be valued at $63.9 Bn by 2025.

Plummeting battery costs fostering a sustainable ecosystem

Source - [2],[3],[4],[14]

Global ecosystem of 3000+ start-ups is making a quick progress



Note : Numbers in the info graphic depict count of start-ups in each sub-sector

Source: Felix Research, (5)

Major economies are supporting EV with encouraging policy frameworks

		Canada	China	European Union	India	Japan	United States
Regulations (Vehicles)	$ZEV_{[3]}$ mandate	✓	✓				✓
	Fuel economy standards	✓	✓	✓	✓	✓	✓
Incentives (vehicles)	Fiscal incentives	✓	✓	✓	✓		✓
Target (vehicles)		✓	✓	✓	✓	✓	✓
Industrial Policies	Subsidy	✓	✓			✓	
Regulations (chargers)	Hardware Standards	✓	✓	✓	✓	✓	✓
	Building Regulations	✓	✓	✓	✓		✓
Incentive (chargers)	Fiscal incentives	✓	✓	✓		✓	✓
Target (chargers)		✓	✓	✓	✓	✓	✓

Source - [3]

Attention Worthy Gaps

Not enough incentives for the consumers of EV. Relaxed toll tax and parking charges are a good start but more incentives are needed.

Governments intend to develop infrastructure in upcoming buildings to create a charging network which will need clear communication and effective execution.

Adoption to standard policies to mitigate the **regulatory arbitrage**.

Regulations

Regulations for vehicles aimed to restrict ICE and promote EVs by policies like zero emission vehicles mandate and fuel standards. Regulation for chargers to maintain standards are also needed.

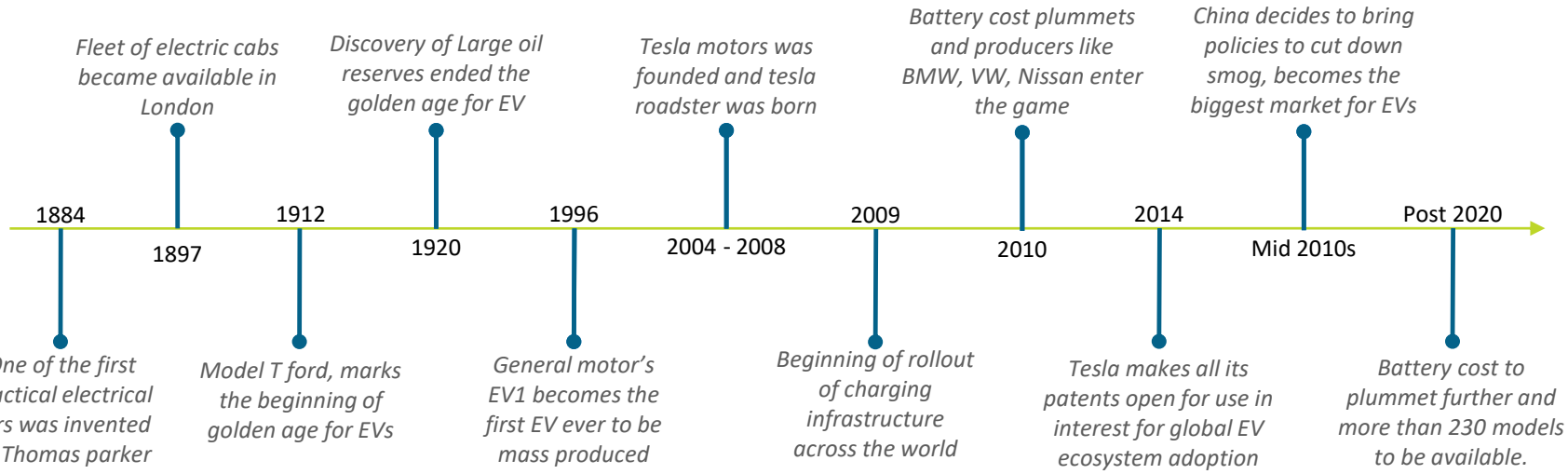
Targets

Targets for vehicles and chargers aimed to be achieved through government orders and use of EVs for state operated vehicles like public buses, etc.

Incentives

While Government policies are focused on propping up the demand side, they are also keen to provide incentives for suppliers to produce vehicles and chargers for ecosystem setup.

EVs kept evolving for last 135 years and now its maturing for scalability & adoption



Source - [12]

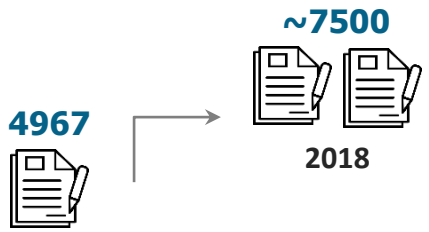
> 46,000

No. of patent families existing related to EV technologies

~43.4 Mn

Value of the most valuable patent in EV technology, on wireless charging

Source - [13]



