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China in Global Lithium Production: A Study on Economic Viability

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ABSTRACT
The study aims to analyze China's strategic role in global lithium production amid increasing demand for critical minerals to support the energy transition. The background of this study is based on the limitations of China's domestic lithium reserves, while the country is able to dominate the downstream sector through processing and refining. The research uses a descriptive-analytical approach with secondary data sourced from USGS, IEA, UN Comtrade, as well as academic and official policy publications for the 2019–2023 period. The analysis was conducted comparatively to compare China's production, import and investment capacity with other major producing countries. The results show that China's dominance is more determined by its mastery of downstream technology, vertical integration, and global investment strategies than by the availability of domestic reserves. Expansion into Latin America and Africa through the acquisition of lithium mines is a key instrument in securing the supply of raw materials. The contribution of this research lies in the synthesis of the literature on mineral geopolitics by highlighting the paradox between resource limitations and the dominance of downstream industries. These findings have important implications for other countries in formulating energy security strategies, supply diversification, and downstream policies in the transition era to clean energy.

1. INTRODUCTION

The global automotive industry is currently undergoing a major transformation towards electric vehicles (EVs) in response to the climate crisis, fossil energy limitations, and the demands of sustainable development. According to the International Energy Agency (IEA, 2022) report, EV sales increased by more than 55% in the 2020–2022 period and are projected to reach 40% of total

new car sales by 2030. These changes are driving an increased need for critical minerals, especially lithium, which is a key component in electric vehicle batteries.

Lithium has the unique characteristics of high energy density, long lifespan, and light weight, making it a prime choice in the production of lithium-ion batteries (Kesler et al., 2012; Vikström et al., 2013). As a result, global demand for lithium has increased sharply in the past decade, with projections to reach nearly 40 times by 2040 compared to 2020 levels (IEA, 2022). This increase in demand has driven global competition in the lithium supply chain, both in terms of primary production and mastery of downstream processing technology (Grosjean et al., 2012).

In this context, China occupies a strategic position not because of the abundance of domestic reserves which are relatively limited compared to major producing countries such as Australia, Chile, and Argentina (USGS, 2023) but because of its dominance in the downstream sector, such as refining, processing, and battery production. Various studies (Pengfei et al., 2023; Altiparmak, 2023) emphasized that China's strategy focuses on mastering the global value chain through foreign investment, industrial policies, and vertical integration in the new energy sector.

Based on this background, this study aims to analyze China's role in the global lithium industry by highlighting the limitations of domestic reserves, international investment strategies, and the dominance of the downstream sector that underpin China's ambitions in the transition to clean energy. However, due to the trade war between China and the USA may affect the flow of export of lithium (Nandy, 2021)

2. LITERATURE REVIEW

Lithium has become one of the strategic minerals in the era of energy transition due to its role as a key ingredient in the manufacture of rechargeable batteries for electric vehicles and renewable energy storage. Several studies emphasize that the development of clean energy technology cannot be separated from the availability and distribution of lithium in the global market (Grosjean et al., 2012). The world's lithium reserves and production are dominated by several countries such as Australia, Chile, and Argentina. Meanwhile, although China's reserves are relatively limited, the country has an important position through its dominance of the lithium processing and refining sector.

Table 1. Literature Review

Author (Year)	Study Focus	Key Findings	Gaps
Grosjean et al. (2012)	Global availability of strategic minerals	Global lithium reserve distribution uneven	Less associated with the strategy of the importing country
Kesler et al. (2012)	Lithium reserves in major producing countries	Australia, Chile, Argentina are dominant in lithium reserves	Haven't linked reserves to downstream dominance
Flexer et al. (2018)	Chinese foreign investment in Latin America	China seeks to secure raw material supplies abroad	Not discussing the broader geopolitical impact
Kaunda (2020)	Chinese mining investment in Africa	China's expansion strengthens Africa's dependence	Has not explained the role of the global supply chain
Vikström et al. (2013)	Geopolitical and environmental risks of lithium	Volatile prices, geopolitical risks and significant environmental impacts	No analysis of China's vertical integration yet

Previous research has shown that China's dominance is not primarily on the upstream side, but on the downstream value chain. Proficiency in processing technology, industrial capacity, and state policy support make China a major actor in the provision of ready-to-use lithium for the battery industry (Vikström et al., 2013). In addition, China's dependence on raw material imports has encouraged national companies to make direct investments in mines abroad, particularly in Latin America and Africa (Kaunda, 2020; Flexer et al., 2018).

In the context of the global market, lithium dynamics are also affected by fluctuating prices and increasing demand due to the penetration of electric vehicles. Some studies emphasize that although China has an advantage in processing capacity, the country still faces challenges in terms of structural dependence on raw lithium imports, geopolitical risks, as well as the environmental impact of the extraction process (Kesler et al., 2012).

Although previous literature has discussed aspects of China's reserves, production, and international strategy, most research still focuses on the technical dimensions and trends of the global market. The study comprehensively highlights the linkages between domestic reserves, import dependence, foreign investment, and China's role in lithium processing is still limited. Therefore, this study seeks to contribute by analyzing China's strategic position in the global lithium supply chain through the latest data-driven descriptive-analytical approach, so as to

enrich understanding of how the country balances domestic resource limitations with its ambition to become a global leader in the new energy sector.

3. METHODOLOGY

This study uses a descriptive-analytical approach to understand China's strategic position in global lithium production and supply chains. The data analyzed is sourced from secondary data obtained through official publications of international and national institutions, including the United States Geological Survey (USGS), the International Energy Agency (IEA), as well as international trade databases such as the World Integrated Trade Solution (WITS) and UN Comtrade.

The analysis units of this study include lithium mine production, lithium reserves, lithium imports, and China's lithium processing capacity in the context of the global market. The research period is focused on 2019–2023 to match the availability of the latest data and the growth trends of the electric vehicle industry.

The quantitative data obtained were analyzed in a comparative descriptive manner, namely by comparing China's lithium production and reserve trends with those of the world's major producing countries, as well as examining the dynamics of China's imports and expansion of foreign investment in the lithium sector. This analysis is then linked to the academic literature related to the lithium industry and energy policy, resulting in a comprehensive picture of China's role in the global lithium supply chain.

