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Supply chain of electric vehicle and batteries

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ABSTRACT

One of the key aspects of the Electric Vehicle Supply Chain that distinguishes it from InternalCombustion Engine suppliers is that vehicles powered entirely or partially by electricity require little maintenance, have a simple mechanical design, an d are difficult to mass produce. It is the fastest technology that runs on charging batteries rather than fossil fuels, and it is known to be environmentally and financially favourable. It is therefore extremely important to continue to grow in this field. EV, like most revolutionary mechanisms, has produced a potential development that comes with its own set of difficulties and opportunities. While it is still reforming its area and the industry as a whole, it is evaluating the market's progress for developers. Concerns about air quality and the scarcity of gasolineare boosting interest in electric vehicles (EVs). This integrative assessment assesses the global EV battery supply chain raw material and identifies potential concerns. Authorized government authorities are generally moving to electric vehicle batteries in an effort to reduce gas emissions from transportation, which offers a considerable reduction in carbon emissions when compared to ignition engine vehicles.

Keywords: *Batteries, Components, Supply Chain, Emissions*

1. INTRODUCTION

Generally, EV batteries have a sizeable growth in its demand and have portrayed a significantincrease in its market share. Although, concerns regarding its infrastructure volumes, have highlighted issues of being capable to handle its production rates and rise in demand. Recentlyits reported that, due to an increase in usage of lithium, there has been a shortfall in its production as against its demand. However, its supply is not based on the material available, but its capability to meets its demand and eventually increase in production. It is estimated togrow demand in lithium to over 50,000 tonnes (per year) by 2050, presuming world demandsfour times US demand, and estimates its sufficient level of production to cover its automotivedemand till 2025, which can further decline post 2035, considering recycling. Its imperative estimate to consider only automotive demand besides portable battery and other non-battery.It's also presumed that an aggressive program on electric vehicles can be positively supportedover decades with known available supplies.

Are EV's actually greener than gasoline vehicles?

EVs have a huge greenhouse gas emission advantage over traditional internal combustion engine vehicles since they do not rely on direct fossil fuel burning to operate. The extractionand processing of materials for batteries, as well as the construction of batteries and the generation of power to charge them, all require energy inputs (typically sourced from fossil fuel sources) that produce greenhouse gases. Variations in the fuel sources used to generateelectricity where EVs are charged and driven produce major changes in greenhouse emissions, although studies have consistently shown that EVs have a lower total carbon footprint.

Are there enough minerals to build batteries that world needs?

To store and use electricity as fuel, EV batteries require a variety of mineral components. Lithium, cobalt, nickel, graphite, copper, manganese, and rare-earth elements like neodymiumare examples of "critical" minerals for which alternatives are scarce or non-existent, and sources are concentrated geographically. Experts disagree about the likelihood of a long-termscarcity, especially in light of evolving battery technologies and chemistries that may become less reliant on these basic materials. Long-term mineral supply constraints, according to somescientists, are unlikely to materialise. Deposit of mineral components and utilization of electricity as fuel are some of the components for EV batteries. Minerals like lithium, graphite,manganese, cobalt, copper, nickel, and rare -earth elements like neodymium are vital mineralswith limited substitutes with concentrated supplies. Experts has predicted on shortfall of minerals in long run, worldwide lithium are reserved at about 14 million metric tons, in comparison of 85K tons in 2018 and globally of about 62 million tons. Also, scientific journal publishes that essential battery components demands could exceed

supply within decades without any evolution in mineral composition. However, extracting minerals available for battery use involves complicated financial, legal and community factors, it requires capital investment, a system mitigating, handling stakeholders in mining circles. Hence mining and supply chain will impact majorly on the market steadiness contributing to in-ground resources. Innovative will bring in the possibility of diversifying supply chain while the industry is also keen in evolving technologies depending upon ample economical minerals. However, demandmay increase with the exponential market, with about more than 900 % lithium, more than 300 % graphite and more than 500% cobalt by 2050 projecting uncertainty of technology impacting supplies, resulting to mineral supply bottlenecks.

