Assessment of Industry Readiness for Manufacturing of BEVs in India

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INDIA

Overview

- Evolution of Battery Electric Vehicles (BEVs) in India
- Various schemes introduced by Indian government for adoption of BEVs
- Current developments in various segments of auto industry
- Battery charging infrastructure
- Investments into BEV supply chain
- Q&A

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Evolution of BEVs in India

First Market introduction

- First BEV in PV segment was introduced in India in 2001
- However, the number of BEVs sold in PV segment were a mere 3,400 in 2019-20
- Similarly, the first Electric two-wheeler was introduced in India in 2006
- And the EV sales in two-wheeler segment stood at 152,000 in 2019-20
- A total of 600 electric buses were sold in 2020.

Why such slow progress?

- Customers' reluctance to shift to EVs
- Manufacturers' reluctance to introduce new products
- Lack of Infrastructure, such as charging stations or battery swapping facilities
- Lack of incentives and push by government for adoption
- High cost of Battery

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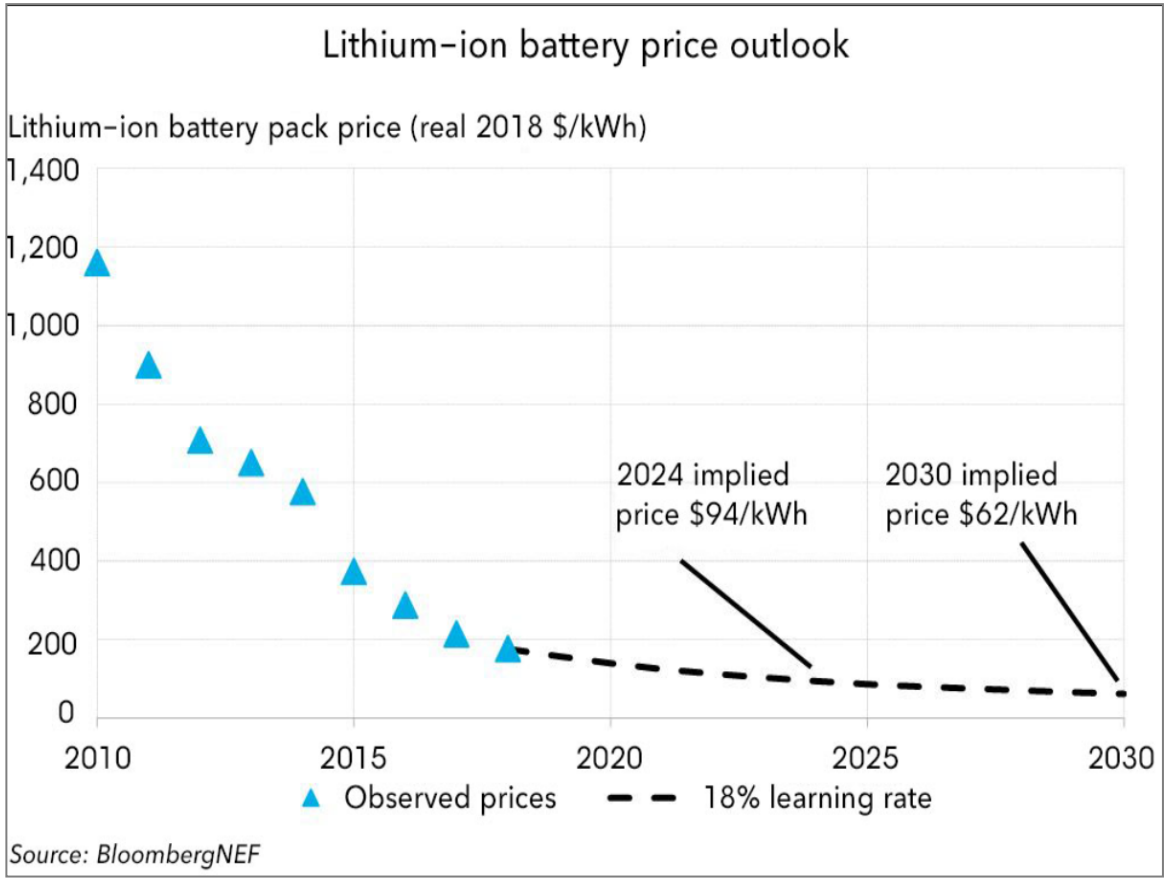
Falling Prices of Lithium-ion Battery

- Battery price was close to $1200/kWh in 2010; but dropped to $200/kWh in 2018.
- By 2025 batteries are likely to cost less than $100/kWh, as cathode chemistries that are less dependent on cobalt or advanced NCA batteries become more popular



