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India's Strategy to Procure Lithium to be a Leading Lithium-Ion Battery Manufacturer

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ABSTRACT

Lithium is one of the foremost valuable metal which is widely used for manufacturing batteries and also has other uses in solar panels, ceramics, glasses and pharmaceuticals. Lithium is third most abundant element after hydrogen and helium but the mostlithium deposits are only in Bolivia (21 million tons), Argentina (17 million tons), Chile (9 million tons), Australia (6.8 million tons), China (4.5 million tons). Bolivia, Argentina, Chile forms so called lithium triangle. Due to depleting reserves of fossil fuels and its harmful impact on the environment has forced the globe to shift to Lithium-ion batteries which is much eco-friendlier alternative. India's push for electric vehicles (EV) may cause a considerable change in its energy security priorities, with securing lithium supplies, a key material for creating batteries, becoming as important as buying oil and gas fields overseas. India doesn't have enough lithium reserves for manufacturing lithium-ion batteries. The majority electric vehicles within the country run on imported batteries, mostly from China. At present a lithium-ion battery accounts for 40% of the overall cost of an electrical vehicle.

Khanij Bidesh Pvt Ltd is a venture firm of three central public sector enterprises namely National Aluminum Company (Nalco), Hindustan Copper Ltd (HCL), Mineral Exploration Company Ltd (MECL). The KABIL would do identification, acquisition, exploration, development, mining and processing of strategic minerals overseas for commercial use and meeting country's requirement of those minerals. The mission is to not allow India to fall in a very vulnerable position with a probable threat of supply squeeze as went on within the case of petroleum, with India being the world's third largest oil importer and to amass cobalt and lithium mines in addition on get into purchase agreements of those minerals. This may help in achieving resourcesecurity with regard to strategic minerals.

Keywords-- Lithium Procurement, Lithium-ion Battery Production, Trade Policies

I. INTRODUCTION

i. Lithium Metal

Lithium, the first metal of periodic table placed at the top left corner of periodic table plays a keyrole in the lives of people. It was Johann August Arfvedson, who first discovered its existence in1817 while analyzing mineral petalite ($LiAlSi_4O_{10}$), which was discovered in 1800.

Lithium has atomic number of 3 and possess a silvery-white colour which tarnishes on oxidationwhen it is exposed to air, it is the most electropositive metal (−3.04 V versus a standard hydrogen electrode), the lightest (M = 6.94 g mol^{-1}) and the least dense (ρ = 0.53 g cm^{-3}) solid element atroom temperature and is highly flammable in nature. Due to this high reactivity, lithium is only available in composites in nature, either in brines or hard rock minerals and need to be stored under anhydrous atmospheres, in mineral oil or closed evacuated ampoules.[1]

ii. Lithium Sources

Lithium is a rare metal compared to about 20 parts per million(ppm) in the earth's crust, about 0.17 ppm in the oceans and trace amounts in space, the food we eat, and our bodies. As lithium is highly reactive, it is not present in the metallic, elemental state in nature, but instead it is found in the form of compounds in minute amounts in igneous rocks and in the waters of several mineral springs. Spodumene, petalite, lepidolite, and amblygonite are the main minerals consisting lithium.

Conventional method of lithium production is through extraction from brine pools or mining from hard rocks. The latter is a time-consuming, energy-intensive and costly process of massive rock excavation in the world in order to obtain a small amount of lithium. Concentration of hugebrine pools with the help of solar evaporation is the most cost-effective and proficient way. Lithium is then produced by the electrolysis method of molten lithium chloride and potassium chloride. In US, China, Chile, Argentina and Russia, they use the brine-based production method. Brines, which come from volcanoes, are found in the highlands in the form of playas or salars (salt lakes). Maximum of the world's lithium production takes place in South America. [2]

