

## **Mining-Energy Public Policy of Lithium in Mexico: Tension between Nationalism and Globalism**

### **Abstract.**

This article addresses Mexico's present situation in the lithium industry and its near future, *ceteris paribus*. Mexico's short- and long-term lithium supply will not improve by the exploration and exploitation planned by the nationalistic objectives of the current government. This analysis demonstrates that significant changes must be made to Mexico's energy policy to promote the development of lithium due to five risks: manufacturing capacity, misaligned incentives, industrial policies, geographic concentration, and limited international coordination. Therefore, although the world's largest lithium mine was found in Sonora in 2019, Mexico's policy approaches to nationalize lithium exploration and exploitation will not allow the country to capitalize on the boom of this industry, as happened in Bolivia. In the short term, Mexico's policies will create an exploration deficit due to the country's lack of know-how and investment. Thus, Mexico will not extract lithium in the long term nor benefit from the demand increase and development of a value chain, especially in North America. Given these risks, this article postulates that Mexico's lithium policy should be revised to open its market to foreign investment and use this nascent market to a good advantage.

**Keywords.** Lithium, nationalism, globalism, Mexico, public policy.

## 1. Introduction.

The world's main lithium deposits are located in the "lithium triangle" that includes Bolivia, Chile, and Argentina (Zícari et al., 2019), as illustrated in Figure 1. Together with Canada and the United States, Mexico could produce large amounts of lithium for industries in North America.

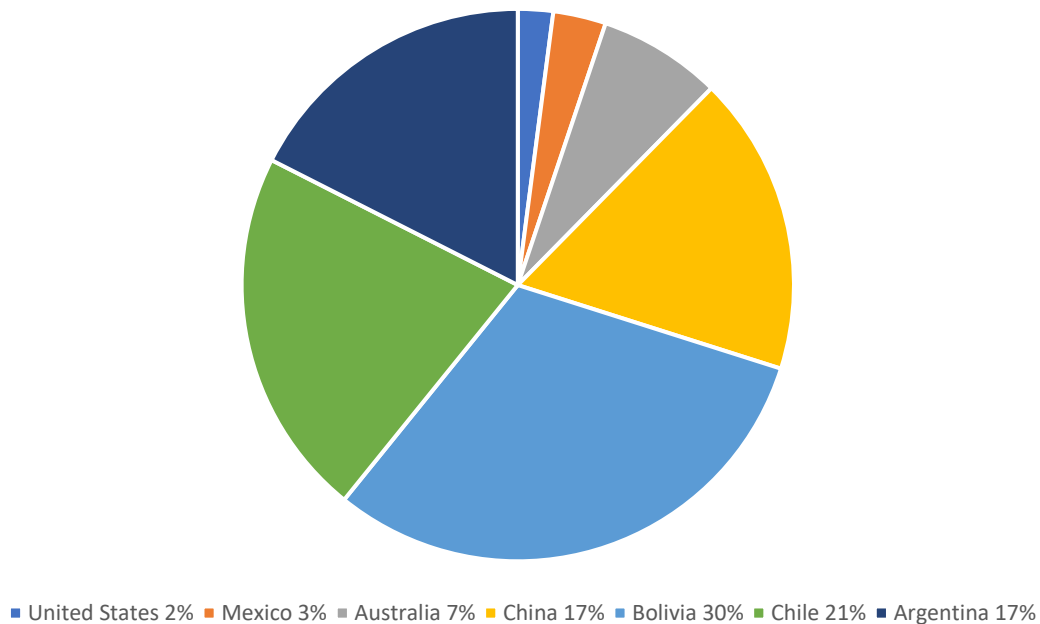


Figure 1 (Zícari et al., 2019) Geographical distribution of world lithium resources by country.

The cost of lithium rose from 350 USD per ton in 2003 to 3,000 USD per ton in 2009 (Geocomunes, 2021). The price of a ton of lithium peaked at 16,000 USD in 2018 but decreased to 13,000 USD the following year (United States Geological Survey, 2020).

Lithium is predominantly used to produce batteries for automobiles or domestic appliances (39%), glass and ceramics (30%), lubricating greases (8%), flux powders for continuous casting and polymer production (5%), air treatment (3%), and other uses (10%) (Ministry of

Economy, 2018). Between 2010 and 2019, the percentage of extracted lithium destined to produce electric batteries more than doubled from 23% to 56% (Geocomunes, 2021).

The lithium market has been historically dominated by a few players, known as the “Big Five”: Albermarle (United States), Ganfeng (China), SQM (Chile), Tianqi (China), and Livent Corp. (United States) (Heredia et al., 2020). Other emerging players include the Australian company Galaxy Resources Ltd. and the Argentine corporation Orocobre Ltd (Heredia et al., 2020). Argentina, Australia, Chile, and China alone produced 96% of lithium worldwide in 2019 (Geocomunes, 2021).

Before the 1990s, Latin American governments did not consider the mining sector an important contributor to their fiscal income. Because most Latin American nations had nationalized mining sectors, mining revenue did not contribute to the GDP due to low mining prices. It was not until the 21<sup>st</sup> century that Latin American governments have allowed foreign direct investment in the mining sector (Perotti & Coviello, 2015). The mineral commodity process has increased by over 300% in the last decade, making it an attractive sector to invest in (Perotti & Coviello, 2015). However, governments have considered this a means to generate a more “balanced” regional economic growth pattern for those regions where mineral resources are located, rather than an economic development strategy (Perotti & Coviello, 2015).

Nevertheless, the income generated by the mining sector was never reinvested in those regions in the same way it was collected. In Mexico, the federal government utilized the deposit of different minerals to develop the country as a whole (El Herald, 2021). For instance, oil and natural gas are mainly found in the states of Campeche and Tabasco, followed by other states such as Veracruz, Chiapas, Puebla, Tamaulipas Nuevo León, and

Coahuila (El Herald, 2021). Together, the nine states concentrate 99.9% of oil production and 99.6% of natural gas production (El Herald, 2021).

Recently, the use of lithium to produce electric vehicle batteries has increased substantially, as shown in Figure 2. The International Energy Agency (2020) estimates that the electric vehicle stock will also grow considerably due to the environmental goals countries aspire to reach in the next decades, demonstrated in Figure 3. California, China, France, India, the Netherlands, and the United Kingdom have established electric vehicle targets and pledged to end the sale of new combustion engine vehicles by 2030-2040. Although electric vehicles currently account for around 0.55% of the global car fleet (Heredia et al., 2020). Moreover, the International Energy Agency (2020) estimates that, by 2030, in a sustainable development scenario, the sales of electric vehicles will reach almost 50% of the total number of vehicles sold worldwide.