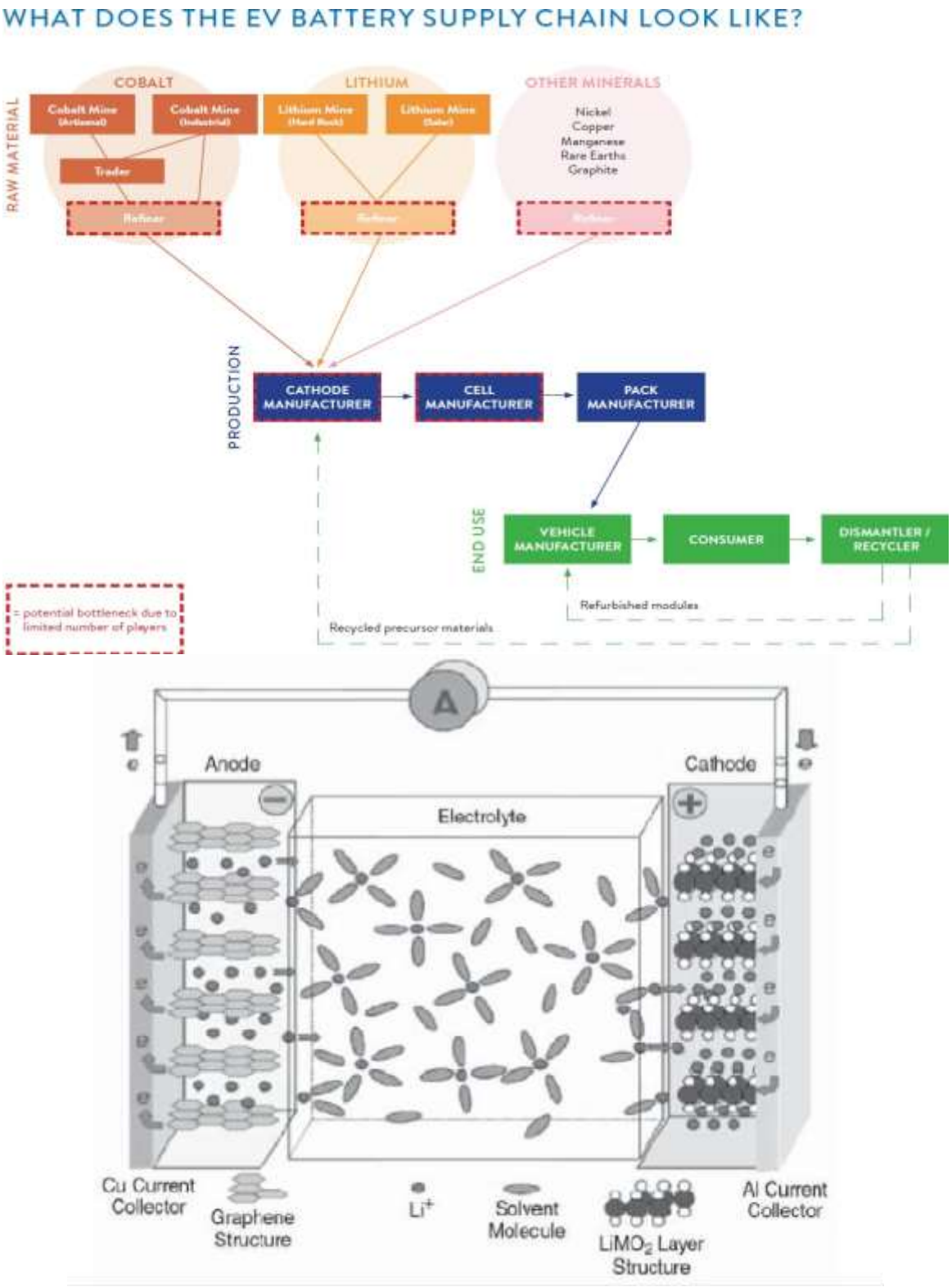


Figure 1: Structure of EV battery

2. LITERATURE REVIEW

A fundamental analysis that has significantly affected the American automotive industry, slowly overtaking the number of fossil fuel vehicles. Issuing guidelines to reducing oil consumption, importing of foreign oil, and also promoting environmental precautionary measures. For instance, Obama administration has pursued the goal of having over one million electric vehicles on streets of US at least by 2015. However, proposing a medium- term focus by others consisting of motor electric vehicles. Around

2030, a minimum of 20% of the total vehicles will create about 30 million vehicles with electric motors. Seeking to responding to queries about the costs involving developing markets, people are open to invest in this technology, availing adequate infrastructure, and quite crucial for a flawless experience, operating throughout the country. This focus of getting close to the destinationof an electric vehicle within a time frame. (Lee, 2018)

