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Creating a Resource
Efficient India

Towards Resource Efficient Electric Vehicle Sector in India

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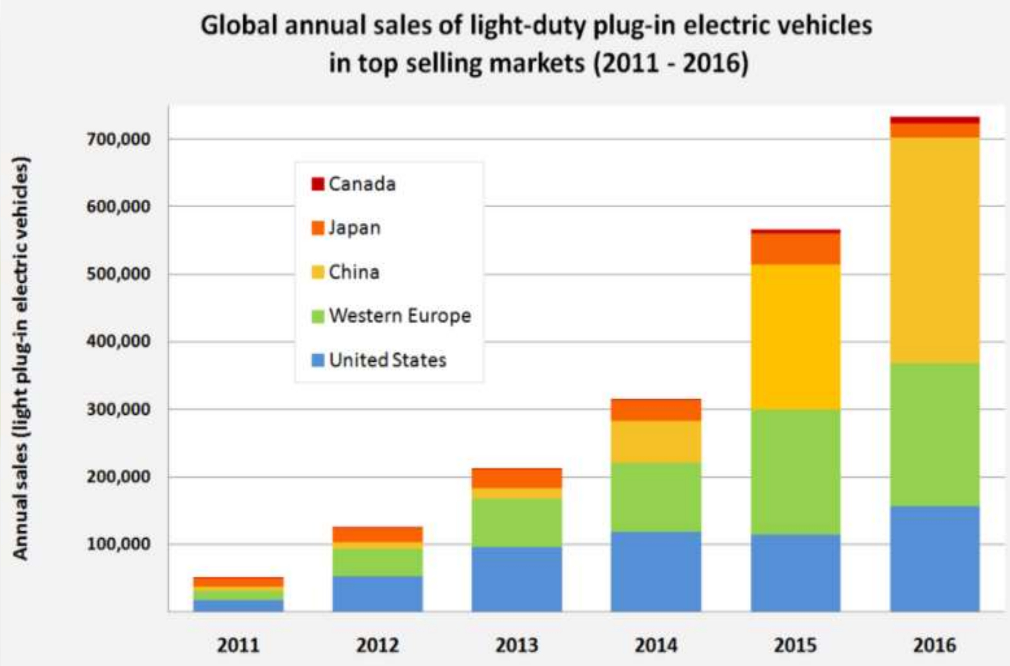
Market of E-Vehicles – Global & India



- India's electric vehicles industry is at a nascent with (0.1 %)
- China world leader 50% annual market share.
- 2 & 3 wheelers bulk of the EVs on road; estimated at than 8 lakhs.
- Electric and hybrid cars is a fraction of the 3 million passenger cars produced annually in India.

- Government announced its aim of increasing share of electric vehicle (EV) from its current share of less than 1 percent to nearly 30 percent by 2030;
- By 2030, total estimated number of electric two wheelers on Indian roads will be more than 200 million; electric cars and buses estimated at 34 million and 2.5 million respectively.
- Many states have declared policies to promote EV policy in India

With E-Vehicles new challenges emerge

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1	Availability and affordable supply of certain materials particularly copper, rare earths and lithium which India is heavily dependent on imports; Competing applications
2	Requirement of disruptive changes in vehicle design and material usage
3	Charging stations required with significant decentralized presence. Also need to have technologies and systems to generate energy from sustainable sources
4	Fragmented and unscientific end of life vehicle management in India;
5	Existing resource recovery from batteries has been confined to cobalt, nickel, and copper due to their high value
6	Limited understanding of environmental threats from unscientific battery, power electronics and motor recycling
7	Requirement of diffusion of knowledge and technical between global and Indian players.

What are we seeking?

- What is the current and future trend in demand for electric mobility in India?
- What quantitative requirement for these raw materials is anticipated for the electro mobility system for India?
- What economic instruments can be used along the value chain that can promote SRM? Role of incentives?
- How can existing ELV management be improved & strengthened that can promote efficient SRM of E/H vehicles?
- What would a framework for sustainable business model for ELEV look like?
- What are relevant best practices available globally and how can it be adopted in the Indian context?