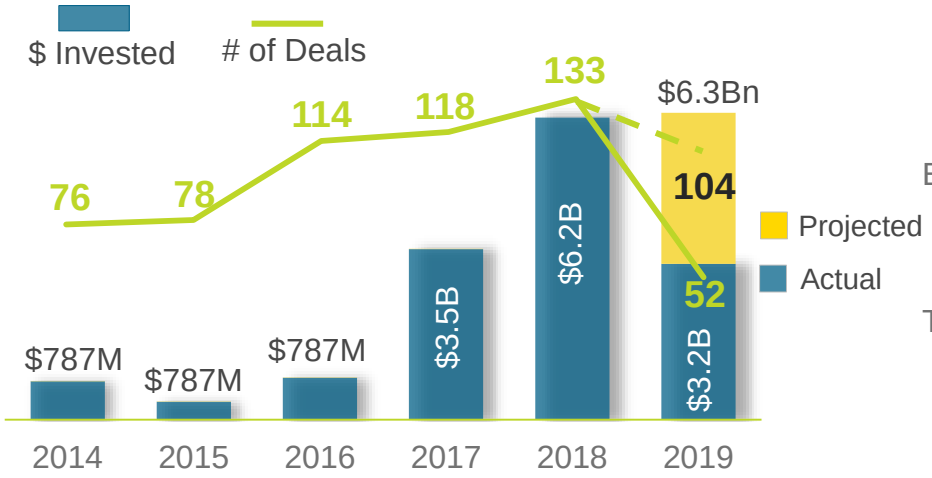
No. of patent application filed related to EV (in US alone)

Increasing Affordability

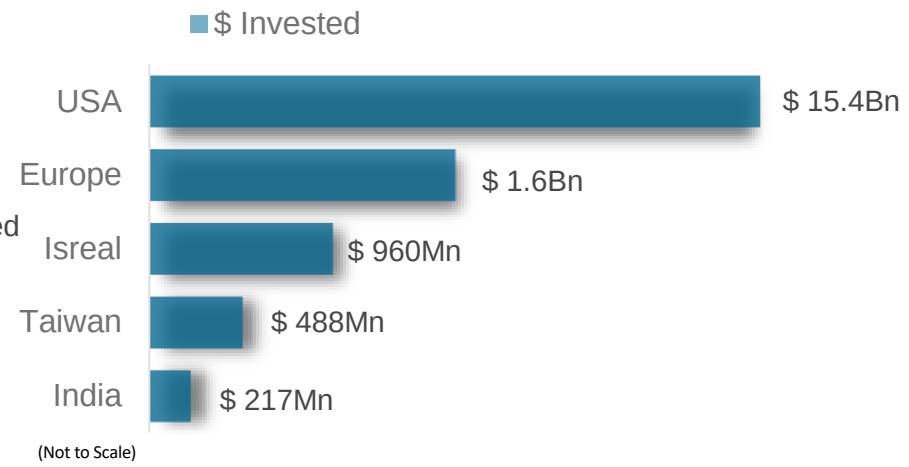
Developments in battery chemistry and expansion of production capacity in manufacturing plants are delivering substantial cost cuts. Redesigning of vehicle manufacturing platforms using simpler and innovative design architecture and the application of big data to right size batteries has also helped in the cause.

Last three years saw a phenomenal uptick in investor interest globally

Global Funding Trend



Investments By Geography



~67%

CAGR (2014 – 18) of dollars invested in EV

~15%

CAGR (2014 – 18) of Number of deals in EV

Notable Recent Deals

- Faraday Future — Electric Supercars Manufacturer » **$1 Bn**
- chargepoint+ — Charging Infrastructure » **$240 Mn**
- BIRD — Electric scooter sharing » **$300 Mn**
- Lime — Bike Rental Service » **$335 Mn**
- LUCID — Electric cars manufacturer » **$1Bn**
- PROTERRA — Electric buses manufacturer » **$155 Mn**

Source: Felix Research, [5]