Electric vehicles can reduce utility costs due to variation in consumption of electricity, being billed overnight, this production of electricity seems cheaper today. It balances electricity needs between day and night, further reducing average cost of electricity and finally resulting to fall in tariffs. Since conventional vehicles use gas as fuel and electric vehicles runon electricity, there can be a significant impact on the future rates of gas and electricity on the profits of the electric vehicles. It is certain to have a growth in the gas prices in the long run. With an increase in the population, there will be an increase in the demand for vehicles,leading to a growth in demand for gas as well. This can also result to a further increase in electricity prices, subject to various factors related to market. Having a very strong benefit of increase in fuel prices, the electric vehicles can focus on the life span of electric vehiclesmaking them much competitive in the market. (Chen, 2021).

Electric vehicles need batteries with higher durability and power. Lithium batteries are competing technologies and are the commonly used batteries in vehicles, although expensive. It is believed that the set price point can bring possible long-term commercialization. A significant increase in the cost incurred in gas can make PEVs cost competitive without reducing batteries cost incurred. Further resulting to reducing in battery prices with higher production volumes given in the recent years. Strategies on investing in hybrid vehicles and battery electric vehicles should be decided upon for the future market. However, the electric dependent vehicles hold more value with regards to the battery durability. Over a period, this value may shift to electronics and other software of power and thermal management systems, constraining the car performances and resulting the automakers to make a way to efficient growth in this market. The potential prospect has led the battery makers including the start-ups to invest into their research anddevelopment of vehicles. Distributions of PEVs will need supply chains to be transformed, creating opportunities for battery makers, cell component makers and other suppliers as well, further cutting out the other component suppliers. These opportunities also depend upon the supplies attending to the companies, negotiating the costs along with the supply chain in order to offer the best deal to their customers and resulting to profit margins. (Todd, 2018)

Based on the technical expertise such as super charging, swapping, recycling waste has nowfluctuated significantly. Lithium being the best conductor of heat and electricity, its significantly utilized by the glass and ceramic industry. Although, it's not economically feasible since its produced from extraction of minerals. Salar de Uyuni in Bolivia is reckoned as its largest resource in the world although currently it does not produce any. Its highly concentrated with about 90% of global resources in regions like Bolivia, US, Argentina, China. South America produces majorly which includes Chile and Argentina, in addition to Australia and China with considerable reservation. In Boliva, lithium deposit is not economical, its mining operations are barely existing and uncertain with its projects in line. (Naor, 2017). Estimates convey that EVs life-cycle is about 50% fewer than the gases per km traveled than ignition engines, about 25% lower in territory where electricity supplies are fossil fuel-reliant, and about 75% lower with renewal energy. However, EVs have a significant emission edge over internal ignition engine vehicles due to lack of transit related emissions. Variation in material and production processes of batteries affect the excretion of EVs profiles. Production of batteries using coal-fired electricity, has significant higher emissions than using cleaner power. Experts suggests that emissions portray about 10-15% of life-cycle of an EV emission, although it varies. EV batteries' usage in quick charging and iscapable of alternate energy storage of batteries used, which can have a vital role in reducingcarbon of the electrical grid and by enabling renewable energy resources. (Lee, 2018).