4. RESULT AND DISCUSSIONS

4.1. Green Energy in China

"Green energy" in the context of economics refers to the sustainable and efficient use of renewable energy sources to reduce environmental risks and ecological scarcity, and to promote sustainable development without environmental degradation (Loiseau et al., 2016). Clean energy sources such as solar energy, wind energy, hydroelectricity, geothermal energy, tidal energy, ocean energy, biomass, and biofuels have a lower environmental impact than conventional energy sources and can provide cleaner and greener energy indefinitely in a sustainable manner. The lithium-ion battery is not a direct part of green energy, but it plays an important role in the

utilization and storage of renewable energy (Tarascon & Armand, 2010). Li-ion batteries can store energy from renewable sources such as solar and wind farms, allowing that energy to be used at a later time (Fergus, 2010). Thus, lithium-ion batteries can be seen as a supporting technology for "green energy". "Green economy" requires a transition to clean energy production based on renewable energy sources to replace fossil fuels, and renewable energy sources such as solar and wind power can completely eliminate the use of fossil fuels for electricity generation by 2035 and completely replace the use of fossil fuels by 2050 (World Economic Forum, 2020).

As the world's largest emitter of greenhouse gases, China is making significant efforts to shift to clean energy sources to combat climate change. This transition is driven by the rapid development of renewable energy technologies such as solar and wind power, as well as the increasing adoption of electric vehicles. Lithium, an important component of lithium-ion batteries, plays a critical role in supporting and potentially expanding the deployment of these clean technologies. The transition to green energy is important for China from both an environmental and economic perspective. The transition to renewable energy offers numerous economic benefits to the country, including increased energy security, employment opportunities, and technological innovation. These benefits can contribute to China's economic growth and sustainability.

First, green energy can increase China's energy security by reducing its dependence on fossil fuel imports. China is the world's largest energy consumer and importer, making it vulnerable to price volatility and geopolitical risks associated with fossil fuel imports. Volatility is a financial indicator that reflects how much the price of an asset or commodity changes over a short period of time. By increasing the share of renewable energy in its energy mix, China can reduce its dependence on fossil fuels and improve its energy security. According to a study published in the National Center for Biotechnology Information (NCBI), reducing the share of coal and oil use by 1% can effectively increase China's green economy by 0.209% (Dong, Zhao, & Taghizadeh-Hesary, 2023). This indicates that reducing the use of fossil fuels and increasing the use of renewable energy can promote China's sustainable development, which is necessary for quality growth and is the only means of transforming a large industrialized economy (Bhuiyan, Kahouli, Hamaguchi, & colleagues, 2023). By increasing the share of renewable energy in its energy mix, China can reduce its dependence on fossil fuels, improve its energy security and

promote green growth. It can also help China meet its carbon emission reduction targets and contribute to global efforts to combat climate change.

Second, the transition to green energy can create new jobs in China. The renewable energy sector is labor intensive and can create more jobs per unit of energy produced compared to traditional fossil fuel industries. According to the International Renewable Energy Agency (IRENA), China's renewable energy sector could generate more than 13 million jobs by 2030, up from 4.1 million in 2019 (Gulzar, Asghar, Hwang, & Hassan, 2020). To meet the growing demand for lithium-ion batteries, mining needs to be expanded significantly. This will create thousands of new jobs in a variety of industries, including geologists, mining engineers, heavy equipment operators, and mineral processing technicians. The expansion of lithium mining is accompanied by significant investment in refining and manufacturing facilities in China. In addition to mining and manufacturing, China's lithium industry is driving the growth of the entire battery value chain. These include companies involved in recycling, utilizing secondary raw materials, and researching next-generation batteries. These companies employ chemists, researchers, technicians and other skilled professionals. The nation's lithium strategy is already creating an increasing number of high-tech manufacturing jobs across the country. For many employees, working in the lithium industry provides a great opportunity to be at the forefront of innovative technologies that are helping China's transition to a more sustainable energy system.

Third, the energy transition can stimulate technological innovation and entrepreneurship in China. The renewable energy sector is a fast-growing industry that requires significant investment in research and development. China has already established itself as a world leader in renewable energy technologies, especially in solar photovoltaics and wind power. Solar photovoltaics is a technology that converts solar energy into electrical energy using solar cells, i.e. photovoltaic cells. By continuing to invest in research and development, China can maintain its competitive advantage in the global renewable energy market and create new opportunities for entrepreneurs and innovators. China has invested heavily in the renewable energy industry, including factories producing products such as electric vehicles, batteries, and renewable energy equipment (The Wall Street Journal, 2024). The Chinese government is encouraging the adoption of clean energy sources such as geothermal and hydropower to reduce the burden on the environment. China's successful clean technology campaign has more to do with its economic strategy than climate policy, and the ability to produce at scale and quality, and to utilize funds

competitively, underpins the impressive growth of wind and solar power in China, as well as lithium battery electric vehicles. The rapid development of clean energy in China must be viewed in conjunction with the continued development of new coal-fired power. More than half of all coal consumed in the world over the past decade was consumed in China, and coal fever in the country is not abating (Zaytsev, Dmitriev, & Sebbaggala, 2022). The challenge for China is to maintain its record in clean technology, but cut off its coal supply. This will require decisive reforms in the country's energy sector, where many regulations still favor coal over clean energy sources. Technological solutions such as energy storage could also help the transition in the interim (Li, 2023).

Fourth, green energy can help China meet its carbon reduction targets and contribute to global efforts to combat climate change. In recent years, China has significantly stepped up its efforts to utilize renewable energy. This has been driven by a combination of environmental considerations and economic incentives, with the country's goal of achieving carbon neutrality by 2060 a strong motivation to accelerate the development of clean energy technologies. By increasing the share of renewable energy in its energy mix, China can significantly reduce greenhouse gas emissions and meet the global goal of limiting temperature rise to below 2°C above pre-industrial levels.