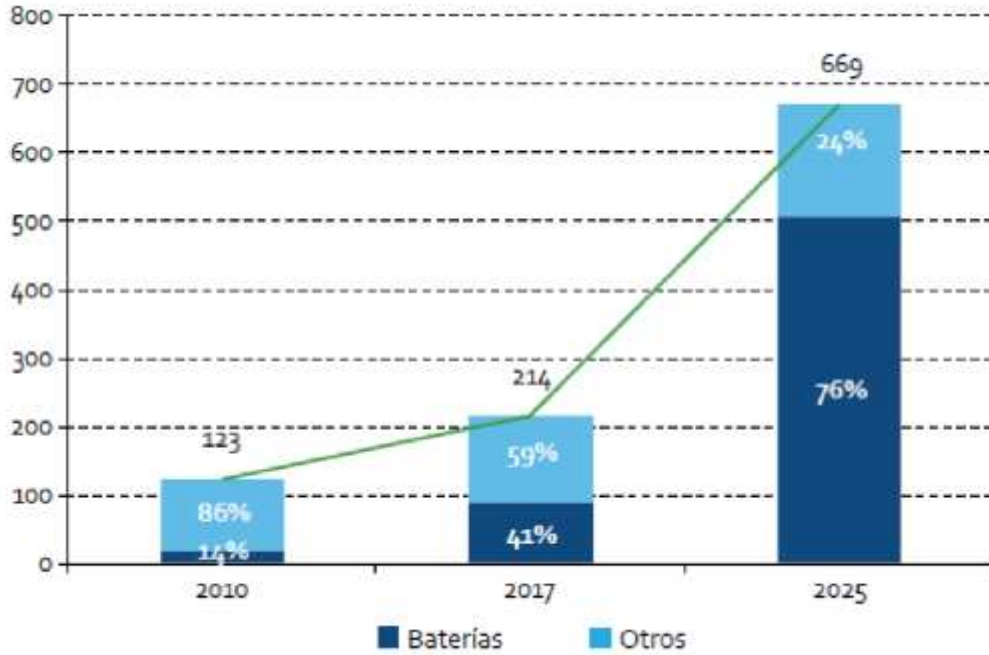


Figure 2 (Obaya & Céspedes, 2021) Evolution of lithium demand by type of use, 2010, 2017, and 2025 in thousands of tons of lithium carbonate equivalent.

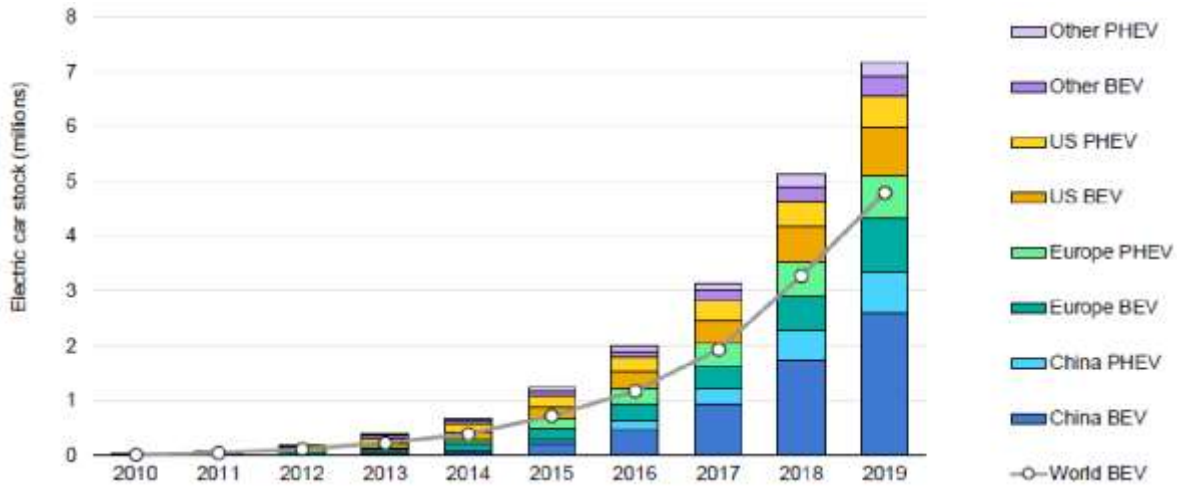


Figure 3 (International Energy Agency, 2020) Global Electric Car stock, 2010-2019.

Mexico should take steps to benefit from the nascent lithium market, especially considering that most hybrid and electric vehicle consumers and manufacturing plants are mainly located near Mexico in the United States and Canada. Furthermore, the International Energy Agency

(2020) predicts that lithium demand will increase from 25,000 tons in 2019 to more than 350,000 tons in 2030 in a sustainable development scenario, as illustrated in Figure 4.

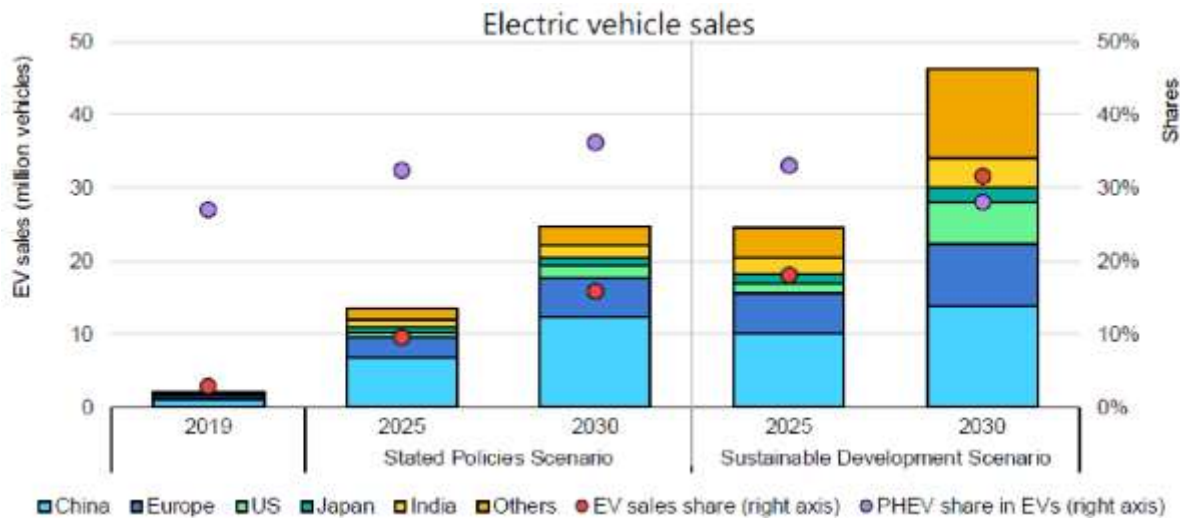


Figure 4 (International Energy Agency, 2020) Global electric vehicle sales estimates, 2019, 2025, and 2030.

Mexico must open its lithium market to private investment to develop its lithium resources efficiently. Mexico should also attempt to supply lithium to consumers throughout North America. Under the United States-Mexico-Canada Agreement (USMCA), as of 2024, 75% of industry components must be produced within North America to benefit from a tariff exemption (Rodríguez, 2021).

Despite the vast resources in the “lithium triangle,” Mexico has a considerable advantage over South America due to its value chain. Mexico could enact agreements with automobile manufacturers in Mexico, the United States, and Canada. Mexico’s proximity to American consumers would also benefit lithium supply to other sectors, such as electric appliances. In 2014, Tesla built a Gigafactory in Nevada to increase automobile production to half a million units per year (Tesla, 2021). To achieve this goal, Tesla will require a considerable percentage of the world’s lithium. Mexico should take advantage of this increase in demand

considering its geographic proximity to Tesla and other vehicle production plants. Even though lithium production in Mexico has not begun, Tesla has already agreed to purchase lithium from Mexico (Fehrenbacher, 2015).

Tesla is the world’s largest producer of electric vehicles, as shown in Figure 5. Its market participation increased by 37% from 2018 to 2019, considerably extending its lead over the second-largest producer, Build Your Dreams (Obaya & Céspedes, 2021). In the first half of 2020, the Tesla Model 3 accounted for 24% of total electric vehicle sales across the globe (Obaya & Céspedes, 2021). It is expected that Tesla will continue to expand its market share in the following years. Its production goals will substantially increase the demand for lithium.

