EXHAUSTED:
HOW WE CAN STOP LITHIUM MINING FROM DEPLETING WATER RESOURCES, DRAINING WETLANDS, AND HARMING COMMUNITIES IN SOUTH AMERICA

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# Table of Contents

I. Introduction .................................................................................................................................................. 4

II. A Snapshot of the Global Lithium Market .......................................................................................... 8  
   A. The Global Demand for Lithium-Ion Batteries Will Continue for Years ............................................. 8  
   B. Different Government Approaches to Lithium Extraction in South America Have Similar Destructive Impacts ...... 9
      1. Chile ....................................................................................................................................................... 11
      2. Argentina ............................................................................................................................................... 11
      3. Bolivia .................................................................................................................................................... 12

III. Lithium Mining Endangers Water, Wildlife, and People in the Salt Flats of Northern Chile .......... 16  
   A. Unique Wetlands and Wildlife Are Threatened by Lithium Mining .................................................. 16
   B. Industrial Mining Disrupts Millennia of Indigenous Agricultural and Pastoral Practices ................. 18
   C. Lithium Extraction Through Evaporation Is Water Extraction ............................................................ 19
   D. Lithium Mining Is Compounding Water Problems That Have Been Building for Decades ............... 20

IV. Recommendations for the Lithium Industry to Avoid Further Damage to the Puna de Atacama ........ 25

V. Conclusions ............................................................................................................................................... 29
I. Introduction

Worldwide, the power generation and transportation sectors are two of the largest sources of air pollution and greenhouse gas emissions (GHGs).\(^1\) Scientists agree that one of the best ways we can mitigate the harmful impacts of climate change is by transitioning away from fossil fuels like petroleum and coal and toward clean energy generation and zero-emission transportation options.\(^2\) Around the globe, governments are already deploying innovative technologies to support this energy transition.\(^3\) Some of these crucial technologies, such as electric vehicles, smart devices, and renewable power plants, depend on lithium-ion batteries, which require lithium as well as other metals and minerals like copper, nickel, graphite, manganese, and cobalt.\(^4\) Lithium is often considered a “critical mineral or material” due to its importance not only to developing technologies but also to everyday devices and national energy security.

Lithium is, in fact, an abundant element with deposits around the globe.\(^5\) However, lithium resources—where it is present and quantifiable—are more limited, and lithium reserves—where it is present, quantifiable, and economically feasible to extract—are more limited still.\(^6\) Lithium exists in high concentrations in only a few key locations, and those locations have long histories of destructive social and environmental impacts caused by the mining sector (Map 1).

Lithium is currently mined in three main ways, extracted from (1) hard rock pegmatites, especially in Australia; (2) sedimentary rock, particularly clay, an emergent source under development in the United States; or (3) brines pumped from beneath arid basins, including basins in South America. This report addresses the extraction of lithium that is pumped from brines in the region shared by northern Chile, northwestern Argentina, and southwestern Bolivia. This dry landscape includes internationally recognized wetlands and protected areas and is a critical refuge for migratory and native species. Despite this, most operations in the area use evaporation to extract the lithium from the brine, even though researchers have found that this mining technique contributes to ecological damage.\(^7\) Local and Indigenous People have engaged in mining activities, both small and large scale, for centuries in the region. However, most large state-run or privately owned companies have failed to obtain free, prior and informed consent from local populations. That means that many local and Indigenous People have no say in—and receive little benefit from—the mining operations that are negatively impacting local water supplies and ecosystems.

This is a global climate justice conflict that cannot be ignored.\(^8\) Solutions to the climate crisis must neither worsen water availability nor compromise the sovereignty of Indigenous Peoples. Nor do they have to. There are a number of options that governments, companies, and communities can employ to avoid or reduce the negative impacts of lithium mining in this region.

This paper has two purposes. First, we wish to raise international awareness of the social and environmental harms that lithium mining is already producing. South American lithium is widely understood to be a critical material for the transition away from fossil fuels, yet few apprehend how the global market for lithium is already negatively affecting some people and ecosystems in the region. To help understand this complicated issue, we detail six examples from different salt flats so that people from these communities can speak to their own experiences. Our researchers conferred with a range of Indigenous leaders,
local representatives, and those involved in environmental defense and advocacy in the region. Some community members feel they are benefiting from these developments; others do not. Sometimes these operations have the support of local and/or national governments; sometimes they do not. In all of the examples, relationships on the ground are complex and evolving. These six communities are not monolithic, and the highlights we report are a mere sample; there are, of course, other salt flats, mining efforts, and peoples who are not included here.10

Second, we propose a variety of ways in which lithium extraction’s detrimental effects—water depletion, drained wetlands, and community harm—can be avoided or reduced. Each actor in the lithium-ion battery supply chain can help ameliorate the current contentious and grave situation. Doing so will help create a globally just transition to clean energy generation and transportation without destroying this unique region or violating Indigenous rights.

**MAP 1: SELECTED SALT FLATS IN ARGENTINA, BOLIVIA, AND CHILE**

Selected Salt Flats in Argentina, Bolivia, and Chile

- **Salt Flats**
- **Chile**
- **Bolivia**
- **Argentina**

**Area of Detail**

Map by Brenda J. Rojas
18 ATACAMEÑO/LICKANANTAY COMMUNITIES OF THE ATACAMA SALT FLAT

Development starts in Toconao, and the agriculture in that area starts to decay; craftwork starts to decay; customs start to go down. This monster is called 'mining with SQM or Albemarle.' It transforms the thoughts and way of life of Native people, in a way that causes division. They tell us lithium is clean. We can offer a way of life. But unfortunately, they’re winning over there, and we’re losing over here. They’re drying up our waters. They’re drying up the conscience we’re lacking.

—Rudecindo Christian Espíndola, Atacameño Community of Toconao/Association of Irrigators and Farmers of Quebrada de Soncor/OPSAL

Rudecindo Christian Espíndola
In fact, we have told the state: Let’s put together a working group through which we can first speed up the handing over of the lands, as per the constitutional acknowledgment of our Native people. And then let’s take a look at different ideas or interests that may exist regarding the law. But today, ideally, the most important things are those two things I just mentioned. Also much more important is to find solutions for issues as basic and tangible as drinking water, sewage, electricity, accessibility. I mean, right in the middle of the 21st century, a country that has come out to say they’re at the threshold of development, of being a ‘developed country,’ still has communities that lack these types of services. That speaks very poorly of an administration. And what’s worse, the wealth in which the state lives, the wealth that the state has, which sustains the economy and the economic power of this country, comes precisely out of these communities. ... Chile, unfortunately, is a country that’s still unable to see its Native peoples. —Sergio Cubillos, former president of the Consejo de Pueblos Atacameños

COMMUNITY HIGHLIGHT I

The Atacama Salt Flat is the site of Chile’s two largest lithium mining operations—by Sociedad Química y Minera de Chile (SQM) and Albemarle—and new projects by Wealth Minerals and Lithium Chile are currently in exploration. The region is home to 18 Atacameño/Lickanantay Communities who are collectively represented by the Consejo de Pueblos Atacameños (CPA), as well as other Indigenous communities and organizations that are not represented by the CPA. In addition to their proximity to lithium mining operations, communities located south of the salt flat have been affected by the large copper mining projects in the water basin, Minera Escondida and Minera Zaldívar. The Community of Peine is nested in between the lithium and copper mega-mining projects and has been particularly impacted by the mines. While we are focused here on the impacts of lithium mining, it is important to remember that many communities face overlapping effects of other mining operations.

When it comes to lithium mining, both SQM and Albemarle have reached accords with local stakeholders. The 2012 benefit-sharing convenio (agreement) established between Albemarle and the Community of Peine reflected Albemarle’s new corporate social responsibility strategy to establish community relationships based on the principle of shared royalties. The company then signed a separate agreement with the government agency CORFO, which approved an expansion project that would triple the brine extraction quota of the salt flat. Albemarle also approached the CPA to negotiate a 2016 agreement based on the historical demands of the Atacameño people, though not all residents found it to be satisfactory. Under the CPA’s principle that any economic activity that takes place in the salt flat should ensure the stability of the natural and human environment, this agreement established that 3 percent of the company’s revenue would be divided among the 18 communities and the CPA. Another 0.5 percent of revenue would be redistributed to the CPA for studies, plans and projects of Indigenous entrepreneurship, as well as additional funds for scholarships and monitoring. Two years later, this agreement resulted in the formation of the CPA’s own Environmental Unit (UMA), whose main—though not exclusive—mission is to fully research and map the Salar de Atacama to build a picture of its ecological health.

Responding to popular criticism, Albemarle also launched a voluntary water monitoring program in 2020. Still, residents note that voluntary self-monitoring gives companies the power to greenwash the production of high quantities of lithium, regardless of broader impacts. For example, in collaboration with Volkswagen, Albemarle asserted that its evaporation ponds use “absolutely zero water” in “a very sustainable process.” Focusing only on freshwater use and not water loss from brine evaporation, the company’s executives have compared the water needed to produce a Tesla Model 3 to the amount of water used to produce 250 grams (8.8 ounces) of beef, 30 cups of coffee, and half a pair of jeans. These comparisons willfully ignore possible interactions between freshwater aquifers and brine, which of course is also largely composed of water (see section C on page 19).