Key components (4 wheeler)

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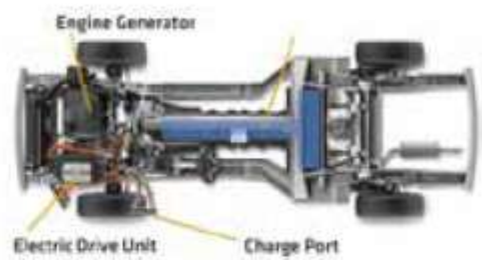
Body/glider



Powertrain

Battery pack

Battery chemistries and use in EVs

Lithium-Cobalt Oxide Battery

- Used mostly in handheld electronics (Cell phones, Laptops and Cameras)
- Risky specially when damaged
- Cobalt is scarce and expensive
- Low discharge rates
- Highest energy density (110-190) Wh/kg

Lithium-Titanate Battery

- Can operate at very low temp (-40°C)
- Rapid charge and discharge
- Used in Mitsubishi i-MiEV
- Lower inherent voltage 2.4 V (compared to 3.7 V)
- Lower energy density (30-110) Wh/kg

Lithium-Iron Phosphate Battery

- Dramatically reduces the risks of overheating and fire.
- Offers much less volumetric capacity
- Used in power tools and medical equipment
- Longer-life and inherently safe
- Lower Energy Density (95-140) Wh/kg

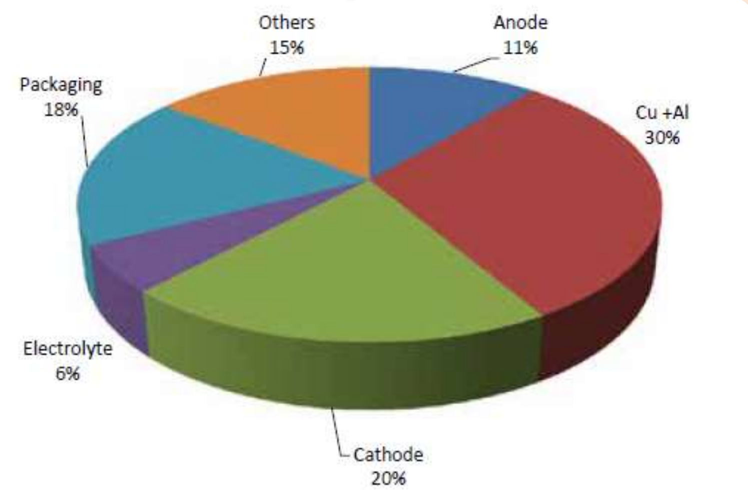
Lithium-Manganese Oxide Battery

- Lower cost
- Longer life and inherently safe
- Used in Hybrid Vehicles, Cell phones, Laptops
- High discharge rates
- Lower energy density (110-120) Wh/kg