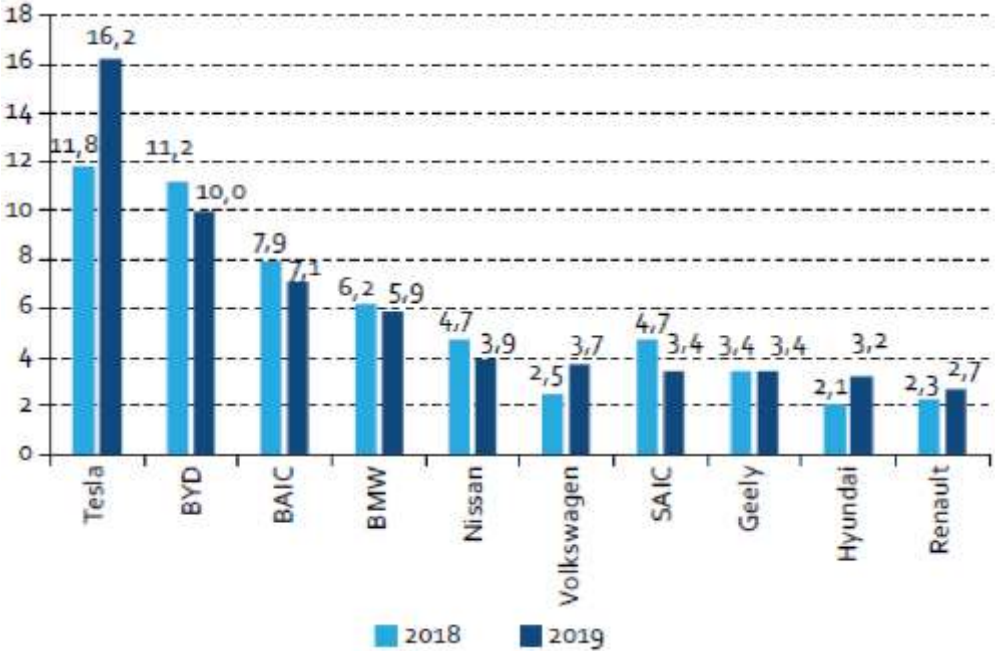


Figure 5 (Obaya & Céspedes, 2021) Percentage of market share of electric vehicle producers in 2018 and 2019.

Furthermore, Mexico should also make use of the regional renewable energies market. The connection between supply and demand will lead lithium prices to increase as demand continues to escalate. There are currently seven projects in North America to develop lithium

resources in renewable energy projects, for example, those led by the United States Geological Survey and the United States Department of Energy to boost the electric vehicle industry while reducing the need for supply from other sources, such as China (Obaya & Céspedes, 2021). Mexico should take advantage of the “lithium triangle” countries’ lack of a market connection with the United States, hindering their ability to benefit from the rise in lithium demand (Obaya & Céspedes, 2021).

This article addresses the risks and uncertainties that Mexico faces in developing lithium since the discovery of the world’s largest lithium mine in Sonora, Mexico. In addition, the increasing demand for hybrid and electric vehicles has put Mexico in an excellent position for the development of lithium soon.

First, the article studies globalism in contrast with nationalism, particularly Latin America. Second, the beginning of the lithium industry in Mexico is described. Third, nationalism in the Latin American lithium industries is addressed. Finally, Mexico’s lithium capacity is examined to determine whether Mexico could meet North American lithium policy goals in the next decades.

## **2. Materials and methods**

This article analyzes lithium exploration and exploitation in Mexico as new energy industry. The Mexican government should prioritize new energy resources to benefit from the growing lithium demand worldwide. However, the current Mexican administration has proposed the nationalization of the lithium industry. Mexico has large lithium deposits that, although subject to concessions to private companies by former president Enrique Peña Nieto, have not yet been developed. As such, this article’s research question is: should the Mexican



government nationalize lithium, as it did with oil? In the alternative, should the government regulate lithium, as it has with other privatized sectors, allowing private investment to catapult the industry? The article will conclude that Mexico should allow the private sector to participate in lithium development. However, this paper will also study multiple negative external factors that could hamper the beginning of the lithium industry in Mexico.

There has been little research on the Mexican lithium industry. Therefore, this study seeks to contribute to the analysis of this sector. The article considers lithium exploration and extraction, examines the growing lithium demand, and evaluates the development of a value chain with consumers in North America. Hence, this law and economics approach provides a unique perspective regarding lithium in Mexico.

The primary methodology used is a benchmark analysis that compares other countries' best practices in a similar situation to Mexico regarding the lithium industry. Particularly, the article studies the development of lithium and the results achieved. Finally, the article will strive to determine Mexico's legal framework to develop its lithium industry effectively.

### **3. Globalism or Nationalism?**

For years, governments have considered the benefits of globalization. The United Nations has reported that globalization and economic interdependence increased the world GDP from 50 trillion USD in 2000 to 75 trillion USD in 2016 (Waldman & Javidan, 2020). However, protectionist, populist politicians have gained favor in many parts of the world. For instance, in the United States, many manufacturers praised the tariffs that former president Donald Trump placed on foreign competitors (Waldman & Javidan, 2020).

Nonetheless, nationalism can have positive connotations, such as patriotism and good citizenship. As such, governments should not choose to be globalists or nationalists; rather, they should determine how to be both simultaneously. Adopting only one of these perspectives can reduce effective communication, understanding, and collaboration. Therefore, in making major business decisions, governments should ponder what criteria a nationalist decision-maker and a globalist decision-maker would adopt and attempt to integrate these two sets of criteria to make a final decision (Waldman & Javidan, 2020).

#### **4. Nationalism in Latin American Lithium Production**

Other Latin American governments also seek to increase the state's role in developing lithium (Gilbert & Sirtori-Cortina, 2021). However, countries with lithium reserves have not successfully added value to their natural resource industries due to their distance from demand centers, primarily located in Asian processing plants (Perotti & Coviello, 2015), and adverse business environments (Gilbert & Sirtori-Cortina, 2021).

There is no relationship between resource extraction and socio-economic development. Many developing countries with vast natural resources do not have the financial capacity or expertise to explore and develop those resources. Thus, the exploration and exploitation of minerals in developing countries depend on foreign investment. To strengthen a positive relationship between resource extraction and national development, it is crucial to instate an effective fiscal regime through which resource extraction revenue can be accrued to the host country (Perotti & Coviello, 2015).

The most direct approach for the government of a resource-rich country to participate in mining rents is the exploration and exploitation of natural resources by public enterprises.

State-led resource extraction can effectively collect rents in countries with strong institutions and accountability, i.e., Qatar and Norway. On the other hand, developing countries with vast mineral resources tend not to have a formal regulation regarding resource extraction; instead, they make ad hoc deals with private mining firms. This practice has proven useful to attract foreign investment; however, it can impede creating a coherent and effective industry-wide regime. Privately negotiated contracts between governments and resource extraction firms also lead to a lack of transparency, which in turn generates higher financing costs, less investment, and fewer opportunities for tax collection (Perotti & Coviello, 2015).

#### **4.1 Argentina**

Initially, Argentine lithium reserves were subject to ad hoc exploitation concessions. Then, lithium was officially incorporated as a substance subject to concessions in the Argentine Mining Code (Witker, 2019). Finally, to propel the lithium industry and begin the local production of lithium batteries, the Argentine government instated a National Bureau of Lithium (Perotti & Coviello, 2015).

Diverse rules and interpretations from Spanish authorities during their colonization of Argentina and those developed by Argentina's native peoples led the country to unify such regulations into a Mining Code in 1886 (Martiré, 1979).<sup>1</sup> The implementation of the Code is entrusted to the country's provinces (Perotti & Coviello, 2015). While lithium exploitation can be subject to concessions in some provinces, it is considered a strategic mineral in others (Perotti & Coviello, 2015).

