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THE UNIVERSITY of EDINBURGH

School of Social and Political Science

Dissertation for the degree of

PhD in International Development

Emilio Soberón Bravo

October 2022
Lithium Overdose

Market Practices and Symptomatology of Lithium Trade in Latin America

Emilio Soberón Bravo
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Dedication

This work is dedicated to Guillermo Soberón Acevedo. His continuous attention to this project and the inspirations of his life’s work have been immeasurable drivers for meeting this project’s academic purpose to completion with singularity, relevance and gravity.
Declaration of own work

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where stated otherwise by reference or acknowledgment, the work presented is entirely my own.

Wordcount in main text: 91,350
Lay summary

Lithium is a material needed in a globally favoured type of batteries. A large share of its mining concentrates in Chile. Lithium mining in Chile has historically happened in the Atacama Desert, where high quality lithium resources are abundant and where it is cheaper to mine it than in other locations across the world. Prior to lithium mining, the Atacama Desert had a background of saltpetre and copper mining. Saltpetre and copper have been important for Chile’s economic progress as an exporter of raw materials, and have established the relations held between the Chilean State and mining. The relevance that Chile has in global lithium supply is comparable to the relevance that the country had on saltpetre and copper supply in the past. This background ties how mining companies and the Chilean State interact through contracts.

This research critically focuses on the contracts held between lithium mining companies and the Chilean government. The contracts that lithium mining companies in the Atacama Salt Flat have with the Chilean government establish terms for mining lithium and for selling it to other companies. These contracts define metrics for quantity output, establish meanings for valuations, and fix processes for client selections. Like contracts for mining copper and saltpetre, lithium mining contracts in Chile affect the choices and compromises that companies make to select partners, prices and clients. This research examines the functions of lithium mining contracts in Chilean politics and global lithium supply, and explores the ways in which lithium supply contracts are affected by copper and saltpetre histories.

Copper and saltpetre mining in Chile established settings in Chilean economy and politics that persist in lithium mining. This research specifically finds that these settings include governance of resources based on contracts, national development based on export taxes, close-knitted oligopolies, lax customs, and resource overvaluations. This research further finds that economic settings of mining in the Atacama Desert introduce incompatible visions for resources which cause disagreements between mining companies and governments. Disagreements are evident from multiple intentions to augment value of resources that are found in this research to include reduction of costs for companies, control of purchases by governments, increases of payment to the State, and uses of natural resources in geopolitical power struggles. This research finds that disagreements introduced by past economic settings and contemporary contracts for mining are a central component of lithium supply in Chile.

This research presents how companies in the Atacama Desert interact with land, materials, governments and other companies. The study analytically contributes to understand how past economic settings for mining can impact the journey that materials take to their final use. This research deepens the existing body of knowledge on the economics of unchangeable, bottleneck materials, with a particular focus on how to detect and study histories of materials and their effects on development and the broader economy.
Abstract

This thesis examines lithium supply and trade in the Atacama Desert in Chile from stances of social studies of markets. It focuses on the contracts held between mining companies and the Chilean State that establish terms for mining lithium and supplying it to other companies. The analyses are centred on three concepts: market devices, assemblages and value chains. These concepts are used to critically examine mining contracts, technology deployment, equity markets, physical material quotas and value added processes as constituents of networks and agency in global commodity supply. The thesis identifies the economic settings for lithium mining in Chile and discusses their similarities to past settings experienced in Chile for copper and saltpetre mining. These settings include: resource governance based on mining-development contracts, national development financing from export taxes, close-knitted oligopolies, lax customs, and resource overvaluations. The thesis examines the effects of past economic settings of mining in Chile on the negotiations held between the State and mining companies on contracts, infrastructure, shareholdings, metrics, prices and tropes. The thesis finds that the economic settings of mining in the Atacama Desert replicate State agendas that aim to separate economic growth from global dependencies but rely on mining law and practice based on private-sector capital structures established for nation-making. The thesis argues that past economic settings for mining are significant drivers for determining value of materials and for implementing tactics and forms of economy and development in a given country. The analytical content of the thesis is framed in a body-economy metaphor that highlights some toxicities of energy devices specific to material trade and use. This body-economy metaphor supports that the findings in the thesis about economic activities for lithium supply in Chile are systemic and part of a unified social metabolism.
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Foreword

My aim in this thesis is to see materials as they are defined and affected by corporate equities. Explicitly, to examine corporate equities as contours of mining economics. This aim is driven by personal curiosity about the interactions that economic conditions and corporate and government actions in markets build for the prevalence of a material and its end-use. Corporate equities are hypothesised in this study to be bedrocks of mining and thereby to be hosting and contouring bodies for material availabilities and preferences.

