

Project Dissertation on

A STUDY ON
ELECTRIC VEHICLE INDUSTRY
AND
OPPORTUNITIES FOR INVESTORS

Submitted By:

Sumit Gupta

2K17/EMBA/545

Under the Guidance of:

Dr. Ram Shringar Rao



DELHI SCHOOL OF
MANAGEMENT

Delhi Technological University

Bawana Road, Delhi-110042

Jan-May 2019

DECLARATION

I, Sumit Gupta, a bonafide student of EMBA Programme at Delhi School of Management, Delhi Technological University here declare that this project report is my original work which is also supported by my current company. This report and the information is first hand information and have not been submitted to any other institute or university in any form for the award of any educational fellowship, diploma or degree.

Place: New Delhi

Date: 23rd May 2019

Name: Sumit Gupta

Roll No.: 2K17/EMBA/545

CERTIFICATE

This is to certify that the internship report entitled '**A study on Electric Vehicle industry and opportunities for investors**', being submitted by **Sumit Gupta (Roll Number: 2K17/EMBA/545)** in partial fulfillment for the requirement of the award of the degree of Executive-Master of Business Administration, to Delhi School of Management, Delhi Technological University, is a record of bonafide work carried out by him under my supervision during the year 2017.

Date: 23rd May 2019

Place: Delhi Technological University

(_____)

Dr. Ram Shringar Rao

Assistant Professor, Ambedkar Institute of Advanced Communication Technologies
& Research, Geeta Colony Delhi, India-110031)

ACKNOWLEDGEMENT

I believe that cooperation and guidance of seniors and experienced people is quite imperative in achieving our desired goals.

I, hereby, express my very sincere gratitude to my kind and supportive mentor Dr. RS Rao for mentoring me and providing me his valuable support till the successful completion and submission of the project. I profoundly acknowledge his efforts and him for giving his guidance, valuable time, support, and very critical reviews about this project despite being occupied in his job responsibilities.

My humble acknowledgment also goes to entire DTU faculty members and my family for great support and care throughout my 2 years of EMBA course and for motivating me to be on track.

Name: Sumit Gupta

Roll No: 2K17/EMBA/545

TABLE OF CONTENTS

Declaration	2
Certificate	3
Acknowledgement	4
Table of contents	5
Background to the study	6
Introduction	7
EV industry in India	11
Battery market in India	12
2-wheeler industry	14
4-wheeler industry	15
Government policies and initiatives – case studies	16
Charging infrastructure	18
Research findings	21
Recommendations	24
Prominent news	25
Annexure	26
References	28

Background to the study

The automotive industry at the global level is about to come at a 360 degree shift from IC engine vehicles to zero pollution emission vehicles because of strict policies and regulations by Governments worldwide because of deteriorating air quality and greenhouse gas emissions. India is proactively looking for cost effective and viable solutions to the serious problem of very poor air quality in many cities as well as India is trying to reduce its high dependence on oil imports. The country have recently announced a considerable shift to an all electricity operated fleet by 2030, which requires attention and action by auto manufacturers, vendors (including battery manufacturers), dealers and utility players on local and global level. As many stakeholders are trying to grasp the possible implications of this transition and re-design their businesses with the agenda of the Governments, there are many questions that requires answers:

- ▶ How current industry balance will change because of the electrification drive by Indian Government?
- ▶ Which are the different segments of vehicles which will lead this electrification drive?
- ▶ What charging models will be suitable for Indian market and how the development of charging infrastructure happens in India?

This report, looks to answer these questions from the investors point of view by providing a deep-dive into the future of Electric Vehicle adoption across various many segments in India.

INTRODUCTION

The Indian automobile industry is one of the largest growing markets of the world and contributes highly in the country’s manufacturing facilities. Not only this, the automotive industry in India is further expected to pull up the

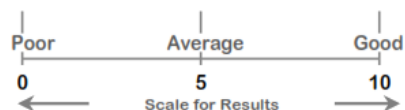
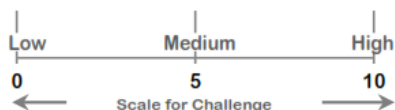
share of manufacturing in India’s GDP to

25% by 2022 from 15% currently, with production of Electric Vehicles being new talk of the town.

However, India’s electric vehicle industry is a newly born baby when compared with the other international markets such as US, China

& Europe etc. But, a face change is definitely anticipated for India’s EV industry with major thrust given by the government.

Signposts	Degree of Challenge	Results in Near Term	Path
Long Range Success Strategy for OEM's in India			The key shall be integrating EV's in their fleet plan
Collaborative Approach			Collaborative approach by OEMs, charging infra enablers, battery suppliers & smart grid service utilities are must to power EV's business case in India
Charging Infrastructure			Setting up of level 2 charging infra at public level shall be the toughest challenge
Customer Awareness			A must to future growth of EV's in India
Customer Awareness			A must to future growth of EV's in India
Shift from "Product - Only" Strategy			Enhancing extended scope capabilities in Indian EV market
Government Support			Government support and subsidies, key to embellish EV market in India