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<sup>1</sup> The Argentine Mining Law can be read in Spanish at the following website:  
<http://servicios.infoleg.gob.ar/infolegInternet/anexos/40000-44999/43797/texact.htm>

What distinguishes Argentina from the other two members of the “lithium triangle” is the country’s aggressive policies to incentivize investment, including a 30-year legal guarantee of fiscal stability and other benefits. This has allowed Argentina to attract private investment in the last decade, which has resulted in 20 lithium development projects (Vásquez, 2021). Most recently, Argentina has sought investment from Chinese companies such as Gotion High-Tech and Ganfeng Lithium (Gilbert & Sirtori-Cortina, 2021). In addition, the Argentine government receives revenues from lithium extraction through a 3% mining royalty (Perotti & Coviello, 2015).

Furthermore, Argentine public energy companies have entered the lithium business while developing downstream industries, particularly battery production (Gilbert & Sirtori-Cortina, 2021). The Argentine government under President Alberto Fernández is examining a proposal to establish a public company for lithium production and a scientific, technical, and commercial commission that brings together representatives from academia, business, government, and indigenous communities. Although Argentina’s current strategy of promoting private investment has fostered the development of the lithium industry, its president and some experts, such as Federico Nacif, a specialist at the country’s National Council for Scientific and Technical Research, are considering increasing public participation by declaring lithium a strategic resource (Lewkowicz, 2021).

## **4.2 Bolivia**

Despite having the largest lithium reserves globally, Bolivia has not developed a significant lithium production (Perotti & Coviello, 2015). Bolivia’s former Mining Code of 1997 regulated the issuance of concessions and allowed them to be transferred to third parties (Aguirre, 2021). In 2006, a Bolivian court declared mining concessions as real estate property

to be unconstitutional (Aguirre, 2021). In 2007, former president Evo Morales affirmed that all existing mining concessions would be respected; however, new concessions would have to form joint ventures with the Bolivian Mining Corporation in which each party would hold 50% of the development (Perotti & Coviello, 2015). In 2009, Bolivia promulgated a new Constitution approved by 61.4% of the Bolivian population in a referendum. The new constitution established that the state controls all strategic natural resources in the country, including lithium (Ministerio de Transparencia Institucional y Combate a la Corrupción, 2010).<sup>2</sup> All concessions were transformed into contracts with the state, and mineral resources were awarded a strategic character of public interest. Consequently, the government controls all processes related to lithium and other natural resources. A subsequent Mining Law in 2014 reflecting these nationalistic tendencies substituted Bolivia's mining legislation of 1997 (Aguirre, 2021).

Before former president Morales nationalized lithium development, FMC, a major American lithium producer, sought to develop Bolivia's lithium resources in the Salar de Uyuni (Thelwell, 2019). However, it abandoned the project due to "government chaos and poor infrastructure" (Thelwell, 2019). Then, in 2014, Bolivia signed a political agreement for cooperation with the Netherlands to develop the lithium industry (Perotti & Coviello, 2015). As a result, Morales' government invested 941.6 million USD in developing the Salar de Uyuni (Ahora El Pueblo, 2021a). However, the project was interrupted due to the *coup d'état* against Morales' government in 2019 and resumed during current president Luis Arce Catacora's administration (Ahora El Pueblo, 2021a). The suspension of lithium development

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<sup>2</sup> The 2009 Bolivian Constitution can be read in Spanish at the following website: [www.oas.org/dil/esp/constitucion\\_bolivia.pdf](http://www.oas.org/dil/esp/constitucion_bolivia.pdf)

caused nearly 19 million USD in losses and impeded Yacimientos de Litio Bolivianos (Bolivian Lithium Deposits), Bolivia's public lithium company, to abide by its financial obligations with the Central Bank of Bolivia (Ahora El Pueblo, 2021a).

In 2013, using its technology and workforce, Yacimientos de Litio Bolivianos began pilot-testing lithium carbonate production by exploiting 10 tons per year (Yacimientos de Litio Bolivianos, 2021a). Also, former president Morales' government formed a coalition between Yacimientos de Litio Bolivianos and the German firm ACI Systems to begin a new phase of lithium development in Bolivia and construct four mineral production plants, including one for lithium hydroxide and another for lithium batteries (Ahora El Pueblo, 2021a). Bolivia controlled 51% of the coalition's shares, while the German company owned the remaining 49% (Ahora El Pueblo, 2021a). Unfortunately, in 2019, the contract with the German company, which would have generated a 1.3 billion USD investment in Bolivia's lithium industry, was canceled by former president Morales' administration (Aguirre, 2021). Current president Arce has stated his intentions to renegotiate the agreement with ACI Systems; however, as of mid-2021, no steps have been taken on the matter (Aguirre, 2021).

In 2021, Bolivia increased production to 600 tons of lithium annually and sold 530 tons to Ganfeng Lithium (Yacimientos de Litio Bolivianos, 2021a). Moreover, Bolivia is testing direct lithium extraction techniques, developing prototype processing, and constructing lithium carbonate and battery plants (Gilbert & Sirtori-Cortina, 2021). One of these plants, which will begin operations in 2022, aims to produce 15,000 tons of lithium per year (Yacimientos de Litio Bolivianos, 2021a). In 2019, Yacimientos de Litio Bolivianos enacted an agreement with Quantum Motors, a Bolivian automobile company, to manufacture electric vehicles with lithium batteries produced in Bolivia (Ahora El Pueblo, 2021b).

Furthermore, in April of 2021, President Luis Arce Catacora invited foreign lithium developers with direct extraction technology to participate in public bidding to exploit lithium deposits in Bolivia (Yacimientos de Litio Bolivianos, 2021b). This technology is necessary to extract lithium from brine and separate it from minerals such as calcium, magnesium, potassium, and sodium (Acarapi, 2021). As a result, American, Chinese, and Russian energy corporations showed interest in the bidding and presented proposals to exploit Bolivian lithium (Yacimientos de Litio Bolivianos, 2021b).

### 4.3 Chile

Chile consolidated itself as a key player in the lithium industry by beginning the exploitation of its Atacama Salar in the 1980s (Heredia et al., 2020). In 2014, Chile accounted for 40% of the world's lithium production (Perotti & Coviello, 2015). This placed Chile as the world's largest lithium producer; however, the country instated an obligation for private entities to sell 25% of its lithium production to Chile's domestic market at a preferential price (Vásquez, 2021). This disincentivized investors, many of whom found a more profitable and stable investment environment in Argentina (Vásquez, 2021).

The leading presidential candidate in Chile also suggests increasing public participation in the lithium industry (Gilbert & Sirtori-Cortina, 2021). Nevertheless, two mining firms, SQM and Rockwood Holdings, were granted lithium concessions before the mineral was declared strategic (Perotti & Coviello, 2015). In addition, Chile was the first to enact agreements with the American chemical industry to explore, research, and produce lithium (Witker, 2019).

In 2014, the Chilean government created the National Lithium Commission, proposing a national policy on lithium governance (Perotti & Coviello, 2015). The Commission met with

stakeholders, experts, and lithium producers to determine Chile's approach to lithium exploitation (Perotti & Coviello, 2015). Moreover, in 2018, the Chilean government approved the payment of 3% of the value of extracted lithium in royalties to the state, which must be used for the development of communities located near lithium deposits and to mitigate the environmental and social effects of lithium production (Witker, 2019).

Chile is in the process of drafting a new constitution that could instate tougher rules for miners (Gilbert and Sirtori-Cortina, 2021). Specifically, the new constitution is expected to include mechanisms for the Chilean government to capture more of the lithium sector's profits, as well as stricter licensing requirements and environmental regulations (Gilbert & Sirtori-Cortina, 2021).