I exercise this aim and hypothesis with lithium raw materials from Chile and energy storage technologies because of personal interests in the lithium industry, and because at the time of research lithium supply in South America was receiving significant political and economic attention, and commercial and political structures for mining battery raw materials at considerable scales in Europe and North America were basically nonexistent. While research fieldwork happened, contracts between the Chilean government and lithium mining firms were being modified and renewed, shares of lithium mining companies in Chile were being acquired by companies registered in foreign countries, lithium spot prices were plummeting, governmental industrialisation policies in Chile were affecting lithium supply chains, and worldwide decarbonisation through lithium-ion batteries was increasing in traction.

To test if corporate equities are frames for material availability and preferences, I question if lithium-ion batteries are in their prevalent position largely due to a result of mining economic practices and histories of corporate equities in Latin America. Understanding the current and former practices for making and using mining companies in the Atacama Puna could expand our understandings of why is lithium in South America being largely sourced and traded from Chile even when lithium resources in the region are known to also exist in great quantities in Bolivia and Argentina. How deep is mining in the Atacama Desert tied to corporate equities? How deep are batteries and climate change mitigation then tied to corporate equities? How far back does this tie go? Maybe so far back and deep enough, that it becomes dark. Can a perspective that stresses the role of corporations and their shareholding value and exchange unveil market interventions that make everyday objects?

With so many electrochemical energy storage technical possibilities, what is it about lithium that has placed it in its market position, why more advancements there than elsewhere? If the reasons for preferences for lithium-ion batteries are inherent to intrinsic material properties as energy density and conductivity, why have the other countries beyond Chile in what is called ‘the lithium triangle’, the geographic area where Bolivia, Argentina and Chile border each other, stagnated in sourcing and trading lithium? Could the reason for this go beyond chemical differences in lithium resources across the lithium triangle and revolve on the specific contexts for mining and corporate equity in the region?

The links of material extraction in Latin America and China's industrial growth have noted correlation
but they have not fleshed-out the weight of Latin American mining enclaves. What then can we learn from an economic sociology approach on matters that have to date been expanded from stances of geopolitics and engineering? Would a perspective on corporate equities and the interventions they may have in materials across the world explain why is the lithium triangle, as expressed to be formed by Bolivia, Argentina and Chile, only an issue that at the time of research involves mostly trade from Chile? Sure, projects are coming online in Bolivia and Argentina, but they have admittedly lagged. Could a focus on corporate equities have anything to say about the conditions and settings that have placed only one of the countries of this triangle to be the global leading exporting source and the only significant exporter in its region? Would the lag of production from other parts of the triangle have more to do with corporate equities than with the chemical compositions of their salt flats?

Corporate actors on global lithium supply for battery futures discuss lithium supply from Latin America as only relevant to regard Chilean sourcing. This study is an exercise of unpacking if this idea is tied to the economic settings and market practices around corporate equity held in the country.

**Usage**

This thesis joins three things: a metaphor, a journey and an analysis. Specifically, these are a metaphor of the energy system as a human body, a journey into the social lives that make market practices for lithium extraction, trade and pricing in Latin America, and an analysis of contemporary assemblages in lithium supply.

The content of the thesis is divided in four sections that metaphorically address lithium intake in the energy system as reflective of bodily responses. Each section reflects on events in lithium supply and politics as symptoms from lithium poisoning in a human body. The sections are: adherence loss – chapters 1 and 2; renal instability – chapters 3 and 4; thyroid instability – chapter 5; and parathyroid instability – chapter 6. Section introductions are creative and experimental. They include first an internal monologue of a person experiencing lithium toxicity. These monologues are followed by a clinical description of the symptom at hand and an analogy of the energy system as demonstrating these symptoms.

On another hand, chapters are narrative and analytical. Each chapter goes through events related to lithium in society as a material traded and used for battery energy storage. Each event is unfolded and analysed through descriptive and narrative writing styles, with expository boxes that introduce academic insights and facts as they are related to the main text. The chapters compose the main body of the thesis where lithium supply and trade is analysed as an assemblage of human and non-human economic actors.
Background – Lithium and Latin America

Lithium is a chemical element symbolised in the periodic table of elements by Li. It is a soft, white alkaline metal.\(^1\) It has a solid state at regular ambient temperatures but is very reactive to its environment.\(^2\) Storing it on its own is problematic which is why it is normally employed as a salt where it can be best kept and manipulated. Lithium as salts include for example lithium carbonate, lithium chloride, lithium sulphate, lithium citrate and lithium hydroxide.\(^3\) These materials are obtained from processing brine or converting mineral concentrates. Mineral concentrates are today divided into either coming from spodumene, lepidolite or amblygonite hard-rock or clay deposits.\(^4\) Processing brine usually derives in lithium chloride which is converted to lithium carbonate. Mineral concentrate conversion is most normally focused on spodumene concentrate processing which results in lithium sulfate that is converted to lithium hydroxide. Recent developments in conversion have made lepidolite mineral deposits a surging source for lithium hydroxide and amblygonite clay deposits one for lithium carbonate. A specific lithium salt can be converted to another type of lithium salt in suitable chemical plants.