For example, a green energy transition offers significant economic benefits to China, including increased energy security, job creation, technological innovation, reduced carbon dioxide emissions, and enhanced image and prestige of the state. However, the green energy transition is also fraught with challenges, including intermittency of renewable energy sources, the need for significant investment in infrastructure and technology, and the need for regulatory and policy support. To overcome these challenges, China needs to continue to invest in renewable energy technologies, strengthen its regulatory and policy framework, and cooperate with other countries to promote sustainable development and combat climate change.

4.2. China's place in world lithium reserves

China's lithium industry has experienced significant growth and transformation over the past decade, becoming a globally recognized hallmark along with China's advances in new energy vehicles. The industry has witnessed the growth of leading companies such as CATL, EVE Energy, Farasis Energy and Gotionhigh-Tech. Since 2020, lithium batteries are rapidly increasing in

popularity due to their high energy density and fast charging capabilities, especially in electric vehicles. This has led to rapid growth in lithium battery exports from China, driven by continuous improvements in local technology and production capacity (EqualOcean, 2023).

In 2021, Chinese lithium battery manufacturers led by CATL accelerated overseas plant construction to tap the expanding global market for new energy vehicles. By 2022, China's lithium battery exports reached RMB 342.656 billion, up 86.7% year-on-year (EqualOcean, 2023). The lithium production chain can be divided into upstream, midstream and downstream stages. The upstream is the part of a river, canal, reservoir or other water body adjacent to a hydraulic structure. Lithium is typically extracted from brines (brine is natural water containing dissolved minerals in elevated concentrations) and hard rock, which today account for 59% of economically viable lithium reserves Government of the People's Republic of China, 2020). The mined materials are processed into lithium carbonate, which is then converted to lithium hydroxide. These lithium precursors are used in the key elements of power cells: anodes, cathodes and electrolytes for making battery cells (Acclime China, 2024).

The world's lithium reserves are abundant but unevenly distributed, with nearly 98.43% concentrated in Chile, Australia, Argentina, the United States and China. Chile has the largest lithium reserves in the world, followed by Australia and Argentina. China's lithium industry has attracted significant attention in the international market, with cumulative exports totaling 69,000 units from January to May 2022, up 14.2 times year-on-year. Sustained high growth in new energy vehicle exports has led to an increase in lithium battery exports (Yuan, Liu, Zhou, Tang, Yuan, & Yuan, 2023).

However, China's domestic lithium battery exports may face certain trade barriers, and lithium battery exports may face various restrictions. Independent researcher Cao Guangping believes that these restrictions include the erection of trade or technology barriers in countries or regions where requirements may include compliance with local regulations on emissions and disposal of battery materials (Bradsher, 2021). In the U.S., the "Inflation Reduction Bill" and other policies are influencing Chinese battery companies, pushing them to actively explore a strategy to "go global" in battery technology (EqualOcean, 2023).

Overall, China has become a significant player in the global lithium battery industry due to strong government support, continuous technological progress and a focus on creating a localized production chain. However, challenges remain, including trade barriers and the need to

maintain a leading position in technology, quality and safety. China's lithium industry plays a significant role in the country's economy, contributing to economic growth through various channels, particularly in the production of lithium batteries for electric vehicles (EVs) (Aktas, 2024). China is the largest electric vehicle market in the world and its lithium battery production accounts for about 57% of global demand. The industry is expected to witness significant growth in the next decade owing to the increased need to reduce greenhouse gas emissions globally and the importance of cleaner energy sources and electric vehicles (Roy Chaudhury, 2023). However, the industry faces challenges such as dependence on imports of key materials, price fluctuations and overcapacity, which require government intervention and industry cooperation. Overcapacity is a situation where a business or industry has surplus production capacity that is not utilized to its full capacity due to insufficient demand for products. This can lead to lower production efficiency, higher costs and loss of competitiveness.

China has significant lithium reserves, estimated at 2,000,000 tons, representing about 13% of the world's total lithium reserves. The country's lithium reserves are mainly represented by lithium brines, which account for 85% of China's total commercial lithium reserves. Salt lakes in northwest China, especially in Tibet, Xinjiang, Qinghai and Inner Mongolia, are the main sources of lithium brines, the most common of which are carbonate and sulfate (Jennings & Nulimaimaiti, 2024). However, lithium mining in China from the Tibet Salt Lake is not fully developed due to geographical constraints and underdeveloped infrastructure. The country relies heavily on imports to meet its domestic needs for lithium carbonate products. China imported about 41% more lithium in 2023 compared to the previous year, mainly from countries such as Australia and Brazil. Net imports of lithium carbonate, a critical raw material for electric vehicles, totaled 149,100 tons, showing an increase of about 18.6% year-on-year (Liu, 2024).

Despite the recent discovery of nearly one million tons of lithium ore in Sichuan Province, which is now considered the largest known source of pegmatite monomer-based lithium ore in Asia, China still faces a gap between untapped resources and the growing demand for lithium batteries. Pegmatite monomer is the molecule that makes up a polymer and is used in the production of polymers such as polyesters. It is highly reactive and is able to form long polymer chains when combined with other monomers. This has led to companies involved in the production of electric cars needing raw materials, and some have decided to go overseas. Chinese companies are stepping up their exploration efforts both at home and abroad. Thus,

although China has significant lithium reserves, the country remains heavily dependent on imports to meet its domestic demand for lithium carbonate products. The recent discovery of a large lithium deposit in Sichuan Province and increased exploration activities by Chinese companies indicate a growing focus on providing lithium resources for the country's rapidly developing new energy industry.