When Chile first regulated lithium in 1932, its Mining Code determined lithium could be subject to concessions (Perotti & Coviello, 2015). In 1983, Chile issued a new Mining Code, last edited in 2014,<sup>3</sup> which established that the development of all minerals would be subject to concessions except hydrocarbons, lithium, and mineral deposits located in the ocean or safety zones (Library of the National Chilean Congress, 1983). According to the law, these exceptions were justified for national security reasons (Library of the National Chilean Congress, 1983). Chile also declared lithium a mineral reserved to the state to use for nuclear fusion (Perotti & Coviello, 2015).

In 2012, former Chilean president Sebastián Piñera announced his intentions to privatize lithium production (Perotti & Coviello, 2015). He proposed the possibility for any company to be granted rights to exploit Chilean lithium through an operating contract for 20 years

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<sup>3</sup> The Chilean Mining Code can be read in Spanish at the following website: [www.bcn.cl/leychile/navegar?idNorma=29668](http://www.bcn.cl/leychile/navegar?idNorma=29668)



(Perotti & Coviello, 2015). However, there was considerable opposition to the privatization of lithium; most Chilean Senate's Mining and Energy Committee members believed that lithium should be managed by the State (Perotti & Coviello, 2015). Nevertheless, despite the Senate's opposition, a 20-year concession was granted in 2012 to SQM, which pays 7% of the total output in royalties to the Chilean government (Perotti & Coviello, 2015).

#### **4.4 Mexico**

In Mexico, mines are developed through concessions granted by the government, which allow private entities to exploit mineral resources in a defined area for 50 years (Witker, 2019). The Mexican Mining Law determines that concessions can be awarded to Mexican individuals, corporations, as well as agricultural communities and indigenous peoples, of which the last two have never obtained a mining concession due to a lack of economic, social, and technological resources required by law to conduct mining activities (Witker, 2019).

Mining concessions in Mexico can be acquired through public biddings organized by the government or by private agreements between a concession owner and another entity. The objective of public biddings is to grant the right to develop mineral resources in an area that the Mexican Geological Service has previously explored. Owners of mining concessions must pay the government royalties to develop the mines and a percentage of the value of the exploited minerals (Witker, 2019).

During presidents Felipe Calderón and Enrique Peña Nieto's administrations, the Mexican government awarded 31 concessions to American, Australian, British, Canadian, Mexican, and Spanish companies to explore lithium deposits in four states (Xantomila, 2021), namely, Baja California, San Luis Potosí, Zacatecas, and Sonora (Aguirre Quezada, 2021). As

illustrated in Figure 1, 26 of the 31 lithium concessions have been granted to Canadian companies or coalitions that include Canadian enterprises (Xantomila, 2021). In turn, some of these Canadian businesses have sold their concession rights to Chinese lithium developers (Xantomila, 2021).

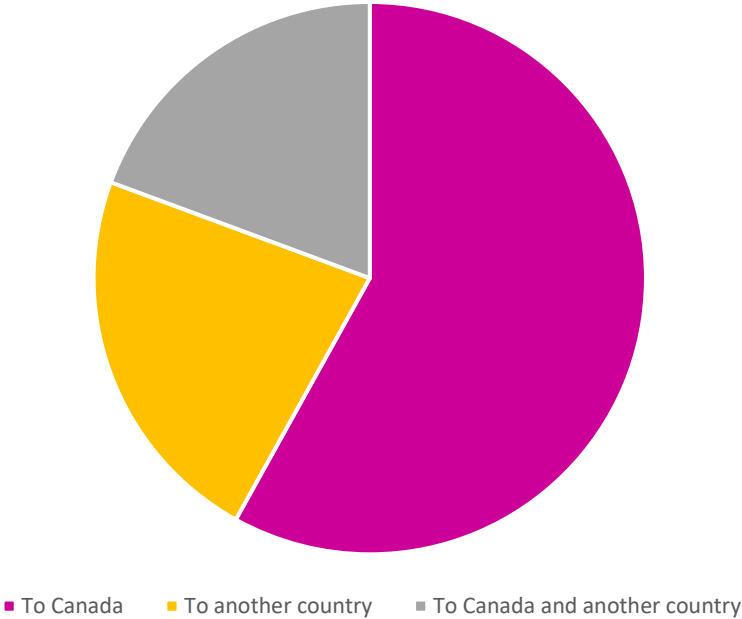


Figure 6 (Xantomila, 2021). Illustration of the countries to which lithium concessions have been awarded in Mexico.

Six of the 31 lithium concessions have been awarded in the northwestern Mexican state of Sonora (Mexican Geological Service, 2019). Sonora generates the largest GDP derived from mining activities of any state in Mexico, with almost triple the GDP of Mexico’s second most prolific mining state (Mexican Geological Service, 2019). Table 1 describes the lithium concessions granted in Sonora.

Concession Name	Mineral	Company	Country	Stage

Ventana	Lithium carbonate	Bacanora Minerals, Candence Minerals, Rare Earth Minerals	Canada, United Kingdom	Exploration
Sonora-Lithium (Fleur and El Sauz)	Lithium carbonate	Bacanora Minerals, Candence Minerals, Rare Earth Minerals	Canada, United Kingdom	Exploration
Sonora Pilot Plant	Potassium-lithium	Bacanora Minerals	Canada, United Kingdom	Production
Elektra (Tecolote 4,500 and Tule 18,125)	Lithium carbonate	Infinite Lithium, Lithium Australia	Canada, Australia	Exploration
Buena Vista, Megalit, San Gabriel	Lithium carbonate	Bacanora Minerals, Candence Minerals, Rare Earth Minerals	Canada, United Kingdom	Exploration
Agua Fría	Lithium carbonate	Infinite Lithium, Lithium Australia	Canada, Australia	Exploration

Table 1 (Mexican Geological Service, 2019). Description of lithium concessions granted in Sonora.

In 2013, a geological consultant conducted an Initial Lithium Resource Estimate study commissioned by Bacanora Lithium, a Canadian energy company, and Rare Earth Minerals, a British corporation, regarding “El Sauz” and “Fleur lithium” concessions located in Sonora (Verley, 2013). The study concluded that significant lithium resources existed in the area, and there were no significant risks that could affect lithium production (Verley, 2013).

Then, in 2019, the world’s largest lithium mine was found in Bacadéhuachi, a town in Sonora (Witker, 2019). The 243-million-ton lithium reserve on 100,000 acres of land was subject to 10 concessions in favor of Bacanora Lithium and China’s Ganfeng Lithium (Witker, 2019). Thus far, Bacanora has carried out its lithium operations through subsidiary companies in Mexico, specifically, Megalit, Mexilit, Minera Sonora Borax, Minerales Industriales Tubutama, and Operadora de Litio Bacanora (Cervantes, 2021). However, Ganfeng, which aims to invest 420 million USD in the Sonora Lithium Project (Castro, 2021), is negotiating to buy Bacanora’s shares for 264.5 million USD (Mining Mexico, 2021). Ganfeng has also invested in lithium developments in Argentina, Australia, and Ireland (Castro, 2021).

The lithium in Bacadéhuachi is trapped in clay rocks, complicating the extraction process (Bahena, 2021b). Nevertheless, Bacanora Lithium claims to have the necessary technology to detach lithium from clay and aspires to produce at least 17,500 tons and 2,200 new jobs during the first phase of development (Bahena, 2021b). At its most productive stage, the corporation anticipates extracting 35,000 tons of lithium per year (Bahena, 2021b). 13 additional areas in Sonora are under exploration to find lithium reserves (Bahena, 2021a).