Historically, lithium is known for being consumed in the human body. It was first eaten as medicine for gout in Europe in the XIX century. Gout was recognised to be linked with uric acid, whose excess was thought of being controlled with lithium dosages.\(^5\) Lithium carbonate intake was thought of as remedy for gout from its effect in decreasing uric acid diathesis; but this was later found to be false.\(^6\) It was not uric acid that decreased by lithium carbonate but rather the symptoms of manic disorders, as melancholia and depression, which were associated to the behaviour of gout patients.\(^7\) Lithium was in fact only having an effect on manic instabilities. Still, in times when it was thought of being related to gout alleviation, lithium treatments were mostly applied in Denmark for depression cases. Particularly, brothers Carl and Frederick Lange, respectively working on neurology and psychiatry, were the first to examine and record lithium therapies.\(^8\) After the Lange brothers, some time elapsed for further use of lithium in medicine. Providing the recognition from medical society at the time that lithium was not curing gout and that it was potentially toxic when overdosed, lithium consumption stagnated.\(^9\) However, lithium did come back to flourish as medicament around the 1950s as further experiments in Australia initially and then

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3. Ibid.
5. First observations linking uric acid diathesis and gout were confirmed by Garrod (1859).
7. Gouty insanity, as coined by Garrod (1859), was later followed by Carl Lange with a work dedicated to lithium carbonate treatments for ‘periodic depressions’. Schioldann (2009) provides an overview of Carl Lange’s record along with a detailed account of the history of psychopharmacology.
9. Remarks of disrepute are made by Schioldann (2009) who links the false hypothesis to the reluctance to follow therapies after observations from the Lange brothers.
worldwide looked into lithium treatments for stabilising mental unbalances.\textsuperscript{10} Although the mechanisms of action in the human body by which lithium prevents and limits bipolar disorders are largely unknown, lithium’s physiological effects are growingly being recognised.\textsuperscript{11} Today it is known that when ingested as medicament, lithium is rapidly absorbed in the gastrointestinal system and eliminated through the kidneys.\textsuperscript{12} While active, lithium distributes in the nervous system where it interferes with neurotransmitters.\textsuperscript{13} Serotogenic neurotransmission is affected by lithium through mechanisms that include increases in serotonin synthesis, increased tryptophan uptake and increased serotonin release. Lithium in the human body likewise affects dopamine and glutamate systems by causing inhibitory actions on dopaminergic and glutamatergic neurotransmissions.\textsuperscript{14} It also has been found to increase activities of the aminobutyric acid neurotransmission, which regulates dopamine and glutamate neurotransmission.\textsuperscript{15} The anti-suicidal, anti-depressive, anti-aggressive, anti-manic and anti-psychotics effects of lithium have been suggested to be related to its inhibitory action on excitatory neurotransmitters and excitatory actions on inhibitory neurotransmitters; specifically on its effects on serotonin, dopamine, glutamate and tryptophan. However, no conclusive evidence exists yet to link lithium’s therapeutic effects and its physiological ones.\textsuperscript{16}

In medicine, lithium carbonate, lithium sulphate and lithium citrate are used indistinctively; it is only the lithium atom in the salt that is effective and there are no clinical differences in the uses of one salt over another.\textsuperscript{17} For other purposes, the choice of the lithium salt, also called lithium material, matters. These purposes specific to lithium material types include ceramics, energy storage and financial derivatives trading. These purposes draw attention to lithium as a commodity and bring forward actions for manipulating lithium price and supply.