SQM, on the other hand, has agreements with CORFO and municipalities but has largely been adversarial to the CPA. For instance, tensions erupted during the expansion of operations among cohabiting workers and community members. Water resources have also been a major point of contention between the company and local residents. In 2019 the CPA filed a successful lawsuit in regional court that paused the approval process for SQM’s $25 million compliance plan needed to expand operations due to the “particular fragility” of the Atacama Salt Flat. Following this success, the CPA went further to demand that SQM’s environmental permits be revoked. In 2020 Chile’s environmental superintendent decided not to rely on SQM’s failed compliance plan but to develop its own comprehensive management plan that would assess impacts of all four of the mega-mining projects at the Atacama Salt Flat. This signals a growing consensus, expressed in a declaration signed by more than 350 advocates and scientists in support of the CPA, not only that more precautions are necessary for expansion, but that the company’s ongoing operations should stop. Atacameño leaders and community members from across Socaire, Toconao, Camar, and Peine have protested both companies for unauthorized operations, subpar working conditions, and inadequate environmental monitoring, employing direct action tactics like road blockades and hunger strikes. In a 2020 report directed to the United Nations, the CPA demanded that SQM and Albemarle stop operations and halt the influx of their workforce, which reaches up to 10,000 personnel, in order to address the public health emergency of the Covid-19 pandemic.

Ultimately, these problems stem from the fact that the communities have not been fully consulted under the principles of the International Labour Organization (ILO) Convention 169 or the United Nations Declaration on the Rights of Indigenous Peoples (UNDPR).
II. A Snapshot of the Global Lithium Market

A. THE GLOBAL DEMAND FOR LITHIUM-ION BATTERIES WILL CONTINUE FOR YEARS

Governments, scientists and other experts, activists, and people in general around the world agree: The earth’s climate is in crisis due to global warming.26 As a result, actions that reduce GHG emissions and help mitigate climate change have become global priorities. Several of the most effective solutions for moving away from GHG-emitting fossil fuels, notably energy storage systems and electric vehicles, currently rely on lithium-ion batteries.

The cost of producing these important technologies is falling every year. In fact, by 2030, experts expect lithium-ion battery prices per kilowatt-hour to drop by half compared with recent prices.27 Consequently, the demand for the components of lithium-ion batteries—e.g., lithium, manganese, and nickel—will grow over the coming decades as well. For example, the International Energy Agency calculates that if countries implement policies compatible with the goals of the Paris Climate Agreement, “clean energy technologies’ share of total demand rises significantly over the next two decades to over 40 percent for copper and rare earth elements, 60 to 70 percent for nickel and cobalt, and almost 90 percent for lithium.”28 Even with the Covid-19 pandemic slowing vehicle sales, experts assume continued growth in the electric vehicle market in the coming years, albeit at a slower pace than previously expected.29 Chilean experts project a sixfold increase in the global demand for lithium carbonate between 2019 and 2030, with electric vehicles accounting for 79 percent of that demand.30

Most of the current demand for lithium comes from three places—China, the European Union, and the United States—where governments have employed a variety of policy tools such as incentives, regulations, and subsidy programs to support the growth of electric vehicles.35 However, other countries and regions such as India, Australia, and Latin America are also growing markets for lithium-ion batteries.36 In Latin America, for example, countries that have comparatively low emissions but face relatively high potential impacts from climate change, such as Costa Rica and Chile, have national plans to promote electric mobility to achieve carbon neutrality by 2050.37 Major Latin American cities such as Bogotá, Mexico City, Montevideo, and Santiago have all introduced electric taxis. Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, and Paraguay all have specific goals for electric vehicles.38 In 2019 Chile launched a new electric bus fleet that is the second-largest in the world, after China’s.39 Argentina has approved a decree that reduces duties on the import of electric cars from 35 to 2 percent and is in the process of passing a National Electromobility Law.40 Uruguay launched the first “electric highway” in the region in 2018 with charging stations located every 60 kilometers, and Montevideo welcomed 30 e-buses in mid-2020.41 In 2015, Bogotá, Quito, Caracas, Buenos Aires, and Mexico City as well as the Brazilian cities Curitiba, Rio de Janeiro, and Salvador all committed to substitute 40,000 buses for cleaner ones.42

WHAT IS LITHIUM, AND WHY IS IT SO IMPORTANT FOR BATTERIES?

Lithium is the lightest of the elemental metals. It is used in ceramics, glass, lubricants, and many other products (see Figure I). Lithium plays an important role in batteries because of its ability to carry a charge back and forth between the battery’s anode and cathode. The first lithium-ion batteries, which were non-rechargeable, became commercially available in the 1970s, and scientists have been trying to improve them ever since.3 Various kinds of lithium-ion batteries now exist, each with different chemical compositions and related benefits and drawbacks.32

Due to lithium’s chemical properties, it exists in nature only in compounds, such as lithium carbonate or lithium hydroxide. Those compounds must be processed in some way to extract lithium for use.

FIGURE I: MAIN GLOBAL USES OF LITHIUM IN 2022 (PROJECTED)33

Source: Adapted by authors from R. Poveda Bonilla, CEPAL, 2020.34
As the demand for electric vehicles and other clean energy solutions grows worldwide, so will the demand for lithium. Recognizing this, research is already well underway to develop battery technologies without lithium. The U.S. Department of Energy has an ongoing “Beyond Lithium” initiative whose purpose is to develop lithium-free batteries for things like energy storage and transportation.\textsuperscript{43} Research into sodium-ion and aluminium-ion batteries are among other efforts already showing significant potential.\textsuperscript{44}

However, most of those projects will require years of research before they become cost-competitive with lithium-ion batteries at a commercial scale. So, while they may alleviate the impacts of lithium mining in the long and medium terms, for the immediate future lithium remains a key element of the clean energy economy.

**B.DIFFERENT GOVERNMENT APPROACHES TO LITHIUM EXTRACTION IN SOUTH AMERICA HAVE SIMILAR DESTRUCTIVE IMPACTS**

South America’s lithium reserves are concentrated in the salt flats—or salares—of the high, arid region that spans northern Chile, northwestern Argentina, and southwestern Bolivia: the Puna de Atacama. These three countries are estimated to hold approximately 58 percent of global lithium resources.\textsuperscript{45} This region is also home to large copper, gold, lead, and tin mines.\textsuperscript{46} Map 3 identifies the major lithium resources in this region, which tend to share the names of the salt flats themselves.

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**MAP 3: SELECTED SALT FLATS WITH LITHIUM RESOURCES**

Selected Salt Flats with Lithium Resources

![Map](image-url)
THE ROLE OF THE UNITED STATES IN RESOURCE EXTRACTION IN OTHER COUNTRIES

After World War II, some wealthy nations including the United States began stockpiling strategic resources like uranium and lithium, which are used in nuclear energy as well as nuclear weapons. Since then, the United States has approached these kinds of resources with a type of "resource nationalism," all the while advocating for free markets for other countries.47

Resource nationalism refers to a set of policies that treat minerals as essential to national security and therefore too politically important to be left to markets alone. Historians and other experts point to the United States' and wealthy European governments' long history of blocking access to domestic sources of strategic minerals and securing, sometimes by force and trickery, preferential access to resources found in other countries.48

In this region of Latin America, distrust of U.S. and European interests remains high. Bolivians in particular have not forgotten a contract signed between their government and a U.S. company in the early 1990s to extract lithium from Uyuni.49 Outraged by the lack of local control or input and what many perceived as an exploitative agreement, Bolivians rioted and forced the government to cancel the contract. This story is regularly retold to explain the initial popularity of President Evo Morales’s lithium industrialization policy, as well as the questioning of it over time.50

Resource nationalism remains strong in the United States and other wealthy countries that see securing privileged access to foreign resource deposits as crucial to their long-term stability and global power.51 Indeed, in the United States, federal and state governments have not only subsidized new lithium-related industrial ventures, but often conditioned these on reopening old lithium mines and developing domestic sources of lithium.52

To remove lithium from the brine under these salt flats, operators drill down through the crust of the salt flat and begin pumping the brine at a rate of up to 1,700 liters per second.53 The subsurface minerals are distributed into a series of cascading evaporation pools (Figure 2). These vast bodies of salty water soak up the desert sun and undergo chemical treatment before separation and transfer to a processing plant to produce lithium carbonate.54 The evaporation process takes 18–24 months, and 95 percent of brine water evaporates in the process.55

Estimates of exactly how many liters of water are lost during the process vary widely—by nearly four orders of magnitude—from a low of 400 liters per kilogram (kg) of lithium to a high of 2 million liters per kg.56 According to Dr. Ingrid Garcés, a professor of chemical engineering at the University of Antofagasta whose research focuses on the salt flat, around 2 million liters of water evaporate for every ton (approximately 907 kg) of lithium produced, which equals about 2,200 liters per kg.57 The wide range of these estimates highlights a concerning lack of certainty and transparency around this information. Without them, it is difficult to reach a common understanding of how much water is available in this arid environment.

Despite its potential environmental impacts, the evaporation process is generally the standard, most cost-efficient way to extract lithium from brine in Argentina, Chile, and Bolivia. All three countries want to both increase production and create their own local value-added supply chains (i.e., not just to mine the lithium but also to develop local industries to refine and process it for manufacturers), but each country has adopted its own way of governing lithium exploration and production. These different policy characteristics shape the way the lithium mining industry has grown in the region to date.