Automakers and shared vehicle operators received a major slice of global funding

< Nontraditional

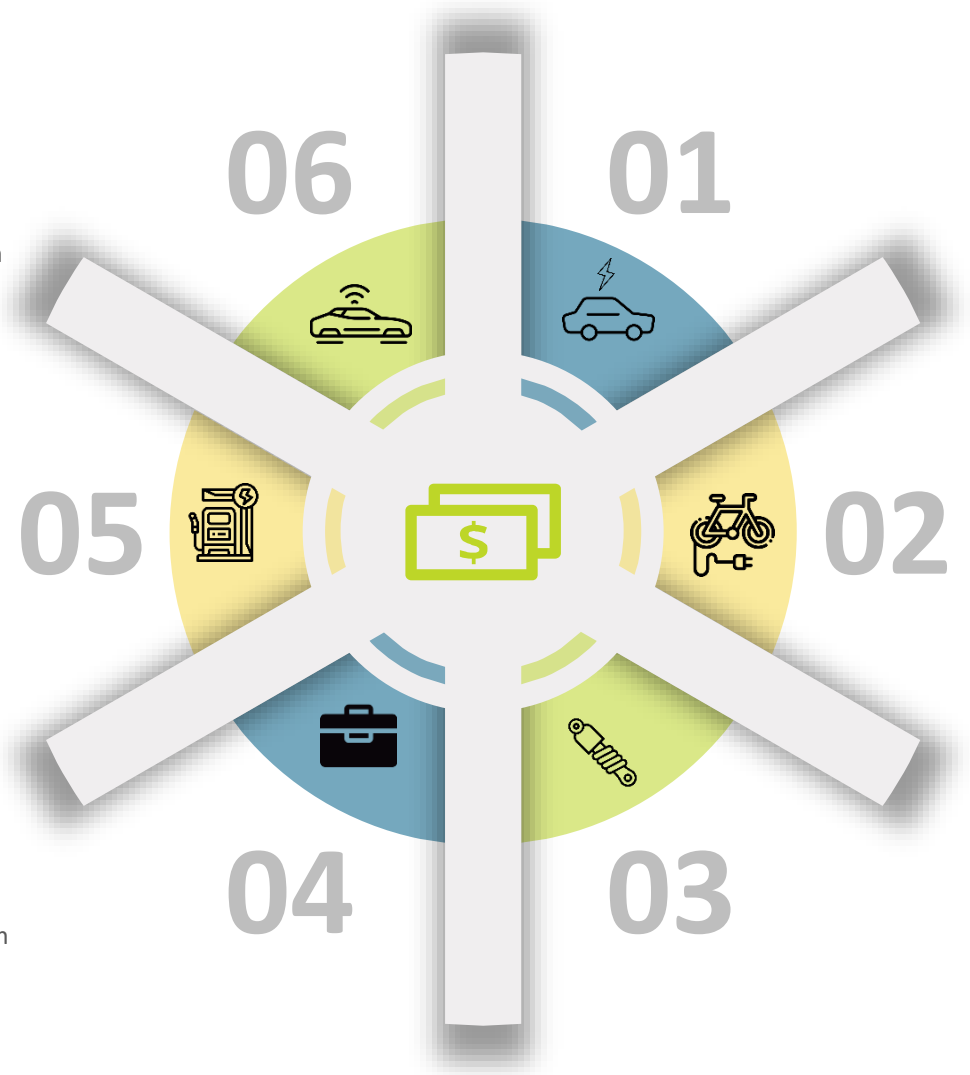
Companies focused on developing electric aircrafts and flying cars.
Investment in last two years - $225 Mn
Top Funded company
Joby Aviation ($100 Mn)

< Charging Solutions

Companies developing network of charging stations for electric vehicles as well as standalone chargers.
Investment in last two years $494 Mn
Top Funded company
ChargePoint ($240 Mn)

< Conversion Kits

Companies developing kits to convert gasoline vehicles to EVs.
Investment in last two years - $38.8 Mn
Top Funded company :
Hyliion 21 Mn



Automaker > Cars

Companies focused on developing Electric Car
Investment in last two years - $7.7 Bn
Top Funded company
Faraday Future ($2 Bn).
Two wheeler manufacturers are soliciting more funding than car manufacturers in India – 22 motors is noteworthy - $65Mn in funding.

Vehicle as a service

Companies offering electric bike sharing services
Investment in last two years - $1.7 Bn
Top Funded company
Lime ($310 Mn)
Indian company mission electric (electric car fleet service) is noteworthy – $250 Mn in funding.

Components > Batteries

Companies focused on developing batteries for electric vehicles
Investment in last two years - $319 Mn
Top Funded company
Romeo Power ($88.6 Mn)

Source: Felix Research, (5)

Though VCs have been shying from automobile sectors in past but now they are the biggest backers of disruption in this space…

95%

% Road Accidents Caused by Driver's Error

45%

% Operating Cost Related to Drivers

Autonomous Driving

- Reduces Operating cost for ride hailing players
- Eliminates human fallibilities inc. driver inattention, speeding, alcohol impairment
- Reduces congestion
- Adheres to traffic rules

30 – 40%

Battery Cost as a Percentage of EV cost

2 – 6 Hrs

Time it takes to charge an EV

Charging Technology

- **Superfast Charging**
  - Cuts down the charging time to as low as 20 minutes
  - Suitable for public charging infrastructure.
- **Battery Swapping**
  - Separates the ownership of battery from vehicle to reduce upfront cost.
  - Takes < 3 mins to swap the battery