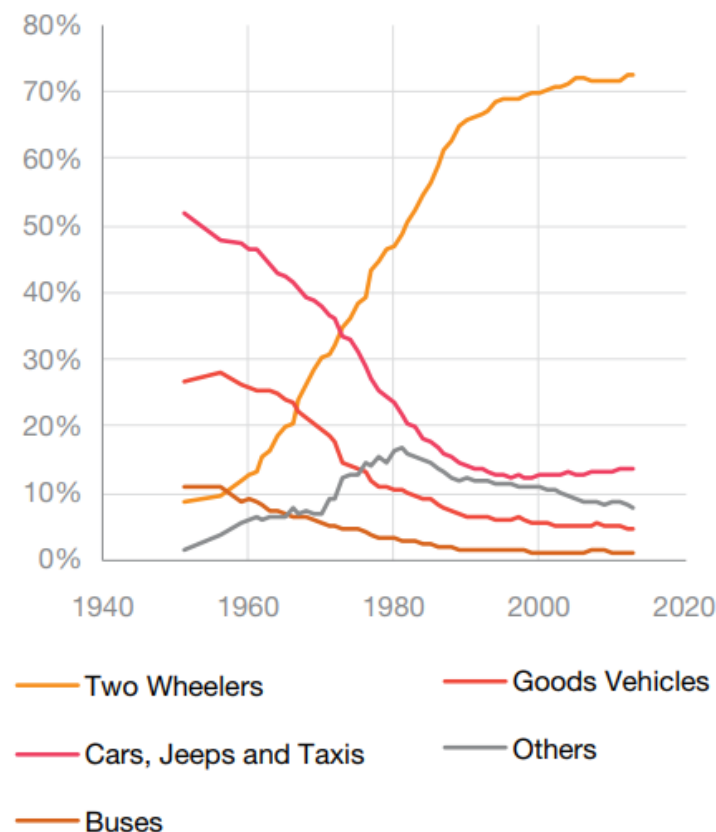


India is the second most populous country in the world with a population of 1.33 billion, and is growing at the rate of 1.1% year on year⁵. At this rate, it is expected to become the country with the largest population in the world in the next 20 years. Furthermore, the advent of industrialisation and commercialisation has spurred employment opportunities and resulted in spreading urbanisation. With this rapid urbanisation, India is expected to see 500 million people living in its cities by 2030⁶. This, coupled with current and projected economic trends, is likely to lead to rising incomes in Indian households, thereby increase the demand for mobility. The automobile industry in India is the world’s fourth largest and is expected to become the third largest by 2021.

The industry accounts for 7.1% of India’s Gross Domestic Product (GDP) and the Automotive Mission Plan 2016-2026 of the Government of India aims to raise this to 12% The Indian automotive industry (including component manufacturing) is expected to grow at a compounded annual growth rate of 5.9% and reach INR16.16-18.18 trillion (US\$251.4-282.8 billion) by 2026, thereby becoming the fastest growing industry in the country.

According to the National Electric Mobility Mission Plan 2020 report, the Indian automobile market is ruled by two wheelers, which account for 75% of the total number of vehicles sold in the country. And the passenger car segment is dominated by the small car segment and there is an increased likelihood for numbers to go up significantly by 2030⁸. This information has been corroborated by the Society of Indian Automobile Manufacturers’ (SIAM) report,

Share of vehicle types



‘Overall Auto Industry Growing in Double Digit Marginal Growth in Passenger Vehicles’, which indicates that the industry has produced a total of 1.95 crore vehicles, comprising passenger, commercial, three- wheeler and two-wheelers vehicles and quadricycle vehicles in April-Oct 2018 compared to 1.71 crore in April-Oct 2017, registering a growth of 14.39%. Although India has been witnessing an increase in its sale of vehicles year on year, automobile ownership in the country still remains low, with only 18 cars per 1,000 citizens, compared to nearly 69 in China and 786 in the US¹¹. This indicates that a major section of Indians do not own vehicles and are dependent on shared or public means of mobility.

With the dominance of and Indians’ increasing reliance on road and rail transport, public buses and trains have been the primary mode of transport in the country. The report, The Key Indicators of Household Expenditure on Services and Durable Goods, published by the Ministry of Statistics and Programme Implementation in 2016, indicated that buses are the most common means of transport both in rural and urban areas. According to the report, the maximum spend of around 66% of households in rural areas and 62% of households in urban areas is on buses.

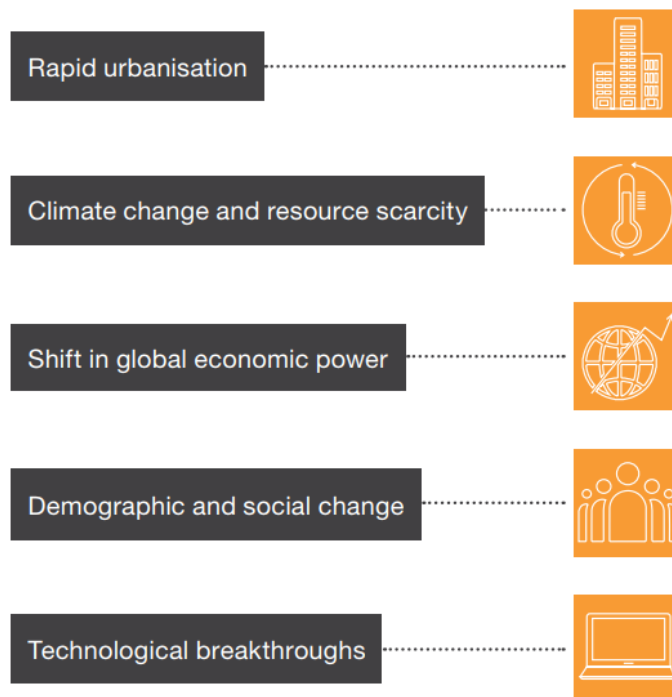
The other modes of transportation include autorickshaws, cabs and trains¹². However, the supply side has not been able to catch up proportionately with growing demand due to the rising population. Moreover, the share of public transport buses has declined, which has necessitated a revamp of the public transport system in the country.

This has resulted in the growth of app-based cab aggregators, and is synonymous with the penetration of smart phones. Today, India’s two largest app-based cab aggregators provide close to 3.5 million rides on a day to day basis¹³. This had transformed the industry in terms of mobility and has been a turn-key solution. However, in view of the longterm perspective, what is needed is an efficient public transport system in the country, with vehicles running on electricity or alternative fuels, which make this mode of conveyance efficient, convenient, comfortable and safe, and encourage people to opt for public transport. In this regard, India’s electric vehicle industry is taking huge forward strides.