From 2016 to 2019, seven new lithium-bearing pegmatite veins were discovered in Kiryin, Sichuan Province, as part of China's National Key Research and Development Program under the "13th Five-Year Plan Period" and the China Geological Survey's project "Comprehensive Exploration and Evaluation of Jiajik Large Lithium Mineral Resource Base in Western Sichuan". Pegmatite veins are vein-shaped bodies of an igneous rock called pegmatite. Pegmatites are formed in the final stage of magma crystallization. Meanwhile, more than 40 pegmatite veins were recently discovered in Guozhai, Jiangxi Province, where a medium-sized or larger ore district is expected to be discovered. The significant increase in reserves is mainly due to the fact that several new lithium-bearing veins have been drilled in the Yakeke area (Figure 1). Total lithium reserves exceed 2 million tons. According to the US Geological Survey, China already has approximately 7% of the world's identified lithium reserves, ranking sixth in the world after Bolivia, Argentina, the US, Chile and Australia. According to Rystad Energy, China controlled 65% of the world's lithium processing capacity in 2021 (fDi Intelligence, 2024). Chinese mining companies are stepping up efforts to expand access to lithium deposits in an attempt to meet growing global demand for lithium. Chinese mining companies have announced a number of deals in South America and Africa. Ganfeng Lithium, which supplies Tesla, has agreed to acquire Argentina-focused mining group Lithea for no more than $962 million, according to a filing with the Shenzhen Stock Exchange. The deal gives Ganfeng Lithium rights to two salt lakes in Argentina, namely the Posuelos and Pastos lithium salt lakes.

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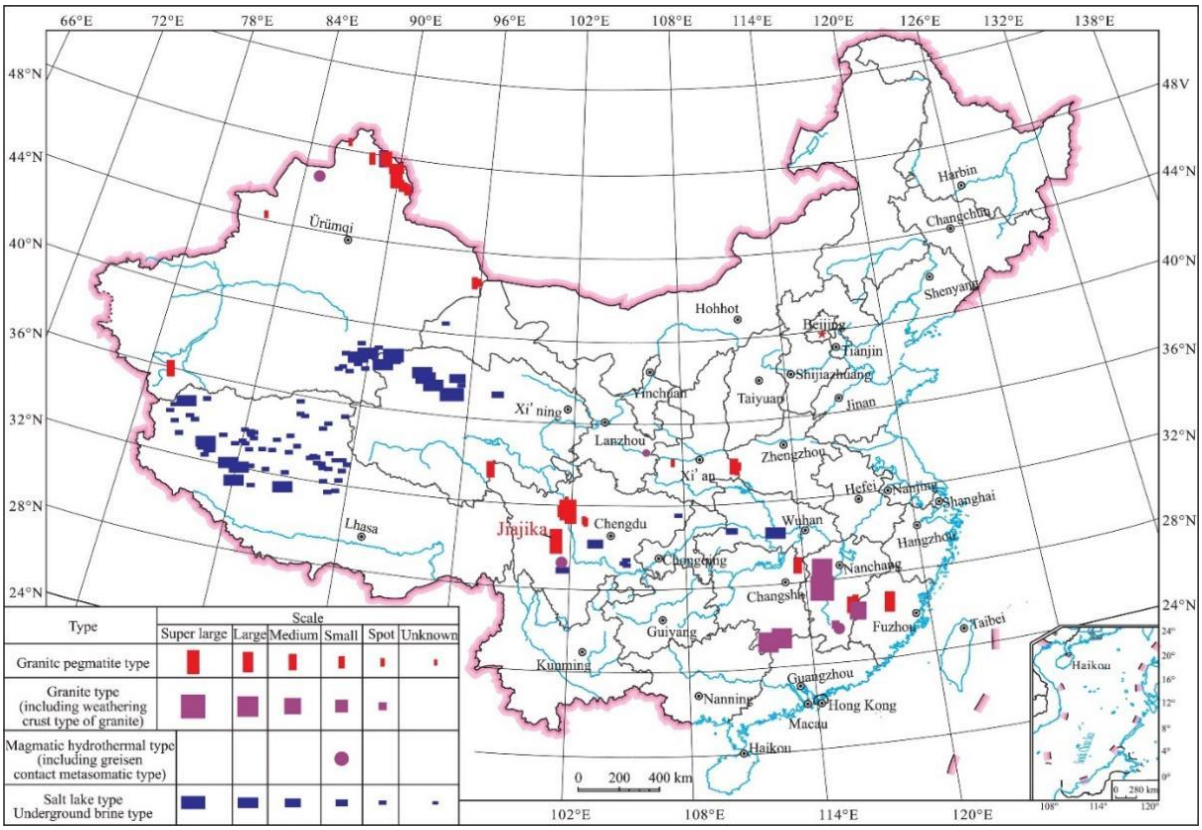

Figure 1. Map of the distribution of lithium deposits in China showing the main discovered deposits (modified from Li J.K. et al., 1995, 2015)

The distribution of lithium resources in China is characterized by dispersion and low quality: 75% of the country's lithium resources are concentrated in the salt lakes of Qinghai and Tibet, while spodumene deposits account for less than 20% of lithium reserves. Spodumene is a mineral, a silicate of lithium and aluminum.

In Qinghai Province, the Qaidam Basin is an important lithium mining center. Major deposits such as the Taijinair, Xinjiang-Duntai and Yiliping salt lakes are located in this region. These deposits are predominantly lithium-containing brines known for their high lithium concentration. Qinghai's prominence in lithium production emphasizes its strategic importance to China's lithium industry.The quality of the salt lake in Tibet is superior to that of Qinghai salt lake due to its unique characteristics of high lithium content and low magnesium/lithium ratio in the brine. However, due to geographical constraints and insufficient infrastructure, lithium extraction from the Tibet salt lake is not fully developed.

Sichuan Province in southwest China is an area with significant potential for lithium mining. The two best known lithium deposits in the region are the Daiying and Rongdingquan deposits, which are located in the Sichuan River Basin. These deposits are associated with the nearby Daiying and Xingwen salt lakes, which contain potassium-rich minerals. This geological feature emphasizes the importance of the area for lithium exploration and mining. The presence of these lithium deposits indicates the potential for significant reserves in Sichuan Province, contributing to the global supply of lithium.