96%

Of the time, an average car is at standstill

9 – 13

No. of average cars removed from the road by one shared vehicle

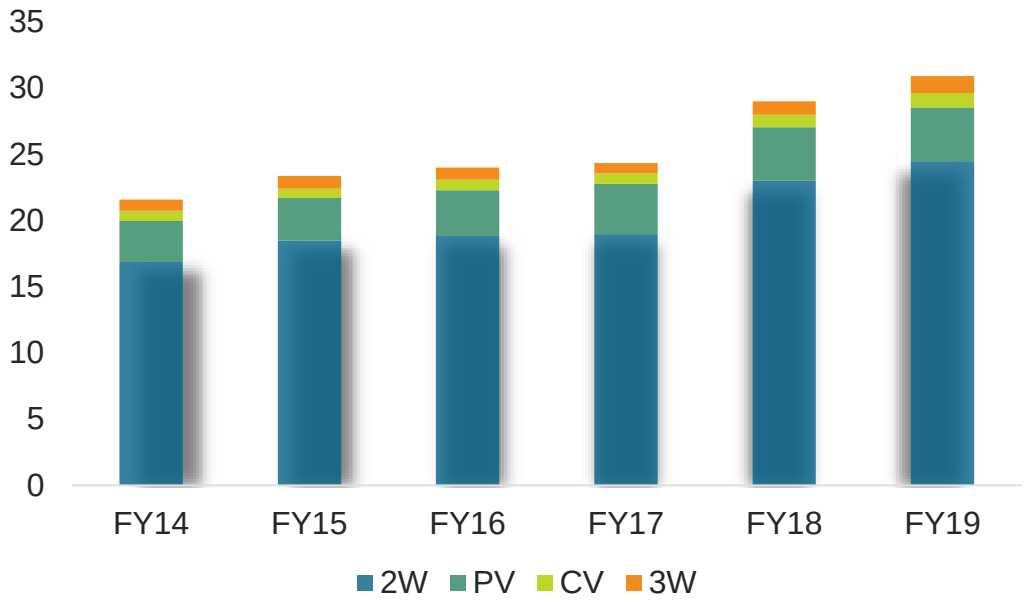
Shared Mobility

- In US alone congestion accounts for 7 billion hours of lost time and costs the economy $160 Bn annually.
- Specially in case of electric vehicles, the saving in operating cost against an ICE vehicle will make up for higher upfront cost faster in shared mobility scenario because of higher usage of vehicle.

Source: [15],[16],[17],[18]

India's big and diverse auto sector is in early stages of transition

Automobile production in India (Volume in Mn)[6],[7]



4th largest market in the world for automobiles

Share of automobile in India's GDP — **7%**

40
Auto OEMs in India

100
Manufacturing plants in India

Growth Drivers

Increasing income of young population

Improving Road Infrastructure

Transition Troubles

A recent slowdown in volumes coupled with technological as well as policy related uncertainties has impacted future plans of the major players in the Industry.

Electrifying the Indian Automobile

High Carbon Emissions

One of India's major development goals is the need to significantly reduce carbon emissions. The widespread use of EVs could reduce the Carbon dioxide emissions by 37%[6].

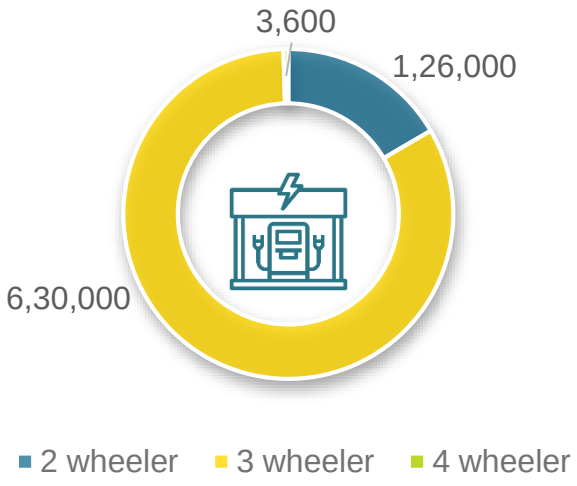
Low Power Demand

Currently only 62.2%[9] capacity of power plants is being utilized. A new source of power demand in the form of Electric Vehicles may lead to stable demand and a 'paying customer segment'.

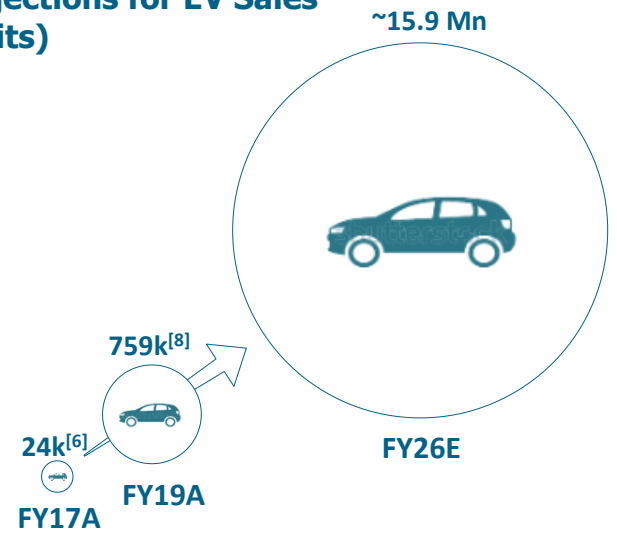
Fuel Security Risk

India can save 64%[6] of passenger mobility-related energy demand in 2030 by pursuing a shared, electric & connected solution. This could result in a reduction of 156 Mtoe (~US $ 60 Bn.) in diesel & petrol consumption.

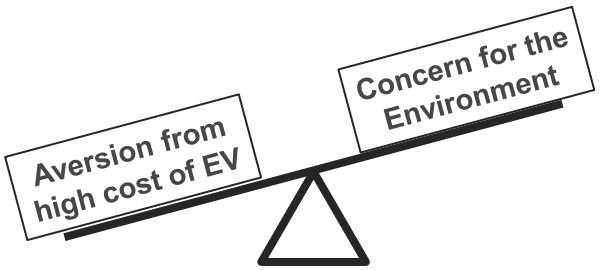
EV Sales (FY19)[8]



Projections for EV Sales (Units)



Consumer Psychology is a Major Concern



Lack of aspirational appeal in the existing EVs

Key long-term growth catalyst are already present

CHARGERS IN EVERY BUILDING

Ministry of Housing and Ministry of Urban Affairs have released amendments to Model Building By-Laws to provide for EV charging infrastructure for residential and other buildings.

