# **3.1.1 LITHIUM SUPPLY CHAIN: MINING AND PROCESSING**

## 3.1.1.1 RAW MATERIAL MINING AND PROCESSING

Lithium mining and processing are essential for the production of lithium-ion batteries, which are used in many electronic devices, including electric vehicles. Lithium is primarily extracted from brines and hard rock ores, and the processing involves several steps to produce high-purity lithium carbonate or hydroxide. The mining and processing of lithium can have significant environmental impacts, such as water scarcity, soil contamination, and greenhouse gas emissions, which need to be mitigated through sustainable practices. Therefore, developing a secure and sustainable supply chain for lithium is crucial for the future of clean energy and the transition to a low-carbon economy.

The most common combination for a lithium-ion battery is Lithium Cobalt Oxide as the cathode and Graphite as the anode, with various other materials making up the remainder. Three critical materials for EV batteries are Lithium, Cobalt, and Nickel, but our project will only focus on Lithium. Specifically, we aim to develop a strategy for securely sourcing the critical raw material of Lithium by refining our scope to the mining and processing of this element.

Timeline

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Fig x. Raw Materials Pipeline for EV Batteries.

## 3.1.1.2 WORLD AND NORTH AMERICAN PERSPECTIVE

### 3.1.1.2.1 NORTH AMERICA PERSPECTIVE

The North American perspective on lithium mining and processing is complex, with various stakeholders expressing different viewpoints. On the one hand, there is significant interest in developing domestic sources of lithium to reduce dependence on imports and to support the growing demand for lithium-ion batteries used in electric vehicles and renewable energy storage systems. However, there are also concerns about the environmental impact of lithium mining and processing, particularly in terms of water usage and contamination, as well as the social impact on communities living near mining operations.

Proponents of lithium mining and processing argue that environmental impacts can be minimized through the use of advanced technologies and sustainable practices. For example, some companies are exploring the use of direct lithium extraction (DLE) methods that can significantly reduce water usage compared to traditional mining methods. Additionally, companies are working to establish partnerships with local communities to address concerns about employment opportunities, environmental impacts, and cultural heritage preservation.

Opponents of lithium mining and processing argue that the environmental and social impacts are too great to justify its development, particularly given the availability of alternatives such as recycling and the use of other battery chemistries. They argue that mining can have long-lasting and irreversible impacts on ecosystems, water resources, and the health of local communities and that these impacts disproportionately affect marginalized and Indigenous communities. They also point to the high energy and carbon footprint associated with lithium production, particularly in regions with coal-powered electricity grids.

### 3.1.1.2.2 WORLD PERSPECTIVE

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| Fig 2. Lithium Supply in the World | Fig. 3 Lithium Ore Processing in the World |

   Lithium is a crucial element in the production of batteries that power electric vehicles and portable devices. Australia and Chile hold over three-quarters of the world's extractable Lithium reserves, with China and Argentina also having significant reserves. The processing of Lithium into usable forms has been monopolized by China and Chinese companies, with about 58% of the world's Lithium being processed by them. Chile processes about 31% of the world's Lithium [5].

China's dominance in Lithium processing is due to its ability to produce Lithium-ion batteries at a lower cost than other countries, making it a leader in the EV industry. Other countries like the US, Canada, and Australia have started investing in Lithium mining and processing projects to reduce their dependence on China.

In conclusion, the demand for Lithium is expected to grow as the production of EVs and portable devices increases. While Australia and Chile have the majority of extractable Lithium reserves, China and Chinese companies dominate the Lithium processing industry. However, with more investments in the Lithium industry, the balance of power may shift in the future.

## 3.1.1.3 CASE STUDIES ON LITHIUM MINING AND PROCESSING

### 3.1.1.3.1 CASE STUDY 1: MINING AND EXTRACTION

The Lithium chemical mining market in North America lags behind the rest of the world, with very low operational output. However, there are ongoing case studies aimed at improving the situation. In this slide, we will take a closer look at these case studies and their potential impact on the Lithium market in North America.

**Business Issue:**

According to recent studies, North America has approximately 1,280,000 metric tons (MT) of Lithium deposits, which amounts to roughly 6.2% of the world's deposits [4][5][6]. However, the current operational output of Lithium mining in North America is low, with only around 5,000 MT of Lithium being mined annually from the Silver Peak Mine [7].

Furthermore, although there are two known Lithium deposits in North America, namely the Thacker Pass, and Tin-Spodumene, they are not yet operational and are still under development.