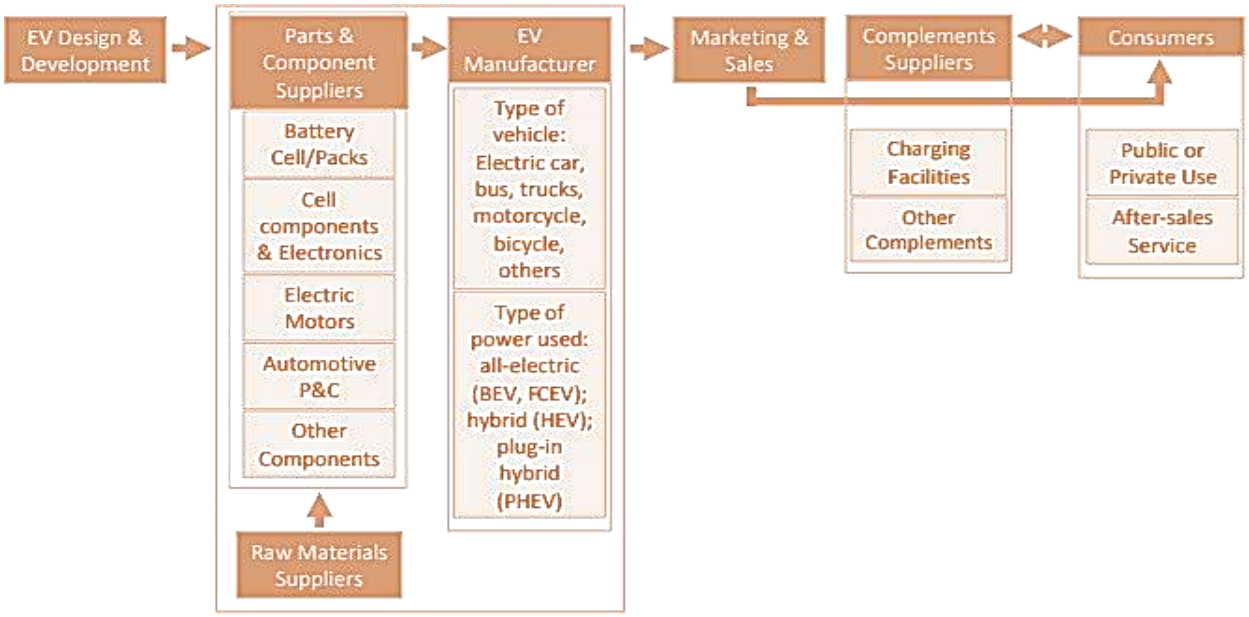
Imperative EV usages will increase as firms grow towards new technologies and has a successful impact of deep decarbonization. Experts also forecasts that with about 50% of reduction in life-cycle excretion of an average EV by 2030, eventually EV can produce about 90% fewer life-cycle greenhouse gases than combustion engine vehicles and are accountable for a fraction of harmful toxics as nitrogen oxide. (InvestIndia, 2021)

India is thriving towards automotive industry serving it markets ie. locals as well global ones"A Future for Electric Vehicles". About 19 million people, signifying more than 5% of workforce have been employed in this sector, focusing mainly on its internal combustion engines. In India, affordability will ofcourse be quite beneficial, in particular within the smaller car segments. Earlier, taxes such as registration tax, vehicle tax and GST rates were much lower and contributing to the introduction. A well-established country makes its position in two-wheelers, compact vehicles, light commercial vehicles and buses making benefitting the segments and catering towards a large proportion of electric vehicles.

Thankfully with these significant efforts from all over, India can very well aspire becoming aglobal center for electric vehicles. (Kumar, 2020). When surveying the economics, some researchers, discovered that the estimates of discount rates offered to consumers varied considerably. Also, it stated that many estimates were below about 10%, but a large number were over 20%. Most of them were between 4% and 40%, which is a wider range, but not improbable, examining a discount rate for energy savings from building or appliances. This choice of discount rate had a considerable influence on the comparison of the net costs of the differently fueled vehicles. (Kumar, 2020)

EV industry begins with designing and developing, making an end towards clients and servicing after sales to these valuable clients. Vehicle manufacturing involved players with parts and raw material suppliers, distribution, manufacturers, sales, components suppliers, and complements suppliers. Similarly, the conventional and electric vehicles, are new and its manufacture components of EV includes electric power steering, water pumps, gear boxes, packs of batteries, basic materials etc., Types of vehicles manufactured such as trucks, passenger vehicles, buses, two wheeled motorcycles, three wheeled motorcycles, bicycles, and all-

electric power used vehicles. Similarly, to automotive, marketing, sales anddistributions are some of the valuable parts of the supply chain with an additional component of charging facility. This innovative ecosystem and environmental policies are vital elements to develop this industry. Here, policies can empower or play as a road block towards growth.