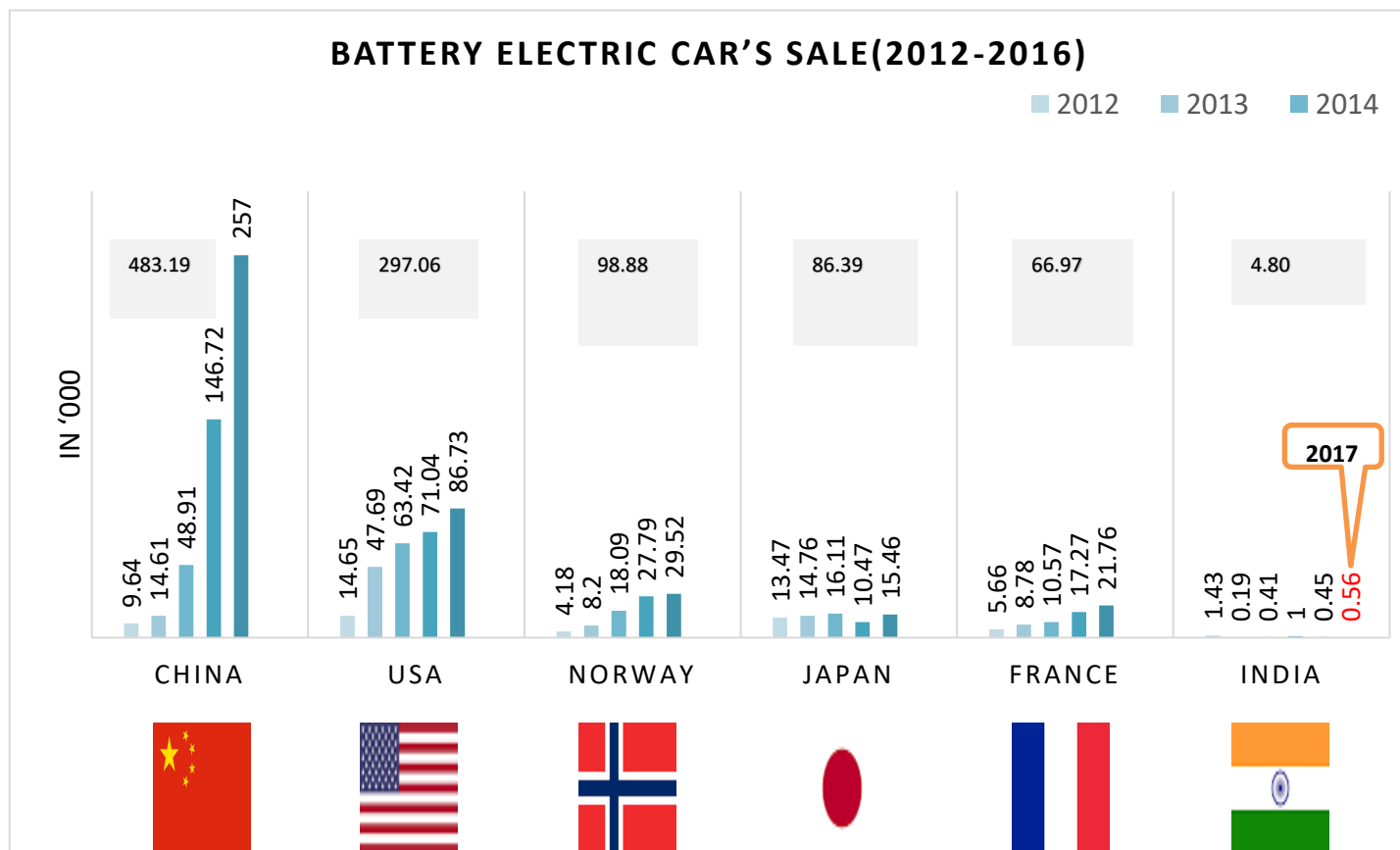
The National Electric Mobility Mission Plan (NEMMP) 2020 was launched by the Central Government in 2013 to boost the manufacture of hybrid and electric vehicles in India and aims to achieve production of seven million electric vehicles by 2020. This initiative has been complemented by the Government providing demand-side incentives through its Faster Adoption & Manufacturing of Hybrid and Electric Vehicles in India (FAME) scheme. Private automobile players have risen to the challenge and have been investing in R&D facilities and setting up additional manufacturing units for e-Vehicles. And with the Government deciding to fund up to 60% of R&D costs for the development of indigenous low-cost electric technology, global automobile players are investing heavily in R&D in electric vehicle technologies in India.

Megatrends and the public transportation imperative

With India being at the heart of a transformation and with numerous factors contributing to this, it is time for some foresight that will provide India the opportunity to search for innovative solutions, achieve significant growth and build stronger communities. PwC has been helping the Government tackle complex changes inspired by five megatrends, including rapid urbanisation, the shift in global economic power, climate change, scarcity of resources, demographic and social change and technological breakthroughs. These trends are disrupting the economy, business and society as a whole. They are expected to make a major impact on the global economic and commercial landscape, and no society, organisation or individual will be exempt from the effect of these megatrends. Therefore, it is important for us to understand how to respond and adapt to the changes they will bring about.



EV industry : India and the world



- In 2017-18, 56,000 battery electric vehicles(excluding 3W) were sold in India out of which 54,800 were 2-wheelers and 1,200 were battery cars(4W).
- India comprises only 0.02% of market share in global electric vehicle but with government aiming to promote EVs, the expected market share will be more than 18%.