Government push for BEVs in India

- India's huge dependence on imported crude oil
  - India imported nearly **85% of its crude oil needs** in the year 2019-20 and spent **$102 billion dollars** on oil imports
- Greenhouse gas (GHG) emissions from ICE based vehicles
  - **22 out** of the **30 most** polluted cities in the world belong to India
- The Indian government began pushing for BEVs in earnest from 2015 with FAME (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India) policy
- **Phase I of FAME** - started in 2015 with an outlay of *Rs.* 895 crore, with a vision that **30%** of the automobiles sold in India should be electric by **2030**.
- **Mild Hybrids** were also subsidized under Phase I, along with strong hybrids, plug-in hybrids and pure electric vehicles; **BEVs with Lead Acid Batteries** also received subsidies
- Two-wheelers with a **speed of 40km/hr** and range of 60-70 Km per full charge got a subsidy of ***Rs.* 22,000**

The Phase II of FAME Policy

- The Indian government announced an outlay of **₹10,000 crore for FAME II policy** to boost the number of electric vehicles in India from April 2019 onwards (nearly $1.4 billion in subsidies to buyers)
- **₹1,000 crore** has been earmarked for setting up **charging stations** for electric vehicles in India
  - 2,700 charging stations shall be set up in metros, cities with million-plus population, smart cities and cities of hilly states across India
- To receive subsidy under FAME II, BEV makers must **source minimum 50% of the components locally**
- The **target** for allocation of financial resources under FAME II:
  - 7,090 electric buses
  - 20,000 strong hybrids
  - 35,000 electric cars
  - 500,000 three-wheelers
  - 1,000,000 two-wheelers

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Additional Incentives for adoption of BEVs in India

- The GST rates on EVs have been reduced from 12% to 5%.
- The GST on EV chargers has been reduced from 18% to 5%.
- Income tax rebates of up to ₹1.5 lakh to customers on interest paid on loans to buy electric vehicles
- Makers of components such as solar electric charging infrastructure and lithium storage batteries can avail investment-linked income tax exemptions and other indirect tax benefits.
- Annual subsidy of Rs 700 crore will be allotted for manufacturing of batteries for electric vehicles and mobile phones.
- Energy Efficiency Services Limited (EESL) is procuring 10,000 EVs from reputed manufacturers for distribution to Government Departments.
- The Delhi Government approved 1000 Electric buses to be used in Delhi's public transport system, and other states have similar schemes.

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Two-wheeler Industry

- **25% of the pollution** in India is being created by two-wheelers, and shift to BEVs will reduce one fourth of our pollution
- Subsidies from FAME II amount to Rs. 10,000 for each kilowatt-hour (KWH) of battery capacity, which is almost 50% of the total battery cost.
- Charging infrastructure is not too difficult to create, only a plug point is needed for AC charging at homes.
- Fast charging can charge up to 80% of the battery in 1 hour (e.g., Ather Energy)
- The industry leaders predict that capacity of two-wheelers should reach 3-4 million by 2024.

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Cost Differential between ICE & BEV

	ICE based	Electric vehicle
2-wheelers	36,600	3,400
4-wheeler (hatchback)	3,06,640	44,000

- The purchase cost of a BEV is nearly twice as that of an equivalent ICE based vehicle
- However, several studies have shown that BEVs cost much less to operate and maintain than ICE vehicles.
- Cost of Operating two-wheeler for 2 years & four-wheeler for 4 years (Maintenance + Operating Cost) in India, based on Indian gasoline costs and the vehicles available in Indian market

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Three-wheeler Industry

- India's last-mile connectivity market is worth $42 billion, largely led by e-rickshaws and auto-rickshaws.
- India has more than 1.5 million battery operated e-rickshaws.
- The aggregators are playing a key role in adoption of e-rickshaws in metro cities like Delhi.
- **SmartE** currently has about 1,000 e-rickshaws, and it has plans to increase its fleet size to 10,000 and expand into 9 new cities in the next 18 months.
- SmartE currently sources vehicles from Mahindra and Kinetic Green and energy solution providers like Panasonic, Exicom and Sun Mobility
- **Ola Electric** plans to deploy one million EVs by 2021 in India. They started this with deployment of four-wheelers and e-rickshaws in the city of Nagpur and Delhi, and are introducing electric 2-wheelers with App Scooter (acquired from Netherlands), in Europe and Asia.
- Companies are trying to figure out what is the **best business model** in BEV context

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Solar rickshaws make debut on IIT-Delhi campus