REGULATORY SUPPORT

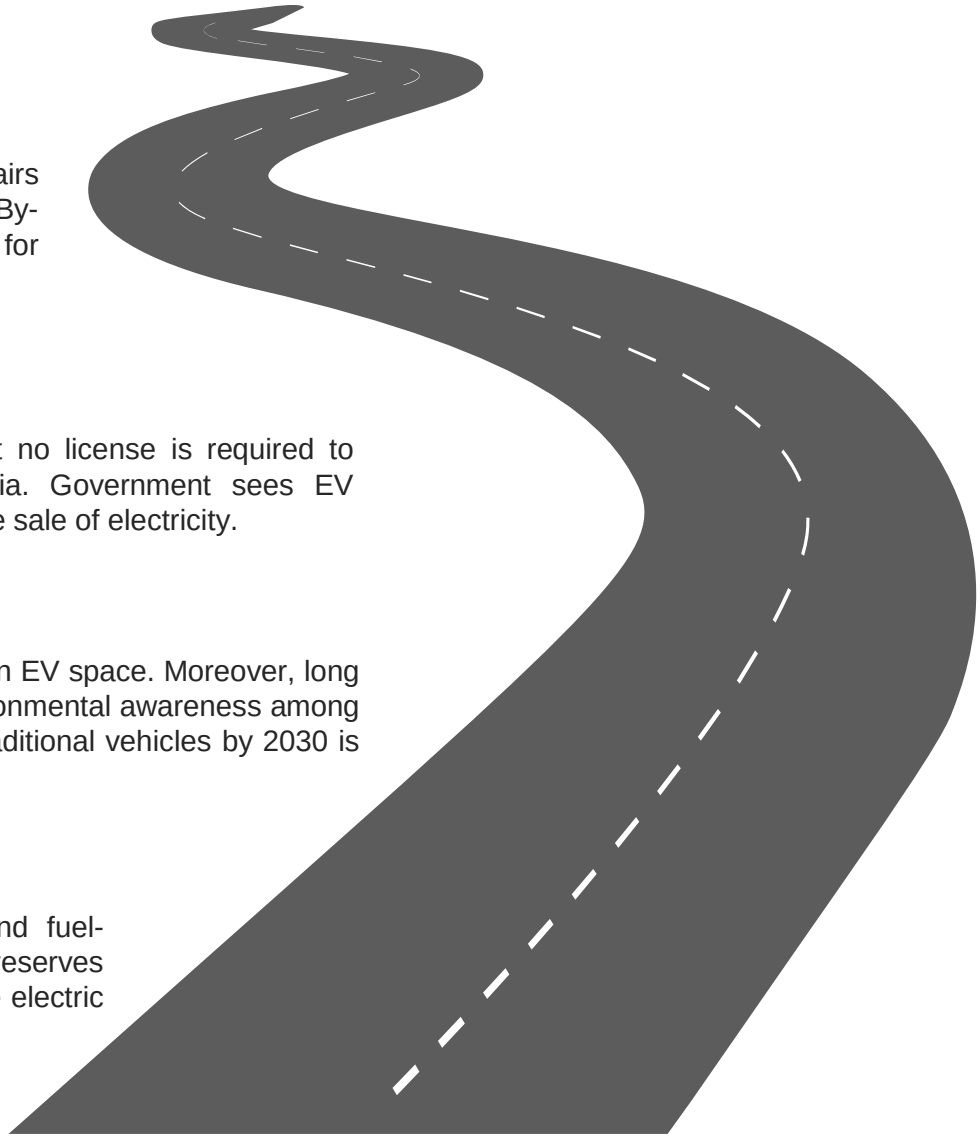
The Ministry of Power has stated that no license is required to operate EV charging stations in India. Government sees EV charging station as a service and not the sale of electricity.