The Nanpanjiang lithium deposit is located in the southeast of Jiangxi Province and is a major source of lithium in hard rock. This deposit is one of the largest lithium-bearing pegmatite formations in China. In the northwest of China, in the Xinjiang region, there are significant deposits of lithium-bearing salt lakes, such as the Xitaiqili and Yingchengzi lakes, which contribute significantly to the country's lithium production. In the southwest of Hunan Province, there is the Shiziling Baishuid deposit, which is a source of lithium in hard rock associated with granitic pegmatites. Lithium reserves in China are diverse, including both lithium-bearing brines and hard rock deposits. Its distribution is concentrated in the western and southwestern regions, especially in the Qinghai, Sichuan and Xinjiang salt lake basins, as well as pegmatite deposits in Jiangxi and Yunnan. China's lithium reserves are estimated at 3 million tons, accounting for 11% of the world's total lithium reserves. Lithium brines contain 85% of the total commercial lithium reserves in China, and the salt lakes are mainly located in northwestern regions of China such as Tibet, Xinjiang, Qinghai and Inner Mongolia, and the types of brines are mainly carbonate and sulfate

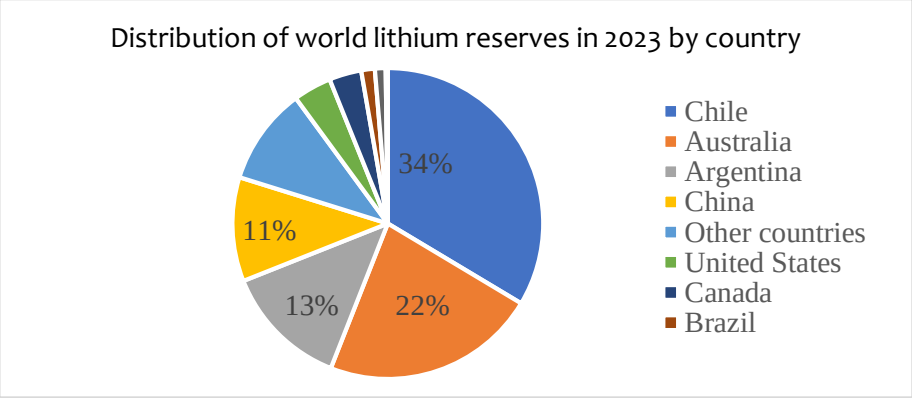

Figure 2. Distribution of world lithium reserves in 2024 by country based on company and government reports.

Despite China's significant lithium reserves, the country remains heavily dependent on imports to meet domestic demand for lithium carbonate products. This is because China's lithium resources are scattered and of poor quality, making it difficult to extract lithium from brines and hard rock deposits. In addition, the development of lithium resources in China is limited by natural conditions, cost and technology, which has resulted in a low exploitation rate (Li, Zhu, Chen, Liu, & He, 2022). To bridge the gap between untapped resources and the growing demand for lithium batteries, Chinese companies have stepped up exploration activities both at home and abroad. The discovery of nearly 1 million metric tons of lithium reserves in Sichuan Province is expected to reduce China's dependence on lithium imports and provide a steady supply for the fast-growing electric vehicle industry. However, actual mining capacity remains limited, and the recently discovered lithium mine in Sichuan Province is located on a plateau, deep underground, which poses significant challenges for mining (Liu, 2024).

In conclusion, despite the country's significant lithium reserves, the scattered and low quality resources make lithium mining difficult, resulting in high import dependence. To meet the growing demand for lithium batteries, Chinese companies have stepped up exploration activities both at home and abroad.

4.3. China's Lithium Production

China, the world's leading consumer of lithium, is actively securing its supply of this critical mineral through strategic investments in overseas lithium deposits and the development of domestic production capacity. As demand for lithium-ion batteries continues to grow, driven by the rapid development of electric vehicles and energy storage technologies, China's lithium security strategy is becoming increasingly important to its economic and technological progress. In order to provide a more in-depth understanding of the specifics related to China's mining of this resource, it is necessary to examine in more detail the imports of lithium, the investments made by the Chinese side in overseas deposits, and the country's plans and capabilities with respect to mining and utilization.

4.4. Country Plans and Capabilities for Lithium Mining and Utilization

China is currently focusing on domestic lithium production as part of its strategic plan to reduce its dependence on imports and ensure a steady supply of this critical resource for its fast-growing battery industry. China is the largest producer and consumer of lithium in the world, accounting for approximately a quarter of global lithium production in 2023 (Liu & Hayley, 2024). The Chinese government intends to maintain this level of production and therefore plans to develop domestic lithium production. China's intention to increase domestic lithium production is driven by its desire to reduce its dependence on lithium imports. In support of this goal, China has identified lithium as a national priority as part of its "Made in China 2025" industrial strategy (Ministry of Industry and Information Technology of the People's Republic of China, 2024), allocating approximately $60 billion in subsidies for electric vehicles to help establish a domestic supply chain for lithium batteries.

China's "Made in China 2025" industrial plan, launched in 2015, aims to make the country a global leader in industrial manufacturing by 2025. A key component of this plan is the development of the lithium industry, which is essential for the production of batteries for electric vehicles. China plans to quadruple lithium production in Yichun, Jiangxi province, to about 350,000 metric tons of lithium carbonate by 2025. This target is equivalent to the annual production of Australia, one of the world's largest lithium exporters. Yichun has been recognized as China's most promising region for lithium production, and the country is focused on reducing its dependence on imports of this essential mineral for the battery industry, which accounts for about 75% of global lithium-ion battery production.

To attract investment, Yichun Qihangyi Trading Co has introduced various incentives and acquired stakes in mining companies to help battery material producers that do not have their own overseas mines, unlike China's leading lithium producers (Rapier, 2022). However, the company is facing challenges from the recent drop in global lithium prices, as well as environmental issues related to waste from mining lepidolite, a lithium-rich aluminosilicate, which has led to the shutdown of some plants (Fujishiro, 2024).

China also plans to begin exploiting untapped sources of lithium within its own borders, in the Xinjiang and Tibetan Plateau areas (Katwala, 2022). The Tibetan Plateau, which contains about 85% of China's total lithium reserves, has become a center of development. Chinese geologists estimate that there are about 3.6 million tons of lithium reserves in hard rock deposits

in Tibet (Tibet News, 2023). A major new lithium processing plant is under construction in Xinjiang that will produce 600,000 tons of "high quality lithium concentrate" per year in the future (Saxena, 2023). This indicates that Xinjiang has significant lithium reserves that China is eager to develop and exploit. However, Chinese geologists do not specifically estimate how much lithium can be mined in the Xinjiang region. Information is limited to indicating that Xinjiang has "large, relatively untapped lithium reserves" (ET Auto, 2023).