The life of an EV battery is determined by the frequency of charge and discharge cycles, speed and temperature operation. Usually, they are drained from the application, while initially 80% can be retained if treated systematically and can also reduce the life-cycle greenhouse gas emissions, maximizing their value economically. Retire EV batteries are channelized towards second life by effective recycling, steering from landfills or unorganizedprocesses, which can lead to health risks, leading to painful and expensive logistics issues of accumulating, depositing, and transporting. Although, EV batteries retain 80% of its capacity, this may not be necessarily suitable for EVs, rather they are appropriately demanding applications such as grid-scale renewable energy storage. These plans align with GOIs plans of installing about 175 W of renewable energy by 2022, estimating that can be served as energy banks until worsened. (InvestIndia, 2021)

Value of a battery less than the material cost or any purchased materials. Furthermore, cellassembly and pack assembly are calculated as a value-added service. Removing the cost of materials, leaving behind the cost incurred on the items purchased before jotting around value-added evaluations of batteries and cells. The evaluation is calculated for pack assembly, which is about 25% of the battery cost under the old techniques used and about 7% under the updated technique. The cost of the materials comes upto about 72% of the battery cost, making up a value-added from the materials and inputs are quite significant.

Lacking the estimate of this part of the battery can underrate the value-added producer's share. Supply chain of electric vehicles batteries and sales have grown significantly in the recent years, while the cost of the batteries has continuously been declining. Further study should also consider, the quantity of value-added is consumed in EV being sold in addition to the effort to extracting value-added from the material cost used in cells making and packof batteries providing a comprehensive outlook of the EV battery supply chain, revealing competitive countries at various stages. (Coffin, 2018)

EV batteries has a sizeable growth in its demand and have portrayed a significant increase inits market share. Although, concerns regarding its infrastructure volumes, have highlighted issues of being capable to handle its production rates and rise in demand. Recently its reported that, due to an increase in usage of lithium, there has been a shortfall in its production as against its demand. However, its supply is not based on the material available,but its capability to meets its demand and eventually increase in production. It is estimated to grow demand in lithium to over 50,000 tonnes (per year) by 2050, presuming world demands four times US demand, and estimates its sufficient level of production to cover its automotive demand till 2025, which can further decline post 2035, considering recycling. Its imperative estimate to consider only automotive demand besides portable battery and other non-battery. It's also presumed that an aggressive program on electric vehicles can be positively supported over decades with known available supplies. (Kumar, 2020).

Although there are countries still pursuing substitute technologies that can lead to ecofriendly by reducing harmful emissions and climate related effects related to fossil fuels. Electric vehicles have significantly gained attention globally with a positivity in increasing sales trends of vehicles in next 10 to 20 years, setting up targets for EV sales and producing newer models. A set target of about 21% in EV share in total vehicles by 2030 and eventuallyabout 50% by 2040. Building the EVIS on EV ecosystem and involving the guidelines such as requirements, testing, standards, protocols etc., information, education and industry development, human resource development and R & D for next generation of vehicles. (Maureen, 2016)

3. IMPLICATIONS AND CONCLUSIONS

The hurdles are as below: -

Hurdles to Development and Solutions		
High cost of PEVs	**Limited Charging Infrastructure**	**Consumer Misperceptions**
Demand Side Strategies	Invest in chargers in public spaces	Develop a consumer education plan
Tax Incentives for purchase	Provide incentives for installing chargers	Establish public demonstration of PEVs
Alleviate battery ownership risk	Collaborate with private charging station providers	Market private sector solutions and advancements
Non-Financial Incentives	Streamline local zoning and permitting	
Encourage utility rate discounts	Disseminate information on charger locations	
Transition government fleet to PEVs		
Encourage PEV Cabs		
Supply Side Strategies		
Public Investments in R&D		
Tailored Workforce training programs		
Business Financing		
Supply Chain Development		

Building strategic connections can develop partnerships with lithium producing countries, resulting to growing stakeholders, less competitive markets and minimal risk against rise in demand. It is predicted to have a shortfall in lithium supply and hence, it is very essential to activate sizable production to avoid any sort of discrepancies in long term demand. Furthermore, various research can be undertaken on the impactful discoveries on lithium's global supply and the EV industry.

The research also clarifies the supply chain of lithium for EV battery manufacturers includes producing capacity, trading partnerships, recycling and geopolitical conditions. It is also obvious that lithium batteries are not only the resourcing problem, but also includes the above issues. Lithium scarcity is a risk to EV supply since they are not easily available. Hence a proactive understanding and addressing the supply is quite imperative, failure to which, can cause a disruptive in supply chain impacting the future of EV market. Lithium being a vital partof the EV market, it is quite important to manage and reduce those uncertainties and maintaining lithium stock, gapping and recycling the supply chain in a much systematic way.

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