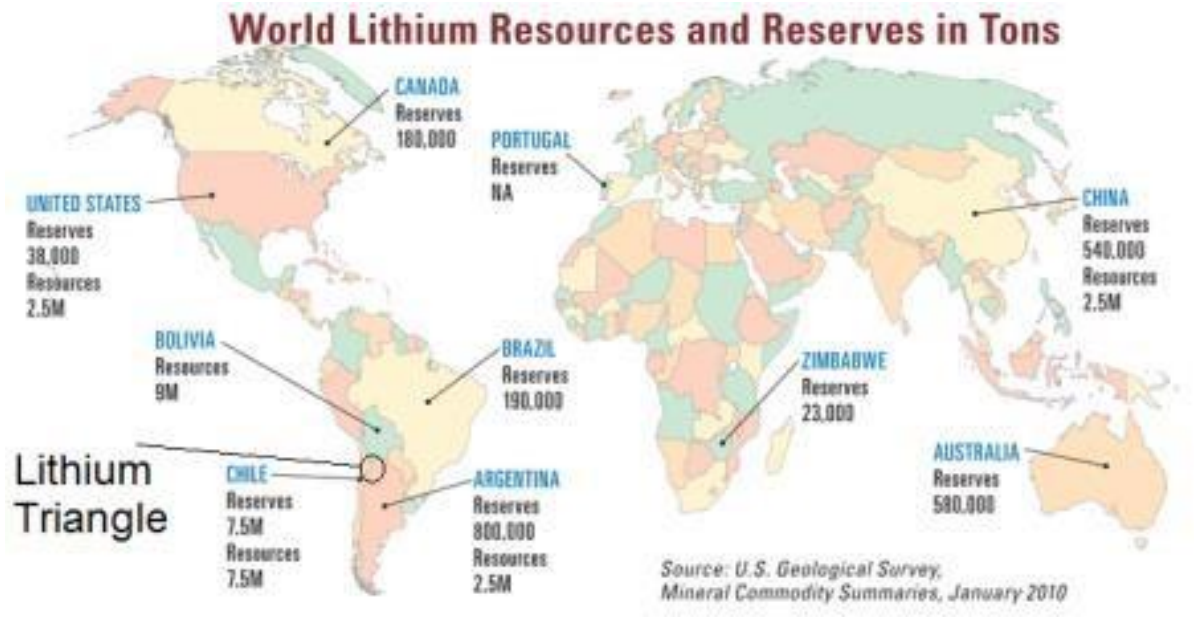

Figure 1: World Lithium Resources[3]

iii. Lithium Triangle

Lithium Triangle States (Argentina, Bolivia, Chile) account for at least 60 percent of the world'sbrine reserves. As noted earlier, the Lithium Triangle seems to be particularly attractive as brine - in broad terms - is more economically viable than hard rock, requiring the use of traditional ironore mining. In addition, the quality and quantity of Lithium Triangle brine resources appear to be, according to experts, the highest in the world. It should not be overlooked that each TriangleStates policy and idiosyncrasies in relation to the mining sector and in particular their lithium resources are completely different from the others. Countries that have demonstrated progressive and sound mining policy have seen many consensus outcomes. Chile is indeed a good example of this; Argentina and Bolivia have a very different situation but are on their way to becoming suitable lithium producers, despite facing some serious problems. [3] The largest brine pool in theworld is the Salt Lake in Bolivia called the Salar de Uyuni. It attracts tourists, sits at an altitude of around 3653m and extends over 12,000 sq. km. and is believed to be one of the most splendid places in South America.

iv. Lithium Applications

Ever since the Lithium-ion rechargeable battery was developed by German-born American professor John Goodenough in the 1980s, the demand for lithium products has been growing exponentially.

Although known for almost two centuries, lithium suddenly made headlines as the main ingredient of the lithium-ion batteries set to power the next generation of electric vehicles and, as a result, could be as valuable as gold in this century.

Aside from the advent of lithium-based batteries recently, lithium niobate (LiNbO3) is an important factor in wireless optics. Lithium is also used in high-temperature lubricants, reinforcing alloys, and heat-transfer systems. It is also prevalent in the fine chemical industry, asorgano-lithium reagents are most powerful bases and nucleophiles used to synthesize many chemicals. Its positive effects on the nervous system have made lithium attractive as a mood-stabilizing drug, and in nuclear research tritium (^{3}H) is attained by irradiating ^{6}Li. [1]

v. Lithium in Future

Collectively, these factors set the stage for controversial concerns about available storage and demands if all vehicles become electric within the next 50 years, worries of scarceness of lithiumresources and thus an astonishing rise in prices such as that encountered currently with fossil fuels.

The annual demand is therefore growing at 7-10%, presently reaching 160,000 tons of lithium carbonate (Li_2CO_3) per year and about 20-25% of which is used for the battery sector.