China has invested heavily in the lithium industry, emphasizing vertical integration throughout the supply chain. This approach allows Chinese companies to own various stages of the production process, reducing dependence on external suppliers and increasing control over the industry. The Chinese government has provided significant financial support for lithium-related projects, including the development of lithium mines, processing facilities and battery plants. The China Lithium Battery Industry Development Index White Paper (Feng & Cao, 2022), published by the China Center for Information Industry Development (CCID) in 2022, highlights China's unchanged position as the world's largest consumer market for lithium batteries over the past five years. By 2021, the global lithium battery market has reached 545 gigawatt hours, with China accounting for approximately 59.4% of the total market (Wang, 2024). China's dominance in the global lithium market is further emphasized by its significant investment in lithium mining and processing. The country has become the world's largest importer of lithium ore, with imports of about 4.01 million tons in 2023, up 41% from a year earlier (Tang & Liau, 2024). Chinese mining and battery giants are actively acquiring lithium assets around the world, focusing on early-stage projects and developments that are on the verge of becoming major producers (Keen & Erickson, 2021). The move is in line with China's broader strategy to secure lithium supplies to meet growing demand for batteries, especially in the electric vehicle sector. The country's investments in Africa, particularly in Zimbabwe, have significantly increased lithium production, and China is expected to capitalize on African lithium resources through its expertise and capital. Despite the current global lithium glut and falling prices, China's significant investment in lithium mining underscores its long-term vision of strengthening its position in the lithium industry (Liu & Patton, 2023).

4.5. China's Imports of Lithium

China's dependence on lithium imports is a pressing issue that has received considerable attention in recent years. The rapid growth of lithium production in the country, combined with limited domestic lithium resources, has led to a significant dependence on foreign sources of lithium. This dependence is multifaceted and can be explained by several key factors.

First, China's domestic lithium reserves are limited and of lower quality than those found in other countries. According to the United States Geological Survey (USGS), China's identified lithium resources account for only about 5.7% of the global total, and most of these resources are low-grade and scattered throughout the country. In 2020, China's consumption of lithium resources reached 186,000 tons, accounting for 60% of global lithium consumption. However, China's domestic lithium production in 2019 was only 12,631 tons, far below the country's needs. This supply-demand imbalance has caused China's external dependence on lithium mines to increase from 67% in 2014 to 75.7% in 2020 and stabilize at this level (Zheng, Chen, Liu, & Hu, 2022). The stabilization of China's dependence on external supply of lithium resources from 2021 was driven by strategic investment in overseas deposits, vertical integration of production chains, reserve accumulation, technological advances in processing, and government price regulation. The level of dependence is shown in detail in Graph 2.

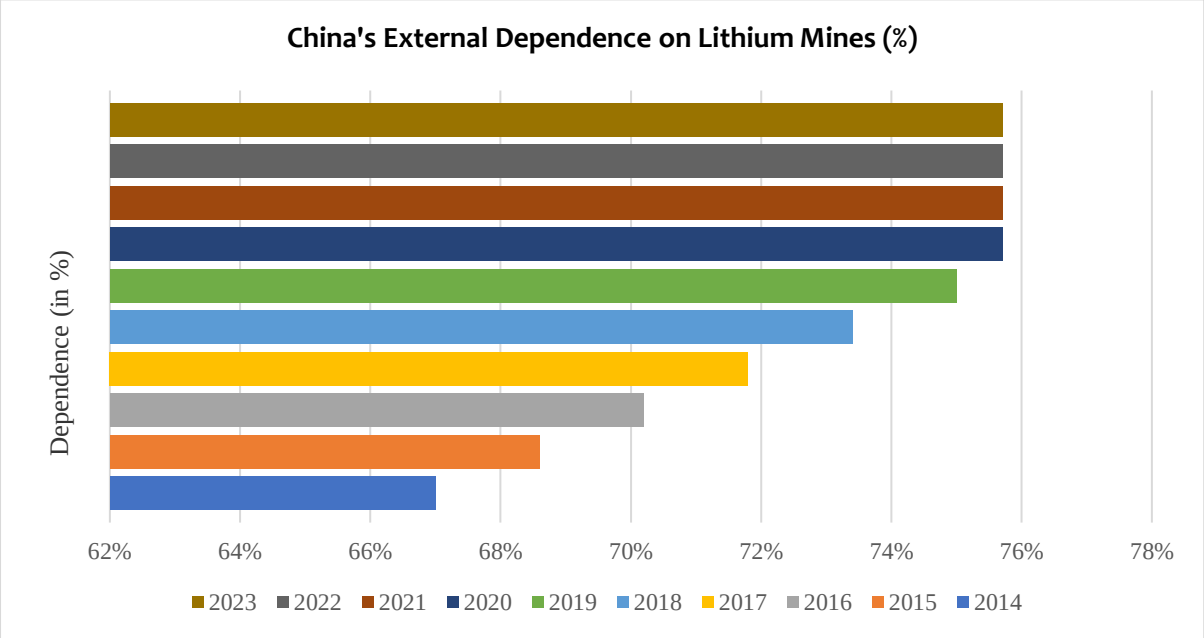

Figure 3. China's external dependence on lithium imports in percent (%) in 2014-2019

Secondly, China's lithium industry is still at an early stage of development. Despite the government's efforts to promote the development of the industry, the country's mining capacity is still insufficient to meet the demand for lithium. The lack of domestic production capacity has forced China to rely on imports to fill the gap.

Third, China's lithium market is strongly influenced by global market trends. The country's lithium imports are largely driven by global demand for lithium-ion batteries, which are used in a wide range of applications, including electric vehicles, consumer electronics and renewable energy systems. As global demand for lithium-ion batteries continues to grow, China's lithium imports are likely to remain high (Altiparmak, 2023).