CARE FOR ENVIRONMENT

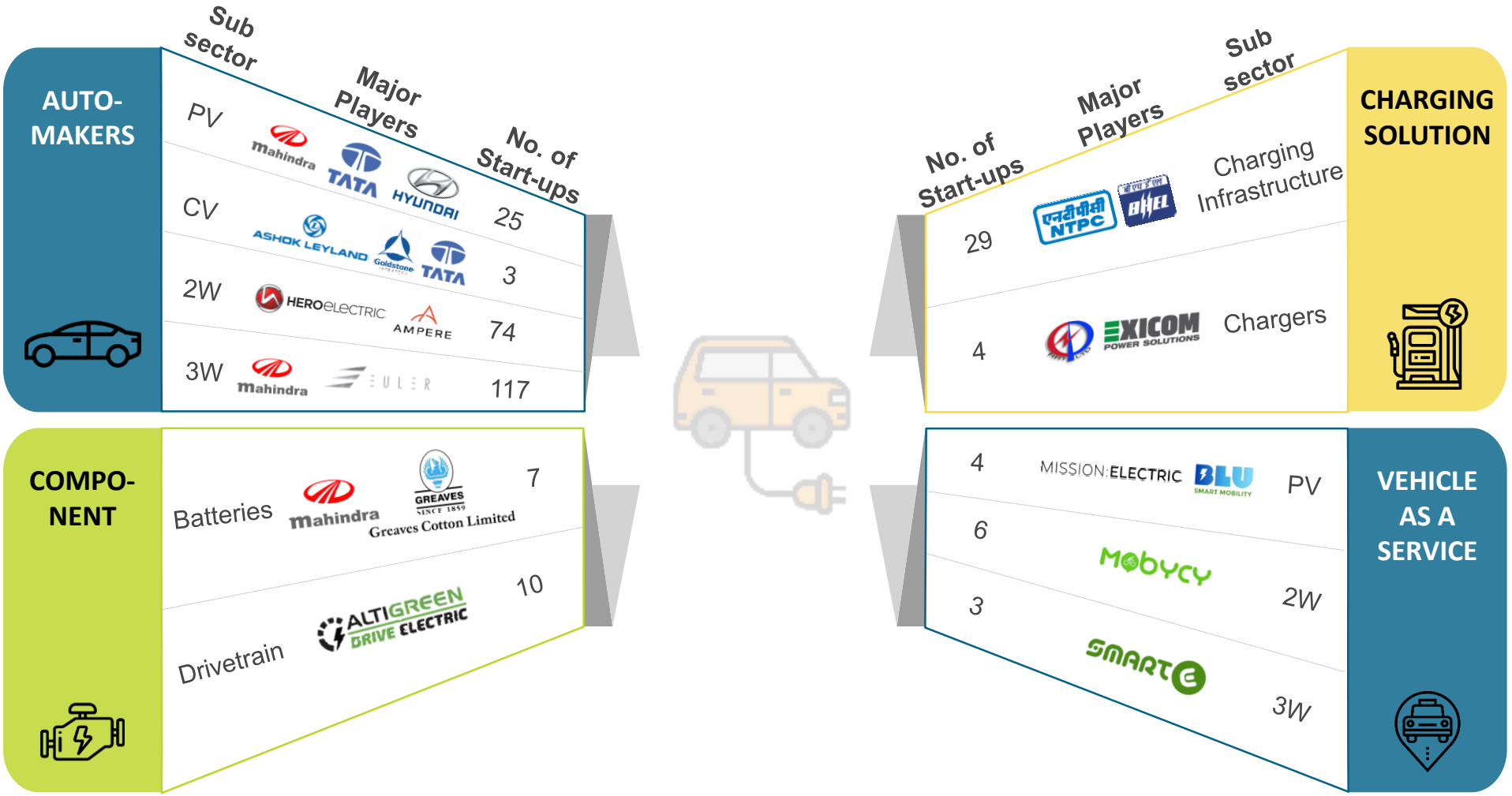
There are a lot of technical advancements in EV space. Moreover, long term savings for the users, increasing environmental awareness among masses and GOI mandate to replace all traditional vehicles by 2030 is expected to boost demand.

SAVING ON FUEL

Worldwide shift to more efficient technologies and fuel-efficient systems, owing to dwindling of petroleum reserves which will inevitably increase the fuel cost will make electric vehicles viable.