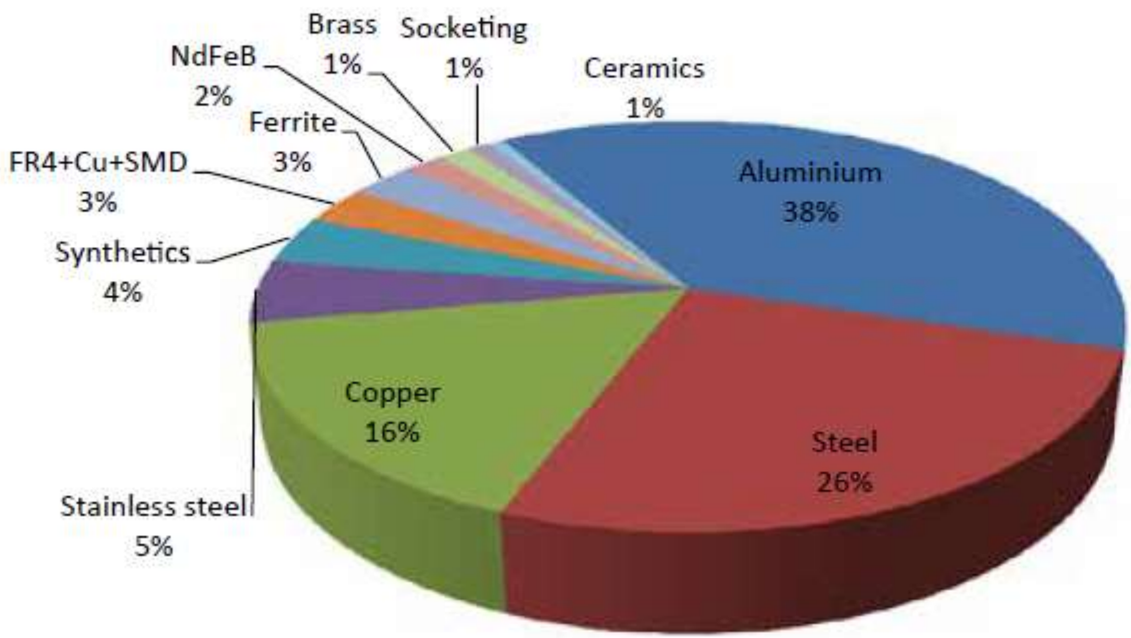
Lithium-Nickel Manganese Cobalt Oxide Battery

- Longer life and inherent safety
- Cobalt is scarce and expensive
- Less prone to heating
- Used in Power tools, e-bikes and electric power trains
- Lower energy density (95-130) Wh/kg

For a four wheeler in the hatchback segment, the battery and associated components on an average weigh in the range of 100 kg to 130 kg.



Electric Drive Motors



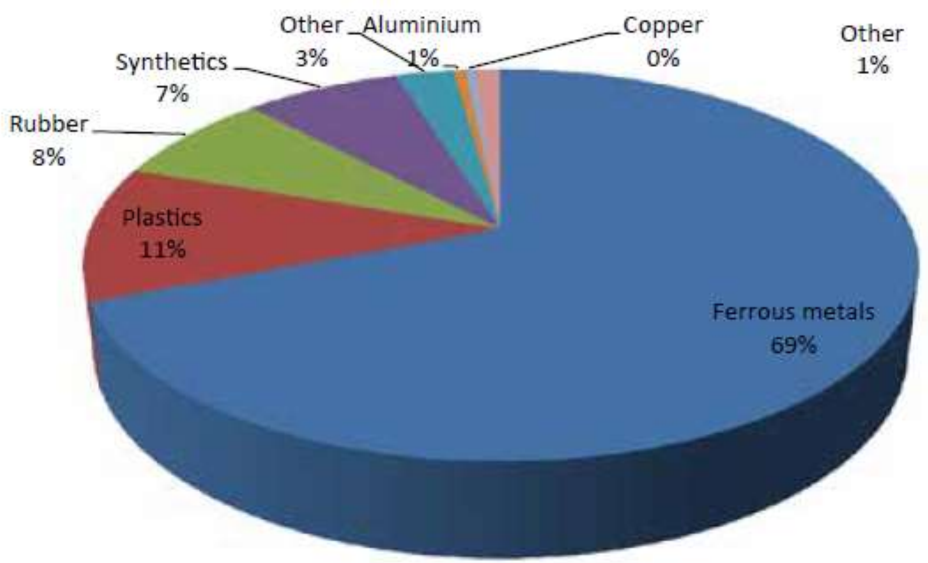
The power electronics also have printed circuit boards with other control electronics equipment. Typically a vehicle with 20 kW of power is estimated to weigh between 40 to 60 kg.