Despite the country's dependence on imports, China continues to develop its domestic mining industry while facing challenges and constraints related to lithium mining and processing. A major challenge is the political implications and vulnerability of the global lithium supply chain. China's dominance in lithium processing, combined with its dependence on imports of key materials, raises concerns about geopolitical stability and increases the risk of disruptions in the global supply chain (Zhang, 2023). The concentration of processing capacity in China, underpinning its lithium monopoly, creates strategic and commercial challenges that governments around the world are beginning to address (Worstall, 2023). The vertical integration (this is the consolidation of all or the main links of production and circulation into a single technological process, creating a holding company with a single infrastructure, with common business processes, technologies, competencies, etc. in the process chain of producing a good or service) of Chinese processors, cross-shareholdings and lack of diversified processing enterprises (a diversified enterprise is defined as one where more than 30% of total sales are for goods and services unrelated to the core activities of the company), the lack of cross-shareholdings and the lack of diversified processing enterprises (a diversified enterprise is defined as one where more than 30% of total sales are for goods and services unrelated to the core activities of the company).

To address the challenges, China's Ministry of Industry and Information Technology (MIIT) and the State Administration of Market Regulation (SAMR) have issued notices aimed at achieving coordinated and stable development of the lithium-ion battery industry. These initiatives are aimed at increasing production capacity, improving quality control, and balancing supply and demand to promote healthy growth of the industry. Despite China's significant

progress in lithium-ion battery manufacturing, there are still challenges such as uneven supply chain development, quality inconsistency and over-dependence on imports, which require strategic interventions to ensure sustainable growth of the industry (China Briefing, 2024).

Chile, Argentina and South Korea are the main lithium exporting countries to China. The growing demand for lithium in China is having a significant impact on the country's economy, stimulating the growth of the lithium market and the increasing adoption of renewable energy sources. As global demand for lithium continues to grow, these countries will play an increasingly important role in meeting China's lithium needs. Chile is the world's largest producer and exporter of lithium, accounting for about 81% of global lithium carbonate exports in 2022 (TrendEconomy, 2024). The Salar de Atacama, a salt flat in the Atacama Desert, contains some of the world's largest lithium deposits. Chile's lithium exports to China are steadily increasing, with a total value of $6.36 billion in 2022 (World Integrated Trade Solution, 2024). The country's lithium industry is dominated by two major companies, SQM and Albemarle.

Argentina is another major exporter of lithium to China, totaling $289 million in 2022. Argentina has become China's strategic partner in the lithium market. Chinese state-owned mining companies have invested in lithium reserves in northern Argentina, securing a significant share of the global lithium market. This partnership underscores Argentina's growing importance as a key lithium exporting country to China.

The total value of lithium carbonate exports from South Korea in 2022 was $34.8 million (World Integrated Trade Solution, 2024). Lithium production in the country is mainly concentrated in the form of lithium carbonate and lithium hydroxide, which are used in the production of batteries for electric vehicles and other energy storage devices. South Korea's lithium exports to China are steadily increasing, driven by the growing demand for electric vehicles and energy storage devices.

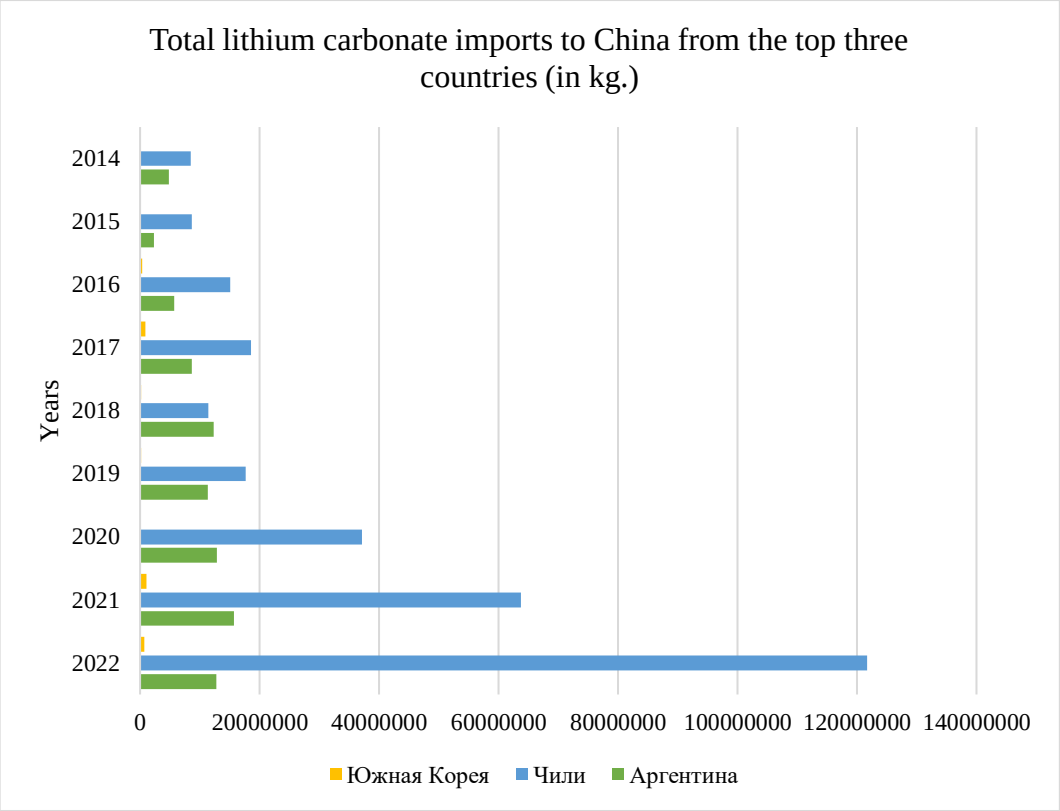

Figure 4. Total imports of lithium carbonate to China from South Korea, Chile and Argentina (in kilograms)

Source: China: lithium carbonate imports by country in 2014-2022 // World Integrated Trade Solution URL: https://wits.worldbank.org/trade/comtrade/en/country/CHN/year/2022/tradeflow/Imports/partner/ALL/product/283691 (accessed on 26.01.2025)

4.6. China's investment in overseas development of lithium deposits

China is the world's leading producer and consumer of lithium, but its domestic reserves of this valuable resource are limited. To meet its growing demand for lithium, China is actively acquiring stakes in lithium mining projects around the world, especially in countries with significant reserves, such as Zimbabwe, Argentina and the Democratic Republic of Congo. By investing in overseas lithium mining operations, China aims to diversify its sources of supply, reduce its dependence on imports, and increase its control over the global supply chain of this critical material. This strategy aims to ensure a stable and affordable supply of lithium for China's domestic industry, which is essential for the country's transition to a low-carbon economy.