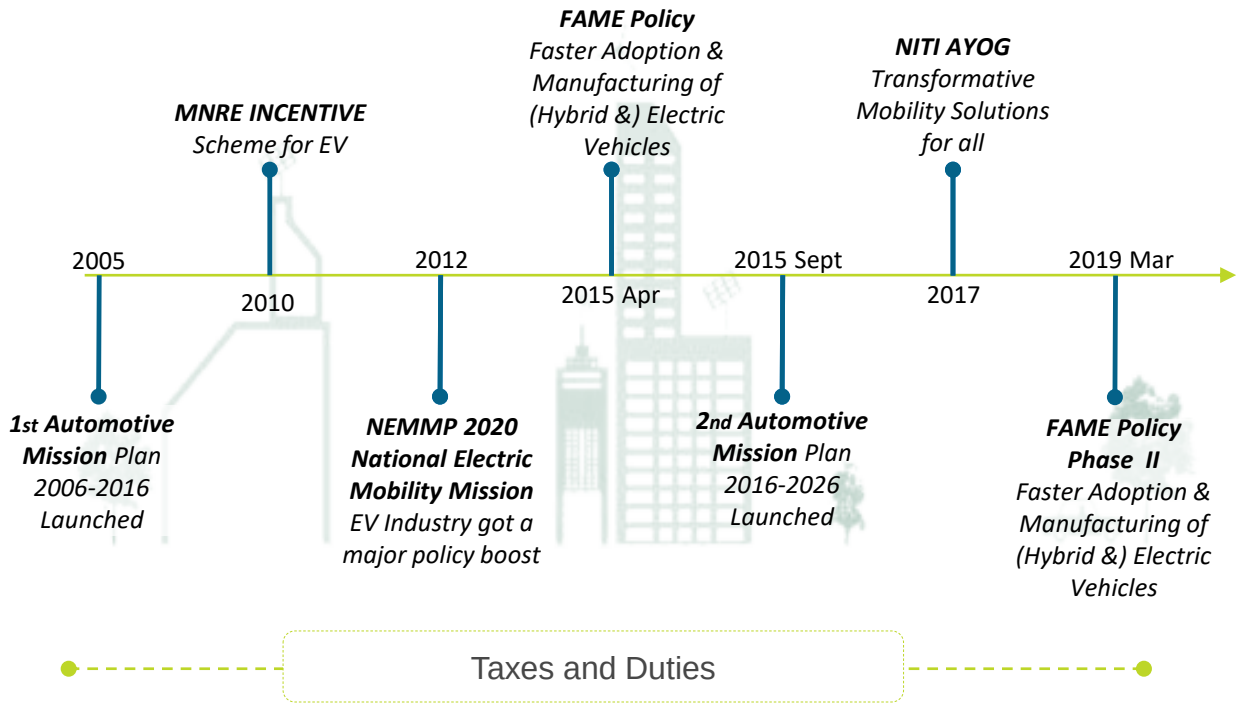


Indian players have sensed the opportunity and are gearing to revolutionize EV market



Source: Felix Research

Though still in progress, India's EV policy framework is evolving quickly



Taxes and Duties

Under the GST regime, EVs are kept at a 5% tax levels, compared with 28% plus cess for Petrol, Diesel & Hybrid Vehicles.

To galvanize Make in India the GOI has put higher import duty on goods that contribute less to value chain (like cars and chargers) and less to no duties on goods that contribute highly to the value chain (like battery, motors etc.).

Fame II

- Fame II has been approved by the Government with an outlay of Rs. 10,000Cr[10] to be invested over a period of 3 years.
- Green Mobility Fund of Rs. 70,000Cr[11] has been set up for the promotion of technologies like E-Mobility programme launched by the Ministry of Power & implemented by EESL.
- Ministry of Power is also focusing on creating charging infrastructure and a policy framework so that by 2030 more than 30% of vehicles in India are electric.

Where India Lags?

- Many countries have implemented ZEV mandate (which is considered to be the most forward looking regulation), India can achieve a good amount of growth through this mandate.
- With little incentives for buyers of EV currently, there is a scope of improvement, India can bring in incentives like relaxation on direct taxes on account of loan repayment for any EV (presently there exists consideration only for interest on loan).

Who will be impacted by this EV disruption?

Probable Winners

The **power companies** which are running below full capacity presently might see a growth in stable demand.

The companies involved in **EV battery and ancillary services** (such as in lithium extraction) will benefit immensely from growth of EV ecosystem as lithium is a major component of battery.

Components OEMs like steering wheel, tires, AC manufacturers will be impact neutral or might gain a large business from this shift.

Ancillary services around a car (insurance and car service) may get a greater number of contracts due to higher volumes.

.

Probable Losers

Indian **Automakers** had undergone considerable amount of expenditure to make their vehicles compliant with recent BS VI[9] norms, they might have to bear the brunt of weakening demand due to EVs.

Fossil fuel Engine producers are expected to suffer a huge hit from EV ecosystem due to government's focus on emission free vehicles.

Component producers like exhaust pipes, drivetrain manufacturers may suffer hit too.

Oil extraction, refinery and marketing players might see a slowdown or even a contraction in demand because presently 53% of oil is used for transport and most of this sales is expected to be in danger because of EVs.

The pre-monsoon showers for EV in India's funding space has just started

Angel and Seed Round

ION ENERGY
Developer of high-performance energy storage products

PMI Electric
Electric bus manufacturer

EULER
Manufacturer of e-rickshaws

Mobycy
Mobile-based platform providing e-scooter, and bicycle rental services

Batt:RE
Manufacturer of multi-category two-wheeler

BLU SMART MOBILITY
All electric taxi service

Major investors

IITM Incubation Cell · Emergent Ventures · venture catalysts · Blume Ventures · Speciale Invest

Series A

Hero Electric
Manufacturer of electric two and three-wheelers

22 KYMCO
Lithium
Develops & markets electric scooters

All-electric car fleet services provider

ALTIGREEN DRIVE ELECTRIC
Developer of electric powertrains

Manufacturer of Electric vehicle for personal mobility

Major investors

unreasonable CAPITAL · Cornerstone · Jupiter · Phi Capital Investments · Axon

Series B

MISSION:ELECTRIC
Develops electric mobility services and charging infrastructure

SMART E
Electric auto-rickshaw booking app

ATHER
Manufacturer of electric scooters

AMPERE
Manufacturer of electric two wheelers

Major investors

TIGER Tiger Global Management, LLC · SoftBank Group · Mitsui & Co. · Hero · Greaves Since 1859 Greaves Cotton Limited

To run faster and longer EV needs growth hacking supercharge

What's Discharging the EVs

Lack of **motivation for buyers** towards environmental sustainability when weighed against availability of options as well as cost and efforts for transformation towards EVs.

EV sector has a chicken and egg problem, unless there are enough **charging stations**, making vehicles won't be viable and with less vehicles on the road, making charging infrastructure won't be viable.

Policies are still in the making and due to multiple stakeholders, it may take a while before a clear horizon for EV emerges.

Currently India will need to import **lithium and cobalt** which will result in shifting of import bill from oil to these minerals, hence net benefit will be lesser.

