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LITHIUM PRODUCTION IN CHILE AND ARGENTINA: INVERTED ROLES

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Two of the world's biggest lithium producers are in South America. Country number one has a booming lithium industry, with generous investment incentives that have attracted dozens of private investors. In country number two, lithium production is managed by the state, and only two companies operate, under strict production quotas and a requirement to sell up to 25 percent of output at preferential prices to local buyers.[1]

Ironically, country number one is none other than Argentina, where populism and perpetual economic crisis have been the norm for the past seven decades. Argentina's investment climate is hindered by government interventions including capital controls, trade restrictions and price controls, but its lithium policy is decidedly market friendly.

Perhaps even more surprising, coun-

All photos by Patricia I. Vásquez

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try number two is Chile, where market-friendly policies over the past 40 years made it a model of economic growth for Latin America. Chile's reforms included the privatization of public utilities and low trade barriers, but it has never relinquished control over the lithium sector.

Jekyll and Hyde

Chile considers lithium a strategic resource and its development is reserved for the state, or private companies that get a special permit from the government. Its production is governed by a 1970s law adopted by the military dictatorship.[2] In Argentina, the sector falls under a 1993 law passed under the most market-friendly government of the past 50 years, led by President Carlos Menem, to encourage mining investments through tax incentives and low royalties.[3]

The two countries' opposite approaches have produced correspondingly different results. Chile's production comes from only one source: the *Salar de Atacama*, in the north, home to the largest lithium reserves in the world, 9.2 million tonnes.[4] Chile is the world's largest lithium producer from brines, and the second largest producer over all after Australia, which produces lithium from rock. Chile produced almost 30 percent of global output in 2021, or 26,000 tonnes. But its sector is dominated by just two companies, with no new projects on the horizon.

Only two private projects in the Atacama – operated by SQM and Albemarle – have government permits to develop lithium,[5] and state control of the lithium industry has discouraged new investment. SQM's lithium license expires in 2030 and Albemarle's in 2043. The second-largest lithium reserves in Chile are in the *Salar de Maricunga*, but private company attempts to develop these salt flats have largely stalled amid environmental concerns, red tape, and legal disputes.[6] State-owned copper company Codelco recently announced it would start exploration works in the *Salar de Maricunga*.[7]

Albemarle's brine operation is in the heart of Chile's Atacama Desert, at 7,500 feet above sea level, amid the white salt covered mountains of the *Cordillera de la Sal* (Salt Mountains), volcanoes, the sandy dunes of the *Valle de la Muerte* and flamingo-filled lagoons. It consists of 15 evaporation ponds on 41,000 acres of the driest land in the world, ideal for producing lithium.

Atacama brines contain high con-

Planta Salar, Albemarle, Chile

centrations of lithium, the highest in the world. The lithium-rich brines are pumped out of the ground and moved to evaporation ponds, where the brine is exposed to the relentless desert sun and wind. After 6-18 months, the brine evaporates, the salts crystallize and an oily and yellowish concentrate forms with a 6 percent lithium content. The concentrate is then trucked to the company's La Negra processing plant on the Pacific coast, where it is refined into lithium carbonate equivalent (LCE) for export to be used in lithium-ion batteries. The evaporation method allows for the recovery of about half of the lithium contained in brines.

Lithium concentration in Argentine brines is not as high as in neighboring Chile, and rains are somewhat more frequent. Nevertheless, the country is the world's fourth-largest producer after Australia, Chile and China. In 2021, Argentina produced 6,200 tonnes of lithium. That was just a little more than a fourth of Chile's output, but Argentina has become the darling of lithium investors. Like Chile, it has two projects in production, in this case, in two different salt flats, the *Salar del Hombre Muerto* in the province of Catamarca and the *Salar Olaroz* in Jujuy. Unlike Chile, Argentina has 36 projects in the pipeline, in salt flats throughout the country.[8] Lithium reserves in Argentina are at 2.2 million tonnes.[9]

Several new projects are expected to start producing over the next few years. One will be operated by Eramine, an Argentine subsidiary of French Eramet, which together with China's Tsingshan is developing a project in the *Salar Centenario*

Quevar Volcano, Salta Province, Argentina

Ratones in the province of Salta. A steep, swirling road, surrounded by cliffs, snakes up desert mountains to 15,000 feet above sea level before descending to 12,500 feet where the Eramine lithium camp is located.

Temperatures there can drop to ~25°F in winter, with strong winds and crisp, sunny days throughout the year. Specialized sunglasses and sun protection are standard at that altitude. The snowcapped Quevar volcano sits in the background. Nearby, vicuñas and flamingos graze. The closest community is 37 miles away.

Eramine's lithium camp, high in an Andean desert plateau, looks like a chemistry lab. A team of geologists, chemists, engineers and technicians at a pilot plant rehearse LCE production. They are developing a process known as direct lithium extraction (DLE) designed to produce LCE in just a week and with a 90 percent lithium recovery rate. The process is untested at commercial scale, but it promises faster speed, higher yields and lower water use compared to traditional evaporation ponds. Eramine is already building a $400 million DLE plant, and it expects output of 24,000 tonnes of LCE per year could by 2024.[10]

Different Results

Argentina has become a magnet for investors trying new lithium production technologies, like Eramine, but also for those using traditional evaporation pools. There have been investment announcements in lithium ventures for some $4.260 billion since 2020, an unusual dynamism for the crisis-prone nation.[11] Con-

tributing to strong investor interest are all-time high lithium prices and estimates of a fortyfold increase in global demand by 2040.[12]

"Argentina has become a magnet for investors trying new lithium production technologies."