China's supply of lithium to South Asia related to the issue of energy security of the South Asian region (Nandy, 2019).

In 2023, significant investment by Chinese companies has been directed towards lithium mining in Zimbabwe, causing Chinese companies to play an important role in the country's lithium sector (Ndlovu & Marawanyika, 2023). In 2022, Chinese companies invested more than $1.2 billion to acquire lithium projects in Zimbabwe. One of the key investments was the opening by China's Zhejiang Huayou Cobalt of a $300 million lithium processing plant at its Arcadia mine in Zimbabwe, which the company bought in 2022 from Australia's Prospect Resources for $422 million (Gbadamosi, 2023). The company has since commissioned a $300 million concentrator at the mine, which has the capacity to process 4.5 million tons of lithium ore and produce 450,000 tons of concentrate per year (Xinhua, 2023).

China views investment in Zimbabwe's lithium resources as a strategic move to secure access to critical minerals necessary for the transition to clean energy and technological advancement. With its vast lithium reserves, Zimbabwe has the potential to become an important player in the global lithium industry, contributing significantly to the country's economic development. The government aims to achieve an economic growth target of $12 billion by 2023. Lithium is expected to play a critical role in achieving this target, potentially generating revenues of at least $500 million (Sanchez, 2023).

Overall, Chinese investment in lithium mining in Zimbabwe has played an important role in developing the country's lithium resources and spurring economic development through partnerships and joint ventures with local organizations.

Chinese investment in lithium mining in Argentina has increased significantly in recent years. Chinese companies such as Ganfeng Lithium and Contemporary Amperex Technology have made significant progress in the region (中国能源网, 2021). In Argentina's lithium triangle, which includes the province of Jujuy, Chinese investment has enabled the development of mines, processing plants, and infrastructure necessary for efficient mining and transportation of lithium resources (Rahman & Lazarus, 2023). Chinese firms have been actively investing in Argentina's lithium sector since 2017, and the surge in investment is creating opportunities for economic growth in the region (Innovation News Network, 2023). These investments have not only focused on mining, but also on developing surrounding infrastructure, such as roads and technology providers, to support the lithium industry in the region. In addition, Chinese companies are

actively involved in joint ventures with Western and local companies, exemplified by the partnership between Canada's Lithium Americas and China's Ganfeng Lithium at the Koshari-Olaroz mine. This collaboration underscores the ongoing Sino-Western cooperation in the lithium mining sector in South America, demonstrating the strategic importance of these investments for both Chinese and Western companies in the global race for critical minerals (Ahmad, 2022). Chinese companies have invested a total of $2.7 billion to acquire lithium projects in Argentina. This includes investments by Ganfeng Lithium, Tibet Summit Resources and Tsingshan Holding Group (Pelcastre, 2023).

Chinese companies, in particular Jinchuan Group (Jinchuan Group Company Limited, 2019), have been active in the mining industry in the Democratic Republic of Congo (DRC) since 2011. In particular, they are involved in the mining of lithium, an essential component for the production of rechargeable batteries. Jinchuan Group, a well-known player in the international mining sector, has strategically expanded its presence in the DRC by focusing on lithium mining at the Shirt mine and other key projects (Jinchuan Group Company Limited, 2023). Jinchuan Group has a significant presence in the Democratic Republic of Congo (DRC) and significant stakes in several mining projects. One of these projects is the Shirt mine, which specializes in lithium mining. These investments in the DRC's mining sector are in line with China's strategic goal of providing necessary resources to growing industries, especially in the electric vehicle sector.

Chinese mining company Huagang Mining is similarly active in lithium mining in the DRC (Gill & Pollard, 2021). The company's investment in the DRC's lithium sector is part of China's broader strategy to secure a stable supply of critical minerals needed to realize its clean technology ambitions. Huagang Mining's involvement in the DRC's lithium sector is not just limited to mining (Makumeno, Malenga, Kahozy, Qing, & Wang, 2024). The company is also investing in infrastructure development in the region, including the construction of roads and hospitals. These investments are part of a broader agreement between the DRC government and Chinese companies that includes the construction of infrastructure projects in exchange for a stake in a joint venture (Shaw, 2024). On January 27, 2024, Huagang Mining announced that the DRC will receive $77 billion in infrastructure financing under a revised mining and infrastructure contract signed with China (界面新闻, 2024). Under the agreement, Huagang Mining will pay 1.2% of its annual turnover to the Democratic Republic of Congo as royalties. Royalties are periodic

payments that a producer or owner of intellectual property receives from a licensee for the use of that property. The trade liberalization is good for China but that should be reviewed (Nandy, and Biswas, 2025).

5. CONCLUSION

The study shows that China occupies a strategic position in the global lithium industry despite facing limited domestic reserves. With the support of state policies, foreign investment strategies, and dominance in the downstream refining and processing sectors, China has managed to establish itself as a key actor in the critical mineral supply chain that underpins the global energy transition. The results of the study confirm that the determining factor for China's dominance is not only the availability of natural resources, but the country's ability to build vertical integration and dominate the global value chain.

The theoretical contribution of this study is to strengthen the understanding in the mineral geopolitical literature and global value chain theory, by showing that leadership in strategic industries can be achieved through global downstream and expansion strategies, not just through the superiority of domestic reserves. Meanwhile, the practical implications of these findings emphasize the importance for other countries to diversify lithium supplies, strengthen domestic processing capacity, and develop industrial policies that are adaptive to global market dynamics.

In the future, research on lithium needs to focus not only on the aspects of reserves and trade, but also on the dimensions of sustainability, environmental risks, and the geopolitical implications of global supply chain dependence. Comparative research between China and major producing countries such as Australia, Chile, and Argentina can also enrich understanding of how these countries are building different strategies in the face of energy transitions and competition over critical minerals. Thus, lithium is not only a strategic commodity, but also an important instrument in shaping global economic governance in the era of decarbonization.

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