FIGURE 2: THE EVAPORATION POND METHOD OF OBTAINING LITHIUM FROM BRINE. THIS IS THE MOST COMMON WAY LITHIUM IS SOURCED IN THE PUNA DE ATACAMA.

Source: Adapted by authors from https://doi.org/10.1016/j.scitotenv.2018.05.223.
1. Chile

Chile’s government exercises exclusive property rights over lithium through Decree 2886 (1979). This means that state institutions—particularly the Corporación de Fomento de la Producción (Production Promotion Corporation), known as CORFO—largely set the conditions under which private companies operate in the salt flats.61

In 1979, following the lead of the United States, the Chilean government under the dictatorship of Augusto Pinochet declared lithium a “strategic mineral” and took steps to safeguard long-term reserves by limiting production through quotas that are verified by Chile’s Nuclear Commission. From the 1980s to today, only two private/public contracts have existed with CORFO: one with the Chilean company Sociedad Quimica y Minera de Chile, commonly referred to as SQM, and one with the U.S. company Albemarle, the latest owner in a long chain of corporate sales.62 Chile is the leading producer of lithium from brines, and the government’s goal has been to further develop ‘value-added’ lithium products that can be used in batteries, not just be a supplier of the raw material.63

It expects that these two companies’ operations in the Atacama Salt Flat can meet 40 percent of world demand.64 However, as demand for lithium has grown since 2008, the Chilean government has struggled to increase production and retain Chile’s market leadership. The murky way lithium is addressed in law, combined with corruption scandals and public opposition, has complicated these efforts. In 2012 the government had to cancel a new lithium concession (an agreement for land access and extraction) after it was accused of unfairly privileging SQM, which was shortly thereafter discovered to be making kickback payments to politicians in all the mainstream political parties.65 At the same time, Chileans from different sectors—especially university students and frontline communities—began to question the social benefits of mining.66 It is worth noting that in Chile, the companies are obligated to provide some benefits to the government. For example, SQM’s contract with CORFO requires the company to pay royalties and sell up to 25 percent of its production to Chilean businesses in an effort to develop a local value-added supply chain.67 However, critics have challenged the government to demand higher payments from the mining companies to improve the flow of money to frontline communities and to take the environmental harms of lithium mining seriously.68 A government-appointed committee in 2015 largely validated these concerns, though government action to address them has been slow.69

Since then, no new projects have been approved, although SQM and Albemarle’s operations have expanded significantly despite myriad corruption scandals and controversies over data transparency (see Community Highlight 1 on page 7 for more details on benefit-sharing agreements the government reached with each company). As Chile enters a two-year period of constitutional reform after a series of protests about the country’s deep inequality that began in late 2019, lithium policy could be revised to allow the state to extract and commercialize lithium directly so as to increase government revenues from lithium, which could then (in theory) be more equitably distributed.

2. Argentina

Without exception, Argentina’s provincial governments (akin to U.S. state governments) have pursued mining as a source of foreign currency and economic growth.70 The provincial governments manage lithium mining concessions within a federal framework that regulates taxes, environmental laws, and other issues. Since the early 1990s, this framework has encouraged foreign investment in mining, including lithium extraction. For example, the Hombre Muerto salt flat—perhaps the best known in Argentina—is home to the Fénix lithium mine owned by U.S. company Livent (formerly FMC). Fénix has been producing since 1998.71 It straddles the Salta and Catamarca provinces, which have granted new lithium mining concessions to numerous multinational corporations without great scrutiny.72

In contrast, the provincial government of Jujuy established the Jujuy Energy and Mining State Society (JEMSE) as a government-owned enterprise that acts as a minority partner with multinational corporations operating in the area.73 Through JEMSE, Jujuy has sought to both attract investment and retain strong local government oversight, with the goals of capturing more government revenue from mining; more equitably distributing mining’s benefits to local businesses, social services, and others; and exerting greater oversight of environmental impacts.

WHY WE DON’T SAY “LITHIUM TRIANGLE”

The borderlands of Argentina, Bolivia, and Chile are commonly referred to by industry and state actors as the “Lithium Triangle.” However, the authors of this study find it more appropriate to use “Puna de Atacama” (which translates roughly in English to “Atacama Plateau”). The Puna de Atacama is a geographical term defined by the characteristics of the ecoregion such as its flora, fauna, elevation, and geology. In contrast, the term “Lithium Triangle” distills the region to just its potential extractive value to industry rather than acknowledging its unique geography and broader significance to local communities. Before the imposition of national borders or industrial siting, the salt flats of the Puna de Atacama shared a common origin as ancient paleolakes that evolved into biodiverse wetlands. Indigenous Peoples adapted to life in this ecoregion through agricultural and pastoral practices, based on local knowledge, that are now disrupted by industrial mining.
Despite the influx of foreign investment in lithium mining, new mines across Argentina are struggling to produce; of 18 or so started since 2015, only Orocobre’s mine at Jujuy’s Salar de Olaroz has begun selling lithium. The delays in Argentina reflect the scientific and technical complexity of extracting brine-based lithium, market conditions, and local opposition motivated by environmental and equity concerns—illustrated in quotes from various community members throughout this report.

3. Bolivia

The Bolivian state owns the country’s lithium deposits, and in 2007 it embarked on an ambitious lithium-based industrialization project. The goal of the country’s mining program is to correct what then-president Evo Morales and his supporters saw as a historical injustice: Countries like Bolivia have long provided the world with raw materials while receiving in exchange poverty wages and destroyed environments.

To break this pattern, the Corporación Minera de Bolivia (Mining Corporation of Bolivia), or COMIBOL, engaged Bolivian scientists who developed and patented a method for extracting lithium from the brines of the Uyuni salt flats. It then built research, production, transport, and other basic infrastructure and produced pilot-scale quantities of lithium and commercial-scale quantities of fertilizer extracted from the same brines. Although the government hired some foreign firms to work on downstream aspects of industrialization (e.g., cathode production), the bulk of this effort has been done by Bolivian experts and workers. Proponents hoped this approach would not only generate profits but also empower Bolivian science and industry.

Despite the large size of Bolivia’s lithium reserves and the energy put behind the project, a number of factors have delayed industrial levels of production. Primarily, in December 2019 the Bolivian military forced Morales to resign. This change, along with the Covid-19 pandemic, largely paralyzed Bolivia’s lithium development. In October 2020, Morales’s party swept back into power, led this time by Luis Arce, raising hopes for a renewal of the state-led industrialization strategy. But even before these events, the program had its critics, with complaints about excessive centralization of resources and authority, the role of foreign interests in downstream stages of industrialization, and the slow pace of progress due to technical hurdles to overcome seasonal rain and high levels of magnesium in the salt flats. Nonetheless, new alliances have formed with China, Russia and US entrepreneurs, promoting direct lithium extraction as a technological fix.

While each of these three countries has its own structure for promoting lithium mining, none has yet succeeded in translating mining operations into equal benefits for a wide range of stakeholders. In Chile and Argentina, while select agreements have provided local employment and served other interests for local and Indigenous communities (see our Community Highlights), the main financial beneficiaries so far have been the lithium mining companies themselves. In Bolivia, the government has invested a lot of resources into the industry but has not yet seen a return on that investment.
An entire [water] vein that supplied the town, which was fundamental to the livestock and agricultural lifestyle of residents, dried up completely. Today there’s nothing there. We’re also suffering from police persecution. This past month they detained five members of one family in Antofagasta de la Sierra, because the mining company went into their land, cut some wires in order to make a path, and a conflict ensued. ... Later on, at Fiambalá, another town with a vast territory and many minerals ... they apprehended me at the square and arrested me, without a single question. ... They didn’t hit me. But in Antofagasta they did beat two women and four men.

—Ezequiel Carrizo, Fiambalá Despierta and PUCARA (Pueblos Catamarqueños en Resistencia y Autodeterminación)

The Fénix mining project, owned by Livent Corporation and operated by Minera del Altiplano S.A., has been in operation since 1998. The lithium operation is large, and plans to expand it further are underway. Fénix produced 15,153 tons of lithium carbonate in 2017 and aims to reach 19,000 tons per year in the short term. After the approved expansion of the operation, it aims to double its output to up to 40,000 tons annually. Minera del Altiplano has worked with the provincial government to appeal to residents—most of whom depend on government jobs—through corporate social responsibility programs. It also directs 1.2 percent of its profits to a mining trust for use in regional infrastructure projects. The company reportedly delivers food to residents, contributes to the church, funds school programs, and built a well and power station (partly for its own use). The project generated 600 jobs during construction and 158 direct jobs during operation.

Despite all of this, the mining project’s relations with local communities have grown contentious over time, as the increased mining activity has not significantly improved quality of life in the long term for residents. People who have been impacted by Fénix include the Indigenous Communities of Antofagasta de la Sierra, often represented by the Comunidad Indígena de Atacameños del Altiplano, and nearby rural towns like Fiambalá, which are integrated with non-Indigenous or criollo (mixed race) populations. Many began organizing against the lithium project as early as 2000; most recently, opponents protested the approval of Fénix’s expansion. Their primary complaint is the operation’s overuse of the area’s limited water resources: The operation’s water consumption ranges from 280 to 304 cubic meters per hour, 24 hours a day. The Trapiche River and local lagoons have dried up, resulting in the deaths of llamas and sheep grazing on the range in the area. The communities fear the continued use of local water resources will further affect local farmers and the surrounding wetland ecosystem, which is recognized as a Ramsar Wetland of International Importance due to the endangered, native, and migratory species that inhabit the area. Concerned communities also argue that the Fénix project was approved without public consultation or a proper environmental impact assessment process.