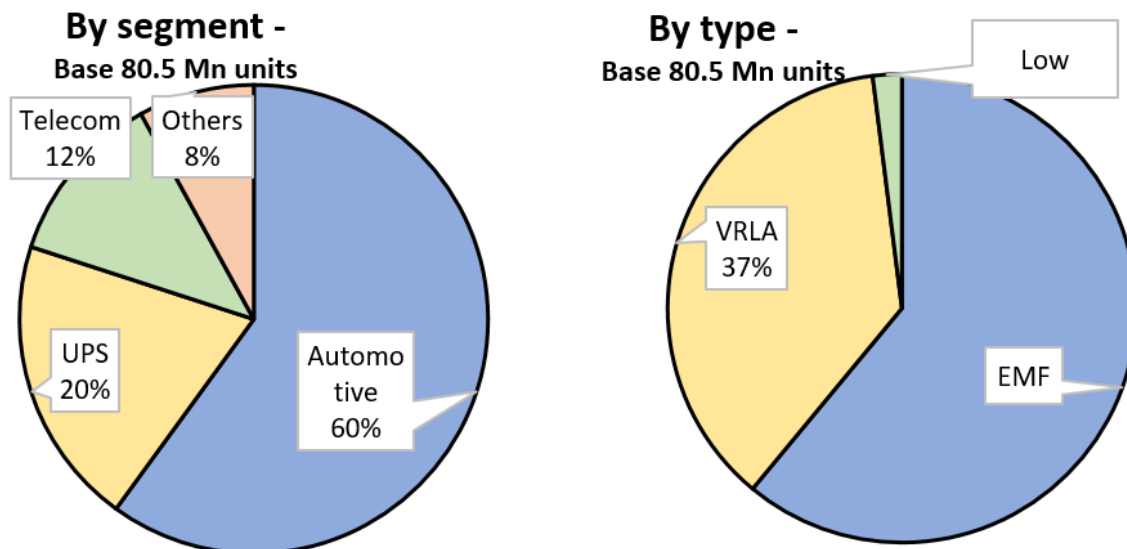
Battery Market in India - An Introduction

Lead acid batteries

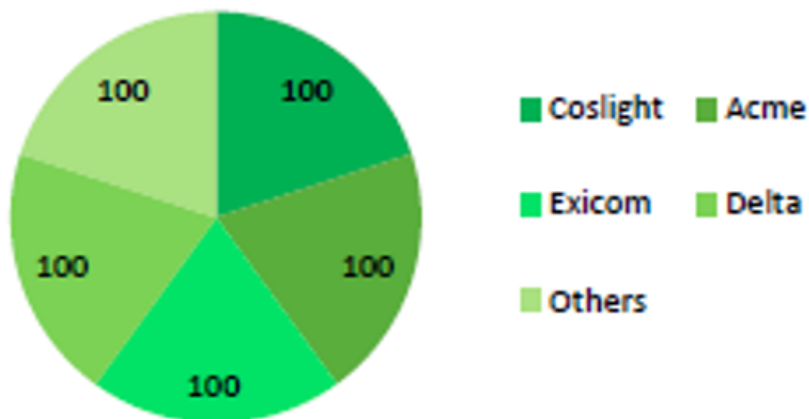
The battery which uses sponge lead and lead peroxide for the conversion of the chemical energy into electrical power, such type of battery is called a lead acid battery. The lead acid battery is most commonly used in the power stations and substations because it has higher cell voltage and lower cost.

- The battery market is a INR 177 billion industry and around 80.5 million units.
- Market dominated only by the Lead Acid batteries
- Unorganized sector accounts for 40% of the market by volume.
- Market dominated by 2 key large players – Exide industries and Amara Raja industries.

Lead acid batteries



Lithium-ion batteries



Major Li-ion battery packaging companies with their annual capacity

Advantages

- High energy density - potential for yet higher capacities.
- Does not need prolonged priming when new. One regular charge is all that's needed
- Low Maintenance - no periodic discharge is needed; there is no memory.
- Specialty cells can provide very high current to applications such as power tools.

Limitations

- Requires protection circuit to maintain voltage and current within safe limits.
- Subject to aging, even if not in use - storage in a cool place at 40% charge reduces the aging effect.
- Expensive to manufacture - about 40 percent higher in cost than nickel-cadmium.
- Not fully mature - metals and chemicals are changing on a continuing basis.

Key points

- Current Lithium Ion battery packaging capacity in India ~500MWh
- Lithium battery packaging started in India since last 2 year.
- Hero Electric purchases Li-ion batteries from China or South Korea, Ashok Leyland sources the batteries for its E-buses from USA.

Electric 2-wheeler industry

Because of the easiness in charging, this segment have got the biggest potential for penetration, even for such areas which are having minimum charging infrastructure or network.

A start to end ecosystem (beginning from in-house manufacturing activities to the set up of charging arrangements and infrastructure) which are being created by many start-ups should increase the adoption of electric 2Wheeler. Two-wheelers is currently the biggest segment in automotive industry of India which represents eighty percent of Indian automotive sales in FY17 (approx. units 17.6 million). The main reason being the variety in this segment, it is believed that it have big potential to promote emission-free mobility in our country. The electric Two-W segment have already proved the potential in 2011-12, when electric Two-Ws marked high sales of approx. 90,000 units. Although, there was a dip in the sales in the following years when the subsidies were withdrawn by the Ministry of New & Renewable Energy (MNRE), with the sales of roughly twenty five thousand units in 2016.