Little if not anything about lithium trade has been thoroughly traced prior to the 1900s. The majority of lithium material volumes have been historically traded through bilateral agreements between mining and chemical companies for long-term physical deliveries. Since its uptake in medicine, most lithium came from Australia, China and United States.\textsuperscript{18} However, supply diversified to regions in Latin America roughly by mid-1900s.\textsuperscript{19} Latin American lithium supply specifically came from the region where Bolivia, Chile and Argentina today border one another, the Atacama Puna, also known as the lithium triangle. Lithium from Latin America started as a by-product in potash industries working with brine for fertiliser

\textsuperscript{10} Malhi (2010) and Bourgeois and Masson (2017).
\textsuperscript{11} Alda (2015).
\textsuperscript{12} Alda (2006).
\textsuperscript{13} Juckel and Mavrogiorgou (2006).
\textsuperscript{14} Bauer and Gitlin (2016).
\textsuperscript{15} Ibid.
\textsuperscript{16} Ibid.
\textsuperscript{17} Bauer and Gitlin (2016).
\textsuperscript{18} Zicari (2015).
\textsuperscript{19} Fornillo (2015b).
production. Still, before that in the Atacama Salt-Flat, saltpetre industries in the 1800s used brine. The Atacama Salt Flat, where Latin American lithium supply started and today remains largely focused, was ground for saltpetre production in the 1880s. Despite that brine production and processing began earlier, it was until 1970 that lithium from brine was commercially produced in Latin America. Coming from Chile, its output at the time represented roughly under a third of global supply, while Australia provided two thirds of it.

Lithium was traded mostly for medical and ceramic uses until the early 2000s. Technology change and increased adoption of consumer electronics in the early 2000s spurred demand for small, light and rechargeable batteries. Consumption burst for small electrical devices meant for unplugged use. At the same moments, lithium-ion batteries were considered and spoken of as the best available battery for them. Battery uses grew onto wider niches devised for electrification as household and industry consumptions, energy generation facilities, electricity grids and transportation. The increase in lithium consumption happened rapidly, but it was not a strict demand-driven affair. Lithium from Chile introduced changes in the cost structure of batteries. Providing cheaper sourcing for lithium materials, lithium-ion battery chemistries were easier to test, develop, and importantly to produce in larger scales. Along that, politics adapted to make ways for lithium materials to be sourced from the Atacama Salt Flat.

Sourcing lithium from Chile meant moving it as well. Metals from the Atacama Desert are usually moved initially in containers through railways or lorries that reach piers leading elsewhere, normally from the Antofagasta city pier. From there, containers are distributed mainly to cathode active material plants and battery manufacturing clients. Mines in the region entail vast infrastructures designed for communication from within the desert to the shore. Increased demand, coupled with feeble monitoring and backgrounds of militarisation in the Atacama Puna, and corruption and collusion in customs, set structures for moving large quantities of lithium materials from the Atacama Salt Flat without thorough and reliable records. Connections among these factors favoured trade opacity. Until 2014, the company with the largest area for mining lithium in Chile, SQM, produced and distributed lithium materials without any control or thorough registers on operations and exports until 2015. To clog these leaks, the Chilean State filed legal complaints in 2014 and renewed bilateral contracts in between 2016 and 2018 to specify and limit production and distribution quotas as well as restraining certain products, as brine, from being sold or shipped. These contracts and complaints targeted all lithium mining companies in the Atacama Salt Flat.

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23 Bruckmann (2012).
Globally, lithium trade structures changed for lithium materials due to the entry of Latin American sourcing and its changing politics. This work starts from this point to analyse closely the lithium mining contracts in the Atacama Salt Flat and their interactions with assemblages for global lithium supply.
Introduction

Storyline / Case

The Atacama Slat Flat is embedded in the Atacama Desert of the Antofagasta region in Chile. On ground it can be accessed by arriving first from the city of Calama to San Pedro de Atacama, a touristic place that mostly focuses on romantic, adventure and holistic getaways. From San Pedro de Atacama, a straight two-lane road goes deep into an apparent barren landscape. This road stretches alongside the Andes range while seemingly diving into an area where open sky above, mountains to a side and continuous nothingness to the other dominate landscape features. A few settlements lay between the Andes range and the Atacama Salt Flat, these are Toconao, Peine and Socaire, all within reach by traversing the mirages that form on the linear road ahead. Toconao is about an hour drive from San Pedro de Atacama, as is Peine from Toconao. Roughly midway in between Toconao and Peine, a perpendicular exit to a sinuous dirt road makes way towards the salt flat. The ground colours nuance into whiter shades as one traverses deeper into and through the dirt bends. Despite its name and its fame for being one of the most arid places on Earth, the landscape of the Atacama Salt Flat conceals diverse and living traits. Close by, life and movement are constant. Within the Atacama Salt Flat, nature reserves and lagoons present spaces that contrast imageries of deserts as hostile and arid frontiers. As dry as it may turn, during the first months of the year, the desert blossoms as an atmospheric pressure system in the Bolivian altiplano induces precipitation in the Atacama Desert, a period known as the Bolivian Winter. Water and fertile rich ground enable myriad species to roam and set within the salt flat. Still, the most obvious occupation in this particular place is human presence.