The current production of Li_2CO_3 is almost half of what would have been needed to convert the 50 million cars produced annually into 'plug-in hybrid cars' (with a 7 kWh Li-ion battery and a combustion engine). The demand becomes astronomic in the near future if we consider complete battery-based vehicles which necessitate an on-board battery of 40 kWh. These numbers bring out the fear of Li's potential shortage in a few decades, painting a small picture. [1]

II. KABIL (KHANIJ BIDESH INDIA LIMITED)

Three Central Public Sector Companies namely MECL (Mineral Exploration Company Limited.), NALCO(National Aluminum Company Limited), HCL(Hindustan Copper Limited.) came together to form a public Company called KABIL(Khanij Bidesh India Limited).[4] The objective of formation of KABIL is to verify and make sure there is enough supply of essential and strategic minerals to the Indian domestic market. The equity participation between NALCO, HCL and MECL was set to be at intervals the magnitude relation of 40:30:30. [5]

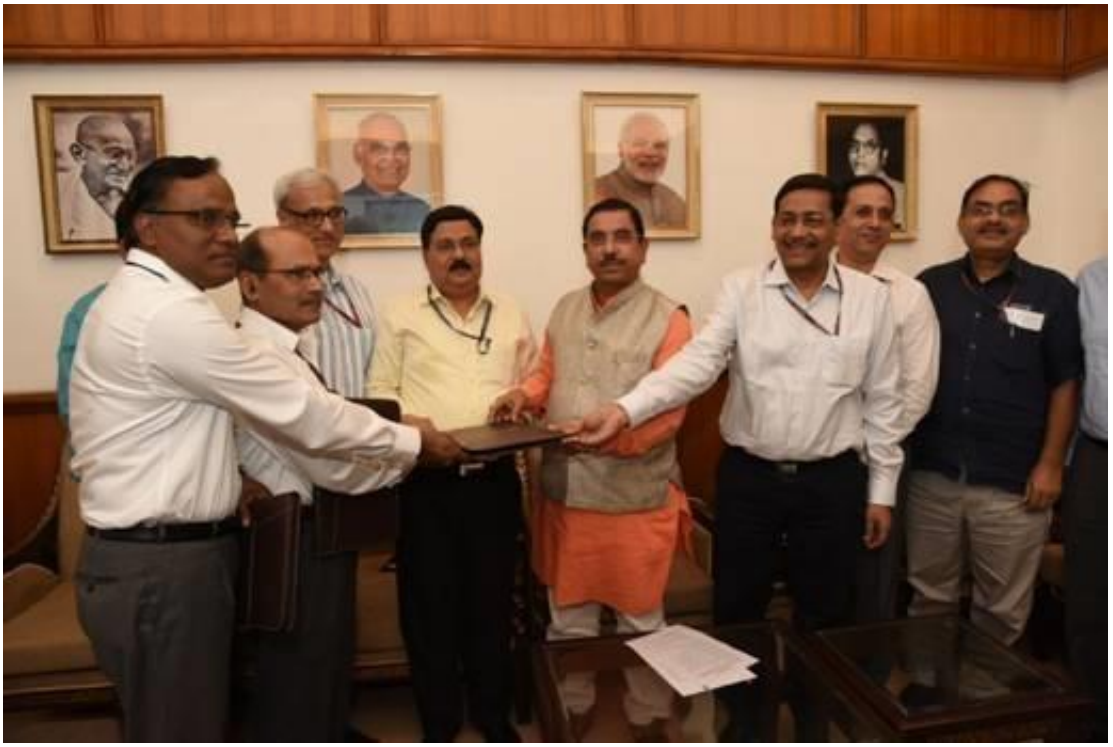

Figure 2: Minister of Mines Shri Pralhad Joshi with the CMDs of NALCO, HCL and MECL who signed on the venture for the formation of KABIL.[6]

i. The Need of KABIL

KABIL would guarantee mineral security of the state, it would additionally facilitate in realizingthe target of the substitution of energy sources. Because the Energy demand of India is most likely to increase, we would like to explore wanting different higher efficiencies and cost effective alternatives. They have to be renewable. Twelve strategic minerals are known. But the initial focus will be on Cobalt (Co) and Lithium (Li) only. [7]

ii. The Functions of KABIL

The KABIL would do identification, acquisition, exploration, development, mining and process of strategic minerals overseas for business use and meeting the country's demand of these minerals. The sourcing of these minerals or metals is to be done by making commerce opportunities, Government to Government collaborations with the producing countries or strategic acquisitions or investments in the exploration and mining assets of those minerals within the supply countries.[8] The new company can facilitate in building partnerships with different mineral-rich countries like Australia and other countries particularly in the continent of South America, wherever Indian experience in exploration and extraction are dependent transfer concerning new economic opportunities.[9]