Name	Establishment	Electric models available	Location
Hero electric	1956	Flash, Nyx, Optima, Photon	Punjab
TVS motors	1978	Creon	Karnataka
Electrotherm India ltd	1983	Yo drift, Yo edge, Yo electron, Yo explor	Gujarat
HMSI	1999	Activa	Haryana
Ampere vehicles pvt ltd	2008	Reo, V48, Magnus	Tamil Nadu
Lohia Auto Industries	2008	Oma star	Uttarakhand
Ather energy pvt ltd	2013	340, 450	Bangalore
Tunwal e vehicles pvt ltd	2014	Sport 63, Storm, Electrika, Lithino-Li	Gujarat
Okinawa autotech pvt ltd	2015	Ridge, Ridge+, Praise	Haryana
Twenty two motors pvt ltd	2016	Flow	Haryana

- As per Government, electrification of 2-wheeler is priority as they comprise 80% volume of the total automotive sale in India.
- As per one of the research done by Hero electric, the average Kms travelled by a 2-wheeler in Delhi NCR is 35-45 Km so range in 2-wheelers will not be of much concern.

Electric 4-wheeler industry

5th biggest automotive- car market in the world, India, with over 30 lakhs cars sold in Financial year 17, there is a significant growth potential observed given the current car density is maintained at 34 cars on 1,000 people. EV sales, however, constituted merely 0.1% of the PV sales in FY17 and have continued to be very low.

Name	Establishment	Models	Plants for EV manufacturing
Tata Motors	1945	Tigor electric, Tiago electric	Sanand (Gujarat)
Mahindra Electric	1994	e2o plus, eVerito, eKuv100	Hosur(Karnataka)

- Both are Indian origin companies, only suppliers of electric cars for government tenders
- Mahindra entered into EV segments in 2007 by acquiring majority stakes in Reva India, modified Reva and renamed it as Mahindra e2o.
- Mahindra is m its 2 electric car models(e2o & eVerito) for private sale while Tata is not selling any of its electric cars for private sales.

Other OEMs which announced EVs in India are:

- Maruti Suzuki – Wagon R model in 2020
- Hyundai – Kona & Ioniq model in late 2019
- Nissan – Leaf in 2019
- Apart from electric cars, electric buses is one of the key segment promoted by the government.
- OEMs like Tata motors, Ashok leyland, JBM & Goldstone have electric bus manufacturing in India.

Government policy & initiatives (By Karnataka state)

Every state in India is free to create its own EV policy.

Only 5 states formulated their EV policies – Karnataka, Maharashtra, Andhra Pradesh, Uttar Pradesh & Telangana (till date)

Incentives & subsidies

Some common benefits have been announced for

Electric vehicle &
its component
manufacturers

EV battery
manufacturing/as
sembly
enterprises

EV
charging/swapping
infrastructure
manufacturers

Concessional registration charges for land

- Subsidized land rates
- Subsidized electricity
- Interest free loans

Other benefits

- Electric commercial & non-commercial transport vehicles
- Tax exemption (like road tax, parking fee) for all electric commercial & non-commercial transport vehicles.

EV service providers

- Electric 2W and 3W – Subsidy for first 100 fast EV charging or battery swapping stations.
- Electric cars and buses – Subsidy for first 50 fast EV charging or battery swapping stations.

Government policy & initiatives

For example: Policies by Uttar Pradesh state

1) Incentives – EVMUs/EBUs

For development of private electric vehicle (PEV) park, subsidies on

- Procurement of plant & machinery
- Developing supporting infrastructures for EVs like drainage, powerlines etc.
- Setting up of testing & quality certification labs for EVs.
- Electricity
- SGST(state tax) reimbursement up to 70%

2) Incentives – EV promotion

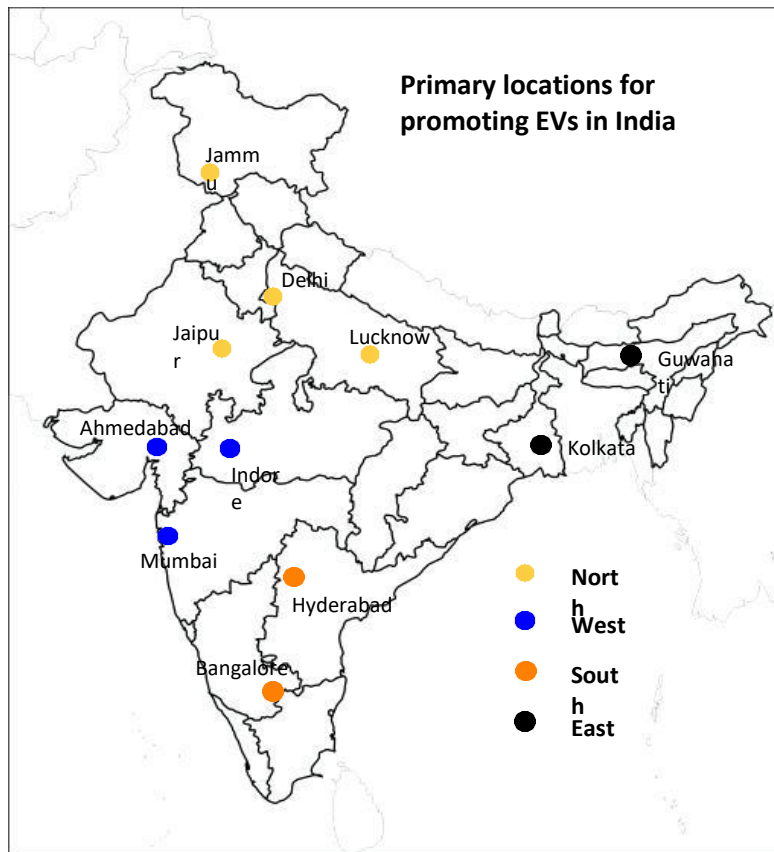
In order to induce demand and create market for electric vehicle

- Exemption from road tax and vehicle registration fee
- Interest free loans to state government employees
- Subsidy on interest of loan for setting up EV charging/swapping stations

3) Incentives – Capacity building/environment protection

- In order to develop the skills and protect the environment in PEV sites
- Subsidized loans for setting up effluent treatment plant(ETP)
- Incentives for imparting skill trainings in EV and battery repair etc.
- Subsidized loans for setting up technologies or innovation centres at PEV parks.