Fénix’s relations with the regional government have also been rocky, as the company has worked to dodge paying royalty fees. Nonetheless, those who stand in opposition to mining have faced violent repression and harassment from the police. Since the Covid-19 pandemic, 250 workers have gone on strike in response to the company’s attempts to keep them working.
ATACAMA COMMUNITIES IN THE SUSQUES DEPARTMENT NEAR THE OLAROZ AND CAUCHARÍ SALTS FLATS (JUJUY, ARGENTINA)

Our struggle to defend water and land, shaken in this area by the arrival of superprojects of lithium mining and other mines that are about to open, I know it affects all of us Atacameños, and that it changes our culture and our ancestral lives, so rich in our history. But what’s most worrisome is that they’re taking our water away: water, which means life to all survivors.

—Carlos Guzmán, Colectivo La Apacheta

Two major lithium projects have grown around the Olaroz and Caucharí Salt Flats in the Argentine province of Jujuy, near the borders of Chile and Bolivia. The Olaroz Lithium Facility formed in 2010 and is a joint venture among Orocobre (Australia), Toyota Tsusho Corporation (Japan), and the state-owned company Jujuy Energía y Minería Sociedad del Estado (JEMSE). The Olaroz facility currently has the capacity to produce 17,500 tonnes of lithium carbonate per year, and the owners plan to expand the facility to produce 42,500 tonnes per year. The Caucharí-Olaroz project, located in the Caucharí Salt Flat, is in the advanced construction stage. Operated by Minera Exar, the project is owned by Gangfeng Lithium (China), Lithium Américas (Canada), and JEMSE (Argentina). It is anticipated to produce 40,000 tonnes of lithium carbonate annually when at full capacity.

The area is also home to approximately 4,000 people, including 10 Indigenous Atacama Communities who continue their agro-pastoral practices of raising goats and llamas as well as subsistence farming of quinoa and potatoes and making artisanal crafts. These rural societies, particularly the villages of Huancar, Pastos Chicos, and Olaroz Chico, have felt the impacts—some negative, some positive—of the Olaroz Lithium Facility and the Caucharí-Olaroz project. Indigenous communities in the region have been divided over the benefits and burdens of lithium development there.

JEMSE’s partnership with Orocobre has resulted in community-based projects that have brought transmission lines, a business park, technical job training, microcredit loans, a community center, transportation, clothing drives, and even sports tournaments to the area. At the same time, many residents believe they have not had sufficient opportunity to participate in the decision-making processes, and benefit sharing is largely symbolic. Some community members argue that depleted water levels in wells, lagoons, groundwater, and wetlands have had detrimental impacts on their agro-pastoral practices, and they have observed increased mortality of flamingos and camelids because of dust pollution resulting from mining activities. A new social movement of agro-pastoral workers called La Apacheta has formed, drawing membership from across local Indigenous communities, to denounce the projects’ approval processes and challenge irregularities in impact studies of water resources.
Indigenous People who work with the salt know where to find it. Its rational management has been an ancestral conception in our communities, avoiding uncontrolled extraction. This practice, as an ancestral heritage of our elders, is being ignored, compromised and exiled by new large-scale mineral mining initiatives (lithium, lead, copper, zinc, borax and others) that prioritize technology and disregard the value of a workforce, to maximize profits, no matter the consequences, even if these modify, damage or degrade the land.

—Kachi Yupi Protocol

The border area between the Atacama Argentine provinces of Jujuy and Salta contains the Salinas Grandes–Guayatayoc Basin. There, the region’s 33 Indigenous Kolla and Atacama Communities have been at odds with the Salinas Grandes lithium mine owners, Pluspetrol Resources Corporation B.V. and Dajin Resources S.A., and its operator, Lithea Inc. Sucursal, almost since its inception. The project is in a state of advanced exploration, with the developers estimating lithium resources totaling 239,187 tons of lithium carbonate. Communities anticipate the loss of artisanal salt extraction and textile work, as well as depleted reservoirs of the Puna for livestock (sheep and llamas) and agriculture.

Commercial explorations of the Salinas Grandes–Guayatayoc Basin as early as 2009 led to protests and confrontations, resulting in a Supreme Court hearing on March 28, 2012. Sixty people from the 33 communities participated, seeking to hold the governments of Jujuy and Salta accountable for licensing mining explorations without prior consultation or assurances of Indigenous rights guaranteed by ILO 169, which Argentina ratified in 1992 and adopted into its constitution in 2000. In 2015 the communities crafted a biocultural protocol called Kachi Yupi: Huellas de la Sal, based on local knowledge in the Salinas Grandes–Guayatayoc Basin, to outline appropriate procedures for free, prior and informed consent. JEMSE, representing the province, has sided with the mining industry.

In December 2019 the communities, which had worked in alliance with the organization Fundación Ambiente y Recursos Naturales (FARN) for more than a decade, filed an environmental protection action against the provincial governments of Salta and Jujuy and the federal government of Argentina, requesting a proper environmental study of impacts on water, grounded in Indigenous rights to consultation and consent. The Supreme Court rejected the communities’ claims, so their case has been mired in provincial courts. The 33 Indigenous communities have heightened their plurinational profile through a vast communications network, a visit from a U.N. special rapporteur on the rights of Indigenous Peoples, and actions filed with the Inter-American Commission on Human Rights.
III. Lithium Mining Endangers Water, Wildlife, and People in the Salt Flats of Northern Chile

Despite the differences between Argentina, Bolivia’s, and Chile’s approaches to lithium mining, one common theme in all three countries is strong discontent among nearby communities toward the industry’s negative impacts on the environment and water resources. These impacts affect people’s livelihoods and cultural practices. Due to resource and research constraints, this report focuses on the lithium mining industry and its environmental and social impacts in Chile, with examples from Argentina and Bolivia where relevant. While the national differences are important to bear in mind, similarities in geography and the evaporation processes used across the region make the impacts in Chile fairly representative of the Puna de Atacama as a whole.

A. UNIQUE WETLANDS AND WILDLIFE ARE THREATENED BY LITHIUM MINING

At the foothills of the northern Chilean Andes, the high-altitude geography and the cool, dry climate interact to form a series of salt pans. Rainfall that does not evaporate at the surface mixes with salts in the earth and seeps into deep aquifers. Beneath the crusty surface layer of salt, sand, and pebbles lie dense masses of brine: a salty solution containing 75 percent water and 25 percent dissolved salts, plus high concentrations of lithium and other compounds and minerals.108 For comparison, the ocean is about 3.5 percent dissolved salts.109 The Atacama Salt Flat Basin, the largest and one of the first to be mined for lithium in Chile, is part of the extensive cross-border region of the Puna de Atacama (see “Why We Don’t Say ‘Lithium Triangle,’” above).110 Since ancient times, its waters have run through ravines and under rocks from the Andes, seeking, without success, the sea.

Despite being a desert, the area is hardly a wasteland.111 On the contrary, it features vital wetlands that are the product of ecological and social interaction over millennia. Biodiverse fauna and flora have coevolved in a fragile symbiosis across multiple scales of life in the hypersaline lakes of the Andes, from flamingos and small mammals to unique communities of microorganisms.112

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment identified wetlands as the world’s most threatened ecosystems.113 Wetlands serve as key sites for migratory birds, and many of the lagoons in this area host migratory and native wildlife. Three of the world’s six species of flamingo migrate there. Approximately 80 percent of the animals residing in Andean salt flats are native, including the culpeo (Andean fox) and a tenacious lizard nicknamed “the salt flats fighter.”114 For these reasons, several of the lagoons in the region are already designated as Ramsar Wetlands of International Importance or nature reserves, and many of the salt flats have some sort of national protected status. Yet many of these same unique areas are adjacent to or overlap with lithium mining, as is evident in Map 6.
CAN THE DESERT’S WETLANDS STORE CARBON?

It is worth noting that some scientists are studying the carbon capture potential of the wetlands in the Puna de Atacama, to better understand how protecting these ecosystems can contribute to global efforts to fight climate change. Some research demonstrates that the Salar de Huasco is an important carbon dioxide sink. Although this line of research is fairly nascent, this issue is highly relevant given the current climate crisis, and it presents another possibility for how this unique place could help fight global warming.
The stressors of brine extraction on water availability and quality pose a significant threat to the area’s wildlife. The most immediately impacted life forms are unique species of microbes and bacteria that are at risk of extinction due to brine evaporation. Scientists and biodiversity conservationists are concerned that this may have knock-on effects for more charismatic megafauna higher up on the food chain. Collective memory from local residents suggests that flamingos are disappearing, but access to relevant data is limited, in part because the flamingo monitoring program is effectively managed by the lithium company SQM through an agreement with Chile’s National Forest Corporation (CONAF). As with much scientific research that has been supported by the private sector in Chile, biological reports exclude mining impacts. So these data are either not being collected, are not publicly available, or are viewed with distrust. We do know, however, that on SQM’s property, 32.4 percent of the native algarrobo trees (Prosopis chilensis) — a drought-tolerant species that sends roots deep underground to survive — were found dying as early as 2013 due to the effects of water shortages.