Glider

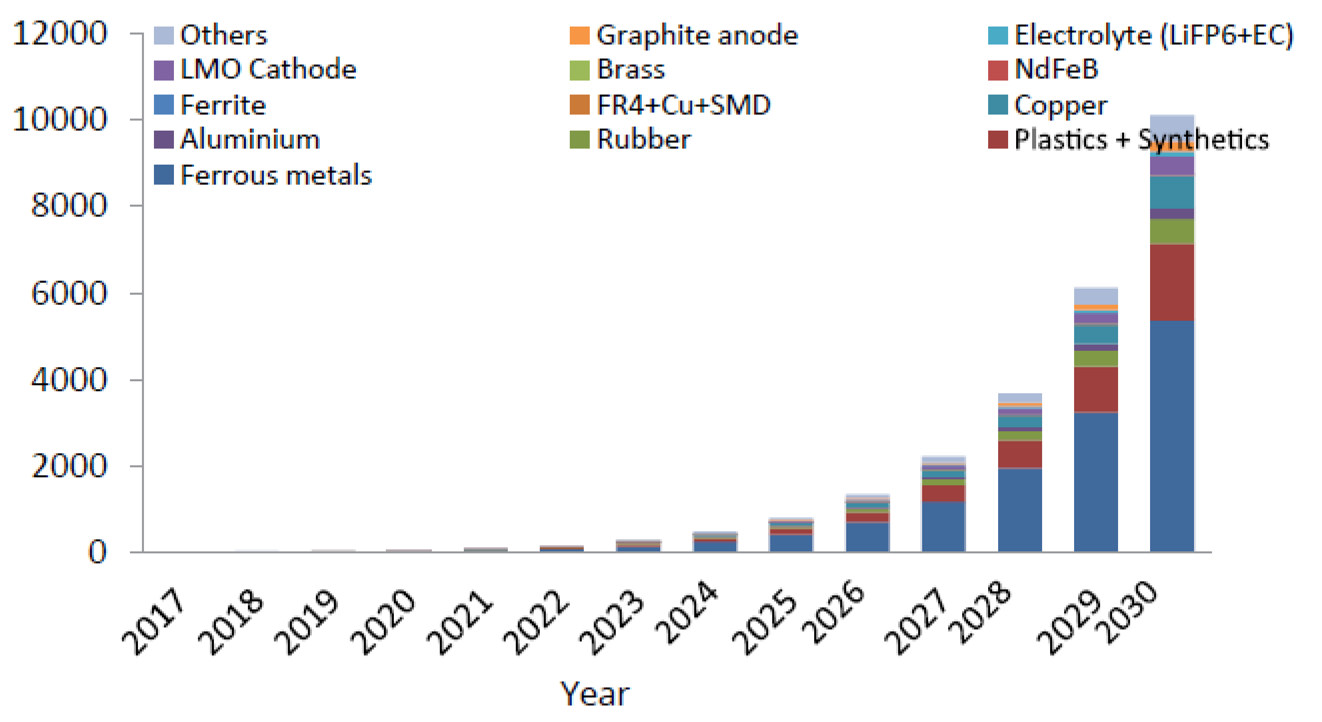
- Steel has remained a major material for the body of an automobile because of its structural integrity and ability to maintain dimensional geometry throughout the manufacturing process.

- Aluminium and plastics are also valuable materials that are used in the body, not only for their lighter weight, but also because of their inherent corrosion resistance

- The total amount of aluminium used in the car is 90 kg that constitutes to somewhere 8 to 10 percent of the vehicle weight.



Material Demand Estimation



- Consumption of materials by 2030 will increase significantly from its current level of 0.03 million tons to 11 million tons.

- Ferrous metals will contribute to 53 percent of the total estimated demand, followed by 17.4 percent of plastics and synthetics, 2.5 percent of aluminium and 7.2 percent of copper.