Charging infrastructure



- Ministry of Power released tenders to procure about 2000 EV charges in 1st phase out of which 1800 will be AC and 200 will be DC. Tender awarded to
 1. Exicom – 1080 AC chargers and 100 DC chargers
 2. SBD green – 720 AC chargers
 3. Delta & BHEL – 100 DC chargers
- The government is also planning to set up 4500 charging stations in India.
- 15 firms currently supplying EV chargers in India
 - 4 wheeler AC chargers – RRT electro power(Chennai), Mass tech control(Mumbai), Exicom(New Delhi)
 - 2. 5-6 Key global firms are eyeing Indian 4 wheeler charger market closely – ABB, Schneider, Siemens etc.
- ❖ Although, the government has released tenders to set up charging stations but the geographical distribution has not been decided yet.
- ❖ Public charging will have lesser share in future.

Charging Infrastructure

	2017-18	2018-19	2019-21	2021-25	Cumulative potential 2017-18 upto 2025
Number of EV Charging stations to be set up	1000	5000	50,000	350,000	406,000
Number of EV chargers to be installed (approx.)	4	4	6	6	
Total installation of EV Chargers to be done (approx.)	4000	20000	X 300,000	2,100,000	2,424,000
AC chargers (in %)	90	80	80	70	
DC chargers (in %)	10	20	20	30	
Number of slow AC chargers to be installed (approx.)	3,600	16,000	240,000	1,470,000	1,729,600
Number of slow DC chargers to be installed (approx.)	400	4,000	60,000	630,000	694,400

Why more % of AC chargers?

- This is mainly because 2Wheelers and private cars are mainly being charged at home or offices and they comprise about 90% of the total automotive sale in India so there is ample time to charge them.
- Cost of DC chargers is 3 times more than that of AC chargers.

Proposed charging stations & no. of chargers

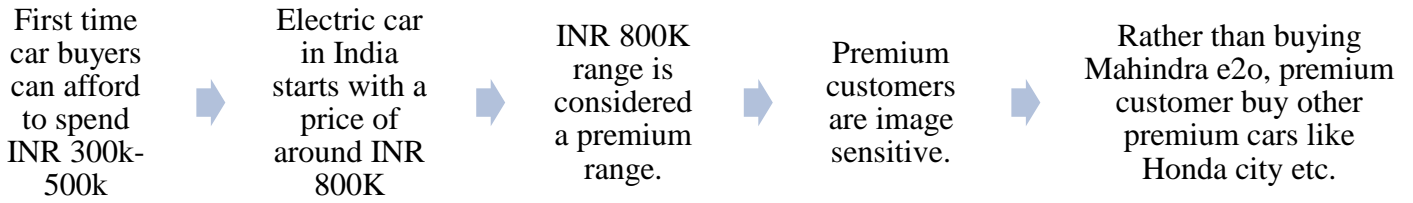
	2017-18	2018-19	2019-21	2021-25	Cumulative potential 2017-18 upto 2025
No of EV Charging stations proposed	1,000	5,000	50,000	350,000	406,000
No of EV chargers per station	4	4	6	6	
Total EV Chargers Proposed	4,000	20,000	300,000	2,100,000	2,424,000
No of AC chargers	3,600	16,000	240,000	1,470,000	1,729,600
(%)	(90)	(80)	(80)	(70)	
No of DC chargers	400	4,000	60,000	630,000	694,400
(%)	(10)	(20)	(20)	(30)	

Why more % of AC chargers?

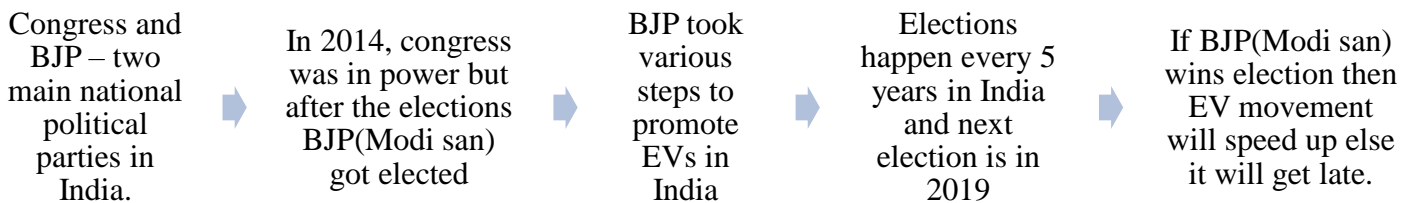
- This is mainly because 2Wheelers and private cars are mainly being charged at home or offices and they comprise about 90% of the total automotive sale in India so there is ample time to charge them.
- Cost of AC chargers is 3 times cheaper than that of DC chargers.