Current Sourcing practices of 2 & 3-wheelers

EV Type	Manufacturer	Battery	Battery Management System (BMS)	Motors	Motor Controller
Electric Two Wheelers	Ampere Vehicles	Imported	Own design	makes own motors, chargers and controllers	
	Hero Electric	Cells imported; battery packs assembled in-house	Own design	Imported from Taiwan & China	
	Ather Energy	Cells imported; battery packs assembled in-house	Own design; locally manufactured	Designed & developed drive train incl. motor controllers	
	TVS Motors	Cells imported; battery packs made in-house	Own design		
	Emflux Motors	Imported from Samsung, Korea	Developed BMS, motor controller and motor		
	Electrotherm	Imported		Designed & developed motors and controllers	
Electric Three Wheelers	Gayam Motor Works	(Local Lead-Acid Battery)	Own design BMS	Imported	Imported
	Lohia Auto	(Local Lead-Acid Battery)		Imported	Imported
	Saera India	Local Lead-Acid Battery		Imported	
	Goenka Elecric Motor Vehicles	Local Lead-Acid Battery		Localised	Localised

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Four-wheeler Industry

- India's largest electric vehicle maker **Mahindra and Mahindra** has committed more than ₹1,000 crore to build manufacturing lines for electric vehicles (eVerito & e20) and powertrains—to be supplied to other OEMs—in Maharashtra and Karnataka.
- **Tata Motors** is working closely with its Jaguar Land Rover unit to design electric vehicles, offers the EV version of its Tigor compact sedan (only for commercial users) & recently launched Tata Nexon SUV for consumers
- South Korea's **Hyundai Motor Co.** introduced the Kona SUV in July 2019, becoming the first automaker in India to offer a long-range battery in an EV.
- New entrant **MG Motor India Ltd** introduced an electric sport-utility vehicle MG ZS EV in India.
- **Mercedes Benz** is launching its Electric SUV, EQC in Indian market in October 2020.
- **Nissan Motor Co** has plans to launch its BEV Leaf in India this year. They have recently introduced it in 4 South American countries (Brazil, Argentina, Colombia and Chile).

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Electric Buses

- Indian government is focusing on converting **public transportation** into electric vehicles
- **Olectra**, a JV between an Indian firm and China's **BYD** is the leading e-bus manufacturer in India
  - Has over 100 buses plying in various cities
  - Has bagged a contract for 765 buses from various state govts in 2020
- **Tata Motors** is one of the first indigenous firms to develop electric buses and won orders from Guwahati, Indore, Jammu, Jaipur, Kolkata and Lucknow
- **JBM-Solaris** and **Ashok Leyland** are the other two major players in this segment
- **133 Electric buses** have been deployed across **Pune city** in the first phase of its e-bus programme
- Both **charging** and **battery swapping** solutions are being explored for operating e-buses in India

Current Sourcing Practices of Electric Car & Bus Makers

EV Type	Manufacturer	Battery	Battery Management System (BMS)	Motors	Motor Controller
Electric Cars	**Mahindra**	Cells Imported; battery packs assembled in-house	Own Design	Imported	Own design
	Tata Motors	Imported	Outsourced	sourced from Electra EV, a group Co.	
	Hyundai Motors	Imported	Outsourced	Imported; sourced from parent Company	
	MG Motors	Imported from SAIC CATL Power Battery System, a JV between SAIC & Amperex Technology in China		Imported; sourced from parent Company	
Electric Buses	Ashok Leyland	Imported	Imported/Outsourced		
	Olectra - BYD	Imported from BYD China			
	JBM Solaris	Cells imported; battery packs (own design) outsourced	own design; production outsourced	Outsourced	Outsourced

Source: based on http://www.eai.in/blog/2018/12/electric-vehicles-supply-chain-india.html - Energy Alternatives India (EAI) and additional inputs from our interactions with OEMs (*)

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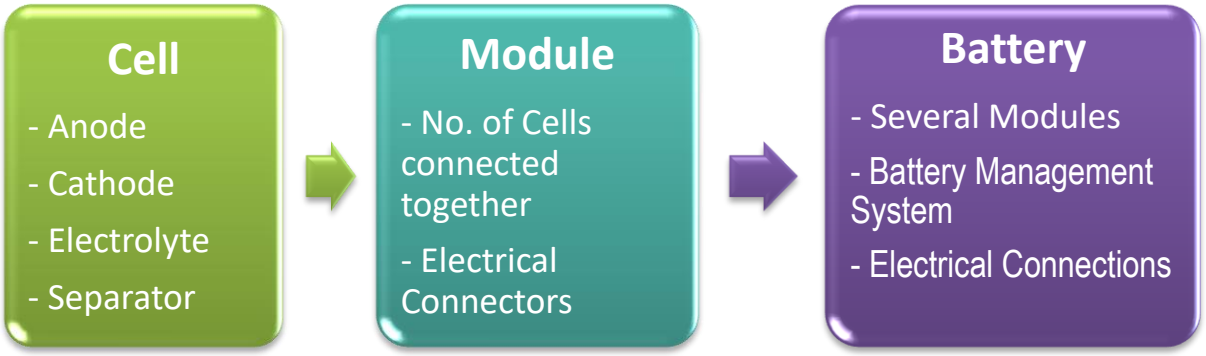
BEV Supply chain