Achieving RE through

RE Attribute	Definition	Indicators
Product Design	• Bill of materials • Dismantling and recycling Potential driven by standards	• Product composition • Modularisation • Material concentration • Horizontal approach
Manufacture	• Material restriction • Material streams • Cluster recycling	• Chemical content • Material purity
End of Life	• Reusability • Recyclability • Recoverability	• Take back share

Reducing rare earths

- Development of magnets which reduce Dysprosium content when to as much as 75% compared to conventional NdFeB materials

Motor technology	Reduced NdFeB magnet	Ferrite permanent magnet	Copper rotor induction	Wound rotor synchronous	Switched reluctance
Peak power	80 kW	80 kW	50 kW	50 kW	75 kW
Peak efficiency	98%	96%	96%	96%	97%
Active material cost per kW	$2.78/kW	$1.93/kW	$2.88/kW	£2.88/kW	$1.57/kW
Torque density	15 Nm/kg	11 Nm/kg	10 Nm/kg	10 Nm/kg	15 Nm/kg

- Toyota Motor Corporation had developed a magnet which replaces around 20 percent of the neodymium, a rare earth metal used in the world's most permanent batteries, with more abundant and cheaper lanthanum and cerium.

- Honda Motors has joined hands with Daido Steel for practical application of a hot deformed neodymium magnet containing no heavy rare earth which still has the high heat resistance properties and high magnetic performance

Other notable interventions

Batteries

- Solid-state battery technology is increasingly seen as the next big development in the EV sector
- have fewer components, cost less, and provide higher energy than the lithium-ion batteries

Design

- Native EVs optimize battery packaging;
- Non-native EVs force the battery into the awkward footprint of the ICE platform, which limits the realized energy capacity.

Power train integration

- Efficient powertrain integration calls for moving many parts of the power electronics closer together and integrating into fewer modules
- It will help in reducing weight and reduced material use (TESLA-3 - 2013 vs 2017).

Promoting 6R principles

- Giving batteries second life into alternate applications
- Material recovery from components; Cu, Li, rare earths, Al, plastics, etc

Key policy design and examples

Material extraction

- Given that many of the resources used in EVs are scarce and experience price volatility, experience environmental hazards countries like Canada, China are increasingly modifying their mining practices to make it sustainable

Standardization

- Standards and labelling becomes a key tool for ensuring design efficiency
- China has announced its focus on the standards for EV battery design and charges especially for power delivery, connector and software protocol

Enhanced material recovery; EPR

- EC has set manufacturing targets for OEMs and battery manufacturers.
- Promote efficiency, reduced use of critical materials, reduced environmental impact and implementation of Eco-design and battery take back targets, etc.

R&D support

- Funds for developing advance energy storage technologies and to enhance PEV value through secondary use of EV batteries
- Sales tax exclusion for advance manufacturing projects, energy and performance density of lithium ion batteries and for research in newer battery chemistries

Policy options for making EV sector Resource Efficient (1/2)

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Objective	Actions	Outcome	Policy
Enhance raw material security of the country	Encourage standardized and easily dismantled product designs Encouraging manufacturers of EV systems to use recycled raw material Formal recycling of vehicles and make use of EPRs to train recyclers to dismantle EVs	Reduced imports; Recovery of secondary raw material	Initial financial support; Set up a modest recycling targets; Investment in formal recycling, Cluster based approach recycling set ups; Issuance of guidelines that specifically provide resource recovery targets Enhanced B2B engagement platforms for cost effective technology development and commercialization
Implementing Extended Producer Responsibility including that for end of life management	Designated players should be made responsible for handling damaged; ELV EVs; Possible market creation of certified used products through appropriate channels	Faster development of knowhow; Business opportunities	Designing EPR guidelines; Scope for verification; recognition Creation of funds through ARFs

Policy options for making EV sector Resource Efficient (1/2)

Objective	Actions	Outcome	Policy
Resource efficiency standards	Ensure that industry comes up with standards of functional parameters of components Independent checks ;(avoid entry of spurious components)	Enhanced use of, remanufactured, and refurbished components sold through organized channels	Introduction of appropriate functional criteria and labels; Monitoring and supervision by independent agencies

Capacity development	Support for R&D in end-of-life activities ICE and EVs; EPR guidelines	Creation of high-value recycling processes for rare, valuable and potentially hazardous materials	Grants for organizing training and Workshops; Funds for developing advance energy storage technologies and to enhance PEV value through secondary use of EV batteries

Thank you

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