But also key for attracting lithium investment has been the government's willingness to set aside some of the country's economic hurdles, such as foreign exchange controls.[13] Additional incentives include a 30-year guarantee of tax stability; a fixed 3 percent royalty rate; and concessions granted for an unlimited period of time.[14] Jujuy grants royalty discounts when the lithium company commits to processing the lithium extracted there locally.[15] That is in contrast to Chile's management of the lithium industry, which discourages new investment and strictly controls production quotas by the companies already operating in the Atacama. Argentina has been the largest source of U.S. lithium imports in recent years, followed by Chile. Argentina represented, 54 per cent of total U.S. lithium imports and Chile 37 percent between 2017-2020.[16]

That does not mean companies in Chile are not trying. Albemarle, for example, is developing a new DLE plant using German technology to reprocess and extract lithium remains from its allocated quota that

Salars surrounded by vicuñas, Salta Province, Argentina

On the way to Eramine camp, Salta Province, Argentina

could not be fully captured during the evaporation process.[17] It has already invested $500 million to double the capacity of its La Negra plant so that it can refine the additional lithium extracted using the new technology. In all, Albemarle expects to increase LCE output from 45,300 tonnes per year to 88,000 tonnes.

Through more efficient production, Chile's lithium output could more than triple, to 48,800 tonnes, and that is without counting potential new projects in the *Salar de Maricunga*.[18] However, Chile's relative contribution to global lithium output will nonetheless decrease over time, as new projects come online elsewhere.[19] By contrast, once Argentina's six lithium projects that are under construction start producing in the near future, the country could increase output to 144,000 tonnes per year, from 37,500 tonnes.[20] By some accounts, in the next six years, Argentina could displace Chile as the second-largest lithium producer in the world.[21]

"Through more efficient production, Chile's lithium output could more than triple."

For lithium investors looking at Chile, the royalty rates are an additional deterrent. Lithium producers in Chile pay sliding royalties that range from 6.8 percent to 40 percent of the lithium export price. At current high prices, Albemarle is paying royalty rates on the upper end of that scale.[22] Moreover, like most extractive companies, lithium producers contribute to local community projects. Albemarle, for example, gives 3.5 percent of its revenue to 18 nearby indigenous communities

gathered in the *Consejo de Pueblos Atacameños*. SQM, for its part, transfers 1.7 percent of its revenue to local communities, in addition to other contributions to community development.[23]

Environmental Challenges

Environmental concerns loom large in both countries, especially with regards to water use, given increasingly frequent droughts in the region. At Eramine's pilot plant, for example, over 60 percent of freshwater is recycled.[24] In the case of Albemarle, its recently expanded La Negra plant recycles wastewater to reduce by 30 percent freshwater use. The company is also considering replacing freshwater with desalinated seawater.[25]

Even so, the environmental and social impacts of lithium production are a source of conflict in both Chile and Argentina. Both Albemarle and SQM are subject to water and brine extraction quotas. Still, communities close to Albemarle and SQM lithium production plants in the *Salar de Atacama* worry that the evaporation ponds have caused irreversible damage to the local ecosystem. They claim that wetlands are drying up, and that water has started to drop in lagoons, causing flamingos that feed from them to leave.[26] In response, Albemarle insists that its lithium production process does not use freshwater, and that the brine that is evaporated in its pools is not

San Pedro de Atacama, Chile

Planta Salar, Albemarle, Chile

apt for human consumption.

"Environmental concerns loom large in both countries, especially with regards to water use, given increasingly frequent droughts in the region."

SQM has had a contentious relationship with local indigenous communities, which sued the company for failing to consult them as required by law, in a case that reached Chile's Supreme Court and the Inter-American Court of Human Rights.[27] SQM recently announced it will invest $1.5 billion to develop new technology that will enable the company to produce lithium without using freshwater.[28]

In Argentina, companies are required to file periodic environmental impact assessments (EIA) that include data about the rate of water use for the production of lithium. But critics say the provincial governments that evaluate the EIAs frequently lack the necessary resources and sophistication.[29] Indeed, independent studies suggest water use may exceed the rate of recharge in high altitude salt flats in Argentina.[30] In general, there is no scientific consensus on the impact of lithium mining on local freshwater sources. However, experts agree on the need for additional research in the salt flats in Chile and Argentina.

Road Ahead

In Chile, the governance of the lithium sector will be determined by political developments in the coming months. Chileans overwhelmingly rejected a proposed new constitution in September that would have

introduced new challenges for mining companies. A new constitutional process was in the making at the time of writing this paper. For the lithium sector, a new constitution could bring increased taxes and stricter environmental regulation and monitoring. The mining sector is almost certain to remain heavily controlled by the state. Indeed, Boric has already begun setting up a state-owned lithium company.

"As in Chile, however, the future of Argentina's lithium industry will depend upon the development of more environmentally friendly production methods."

In Argentina, economic and political turbulence will likely continue in the run-up to the October 2023 presidential elections. However, the lithium sector appears immune to the turmoil. That is thanks to a rare political consensus regarding Argentina's opportunities as a lithium producer, both among national political leaders and the provincial authorities that exercise significant control over the industry. As in Chile, however, the future of Argentina's lithium industry will depend upon the development of more environmentally friendly production methods.

Notes

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