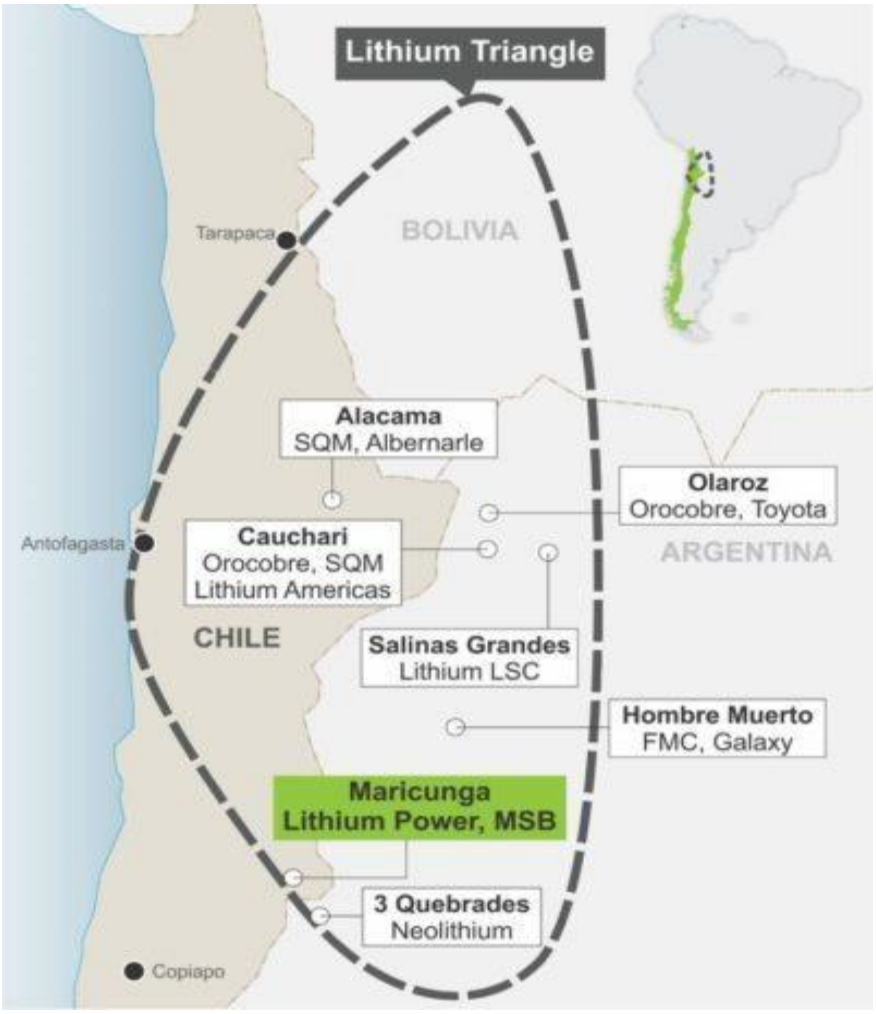

Figure 3: Lithium Triangle[18]

III. MOU WITH COUNTRIES

i. MoU with Argentina

India and Argentina signed a strategic agreement on Lithium also known as South-South Co-operation.

India and Argentina inked this MoU to determine an advert link and scientific-technological development within the field of Lithium. The MoU is signed between Khanij Bidesh India Ltd. and JEMSE (Argentine state-owned enterprise). (Indian venture company) also referred to as KABIL. It was done in presence of the Governor of South American nation Province of Jujuy, Gerardo Morales, along with the top of JEMSE, Felipe Albornoz, and the CEO of KABIL India, Ranjit Rath. In the video conference the Secretary of Mining, Miguel Soler participated in the meeting the Indian Minister of Mines, Sushil Kumar and the ambassadors of both countries, Daniel Chuburu for Argentina and Dinesh Bhatia for India.

MoU establishes joint works in exploration and production of minerals like lithium and polymetallic, and also addition of the worth of Lithium carbonate, etc. projects. Information and mutual assistance of as how to cooperate before the likelihood of forming a Strategic Alliance for the exploration, exploitation and subsequent commercialization of mineral products.

Argentina is part of Lithium Triangle, countries with 67% of proven Lithium reserves. Argentina is also ranked 3rd for lithium production within the world.[10]

ii. MoU with Bolivia

India and Bolivia have inked a Memorandum of Understanding (MoU) for the event and industrial use of lithium for the assembly of lithium-ion batteries. Bolivia will support supplies of Lithium and Lithium Carbonate to India, moreover as joint ventures between the 2 countries for lithium battery production plants in India.