What's going to boost it to home

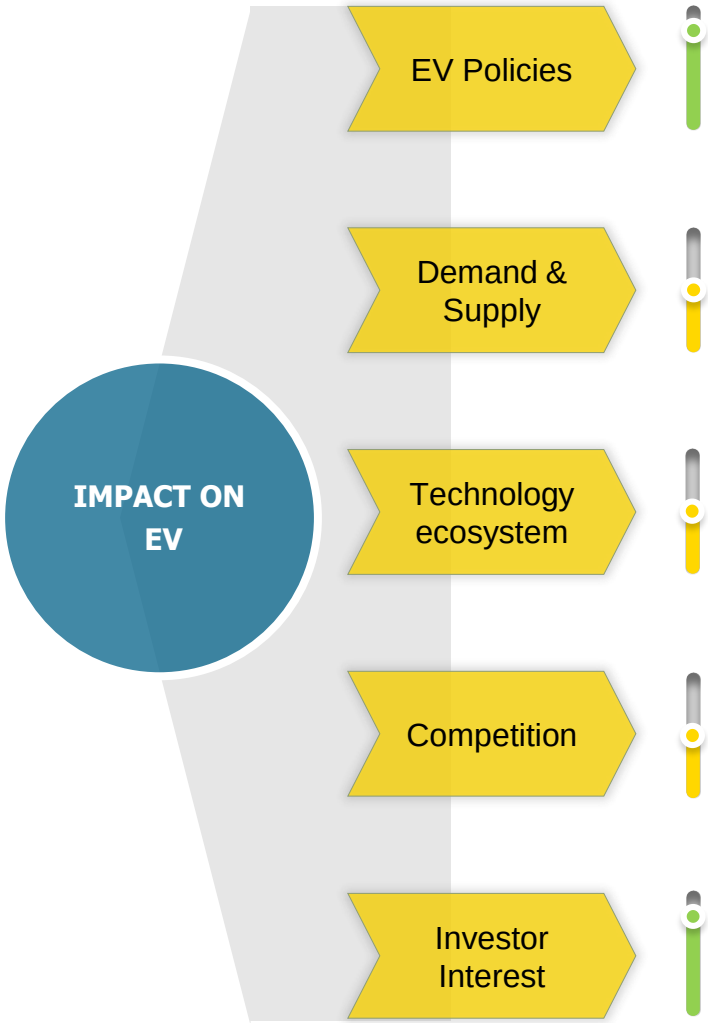
With growing number of vehicles fleet, the viability of ecosystem may drive the prices down and make the cost – benefit analysis positive for individual buyer.

Commercial application of EVs (Taxi Fleet) has already begun gaining traction which may lead to viability of charging solutions and end this problem.

The government is visibly keen on growth of this sector and hence, we should probably see establishment of framework and policies in near future.

A JV "Khalij Bidesh" among NALCO, HCL and MECL has been formed for exploration and procession of strategic minerals - lithium and cobalt are a major part of it.

So what does that mean?



- Government is taking proactive steps on EV policies and trying to sync it with global standards
- Some of the major steps are yet to be implemented (like ZEV mandate).
- We might see a lot of development in this area which will prove to be a tailwind for the sector.

- There are a few options for the consumers in EV and they are more expensive than ICE alternatives owing majorly to the high input cost, due to batteries, for the suppliers.
- The consumers as well as producers are seemingly willing to shift to EV which will lead to faster enabling of the ecosystem.
- The cost-benefit analysis is expected to be on positive side in the future with faster adoption.

- In wake of the current advancements in battery technology, the battery cost in expected to decrease drastically in the future.
- There is also a lot of research going on over development of superfast chargers, the commercialization of which will make charging infrastructure space fairly viable.

- GOI is encouraging a lot of investment in this sector hence there are little barriers to entry from regulation perspective. Though, auto manufacturing remains a capital intensive play.
- The space is expected to experience a tremendous growth, a lot of players will be competing.
- The one who is able to stay ahead in the innovation curve will emerge victorious in competition.

- The sector is attracting public and private investments.
- EVs are expected to be inevitable in the foreseeable future and considering the high growth, significant future funding is anticipated.

2W EV is already on its way and the 4W EV will reach home sooner if all of the above works in tandem.

Glossary

Term	Full form	Meaning
Mn	Millions	
Bn	Billions	
A, E ,F (in graphs)	A – Actual, E – Estimated, F - Forecasted	
EV	Electric Vehicle	
CAGR	Compounded annual growth rate	
OEMs	Original Equipment manufacturer	An OEM is a company that produces parts and equipment that may be marketed by another manufacturer
ZEV Mandate	Zero emission vehicle	Manufacturers get certain credits for each EV they sell and have to maintain a certain amount of credit for a given year.
ICE	Internal Combustion engine	Regular petrol and diesel engines which work on combustion of fuel.
GOI	Government of India	
Regulatory arbitrage	NA	When two Countries have different policies and the businesses shift their operations to the place with more lenient rules.
Mtoe	Million Tonne of Oil Equivalent	Unit of energy equal to energy generated by burning a million tonne of crude oil.
FY	Financial Year	April 01 to March 31 of succeeding year
Patent Family	NA	When a patent for a particular technology is filed with various patent offices

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