At the same time, climate change is hastening the retreat of glaciers and the disappearance of lakes from the landscape. As a result, the area has been suffering from the slow violence — the uneven effects that take place gradually and often invisibly — of an ongoing water crisis. Climate adaptation, human rights, and environmental degradation are more serious concerns than ever.

Although many questions remain about the impacts of brine extraction and climate change in Puna de Atacama, scientists know that healthy lagoons are vital for flora and fauna in the salt flats. Recognizing the importance of protecting the biodiversity and the cultural value of the Atacama region, Chile’s Ministry of the Environment has called its national salt flat aquifers areas of “biocultural patrimony.” In 2015 a government-appointed committee acknowledged that extraction negatively impacts the ecosystem, but rather than regulating brines accordingly, it reaffirmed the Chilean state’s longstanding policy of regulating lithium production. On January 9, 2020, the International Rights of Nature Tribunal issued a nonbinding verdict denouncing lithium mining for endangering water and proposed a moratorium on lithium mining in the Atacama Desert.

B. INDUSTRIAL MINING DISRUPTS MILLENNIA OF INDIGENOUS AGRICULTURAL AND PASTORAL PRACTICES

Humans have lived in the area of the Atacama Salt Flat since at least 10,000 B.C. Atacameño (also known as Lickanantay) culture and livelihood adapted to the seemingly hostile high-desert environment through local agro-pastoral practices such as growing maize, quinoa, alfalfa, and fruit as well as raising llamas and other livestock. For the Atacameño (Lickanantay) Indigenous People, water relations have been the guiding thread of a long history of adaptation to one of the most arid environments in the world. “We are grateful for every drop of water and understand its cycles,” says Jorge Muñoz Coca, of the Atacameño (Lickanantay) Community of Solcor and member of Observatorio Plurinacional de Salar de Andinos (OPSA). In addition to the Atacameño (Lickanantay) Communities encircling the salt flats near San Pedro, multiple transandean Indigenous communities have survived and thrived in the area since Spanish colonial dispossession — from the Aymara People, whose territory crosses over from Bolivia and Peru in the far north, to Colla and Diaguita Communities located in Norte Chico, Chile, and northwest Argentina. Depletion of local water resources and the imbalance of water rights are threatening the agricultural and pastoral practices of these Indigenous communities.

AGRICULTURE AND PASTORALISM IN THE DESERT

In simple terms, there are two main types of agriculture in the Atacama: valley agriculture and highland agriculture.

Valley agriculture refers to the agriculture practiced in the town of San Pedro de Atacama (elevation: 2,420 meters), and is associated with the San Pedro and Vilama Rivers. The oasis of San Pedro de Atacama is the most populated area in proximity to the Atacama Salt Flat and is home to small farms that have long conserved the biological and genetic diversity of the territory. Raising grazing animals, although less visible, continues to occupy a small part of the population of the valley and provides nonindustrial fertilizer to the lands that are sown each spring with the beginning of irrigation.

Highland agriculture refers to the various agro-pastoral practices encountered in higher-altitude areas (elevation: 2,700 to 3,700 meters) associated with ravines and rivers that descend, from east to west, from the mountain range to the Salar de Atacama. This type is found in the Indigenous Atacameño (Lickanantay) Communities of Toconao, Soncor, and Peine, among others. There, the soils tend to be sandier, and the surface shallower, mainly due to the slope and the presence of volcanic rock. Both of these systems depend on irrigation channels that are managed by irrigation associations and farmers or by the communities themselves. This practice is passed down from generation to generation.
The availability of water for irrigation in the Atacama is decreasing, in terms of both quantity and quality.\textsuperscript{132} This led the irrigation associations of both of the local rivers, the San Pedro and the Vilama, to limit water concessions by requesting a Declaration of Exhaustion (agotamiento) of these sub-basins. The request was ratified by the government agency charged with managing the country’s water resources, the General Water Directorate (DGA), in 2017.\textsuperscript{133} This declaration officially states that the watershed is “exhausted” and does not have enough surface water to allow additional water rights to be granted. Even with this intervention, the remaining water is insufficient for the communities’ needs, according to irrigators who measure the decrease in water every planting season. Many farmers have had to reduce the planting area of native corn by up to two-thirds, giving way to new tensions among disparate groups of irrigators who seek to ensure their own access to water in order to save their respective crops.\textsuperscript{134}

In 2018, technical reports indicating ecological exhaustion caused the DGA to declare a prohibition on groundwater use for extractive purposes in the aquifer by the Atacama Salt Flat.\textsuperscript{135} Additionally, it recognized that it had given out more rights to fresh water resources than were available.\textsuperscript{136} Despite this overpromising of water resources, local communities have received rights to far less water than the mining companies have; in the Atacama, they have rights to about 92 liters per second, compared with a combined 2,739 liters per second owned by the mining companies operating in the area.\textsuperscript{137}

Although water scarcity in the basin is widespread, it is the communities and ecosystems to the south of the salt flat, which are closer to the freshwater and brine extraction wells, that are now experiencing the most direct impacts of mining activities in the territory. When an elder of the Peine Community was asked how lithium mining affects her daily life, she responded, “What can I do alone against other human beings, against the government? When they come to ask me, I don’t want to go to give an opinion, because it makes me sad. We are divided by money . . . Who controls that? . . . My father practiced agriculture and livestock there in Tilopozo . . . Today we can’t have any animals.” This woman did not know that the aquifer that feeds her family’s \textit{vegas} (wetlands) and fields was declared depleted by the DGA.\textsuperscript{138}

C. LITHIUM EXTRACTION THROUGH EVAPORATION IS WATER EXTRACTION

As mentioned above, this northern area of Chile contains internationally recognized wetlands and nationally protected areas whose boundaries often overlap with salt flats. As a result, lithium mining companies are also exploring and operating in or very near these areas.

Lithium mining operates under the assumption that the brines extracted from the salt flats are separate from the adjacent wetlands and aquifers. Industry actors acknowledge that lithium brine contains water, but they point out that brine is not suitable for irrigation or human consumption without high-energy processing.\textsuperscript{139} For that reason, the lithium industry argues that brine is not water and should not be regulated as such. Moreover, lithium mining operators have argued that their extraction methods are “natural” or “artisanal,” downplaying the industrial use of water required to extract lithium from brine.\textsuperscript{140}

However, these assumptions are overly simplistic. Researchers still are not in full agreement about how fresh groundwater connecting distant wetlands across the region interacts with the salty brine water.\textsuperscript{141} Recent studies of the Salar de Atacama suggest the briny area is recharged mostly through the surface (particularly through rainfall in the mountains), while an underground “mixing zone” separates brine aquifers from freshwater aquifers.\textsuperscript{142}

Definitive hydrogeological research at the time of this paper’s publication remains contradictory, inconclusive, or unavailable because, controversially, mining companies have pursued their own independent research without full disclosure.\textsuperscript{143} But there is heightened concern about the quantity and speed of fresh (or less salty) groundwater flowing into the salt flats to fill the space left by evaporated brine water.\textsuperscript{144} This may decrease freshwater availability for flora and fauna as well as humans.

Salt flats are inextricably connected to the wetlands and rivers that support life in this arid region. The evaporation methods that the lithium mining industry uses are contributing to conditions of ecological exhaustion for these high-altitude environments.\textsuperscript{145} What’s more, the brine extraction process not only potentially stresses water availability but also transforms the landscape by leaving behind hills of salt on the surface of the salt flat and contaminates the environment with an array of toxic chemicals including diesel, magnesium, lime, organotin, and polyvinyl chloride (PVC) from pond linings and tubing.\textsuperscript{146}
Lithium mining companies and government agencies are finally starting to take note of these issues. In response to concerns and pressure from their own clients, Albemarle announced in early 2020 a broad water monitoring program (details had yet to be released as of July 2021). Monitoring has been long overdue, and this could be an important first step. However, Chilean environmental and community advocates are concerned about the transparency and reliability of this effort.

**D. LITHIUM MINING IS COMPOUNDING WATER PROBLEMS THAT HAVE BEEN BUILDING FOR DECADES**

Mining, which can use large quantities of water regardless of the metal or mineral being mined, has been a significant activity in Chile’s Atacama Salt Flat since even before the imperial intrusions of the Inca or the Spanish conquistadors. By the early 20th century, nitrates and copper from this region provided nearly all of the Chilean government’s revenue. A century later, mineral extraction contributed around 10 percent of the nation’s gross domestic product, with copper alone accounting for 7 percent. Initially, small-scale extraction was a welcome source of employment for Atacameños. However, in the 1980s and 1990s, large-scale copper, gold, and brine-based fertilizer and lithium extraction boomed in the Atacama Desert due to global market demand and business-friendly policies that followed the neoliberal economic guidelines of the Pinochet dictatorship of 1973–1990.

Despite decades of operations, the mining industry’s devastating impacts on this region’s water resources have been recognized as a serious problem only relatively recently. As of this report, there are four large mining operations in the Atacama Salt Flat in Chile’s Antofagasta Region, two extracting copper and two producing lithium. The two main copper mines in the Salar de Atacama Basin, Minera Escondida and Minera Zaldívar, have been loudly criticized for their freshwater use and damage to the local environment. Lithium extraction, the newest industry to the region, is now yet another way the scarce water resources are being depleted.