Research findings : Shortcomings for EV industry

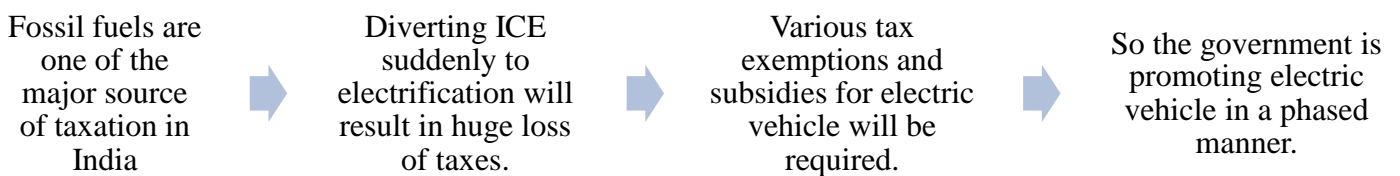
Consumer behaviour



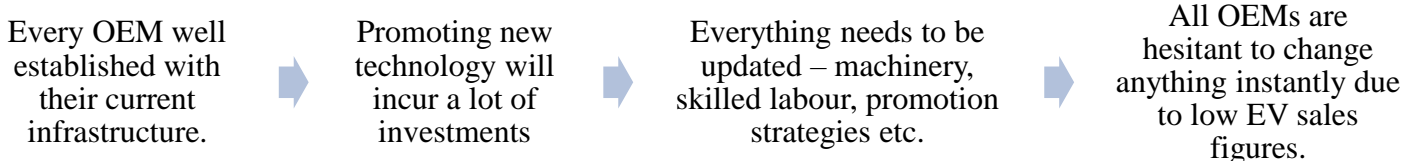
Impact of Elections on EVs in India



Long term planning of government



OEMs selfish needs



Research findings : Positives for EV industry

Reducing Li battery cost:

- Cost has fallen from USD 273/Kwh to USD 200/Kwh in 1 year.
- Expected to be USD 73/Kwh in 2025 as per government statement.

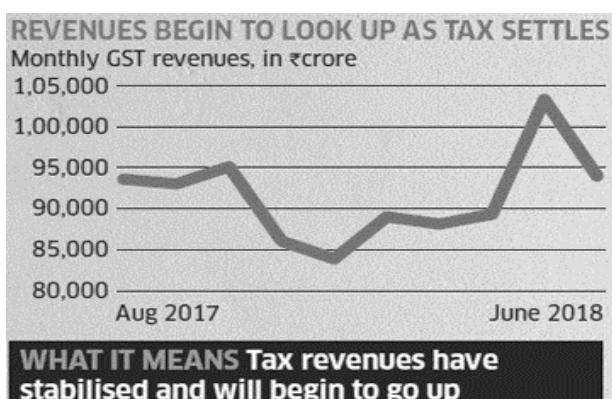
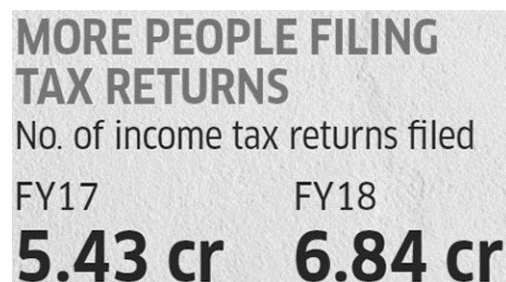
Reason – the growing volume of EVs and stationary storage system in renewable energies across the globe.

Clever decisions by government :

- GST, demonetization and other reforms – increased the tax contribution of the people
- This increased tax will strengthen the economic structure
- Once the economy gets stable, full-fledged EV promotions will start.

According to the Economic Survey 2017-18, the base of indirect tax payer has increased substantially by more than 50% after the implementation of GST.

Tax collections for financial year 2017-18 is 17.1 percent higher than the net collections for FY 2016-17.



Research findings : Positives for EV industry

Growing start-ups :

- Hundreds of start-ups related to EVs have come up in India in past 4-5 years which clearly shows the future of EVs in India.

Name	Establishment	Manufacturer profile	Location
Ather energy pvt ltd	2013	EV – 2W	Bangalore
Tunwal e vehicles pvt ltd	2014	EV – 2W	Gujarat
Okinawa autotech pvt ltd	2015	EV – 2W	Haryana
Twenty two motors pvt ltd	2016	EV – 2W	Haryana
Ati Motors	2017	EV – Cargo vehicle	Bangalore
Grinntech motors & services pvt ltd	2017	EV – Battery	Chennai

Early birds – EV components :

- Most of the automotive component manufacturers have either started research for EV components or are manufacturing components related to EVs (particularly for electric 2W & 3W)

Information shared during interviews – Companies like Napino, Minda, Infineon etc. have already started working/ manufacturing EV components

BS-VI to felicitate EV move:

- Highest judiciary in India has directed government to roll out BS-VI norms from April, 2020
- Since BS-VI will incur huge cost in the form of upgradation of infrastructure so move towards EVs will attract OEMs

Recommendations

Right time:

- Import will play a major role for EV OEMs in India till next 5-7 years.
- Most favourable time for MMC group companies to come to India and analyse the basic component needs of EVs and create an action plan accordingly.

Interesting news for investors

- The segments which will have growing demands are:

1. Aluminium industry

Electric vehicles use 25-27% more aluminium than the typical internal combustion engine car.

2. Electronics industry

The power electronics demand in EVs is expected to register a growth of 17.2% CAGR during period 2018 - 2023

New opportunities for investors

- Battery thermal management solution :
- Optimum temperature for Li-ion batteries to work efficiently is between 20°C - 23°C. While in India the temperature varies from 2°C in winters to 47°C in summers.

Information received while interviewing them

- Pranav Vikas (competitor of Imax) is developing thermal management solution for batteries.
- Companies like Exicom are searching for solution like this.

Some Prominent news

Ather energy gets funding of INR 3.3 billion from Hero Motocorp in 2 years

Hero MotoCorp currently owns a 32.31% stake in Ather. Ather has raised around \$62 million so far.

EV company Ampere backed by Ratan Tata to sell its 67% stake to Greaves cotton

Ampere Vehicles had raised an undisclosed amount from Ratan Tata in 2015. It has so far raised \$ 1.2 Mn funding.