Jorge Vidal, Sonora’s Minister of the Economy, indicated that the Bacanora Lithium and Ganfeng Lithium coalition would benefit the region by installing a value chain in Sonora, including all processes from lithium extraction to battery production (Bahena, 2021b).

Gangfeng alone could create 7,000 new jobs in the area and has expressed its intention to install a 10-acre lithium production plant in Hermosillo, Sonora's capital (Bahena, 2021b). The Chinese corporation has business agreements with electric vehicle manufacturers such as Tesla and Lucid Motors (Bahena, 2021b). The plant would supply the United States' growing demand for lithium batteries for electric vehicles and recycle batteries used in Tesla automobiles and Chinese-made electric buses throughout Latin America (Cervantes, 2021).

Mexican president Andrés Manuel López Obrador has criticized his predecessors' granting of lithium concessions to private corporations for lithium development and has considered nationalizing the industry (Mayorga, 2021). Mexican Senator Alejandro Armenta of the Morena party, founded by president López Obrador, unsuccessfully proposed lithium nationalization to the Mexican Congress (Mayorga, 2021). Nationalization was also promoted by Mexico's former Minister of Environment and Natural Resources, Víctor Manuel Toledo Manzur (Mayorga, 2021).

Regarding the Mexican government's proposal to nationalize lithium, Jorge Vidal expressed that this would continue to impede the economic development of areas where lithium reserves have been found (Bahena, 2021a). He also claimed that lithium production in Sonora is a major business opportunity and that the awarded concessions must be respected (Bahena, 2021a). Vidal mentioned a similar situation in Sonora with the nationalization of uranium (Bahena, 2021a). The Mexican government failed to develop a strategy to exploit uranium; as such, all prospects of developing the mineral were abandoned (Bahena, 2021a).

President López Obrador has claimed that his predecessors granted an excess of lithium concessions and that, instead of developing Mexico's mining resources, concession owners have sold their concession rights to other companies (Office of the Mexican President, 2021).

Therefore, numerous concessions granted have not resulted in mining activities and investment (Office of the Mexican President, 2021). Consequently, the president declared that his government would not award more lithium concessions (Office of the Mexican President, 2021). Furthermore, in September of 2021, president López Obrador's government determined its lithium-ion policy by proposing a constitutional reform to the energy sector (Barragán, 2021). In addition to modifying several constitutional articles to expand the government's involvement in electricity and hydrocarbon production, the reform would involve changing the Mining Law to nationalize Mexican lithium and consolidate it as a strategic resource (Barragán, 2021).

In January of 2021, the Mexican Ministry of Economy issued a document describing the market profile of lithium in Mexico (Ministry of Economy, 2021). The report indicates that the only national legal framework on lithium is article 4 of the Mexican Mining Law, which mentions that lithium extraction shall be regulated by that law (Ministry of Economy, 2021). Mexico's Mining Law was first passed in 1992 and reformed in 2014 (Mexican Congress, 2014).<sup>4</sup> According to the Mexican Congress, what motivated the federal government to enact the law was promoting the country's modernization and social and economic development (Mexican Congress, 1992). In addition, Mexico's 1989 – 1994 National Development Plan mentions strengthening the mining industry's normative basis and technology development as strategies to expand this sector (Mexican Congress, 1992).

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<sup>4</sup> The most recent version of the Mexican Mining Law can be downloaded in Spanish on this website: <https://legislacion.scjn.gob.mx/Buscador/Paginas/wfResultados.aspx?q=Bum7LdQODg535FX31WpLYIGPMI ZpPwoL9iZuWzhlb+s/IWwVQPa8NgGeK/I5BJC89XGMjMSFx9P6lwe3aEPWkrAoLgVeHfIVrunAkm2mk H3wn6uh9HtlhXATSKEHizqU0HX/i8hhuvnEXSVZWRo9K79JqKXwd+9vu/Pd5mF0CwdcEu63KrPDnbuScenMioDF6Rrw4JAc+XT7+tc5MBSSgJOyRhF98+HoYDEFastua+OMr+Q3QW+gnuwoaJywVzHmZY3b3 7Am+Os5D5UaMOTq4eKAquogUNyPjNexDTEKpII/SkIT7vPX6tmx1QcdQoHV>

Another regulation mentioned by the 2021 report published by the Mexican Ministry of Economy establishes that electronics engineering will be used to determine the electricity consumption of lithium batteries (Ministry of Economy, 2021). The report also cites two international norms regarding testing standards for lithium, potassium, and sodium in seawater and brine (Ministry of Economy, 2021). Additionally, according to Mexico's free trade agreements, the report mentions that lithium carbonate, lithium oxide, and lithium hydroxide are exempt from all tariffs on exportation and importation (Ministry of Economics, 2021).

The report addresses the lithium market in Mexico, the United States, and worldwide. Bacanora Lithium is constructing a lithium production plant in Sonora, which aims to process 1.1 million tons by 2023 and 2.2 million tons in its second stage of production (Ministry of Economy, 2021). On the other hand, the United States has a lithium brine deposit in Nevada and a lithium hydroxide production plant in North Carolina (Ministry of Economy, 2021). The United States also imports lithium from South America to produce lithium compounds such as lithium carbonate, lithium chloride, and lithium hydroxide (Ministry of Economy, 2021). Since 1992, the United States has also recycled lithium batteries through two plants in Ohio and British Columbia, Canada (Ministry of Economy, 2021). The use of brokers between lithium producers and consumers is common in the United States, especially in large-scale projects (Ministry of Economy, 2021). Finally, global lithium production increased by 24% between 2017 and 2018 due to a greater demand for lithium batteries (Ministry of Economy, 2021). During this period, Australia increased its lithium production by 28%, while Chile and Argentina boosted production by 13% and 9%, respectively (Ministry of Economy, 2021).

Moreover, the report pinpoints that Mexico exported 36.4 tons of lithium in 2018, primarily to the United States and France, with total revenue of 652,400 USD (Ministry of Economy, 2021). By contrast, in 2018, Mexico imported 195 tons of lithium from Chile and Slovenia (Ministry of Economy, 2021) for a total cost of 3.8 million USD (Aguirre Quezada, 2021). The price of lithium varies among producers due to the mineral's purity, size, packaging, and other factors (Ministry of Economy, 2021). Therefore, expanding lithium production in Mexico would have multiple advantages, including the country's proximity to American lithium consumers (Ministry of Economy, 2021). Furthermore, in 2021, Mexico will begin constructing a battery production plant for electric vehicles (Morales, 2021). In addition, the Mexican Ministry of Economy and the Mexican Automotive Industry Association have also met in an attempt to strengthen Mexico's supply chain for vehicle production (Morales, 2021).

Although it does not have significant upstream lithium resources in its territory, China has become dominant in the downstream lithium industry due to the aggressive growth of private firms such as Ganfeng and Tianqi (LaRocca, 2020). Australia generates the largest production of unprocessed lithium minerals, of which 80% are exported to China (LaRocca, 2020). In China, lithium ores are processed, refined, and manufactured into batteries for electric vehicles (LaRocca, 2020). Chinese lithium developers are also seeking to grow their stake in South American lithium, particularly Chile, to prevent supply constraints (LaRocca, 2020). Moreover, China is the largest exporter of lithium compounds, primarily shipped to the United States (LaRocca, 2020). In 2019, Chinese exports of lithium-ion batteries to the United States, Germany, South Korea, India, and Vietnam totaled 13 billion USD (LaRocca, 2020).