**MAP 5: 18 SELECTED INDIGENOUS COMMUNITIES AND THE FOUR LARGEST MINING OPERATIONS**

18 Selected Indigenous Communities and the Four Largest Mining Operations

- Selected Communities
- Copper Mine
- Lithium Mine

- Atacama Salt Flat
- Chile
- Bolivia
- Argentina

Map by Brenda J. Rojas
Unfortunately, Chile’s water regulations have not kept pace with its mining activity. Chile’s 1980 Constitution, together with the Mining and Water Codes, privatized access to and use of minerals and water.\textsuperscript{152} Chilean regulators began tracking water consumption from copper mines only in 2009; consumption from all mines is unknown.\textsuperscript{153} Notably, regulators count only surface water, freshwater aquifers, and ocean water—not the brines used by lithium mining. Neither the Mining Code nor the Water Code recognizes brines as resources to be regulated. As a result, Chilean authorities may not know precisely how much brine is drawn out or if any remaining portion is reinjected after minerals are extracted. While permits are needed for brine under the environmental authority, these documents do not consider the specifics of lithium extraction, which some experts argue is more akin to water-intensive forms of agro-industrial “harvesting” than to mining in the first place.\textsuperscript{154}

\begin{center}
\textbf{MAP 6: MINING ACTIVITIES OVERLAP WITH SALT FLATS, PROTECTED WETLANDS, AND COMMUNITIES}
\end{center}
PUNTA NEGRA: AN EXAMPLE OF HOW MINING CAN DESTROY SALT FLATS

The economic boom of the mining sector in proximity to the Atacama Salt Flat has already resulted in the “ecocide” of the nearby Punta Negra Salt Flat, which may serve an example for the Puna of Atacama more broadly. In April 2020, the Environmental Court of Antofagasta accepted a lawsuit against Minera Escondida for “continuous, cumulative, permanent and irreparable environmental damage to the Punta Negra Salt Flat,” citing 27 years of intensive water extraction from 1990 to 2017.

Concerned local citizens are arguing that the depletion of water resources threatens wildlife, including more than 30 species of birds like flamingos and ducks; mammals like vizcachas, foxes, guanacos, and vicuñas; and 24 plant species. They also argue that Minera Escondida’s activities threaten their culture and traditions. Meanwhile, in July 2020, the superintendent of the environment for Antofagasta charged Escondida with extracting more than the maximum level of water allowed, in violation of its 2005 commitment to lower its extraction rate. In June 2021, the mining company reached an accord with local Indigenous communities to implement measures to try to rehabilitate the area.

This example points to the mining sector’s record of carelessly exhausting water resources and its disregard for local wildlife and cultures around the Atacama Salt Flat.

At the same time, freshwater scarcity in Atacama Salt Flat is compounded by the growth in tourist activity over the last two decades. Locally, tourism represents the highest income and number of jobs in the area, which has led to a progressive increase in population to more than 10,996 inhabitants in 2017 (including tourists), up 121 percent from 2002. The village of San Pedro de Atacama provides an example of the impact of tourism: Potable water there comes from brine that’s treated by reverse osmosis for a capacity of up to 6,000 people. Neither the osmosis plant nor the sewage treatment plant is capable of providing service to the current number of inhabitants. This has led to a sanitary emergency due to contamination from black waters and a serious crisis in the management of rural potable water.

Unfortunately, the investment in, taxation of, and even a large part of employment in tourism is directed outside the region, the territory, and its original inhabitants. The tourism boom has not been reflected in infrastructure development, which remains unchanged from when only 3,000 people lived in the area. Without supervision or investment to respond to the needs of this new and growing industry, the population suffers constant cuts in electricity and drinking water.
Lesley Muñoz Rivera

We have Indigenous consultations in which, if they come and ask you as an Indigenous person and part of the territory they are interested in exploiting, “Do you agree with what we want to do?” and as Indigenous people, we say no, then this consultation process is considered done and fulfilled. That is to say, there is no interest in preserving Indigenous cultures, territories, and environments in general. What’s more, this means that our knowledge is not taken into consideration, and therefore there is little that we can do to stop projects that seek to extract lithium from the Maricunga Salt Flat under the current normative order of the Indigenous consultation process.

—Lesley Muñoz Rivera of the Indigenous Colla Community, Comuna de Copiapó and member of OPSAL 162

The Maricunga Salt Flat is the site of much exploration by the lithium mining sector. Currently, Codelco (the National Copper Corporation of Chile), SIMCO SpA, Sales de Maricunga SpA, ENAMI-Wealth Minerals Ltd., Talison Lithium, and SQM all have projects in some stage of early development. The most advanced project in the salt flat is Minera Salar Blanco S.A., a joint venture whose primary participants are Lithium Power International (Australia), Borda Grou (Chile), and Bearing Lithium Corp (Canada). Minera Salar Blanco received environmental approval in February 2020.163 Project developers anticipate an annual yield of 20,000 tons of lithium and 58,000 tons of potassium chlorate over a 20-year period.164

The Colla People of the Comuna de Copiapó and the Community of Diego de Almagro, whose ancestral territories stretch east of the mining city of Copiapó, are the Indigenous groups most impacted by the activities of Minera Salar Blanco and the other prospectors. Minera Salar Blanco asserts that its environmental impact assessment included a “lengthy process of social engagement with the Colla Indigenous communities in the area,” but free, prior and informed consent to operate has not been obtained from all Colla Peoples in the area.165 According to local Indigenous leaders from the Colla Community of the Comuna de Copiapó, a consultation was held with the Community of Diego de Almagro but not with them.165

Perhaps more egregiously, developers of another mining project, Sales de Maricunga, never offered a consultation at all.167 Thus, while the companies claim to have the same baseline status, only one has gained approval, and the consultation process remains incomplete. In addition, mining activities have disrupted ancestral ceremonies of the Colla People, violating their Indigenous rights.

On top of procedural concerns, environmental impacts are at issue, for Maricunga is the southernmost salt flat of the whole Altiplano, which gives it particular biogeographical importance. According to Dr. Ingrid Garcés, this salt flat hosts 11 native plant species. At the southern end of the salt flat, just 10 kilometers from one of the extraction sites, is Laguna Santa Rosa, located within Parque Nacional Nevado de Tres Cruces, which is also a Ramsar Wetland of International Importance. The Laguna is home to three species of flamingo and seven more native flora species. Seventeen of its 53 animal species are endangered (nine are vulnerable, five are at risk of extinction, and three are considered rare).168
We are desperate, and there's no way to stop this. We are facing a tank well protected by the republic's constitutional law. And they tell us that neither the Indigenous Law can help us, nor did ILO 169 help us. We can’t grow our quinos; we can’t raise our llamas; we can’t carry out our ceremonies and customs, etc. If lithium arrives, it will also be the end of animal life, of agriculture, of our Indigenous people, of our ancestors.

—María Gómez, president of the Aymara Community of Ancovinto, Comuna de Colchane, Tarapacá, Chile

The Coipasa Salt Flat straddles the Chile–Bolivia border and is the site of several lithium exploration projects. In Chile, Lithium Chile (Canada) and Minera Atacama (Chile) are the two companies with the most advanced efforts, with Lithium Chile controlling more than 70 percent of the land on the Chilean side of the Coipasa Salt Flat. The Indigenous Aymara Community of Ancovinto in the Comuna de Colchane, of the Tarapacá region, is likely to be most impacted by these explorations; its members are the surface rights holders of the land, which is their ancestral territory. Even though no project is operational yet, local residents have felt the impacts of lithium exploration for years. One community member reported in December 2019 that Minera Atacama had been a presence for more than a decade, with welding and mining operations underway without consent. Lithium Chile has also done extensive surveys, mineral sampling, and geophysical analysis, identifying a 58-square-kilometer lithium brine target area to drill on May 7, 2018. Lithium Chile asserts that it received approval from the Indigenous Aymara Community of Ancovinto by a vote of “over 65 percent” in March 2019. The company celebrated reaching the final stage of a process to grant a binding access easement in Chilean court on September 12, 2019, and met with Chile’s Ministry of Mining to confirm government support on September 25, 2019. However, as of May 31, 2021, a compensation plan for the community—a key element of community approval—had not yet been established or agreed on, even though the company was preparing to drill. Community members view this as a coercive form of accessing lithium through legal avenues while disregarding the community’s right to water on its own ancestral territory.
IV. Recommendations for the Lithium Industry to Avoid Further Damage to the Puna de Atacama

Lithium-ion batteries are, for the short and medium term, a critical component of the global strategy to fight climate change and mitigate air pollution by electrifying vehicles and providing energy storage for intermittent renewable energy. Yet the ecosystems that contain the earth’s lithium resources—and the people who live there—should not be sacrificed to extract this material and build a market. Experts looking at a variety of global lithium demand and supply trends have specifically noted that the “long-term sustainability of the transport sector” is at risk “unless a mix of measures is taken to ameliorate the challenge” of balancing demand with the need to protect local communities.176

Fortunately, there are myriad ways that communities, governments, and the private sector throughout the lithium-ion battery supply chain can mitigate or even eliminate the negative impacts of lithium mining in the Puna de Atacama and other environments. Every actor—from local authorities to local and international mining companies to global battery vehicle manufacturers and even to governments in consumer countries—should embrace these solutions by implementing the actions appropriate to their roles in the chain and requiring those they do business with to do their parts as well.