- 17 parts in an EV replace an internal combustion engine (ICE) with over 400 parts
- EVs also need less servicing and require no value-added consumables like the ICE based engine
- India only has cell-to-pack manufacturing (assembly) plants totalling 1 GWh of annual production capacity, but needs 10 GWh capacity by 2023 and 30 GWh capacity by 2025
- The existing OEMs are importing batteries from China, Taiwan, and Korea.

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Planned Investments into Battery Plants

Manufacturer	Technology Partner	Plant Location	Capacity MW/Year	Items to be made
Delta	Taoyuan Taiwan	Krishnagiri, TN	50 MW	Battery Module & Assembly
BHEL	LIBCOIN, Australia		1 GWh	LI-Ion Cells & Batteries
Mahindra Electric	LG Chem, South Korea	Chakan Maharashtra	Rs. 1000 Crs	Battery Module & Assembly
Exide	Leclanche, Switzerland	Gujarat		Battery Module & Assembly
Acme		HP	300 MW	Battery Assembly
Adani		Gujarat		Integrated Li-battery mfg
EON Electiric		Haridwar, Utt		Battery Module & Assembly
Exicom		Gurugram	500 MW	Battery Module & Assembly
HBL Power Systems		Hyd Telengana		Li-Ion Cells & Batteries
Suzuki Toshiba Denso		Hansalpur Gujarat	Rs. 1150 Cr ($180m)	Battery Module & Assembly
Amara Raja Batteries Limited	ISRO	AP	100 MWhr $300bn	Battery Module & Assembly
Tata Chemicals Limited	ISRO	Dholera Gujarat	Rs 40 bn ($600m) 10 GWh	Li-Ion Cells & Batteries

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Charging Infrastructure

- Indian government has earmarked **₹1,000 crore** for setting up **2,700** charging stations
- Availability of at least one charging station in a **grid of 3km x 3km**
- Major highways connecting major cities on both sides of the road should have a charging station at an interval of about **25 km** each
- The Indian government has also roped in **public sector oil** companies like BPCL, HPCL and Indian Oil to create charging infrastructure in the country.
- **SAIC** recently tied up with Finland-based clean energy major Fortum to install 50-kilowatt **fast-charging stations in five cities** in India.
- Sun Mobility is working with various state and central government agencies, as well as fleet aggregators like SmartE to create battery **swapping infrastructure** in India

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Academic & Research Institutions

- Central Electrochemical Research Institute (CECRI), based out of Tamil Nadu, has decided to set up a factory to produce batteries for electric vehicles, with Rs. 100 crore investment.
- CECRI claims to beat Chinese players on prices (while current prices are ruling at $220/kW, CECRI can sell for $190)
- CECRI is also in the process of getting technical help from Fraunhofer Institute of Germany to improve battery performance and with the manufacturing unit.
- Professor Ashok Jhunjhunwala of IIT Madras nurtured several start-ups and groups to develop new batteries and EV models in India.
- Center for Battery Engineering and Electric Vehicles (C-BEEV) of IIT Madras is a start-up that is collaborating with several manufacturers and trying to find a cost effective BEV for India


Thank
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	Lohia Auto	(Lead-Acid Battery)		Imported	Imported
	Saera India*	Local Lead-Acid Battery		Imported	
	Goenka Elecric Motor	Local Lead-Acid Battery		Localised	Localised
Electric Cars	Mahindra*	Cells Imported; battery packs assembled in-house	Own Design	Imported	Own design
	Tata Motors	Imported	Outsourced	Sourced from Electra EV, group co.	
	Hyundai Motors	Imported	Outsourced	Imported; sourced from parent Company	
	Toyota Kirloskar	All Items (designed & developed Toyota Japan) by imported from parent company			
Electric Buses	Ashok Leyland*	Imported	Imported/Outsourced		
	Olectra*	Imported from BYD China			
	JBM Solaris*	Cells imported; battery packs sourced (own design)	own design; outsourced	Outsourced	Outsourced