In 2015, the Chinese government announced a program requiring Chinese firms to acquire a significant domestic and global market share of 10 advanced technology industries by 2025 (LaRocca, 2020). Two of the program's objectives were for Chinese domestic firms to have 70% of the Chinese market for electric vehicles by 2020 and two Chinese firms to be among the world's top ten largest electric vehicle producers (LaRocca, 2020). In addition, China is pursuing a large global position in generating lithium-ion batteries to support its electric vehicle production goals (LaRocca, 2020).

In June of 2021, the United States government published a report in response to an executive order signed by President Joe Biden that ordered a review of American supply chains and the development of a strategy to promote resilience (The White House, 2021). The government emphasized that strong supply chains are essential for economic security, technological leadership, and military preparedness, all of which require an ecosystem of innovation, skills, and production facilities that the United States lacks (The White House, 2021). In addition, the report identified four crucial supply chains, including large-capacity batteries and critical minerals, which are fundamental to transition away from fossil fuels and supply the growing demand for electric vehicles (The White House, 2021).

The COVID-19 pandemic has impacted the electric vehicle market and most economic sectors. For instance, China experienced a drop in electric vehicle sales of 54% in January 2020 and a 79% drop in February 2020 compared to the same months in 2019. The International Energy Agency executive director stated that governments must use the current global health crisis to accelerate their climate ambitions and implement sustainable stimulus packages focused on clean energy technologies. COVID-19 should not be allowed to do more damage to the world by hindering clean energy transitions. Rather, countries should seize the

opportunity to make significant changes across their economies to invigorate clean energy transitions (Heredia et al., 2020).

Additionally, the report published by the United States government pinpointed five risks contributing to supply chain vulnerabilities (The White House, 2021). First, an insufficient manufacturing capacity is partly due to competition with low-wage nations such as China (The White House, 2021). Second, misaligned incentives and short-termism in private markets are reflected in the failure of American market structures to reward firms for investing in quality, sustainability, or long-term productivity (The White House, 2021). Third, the industrial policies adopted by allied, partner, and competitor nations (The White House, 2021). For instance, the European Union has supported policies, incentives, and regulations to stimulate the production of electric vehicles and lithium-ion batteries (The White House, 2021). Fourth, the geographic concentration of global sourcing in a few nations leaves companies vulnerable to disruptions caused by natural disasters, geopolitical events, or a global pandemic (The White House, 2021). Finally, limited international coordination to develop collective approaches to supply chain security (The White House, 2021).

Moreover, the report provides numerous recommendations to strengthen supply chains (The White House, 2021). Some of these include providing incentives to increase consumer adoption of American-made electric vehicles; establishing a supply chain resilience program to monitor and analyze supply chain vulnerabilities and partner with industry and labor actors to strengthen resilience; investing in the development of next-generation batteries to improve the United States' competitiveness in this sector; creating 21<sup>st</sup>-century sustainability standards for the extraction and processing of critical minerals, such as lithium; and ensuring that automotive battery production in the United States adheres to high labor standards,

including wage requirements and the workers' choice to organize and bargain collectively (The White House, 2021).

Regarding the large-capacity battery supply chain, the report highlights the importance of increasing the upstream production of lithium when labor standards and environmental and cultural protections are applied to support economically viable extraction (The White House, 2021). Also, boosting the United States' capacity to process and refine raw minerals would bolster the battery supply chain and, coupled with recycling, is the most effective way to secure the supply chain for minerals of which the United States does not have significant reserves to extract (The White House, 2021). The United States has less than 10% of the global market share concerning battery material manufacturing, while China has over 75% (The White House, 2021). The report recommends additional federal funding to catalyze greater private sector investment in this market (The White House, 2021).

On the other hand, the report mentions that the critical minerals and materials supply chain is at risk of disruption due to natural disasters, political intervention, and distortionary trade practices such as the use of forced labor (The White House, 2021). Furthermore, the need for these strategic minerals and materials is likely to intensify because of their enablement of environmentally friendly technologies, for example, electric vehicles, wind turbines, and advanced batteries (The White House, 2021). For instance, 71% of the lithium market involves the production of batteries (The White House, 2021). In North America, notable lithium deposits are located in Mexico, the development of which could increase today's worldwide lithium production by 50%, and in multiple areas throughout the United States, including Nevada, North Carolina, and Arkansas (The White House, 2021).

An analysis of the Mexican Ministry of Economic's report on the lithium market and the White House's publication on supply chains can conclude that Mexico should attract private investment to develop its lithium resources. However, as emphasized by the report by the White House, Mexico should foster lithium production to promote social and environmental sustainability and a resilient supply chain through adequate regulation and coherent public policies. The country could also cultivate a supply chain with its partners in the USMCA, which requires 75% of the components of vehicles commercialized between the three-member States to be produced in North America (Plaza Fráncfort, 2021). In Mexico, car manufacturing plants could more easily comply with this requirement if they utilized batteries produced in Mexico with the country's vast lithium resources (Plaza Fráncfort, 2021).

Strengthening the lithium and electric vehicle supply chain in North America through the USMCA would allow the three countries to compete with China. Chinese companies, particularly Tianqi and Ganfeng, now control nearly half of global lithium production and 60% of electric battery manufacture (Heredia et al., 2020). Moreover, it is predicted that China also can supply 60% of the world's electric vehicles (Heredia, Martínez, & Surraco Urtubey, 2020). A joint North American effort to develop lithium resources and electric vehicle production would prevent these crucial industries from becoming monopolies while taking significant steps to green the transportation sector. On the other hand, Mexico could also consider a partnership with China through the Reciprocal Investment Promotion and Protection Agreement between both countries, which would strive towards a diversified lithium market that avoids excessive dependence on American consumers.

Since 2018, five initiatives have been presented to the Mexican Congress to regulate lithium development in Mexico (Aguirre Quezada, 2021). Four of these proposals have not yet been analyzed by the legislative commissions in Congress, while the fifth was withdrawn (Aguirre Quezada, 2021). In Table 2, which illustrates the content of these proposals, the term “hard nationalism” identifies proposals that prioritize public participation in lithium development, prohibit the granting of concessions, and allow the celebration of contracts with private entities for lithium production. In contrast, “soft nationalism” establishes mixed public and private participation in the lithium industry, allowing concessions.

Name and date of the initiative	Objective	Presented by	Status	Hard nationalism or soft nationalism
Law to constitute Litiomex, a decentralized public body December 8, 2020	To create Litiomex, a decentralized public body.	Representative Carlos Iván Ayala Bobadilla	Pending analysis	Soft nationalism. The proposal indicates that Litiomex can develop lithium in Mexico on its own or through contracts and concessions with entities of the private and public sectors (Mexican House of Representatives, 2020a).
Law for the sustainable	To establish guidelines for		Withdrawn	Soft nationalism. The proposal determines that

<p>development of lithium minerals September 8, 2020</p>	<p>the sustainable development of lithium in Mexico and create a</p>	<p>Representative</p>		<p>lithium is a strategic mineral developed by Mexican public bodies or through concessions granted to private</p>
<p>Law for the sustainable development of lithium minerals February 17, 2021</p>	<p>National Lithium Commission.</p>	<p>Hirepan Maya Martínez</p>	<p>Pending analysis</p>	<p>Mexican entities whose stock does not exceed 49% of foreign ownership (Mexican House of Representatives, 2020b).</p>
<p>Amendment of article 27 of the Mexican Constitution November 11, 2020</p>	<p>To regulate lithium extraction in Mexico and determine that lithium is part of the inalienable property of the Mexican State and cannot be subject to concessions.</p>	<p>Senator Alejandro Armenta Mier</p>	<p>Pending analysis</p>	<p>Hard nationalism. This proposal indicates that lithium shall not be subject to concessions and exploited by public bodies who can conduct mining activities themselves or through contracts celebrated with private entities (Armenta Mier, 2020).</p>

Amendment of article 31 of the Solid Waste Management and Disposal Law April 29, 2019	To classify lithium batteries as hazardous wastes and determine a management and disposal plan for such batteries.	Senator Miguel Ángel Mancera Espinosa	Pending analysis	This proposal does not address private or public participation in lithium development. Instead, its purpose is to amend the law, so lithium batteries are included among hazardous wastes that require a management and disposal plan (Mancera Espinosa, 2019).
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Table 2. Description of six legislative proposals related to lithium presented to the Mexican Congress.