1. RESPECT AND ENSURE FREE, PRIOR AND INFORMED CONSENT FOR INDIGENOUS AND LOCAL COMMUNITIES.

While the existing benefit-sharing agreements in this region may offer a foundation for industry partnerships with communities, these agreements have thus far formalized conflicts: they describe the conflicts on paper but have not necessarily resolved all problems on the ground. In order to operate in a sustainable and equitable way, it is imperative that mining firms and state agencies respect and uphold the rights of Indigenous and local communities every step of the way. Specifically, governments should require and monitor, and companies should fulfill, the requirements of:

- International Labour Organization Convention 169 (ILO 169), which recognizes the rights, cultures, and land ownership of Indigenous Peoples and requires that “studies are carried out, in co-operation with the peoples concerned, to assess the social, spiritual, cultural and environmental impact on them of planned development activities.”177

- The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), particularly the right to free, prior and informed consent for use of land, territory, and resources.

The United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP), which suggests that traditional agricultural and pastoral practices should be protected as a means of food sovereignty and security.

It is worth noting that ILO 169 is ratified and in force in Chile, Argentina, and Bolivia and that all three countries voted in favor of UNDRIP and UNDROP.

In addition, although they are often ignored or inconsistently applied, several Indigenous-led land-use protocols, such as the Kachi Yupi Protocol, are instructive.178 The concepts and practices these protocols outline—especially those developed locally—should be prioritized by the relevant governments and companies. This includes recognizing communities’ rights to say no to mining proposals and instead continue making a living through established local economies like salt extraction and livestock raising in Salinas Grandes or small-scale agriculture and tourism in Atacama.

2. PRIORITIZE INDIGENOUS KNOWLEDGE AND SCIENCE OF LOCAL ECOSYSTEMS.

As we have seen throughout this report, many community members in the Puna de Atacama are concerned that they and their local environments are being sacrificed to create national economies based on the global lithium market. If sourcing agreements or battery chemistries change, the growth of South America’s lithium market could reverse, meaning the sacrifice would be for nothing.

The lithium sector is applying the conventional business practices of industrial mining companies, which depend on global markets and on decades of experience garnered from projects in other parts of the continent or the world. This approach ignores local needs and the millennia of experience gained by communities that have developed deep knowledge of their area’s natural resources and how to use those resources sustainably. Current industry practices ignore and diminish the contributions of traditional ecological knowledge. Instead, companies and governments should prioritize learning from local Indigenous Peoples and earnestly incorporate that knowledge into the heart of their practices.

Indigenous knowledge of local ecosystems may also help with environmental monitoring, building local food production, and safeguarding biodiversity. As highlighted in the UNDROP, peasant and rural societies have for centuries contributed to conserving and improving biodiversity, “which constitute the basis of food and agricultural production throughout the world.”179 There
are myriad models of Indigenous-led land-use planning and environmental management to follow for protecting areas of high biodiversity, and Indigenous knowledge and science may be complementary in the formation of appropriate co-management of resources by local communities and governments. Recognized systems of environmental governance that prioritize environmental health over corporate profit, like Integrated Watershed Management, can provide useful guidelines for privileging local knowledge and avoiding ecological and social harm.

A more just and equitable approach to resource management is critical to building a relationship that is more democratic among all actors. Fortunately, Chile may be in a position to incorporate this change during its process to create a new constitution after massive protests in 2019–2020 resulted in a call to replace the current one. The Constitutional Convention has commenced presided by Dr. Elisa Loncón, an Indigenous Mapuche linguist, with regional constituent representation of Antofagasta by Dr. Cristina Dorador, a microbiologist with expertise on the biodiversity of salt flats. In this context, Dr. Dorador joined OPSAL in launching the Plurinational Initiative for the Valorization and Protection of Andean Salt Flats and Wetlands, a community-based dialogue that will form the basis for a bill to recognize the importance of defending these ecosystems against further industrial extraction in a participatory and inclusive manner. According to Dr. Dorador, “The north of Chile has been viewed by the country as an exploitable territory because there is no life there.” Deconstructing that image implies profound changes. The extraction of lithium is like taking the soul out of the salt flats.”

Dr. Dorador emphasizes the great need to integrate knowledge of Indigenous Peoples and break with the dominant hierarchies of knowledge, highly centralized in Chile’s capital of Santiago. On October 4, 2021 the Constitutional Convention, led by Drs. Loncón and Dorador, voted to declare a Climate and Ecological Emergency.

### 3. STRENGTHEN ENVIRONMENTAL STANDARDS FOR MINING OPERATIONS AND MONITOR ACTIVITIES.

In addition to deeper engagement with Indigenous communities, mining activities should meet stronger environmental and social standards in general. Many organizations and institutions, from the United Nations Development Program to a variety of nongovernmental organizations, have produced recommendations that could be used. Some of their key points address community engagement, mining waste, water consumption and pollution, and air pollution.

Experts on the Puna de Atacama area also suggest that more robust environmental monitoring is both possible—through a combination of remote sensing, oral history and ethnography—and necessary. These techniques could help identify changes to the water table, shifts in the population dynamics of local plants and animals, and other key environmental indicators. Monitoring should happen in ways that build trust locally and nationally and produce meaningful data that communities and citizens can use to hold mining companies accountable. To this end, funding for monitoring efforts should be transparent and independent of these companies; they could be carried out by, for example, universities or public agencies.

### 4. REGULATE AND MONITOR THE USE OF BRINES AND MAKE DATA ABOUT LOCAL WATER RESOURCES AVAILABLE AND TRANSPARENT.

Governments and mining companies alike should address the lack of regulation and transparency over the water resources involved in lithium extraction from brine and take steps to obtain robust, transparent, and publicly available data on brine and water usage. In Chile specifically, the Water and Mining Codes taken together classify brine as a mineral, not as water, and do not require the government to regulate it or monitor how much brine is being pumped out of the salt flats by mining companies. Companies do not have to disclose this information. As a result, these resources cannot be adequately regulated, and the local environments and communities suffer for it.

Particularly in Chile, authorities should reclassify brine so they are able to better monitor and safeguard this resource. If not already in place, governments around the Puna de Atacama should also adopt legislation and regulations that would enable them to:

- Study and measure available groundwater and brine resources and/or provide funding to independent professionals who can do so.
- Regulate the distribution and use of these resources.
- Require companies to disclose their use of these resources.
- Make the data available to the public in a transparent and regularly updated way.

A potential guide is the California Sustainable Groundwater Management Act. Though still recent, this framework is designed to empower local agencies to sustainably manage groundwater resources, by limiting overuse of aquifers in the long term. However, given the urgency of addressing water depletion in both California and the Puna de Atacama, a less gradual timeline is advisable.

It is worth noting that the lack of available data is not just a sticking point in the community–company relationship. It is also causing friction between SQM and Albemarle, the two companies operating in Chile, as well as between Albemarle and CORFO, the government regulator. This is a fundamental problem for all actors and should be addressed.
5. ENCOURAGE, INVEST IN, AND IMPLEMENT ALTERNATIVE WAYS TO OBTAIN LITHIUM.

Given the rate of water use involved in the evaporation method of obtaining lithium and its impacts on the region, it behooves public and private actors not just to fund research and design but to deploy technological alternatives to the evaporation method in earnest. Many alternatives are already under development. These include (but are not limited to):

Extending the life of batteries on and off the road

One way to reduce the demand for lithium is to make more durable batteries that last longer, like Tesla’s planned “million-mile battery.”

Technological advances that can keep each battery on the road can help reduce the overall amount of materials needed to meet climate goals. Another way to limit demand for lithium is through innovative manufacturing practices. Advanced techniques that can reduce the amount of lithium lost during a battery’s chemical reactions will lessen the need for new lithium material for the same energy storage payoff.

Additionally, there are several circular economy strategies that can lengthen the life of a lithium-ion battery or its components. Once a lithium-ion car battery can no longer hold a sufficient charge to power a vehicle, it can still serve as energy storage elsewhere—in residences or buildings connected to the transmission grid or off the grid entirely.

For example, the Johan Cruijff Arena in Amsterdam uses a hybrid first-life/second-life system to help power the stadium; Nissan’s headquarters in Europe also has a second-life battery system. Policies that support efforts to reuse batteries in these ways, accompanied by public and private sector investment, would help accelerate their development.

Similarly, researchers are studying ways to improve remanufacturing options for lithium-ion batteries, where only the worn-out components are replaced rather than the whole battery. Remanufacturing has been found to reduce energy consumption and greenhouse gas emissions in the manufacturing process (relative to manufacturing completely new batteries) and can be cheaper as well.

Recycling lithium-ion batteries

Recycling the pure chemical lithium contained in old batteries can reduce the need to mine more new minerals. Even though the chemistry involved is generally understood, recycling facilities are not focused on recovering the full range of materials in lithium-ion batteries. Currently very few lithium-ion batteries are recycled, and when they are, in some cases only the cobalt or nickel is recovered while the lithium is discarded as waste. However, we know that widespread battery recycling can be achieved, especially with the help of policy. For example, recycling rates of lead acid batteries (the type that power common consumer goods) have climbed to upwards of 90 percent in many countries. This is partially a result of waste regulation practices that encourage recycling in places like the United States.

Recent research by Earthworks found that recycling EV batteries at the end of their useful life can reduce primary demand for lithium by as much as 25 percent. It can also reduce the primary demand for cobalt and nickel by 35 percent and for copper by 55 percent.