Bolivia is estimated to have the most Lithium Reserves in the world, the lightest known metal, which is required for lithium-ion batteries for portable electronics, and electric vehicles, but has not yet started manufacturing it commercially. India, as the second largest manufacturer of mobile phones within the world, and with the ambitious goal of 30 per cent electric

vehicles by 2030, imports all its lithium-ion batteries. With the MoU, the likelihood of Indian companies fitting production capabilities in Bolivia goes up, also helping in the import of lithium to India. Domestic production is additionally set to determine a lift, from the automotive perspective. The arrival of hybrids and electric vehicles from as early as 2020 onwards, will force manufacturers to look for at local production. [11]

IV. MOU WITH COMPANIES

i. Suzuki Motor Corporation

Suzuki Motor Corporation, in venture with Toshiba and Denso, has already laid plans for the country's first lithium-battery plant in Gujarat, slated to be running by 2020. The plant, with a proposed investment of USD 180 million, will make lithium-ion batteries to be used in hybrid cars for the worldwide market, in addition as domestic. [11]

ii. Exide Industries

Exide Industries partnered with Leclanche a French energy firm, has also announced plans to manufacture lithium-ion batteries at its newly acquired factory in Gujarat. the corporate initially plans to import the cells it needs from Leclanche's plant in Germany, citing production at the plant will likely start off by mid-2020.

iii. BHEL (Bharat Heavy Electronics Limited)

BHEL (Bharat Heavy Electronics Limited) and a consortium of energy companies and investors known as Libcoin, is looking to line up what it calls a lithium-ion 'gigafactory' in India within the coming years. The project aims to target domestic production of core cost components, namely the battery cells themselves.

iv. Barrel Energy

Las Vegas-based Barrel Energy (an energy and minerals sector player) has signed a Memorandum of Understanding (MoU) with Roshan Energy Technologies, located in Hyderabad, India, for Lithium Battery development and production in India and North America.[12]

v. Electrovaya

Electrovaya Signs MOU to determine India's First Lithium-Ion Polymer Battery Plant Electrovaya Inc. has inked a non-binding MOU with Electrotherm India Ltd. to ascertain a sophisticated Lithium Super Polymer battery plant in India, with a capacity of up to 10MW hoursper month. [13]

vi. Pure EV

Pure EV signs MoU with CSIR-CECRI for indigenous lithium-ion technology.

Pure EV has signed a MoU with CSIR-CECRI to conduct a joint research on the validation of LIB cells, assembly of battery packs and addressing the precise requirements to confirm the suitability of developed LIBs for critical performance at the quality procedure (SOP) conditions.[14]

V. FUTURE SCOPE

India aims to generate 40 percent of its energy from renewable resources and become 30-40 percent electric vehicle nation by 2030. Therefore, self-sufficiency and localization are high on national priority, but it requires strong strategies. The government has already launched the FastAdoption and Manufacturing of Electric Vehicles (FAME) in 2015, a subsidy and charging infrastructure-based incentive program. India is also setting up goals for giga-scale storage factories of Li-ion batteries. In the immediate future, lead-acid battery-powered two-wheelers will still dominate the Indian EV space thanks to cost-sensitivity. But lithium-ion battery packs are fast becoming popular. Much of the present manufacturing of auto batteries in India revolves round the integration of lithium-ion cells and related sensors, electronics and creating the algorithms for the battery management system. The sale of EVs in India is very hooked in to government incentives. Still, the effect of pollution in cities has forced governments to specialize in EVs. The govt of the capital, Delhi, is pushing for BEVs (battery electric vehicles) as new conveyance vehicles, starting with locally assembled e-rickshaws. The government is allowing EV makers to sell their vehicles without an inbuilt battery pack. the customer can then prefer to lease the battery from the vehicle maker or a 3rd party. this might spawn battery-swapping stations, yet one more path India may take. [15]

VI. CONCLUSION

The current pandemic has strengthened the need for encouraging domestic manufacturing in India as it is overly dependent on imports to suffice its needs. As geopolitical tensions with China are growing making trade increasing difficult. In 2019-20, India imported about Rs 8,500 crore worth of Li-ion batteries. The same thing happened in 2018-19. It has increased six times since 2014-15.[16] In future as EV market grows, India's oil import will be reduced, which also contribute to cleaner air as pollution will reduced. If the supply of domestic advanced batteries is not sufficient, India will move from an oil-depended country to a battery-depended country. India is almost entirely dependent on global (especially Chinese) resources and technology for this energy transition. Recent tensions with China have made the country more aware of this vulnerability. Currently India lacks the capacity to manufacture batteries. India should back research in battery manufacturing like Battery-Chemistries with higher energy density, solid state batteries and chemicals withstanding higher energy densities, etc. Government should offer high risk funding to research. India should also plan for battery recycling and battery disposal as it can be hazardous for environment. India has been importing oil, it imports Solar PV equipment and now Batteries. India is at risk of supply squeeze, hostage to

supply chains and geopolitical tensions. EV growth is inevitable, hence it important that India builds ecosystem that will enable indigenous battery manufacturing industry.

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