President López Obrador’s energy policies and these legislative proposals presented by his party, Morena, could infringe on Mexico’s commitments within the USMCA and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (Morales, 2020). Both agreements include a ratchet clause, which pinpoints that a Member State’s opening of an economic sector to foreign investment cannot be reversed (Morales, 2020). Furthermore, in 2014, Mexico enacted a constitutional reform to allow private participation in its energy sector (Morales, 2020). Lopez Obrador and Morena’s intentions to instate an energy counter-reform to strengthen public energy companies *Petróleos Mexicanos* (Mexican Petroleum) and *Comisión Federal de Electricidad* (Federal Electricity Commission) violate Mexico’s obligation to allow private participation in the energy sector since the industry’s liberalization in 2014 (Morales, 2020). The mining sector has also been liberalized since the 1990s

(Guevara González, 2016). Thus, prioritizing public participation in lithium development would also infringe the ratchet clause.

Moreover, the USMCA determines that any benefit regarding international trade and investment awarded by Mexico to domestic entities must be extended to the United States and Canada (Morales, 2020). The consequence of infringing treaties that include a ratchet clause is the possibility for affected companies to initiate an investor-State dispute settlement mechanism (Morales, 2020). If Mexico were found responsible by this mechanism, the country would have to award compensation to the aggrieved investors (Morales, 2020). Affected countries also have the right to establish a dispute resolution mechanism between States (Morales, 2020). If the affected country successfully resolves this conflict resolution, it would be authorized to retaliate against Mexico in any economic sector it chooses (Morales, 2020).

## **5. Results and discussion**

Mexico should follow a strategy similar to Argentina and Chile's, classifying lithium as a strategic material of national interest while awarding concessions to private entities to develop the resource. Further, Mexico should refrain from nationalizing lithium, as occurred in Bolivia, because this would hinder exploration and extraction and lead to the industry's abandonment due to a lack of financial resources and technology. In the short term, Mexico should respect the concessions granted by former president Enrique Peña Nieto, allow private entities to continue exploring and producing lithium, and position itself as a future supplier for lithium consumers in North America. On the other hand, Mexico should develop the conditions necessary to attract additional investment to develop its lithium industry in the long term.



A lithium policy in Mexico similar to Argentina and Chile would likely reap similar benefits. First, Argentina has aggressively incentivized investment from private entities through policies that promote a stable regulatory environment. As a result, Argentina has attracted investments to develop 20 lithium projects and can receive capital from key lithium players, such as China's Ganfeng. Moreover, the country has struck a balance between nationalism and globalism by allowing the participation of private corporations while manufacturing lithium batteries through its public energy companies. Mexico could implement a similar strategy of allowing private actors with the necessary technology and resources to explore and extract Mexican lithium while fomenting a national and North American downstream lithium industry. Mexico already has a significant automotive sector that could facilitate lithium batteries and electric vehicles. Additionally, within the USMCA, Mexico should foster a stronger North American value chain in the automotive sector. This obligation can turn into an opportunity for Mexico to build, with its partners in the agreement, a lithium industry that will effectively compete with Australia, China, and the "lithium triangle."

Second, Chile's approach to regulating lithium has been more tumultuous than Argentina's. Its history with this mineral resource has included considerable attempts to impede private participation. Nonetheless, the production of Chilean lithium through concessions awarded to SQM and Rockwood Holdings and Chile's agreements with the American chemical industry to develop lithium have undoubtedly been crucial in Chile's consolidation as a key player in this industry since the 1980s. Moreover, the evidence shows that private investment in Chilean lithium has successfully developed the industry while increasing public participation has not produced the same benefits. What Mexico can learn from Chile is that

technology and resources from private actors are essential to becoming a competitive player in the lithium market.

Unlike the other two members of the “lithium triangle,” Bolivia has not developed a significant lithium production despite having the largest reserves worldwide. Former president Morales’ decision that recipients of new concessions would have to collaborate on a 50-50 basis with Bolivia’s Mining Corporation disincentivized investment and hindered the country’s prospects of developing its vast lithium resources. The American lithium company FMC abandoned its intentions to develop Bolivia’s lithium due to poor governance and infrastructure. Then, Bolivia excluded indispensable know-how and financial resources by assuming total control over lithium production. The *coup d’état* against Morales’ government also interrupted a cooperation agreement with the Netherlands to develop Bolivian lithium. Such political instability not only quashed an opportunity for Bolivia to cultivate its lithium but also caused millions in losses and the country’s inability to abide by its financial obligations with its central bank.

Furthermore, Bolivia turned away from another endeavor to propel its lithium industry when Morales canceled a 1.3 billion USD contract with German enterprise ACI Systems. Fortunately, current president Arce has invited foreign lithium developers with crucial technology to extract the mineral from brine and separate it from other elements to participate in public bidding. Unfortunately, Bolivia is an example of excessive nationalism, which, in turn, severely hinders the country’s national interest in socio-economic development through its lithium resources. This approach, coupled with severe political instability, has impeded Bolivia from profiting from its unmatched lithium resources for decades. Mexico should refrain from adopting a similar model in which the government’s strategy regarding lithium

changes with every new administration or even multiple times within the same administration. This only repels critical technological and financial input and prevents Mexico from taking advantage of its sizable lithium deposits and potential to develop a competitive North American value chain.

## **5.1 Conclusions**

This benchmark analysis of other Latin American countries has demonstrated that lithium production in Mexico remains compromised. Long-term lithium development is uncertain due to the current government's intentions to nationalize the industry and impede private participation. In addition, the Mexican government lacks the financial and technical capacity to invest in lithium development, particularly Sonora, where lithium deposits are trapped in clay rocks. Thus, a scenario of absolute nationalism where the government conducts the exploration and extraction of lithium is implausible. Instead, Mexico requires the investment and technology of private entities to produce lithium.

Also, Mexico should use the USMCA to create a lithium value chain among the three-member States to compete with China. This would also strengthen the Mexican automotive industry and allow Mexico to produce 75% of vehicle components within North America, as required by the USMCA. On the other hand, Mexico should also seek investments from China through their Reciprocal Investment Promotion and Protection Agreement, which would reduce excessive dependence on American lithium consumers.

The Mexican government has made multiple normative proposals to determine its policy regarding lithium. Mexican legislators first proposed nationalization: however, the Ministry of Economy then considered other options to allow private participation in lithium

production. In September of 2021, López Obrador's government proposed another constitutional reform to consolidate lithium as a strategic resource. Nonetheless, Mexico's policy regarding lithium is not set in stone. As such, the country still can opt for a policy that balances nationalism and globalism, which would allow Mexico to benefit economically from its lithium resources while attracting private investment through the formation of alliances with its USMCA partners and China.

## **6. Acknowledgments.**

The authors would like to thank Lisa Reilly-Solís, Fabio Clavijo-Wilkinson, and Josemaría Gómez-Arceo for their valuable assistance and comments.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Declaration of interest: none.

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