One fundamental obstacle to widespread and thorough recycling of lithium-ion batteries is cost: extracting lithium from discarded batteries is more expensive than extracting it from brine via evaporation. To overcome this barrier, governments can and should establish policies to ultimately require full recycling of batteries. We can also anticipate that market forces will make recycling more cost competitive: as demand for lithium rises within the buildout toward our climate goals, the price of lithium will rise, increasing the value of the secondary market. At the same time, continued research into improved recycling technologies and systems can help recover more material more efficiently, driving down costs.

In fact, various types of recycling technologies are already in development to make the process more cost efficient and replicable on a wide scale. Around the world, research centers have been established to improve existing lithium-ion battery recycling methods. Examples include the ReCell Center in the United States, the Faraday Institution ReLiB Project in the United Kingdom, the Commonwealth Scientific and Industrial Research Organisation in Australia, and the ReLiVe, Lithorec and AmplifiII projects in the European Union. Private companies such as Li-Cycle, Northvolt, and Umicore, among many others, have also stepped into the arena.

Governments are assisting with funding for those efforts and are beginning to enact policies designed to support the development of lithium-ion battery recycling programs. For example, starting in February 2018, the Chinese government imposed a series of regulations to ensure that automobile manufacturers collect and recycle lithium-ion batteries, that collection is done safely, and that recycling recovers a minimum amount of major battery metals including lithium. The European Union established its Battery Directive in 2006 to address battery waste and is currently finalizing a proposal to update the directive to address new challenges faced by the industry, particularly with respect to lithium-ion batteries, in line with the concept of circular economies and with the European Green New Deal. The U.S. Department of Energy announced in January 2019 a new research and design center dedicated to lithium-ion battery recycling (the aforementioned ReCell Center) and a Recycling Prize for entrepreneurs to find innovative solutions for addressing recycling challenges.

Federal legislation, the Battery and Critical Mineral Recycling Act, has been introduced to invest $150 million in the next five years to support further research.
Latin American countries looking to add value to the lithium battery supply chain beyond being a source for lithium can and should invest in becoming part of a more circular process. They can do this by investing in recycling research and infrastructure themselves or by connecting with other countries or actors who are further along in developing those capacities.

**Extracting lithium from geothermal brines**

Experts are looking at ways to extract lithium from brines at geothermal power plants, combining clean energy generation with direct lithium extraction. Operators would remove lithium from the brines pumped up for geothermal energy generation before reinjecting the brines back into the closed cycle. Proponents position this process as the most sustainable way to recover lithium. This technology is being developed in California’s Salton Sea, Germany’s upper Rhine Valley, and England’s Cornwall region. If done with appropriate safeguards for environmental justice and equity, this could be a beneficial coupling.

**Direct lithium extraction**

Direct lithium extraction (DLE) technologies, including adsorption, ion exchange, and other selective electrochemical processes can remove lithium (as well as sodium and potassium) ions from brine water in hours rather than months, avoiding the loss of so much water in evaporation. Less brine evaporation could reduce the risk of water depletion. DLE is already being used or planned for use at brine fields in South America; for example, it is in use in at least one stage of the production process in Livent’s mines at Hombre Muerto in Argentina. Direct lithium extraction should be duly studied to ensure that its impacts—especially those of disposing treated brines and its use of freshwater—are understood and monitored.

**6. ENSURE THAT COMPANIES THROUGHOUT THE BATTERY SUPPLY CHAIN REQUIRE BETTER PRACTICES FROM THEIR SUPPLIERS ON THE GROUND.**

Pressure to protect the local environment and reduce the social impacts of lithium mining should come from companies farther up the battery supply chain—from battery makers to EV manufacturers—as well as from local stakeholders. For example, Tesla and BMW have signed agreements with cobalt mining companies. This gives them the ability to exert direct pressure on those companies to stop the child labor and human rights violations that have plagued the sector in the Democratic Republic of Congo.

Governments could also require companies to perform this kind of due diligence in their supply chains. Third-party certification efforts could support this with adequate safeguards to prevent greenwashing.

**7. APPLY LONGER-TERM SOLUTIONS THAT REDUCE THE NEED FOR NEW BATTERIES, AND THEREFORE NEW BATTERY MATERIALS LIKE LITHIUM.**

Another approach to reduce the impacts of the lithium mining industry is to enact policies that reduce the future demand for new lithium-ion batteries. Policymakers, private companies, and citizens can help push forward a range of strategies, including:

- Improved land use planning, local siting, and public policy tools to allow greater access to and use of public transit, biking, and walking to reduce long-term dependency on single-passenger vehicles (Chile is one of several Latin American countries already creating an electric corridor for public buses).
- Retrofitting or building affordable, energy-efficient, and regenerative homes and buildings for all.
- Investing in and adopting long-duration methods of renewable energy storage (e.g., gravity-based or iron flow) that minimize extraction and maximize efficiency over time as an alternative to lithium-ion energy storage technologies.

**8. ENFORCE A MORATORIUM ON BRINE EVAPORATION THROUGH APPLICATION OF THE PRECAUTIONARY PRINCIPLE.**

According to UNESCO’s World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), “When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.” This, essentially, is the precautionary principle. Because brine evaporation is thought to exacerbate ecological exhaustion in the Puna de Atacama, and because the actors responsible for this activity have failed to disclose clear evidence establishing that it does not do so, precautionary measures should be taken. In this instance, the burden of proof is on the extractive industry to show definitively that water availability is not threatened by brine evaporation, and until it has done so, it is in the public interest to cease this activity in the Puna de Atacama.

Following demands from the CPA, as well as the nonbinding verdict of the International Rights of Nature Tribunal denouncing lithium mining for threatening water availability, a moratorium should be enforced on lithium mining through brine evaporation in the Puna de Atacama.

There is no single silver bullet to stop the environmental and social problems that lithium mining is currently producing in the Puna de Atacama. Rather, a diverse mix of the above solutions involving the urgent action of governments, the mining sector, other private sector actors, and civil society are required to fight climate change without perpetuating these impacts.
Conclusions

Given the urgency of the climate crisis, we cannot wait to move away from fossil fuels. Without a major technological change, lithium will likely continue to be a critical material for the global energy transition, particularly in transportation and energy storage sectors, which currently rely on lithium-ion batteries.

Yet, at the same time, climate action should not sacrifice local ecosystems and communities that have lived in and shaped the landscapes that contain the resources needed for batteries. The present and predominant method of extracting lithium from South America’s Puna de Atacama region—the evaporation method—is destructive. As a result, the area’s already scarce water resources are disappearing. As we have seen throughout this report, these changes are impacting people’s livelihoods and environments in severe ways.

What’s more, brine evaporation is a much longer process than the recycling and direct extraction methods discussed in the Recommendations section, taking months as opposed to just hours or days. The urgency of addressing global warming underscores the value of faster processes for sourcing materials, especially if they are better for communities and the environment.

The status quo is not just, not responsible, and not acceptable. Better solutions exist and should be implemented without delay. The recommendations above can help bring about these important changes and should be embraced by the full range of actors in this industry, from local stakeholders to global car manufacturers and everyone in between. Doing so could help heal the “exhausted” Puna de Atacama region without impeding the transition to a cleaner future for the planet.
That’s the Problem With That Lake; It Changes Sides’: Mapping Extraction and Ecological Exhaustion in the Atacama,”


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Dr. James J. A. Blair, Cal Poly Pomona, personal communication Sergio Cubillos, 2019, transcribed by Bianca Delgado and translated by Amanda Maxwell and Language Divas.


Volkswagen, “Fact-Finding Expedition to the Lithium Desert of Chile,” video, March 11, 2020, https://www.volkswagenag.com/en/news/stories/2020/03/fact-finding-expedition-to-the-lithium-desert-of-chile.m8. Volkswagen and Daimler have since launched a study through the German aid and development agency GIZ to promote more “sustainable” lithium mining in Chile.


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Page 23


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97 On the Argentine side of the Puna, the preferred Indigenous category is Pueblo Atacama rather than Atacameño. Jerez Henríquez, “Impacto Socioambiental de La Extracción de Lítio.”


Jerez Henríquez, “Impacto Socioambiental de La Extracción de Lítio.”


101 These 33 communities include Tambillo, Cochagaste, Casabindo, Santa Ana de la Puna, San Francisco de Alfarcito, Rinconadilla, Santuario de Tres Pozos, Abralaita, Agua de Castilla, Río Grande, Quera, Agua Caliente de la Puna, San Miguel de Colorado, El Moreno, El Angosto, Lipán, Aguas Blancas, Cianzo, Barrancas, Santa Ana de Abralaita, Quebradillas, Gayate Oeste, Agua Chica Romque, Aguilar Chica y Fabelón, all on the Jujuy side of the area; and Cobres, Cerro Negro, Rangel, Esquina de Guardia, Tipán, Casa Colorada, Matancillas, and Esquinas Blancas on the Salta side. Government resources say the mine is entirely owned by Pluspetrol, but on its website Dajin Resources lists itself as maintaining 49 percent, demonstrating the complicated relationships among the companies themselves. See Jerez Henríquez, “Impacto Socioambiental de La Extracción de Lítio,” 33; and Subsecretaría de Desarrollo Minero, Secretaría de Política Minera, Ministerio de Producción y Trabajo, Presidencia de la Nación, “Argentina: Advanced Lithium Projects in Salars.”


121 Heubl, “Lithium Firms Depleting Vital Water Supplies.”


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