Another major issue facing the Lithium market in North America is the lack of secure access to Lithium chemicals for North American companies. This lack of secure access to Lithium chemicals can hinder the growth of Lithium mining and processing industries in North America, which may impact the region's ability to meet the increasing demand for Lithium in the global market.

**Business Opportunity:**

The demand for Lithium in North America is expected to increase significantly due to the growing production of electric vehicles (EVs). In the US alone, it is projected that around 360,000 metric tons (MT) of Lithium will be required by 2050 to meet the demands for EVs [8].

Moreover, there is a business need for secure access to raw materials in the domestic supply chain for Lithium-ion EV batteries in North America. This would enable the region to reduce its dependence on foreign sources for Lithium chemicals, which can improve the stability and security of the supply chain.

To achieve this, efforts are being made to enable domestic mining operations in North America. Albemarle, which currently operates the Silver Peak Lithium mine, plans to increase its output to 10,000 MT [7][3]. Lithium Americas also has plans to mine 35,000 MT of Lithium at the Thacker Pass Lithium Mine [9]. These developments may help to increase the operational output of Lithium mining in North America and improve the region's ability to meet the growing demand for Lithium in the global market.

**Value Creation:**

The mining of Lithium is a critical aspect of the electric vehicle (EV) battery value chain, as it is a key component of Lithium-ion batteries. The operation of the Thacker Pass in Nevada, along with the Silver Peak Lithium Mine, is expected to produce approximately 100,000 metric tons per annum (TPA) of Lithium Carbonate Equivalent (LCE) [9][10].

In-house mining operations can help reduce the cost of production of Lithium chemicals, which can benefit the domestic manufacturing sector. This can also improve the market share of North America in the EV battery value chain.

Domestic mining of Lithium can also enable secure access to the critical raw material, which can reduce the region's dependence on foreign sources for Lithium chemicals. This can help to improve the stability and security of the supply chain, while also supporting the growth of Lithium mining and processing industries in North America. These developments may ultimately help the region meet the growing demand for Lithium in the global market.

### 3.1.1.3.2 CASE STUDY 2: LITHIUM PROCESSING

The lack of processing of Lithium chemicals in North America has resulted in a limited supply of raw materials for electric vehicle (EV) battery manufacturing, which can pose significant challenges to the region's EV industry. To address this issue, several organizations are working on implementing processing plants in North America. In this slide, we will examine some case studies that are aimed at improving the region's ability to process Lithium chemicals and support the growth of the EV battery sector.

**Business Issue:**

North America faces a significant challenge in that only 1% of Lithium is processed and produced domestically, amounting to approximately 1000 MT per year. In contrast, about 79% of the world's Lithium is processed in China [4]. The lack of infrastructure, resources, and support for domestic processing in North America means that companies in the region are heavily dependent on importing Lithium. However, strict regulations due to environmental hazards associated with Lithium processing have limited domestic processing.

As a result, the USA alone imports over 2500 MT of Lithium Carbonate Equivalents (LCEs) each year, incurring an expenditure of over $80 Million. The high import costs and dependence on foreign supplies of Lithium pose a significant challenge for the region's EV battery sector, necessitating the establishment of local processing facilities to ensure a reliable and secure supply of Lithium for Battery Manufacturing [4][8].

**Business Opportunity:**

Piedmont Lithium's initiative to enable the domestic processing of lithium in North America is expected to have a significant impact on the lithium market. Piedmont has invested $58 million in a project to process 30,000 MT of lithium annually at the Tin-Spodumene belt in North Carolina. This move is expected to reduce North America's dependence on imported lithium and provide secure access to raw materials for lithium-ion battery manufacturing [11].

Piedmont has also partnered with Atlantic Lithium to provide spodumene concentrate for the domestic processing of lithium hydroxide at Tennessee Lithium. The location of Tennessee Lithium offers several benefits, including proximity to customers, reduced transportation distances, and excellent infrastructure, including rail, road, and river transportation. The project is expected to boost the domestic lithium processing industry in North America, create job opportunities, and provide a sustainable source of lithium for the lithium-ion battery sector [11].

**Value Creation:**

The establishment of domestic processing plants for Lithium oxide in North America will reduce the region's dependence on imports from China, the dominant market. Government initiatives aimed at accelerating the domestic processing of raw materials for EV batteries include tax credits and incentives. Vertical integration of critical material processing enables control over costs and supply chain disruptions to ensure quality control.

With such initiatives, there will be more control over costs and the supply chain, reducing the likelihood of disruptions. The initiatives will help to maintain quality control and produce better products. This move will enable North America to play a more significant role in the global EV battery value chain.

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