Greaves cotton will reportedly acquire 67% stake in Ampere Vehicles for \$10.8 Mn (INR 77 Cr) in the first phase of acquisition.

CK Birla Group's Avtec To Invest \$88Mn In Electric Vehicles

Avtec, the engine and transmission manufacturing arm of the CK Birla Group, has plans to infuse \$88 Mn (INR 600 Cr) in producing electric vehicles and its components in the next three years.

Kia Motors To Bring Its EVs In India By 2021

South Korean automaker Kia Motors is set to roll_out its EV fleets in India by 2021 through an investment of \$1.1 Bn in its Anantpur manufacturing plant in Andhra Pradesh. It plans to produce 3 Lakh electric vehicles annually

Mercedes-Benz Plans To Manufacture EVs In Pune

The company has announced to **start global sales of its new electric vehicle sub-brand 'EQ' from next year**

Bolivia Invites India To Develop Lithium Reserves Essential For EV Manufacturing

Bolivia mines the largest reserves of lithium in the world, has made an offer to help India source lithium for EV batteries. China is already acquiring lithium from Bolivia.

Tata Group's 'One Tata Approach' To Address Needs Of EV Segment

Under its new plan, **Tata Motors** will offer the car, **while Tata Power** will set up charging stations, and **Tata Realty** will help build physical infrastructure, depots, or dedicated EV stations.

TCS will help develop an app or software platform. At the same time, the company's Motors Finance will offer financing or leasing solutions to EV buyers.

Bharat Forge Invests \$13.3 Mn To Develop EV Solutions

Auto components major Bharat Forge Ltd has announced a strategic investment of \$13.3 Mn (£10 Mn) in UK-based electric powertrain solutions provider Tevva Motors. **This is Bharat Forge's third major initiative in the EV space** and comes shortly after the start of its Engineering and Development Centre at MIRA, UK, and its investment in electric drivetrain company Tork Motorcycles in India.

Entry into India's EV Market announced by Sona Group

The firm has signed a contract with a European electric vehicles manufacturer to supply forged components, including electric axles for three-wheelers.

JSW energy increases investment for EVs To 965\$ Mn

Making an entry into the automobile market, especially the electric vehicle space, Mumbai-based JSW Energy recently announced to have increased its capex plan to \$965 Mn (INR 6,500 Cr) from \$520 Mn- \$594 Mn (INR 3,500-4,000 Cr) to launch electric buses, light pick-up trucks along with charging facilities

Annexure

Questionnaire for interviews

Objective: Market size of EV

- 1) Currently how many electric cars/bikes are being sold/manufactured by you?
- 2) How much percentage share of total cars/bikes sold in India will be EVs in 2022?
- 3) Why the current demand looks subdued and till when you expect the demand of EVs to kickoff?

Objective: Future of EV manufacturing

- 4) Do you think that electric cars in India will be a hit show or a flop show?
- 5) How many companies in your knowledge are planning to manufacture EVs in India? If you can name some of them?
- 6) In what ways EV manufacturing in India is challenging?

Objective: Policies to support EVs

- 7) How government is supporting the EV drive in India?
- 8) What benefits will the consumers get if they opt to buy EVs?
- 9) What are the tax benefits in manufacturing EVs?
- 10) Are some special benefits/facilities need to be provided to EV manufacturers/EV component manufacturers?

Objective: Suppliers of EV components

- 11) Is it difficult to find EV component suppliers in India?
- 12) What all components are majorly imported and from which countries for EVs in India/
What support you expect from foreign suppliers?
- 13) Are the current ancillaries of different OEMs also thinking or have started to manufacture components for EVs?
- 14) What are the main components of an EV which are different from a Petrol/Diesel engine car?
- 15) How do you think the auto component's market will change during this shift to EVs?

Objective: Charging infrastructure

- 16) Is the charging infrastructure enough for the growing EV market?
- 17) How many charging stations are there in India currently?

- 18) What type of charging technique is suitable for Indian market, Battery Swapping or Charging stations?
- 19) Can we expect new comers in Charging station business or the same will be taken care by petrol pump operators?
- 20) How many companies are currently there in India which are either Li-ion battery manufacturer or planning to set up the battery manufacturing plant?
- 21) Apart from Li-ion battery, what other alternatives can be seen for charging?
- 22) The time taken for charging/battery swapping is quite high, can it be reduced?

Objective: Pricing strategy for EVs

- 23) How different will be the parameters for pricing of these new EV cars and bikes?
- 24) Will the price of EVs be competitive to current petrol/diesel variants, if not then how much it can vary?
- 25) How much will the operating cost of a car/bike be reduced if a consumer opts for EVs?
- 26) Will power grids be able to handle increased electricity demand from EVs when the EVs will be in majority?
- 27) How much price benefit can a local manufacturing company get as compared to foreign EV manufacturers?

Objective: Challenges

- 28) What are the major challenges for EVs in India?
- 29) Will selection of component manufacturer of EV a major challenge for EV?
- 30) Will import still play a major role while choosing components?

REFERENCES

1. Interviews and group discussions with
 - Exicom(R&D and marketing team)
 - Minda Sical(Plant head)
 - Napino Auto(R&D)
 - Subros (Supply chain dept, Purchase dept)
 - Lohia Auto(Head – Technical services)
 - Pranav Vikas (Supply chain dept)
 - Delta electronics(R&D)
 - PPAP Automotive(Marketing department)

2. Telephonic conversation with
 - Hero electric
 - Okinawa
 - EV analyst
 - Mahindra electric
 - Osram India
 - Infineon technologies

3. Reference websites for data
 - SMEV
 - Niti Aayog
 - UP state government
 - Karnataka state government
 - Aluminium industry market
 - Various company research reports