Energy infrastructures are immediately visible while approaching San Pedro de Atacama. Once making way from the Calama airport, large wind turbines and vast solar panel arrays side-line a highway that enters the Moon Valley separating Calama and San Pedro de Atacama. These structures are testament to the presence and strength of intermittent renewable energy sources, and they introduce a vision that Chile might have for its energy futures. Still, other infrastructures are somewhat recognizable from a distance, these are mining sites and machineries. The road does not traverse mines as it does through renewable energy generation plants; which also suggests a vision of the approach that Chile, as a politically influent country in its region, might have for its image as engaged with sustainable futures, somewhat displayed by devices of clean energy and sustainability. Despite the located suitability and growing interest for solar and wind energy technologies, the Antofagasta region is historically rooted to mining. As it advances in the Atacama Desert, the road to the Atacama Salt Flat from Calama increases one’s recognition of mining operations. Questions about their histories inevitably rise as mines appear somewhat concealed in a desert filled with clean energy machines. The overlap of multiple contrasting
sorts of sites and equipment for resource and energy use and transformation call to question relations that exist within and among material bases and sustainable energy devices. The same questions of relations are brought for the images, ideals and strategies that they have and are driven by.

Today, the Atacama Salt Flat is a mining concession that encompasses touristic and conservation areas. The Atacama Desert, where it sits, borders Argentina, Bolivia and Peru. Past conflicts between Chile with Bolivia and with Peru respectively defined the desert to what it is today. Treaties held in 1883 between Peru and Chile and in 1904 between Bolivia and Chile provided great benefits for Chile in terms of land acquisition.\textsuperscript{25} Land acquisition then, reflects resource wealth today. Its contrasting landscape composed of mountains ranged in front of vast plains covers a wealth made up of liquid form. Access to water has triggered conflicts in the past as it does today; ocean water in the 1880s and groundwater since the 2000s. Groundwater in the Atacama Salt Flat carries riches washed from the Andes. Minerals are weathered by water draining within the mountain ranges towards the Altiplano where it sits and evaporates and deposits its components, rendering whatever water is left even more concentrated with dissolved minerals.\textsuperscript{26} This water, distinguished by its saturation of washed minerals, is called brine. Only a few species can endure brine coupled with intense sun. But those that endure, thrive. Its location and composition results in an ideal environment for species as brine bacteria and shrimp, and endemic flamingos and cacti.\textsuperscript{27} Brine also favours particular materials. Brine from the Andes, combined with evaporation planes, provides an environment abundant with readily available evaporitic minerals as salt, potash and saltpetre. Today, when sourced in flat lands below the Andes where high evaporation rates naturally occur, brine becomes a central point for easily producing lithium dissolved in it, particularly materialised as lithium carbonate, lithium chloride and lithium hydroxide. Even though these materials are not exclusive to Chilean salt plains, brine under the Atacama Salt Flat is recognised as a distinctively purer brine for lithium materials.\textsuperscript{28} Still, the histories of extraction in the area, with their nationalist and colonial legacies, and the global and local imaginaries of resources impact how these materials are perceived, politicised, materialised, valued, priced, traded and used. The Atacama Desert then provides a frame for observing, tracing and understanding the components of today’s lithium supply chain.

The Atacama Salt Flat, its inhabitants, owners, and users, all recognise a global stare on this place. This attention is today drawn due to its stake on a material posed as necessary to rapidly reach electrification

\textsuperscript{25} Zapata (1992).
\textsuperscript{26} Herrera \textit{et al.} (2018).
\textsuperscript{27} See CIREN (2016) and Santiago \textit{et al.} (2018).
\textsuperscript{28} Mohr \textit{et al.} (2012) and Fornillo (2015b). Discussions of the ‘Lithium Triangle’ include Argentina and Bolivia into a globally abstracted image of a lithium rich territory. However, for the purpose of understanding lithium supply and trade from Latin America, only the sourcing from Chile is pertinent proving not only its brine purity and privatised governance, but importantly its commercial maturity which is lacking in the rest of the constituent countries of the lithium triangle.
Introduction

futures. An abstracted image of global material needs turns a locally pressed urge to mine, price and supply. This thesis situates the transformations and dynamics between global and local images and imaginaries through a supply chain perspective, recognising an ambivalent balance between the weights and agencies of supply and demand experiences. The Atacama Desert has a long history with the supply of global metal bases. Copper mostly dominates remembrances in the region, but other materials as molybdenum, tin, potash and saltpetre hold intricate stories that today makeup the current relations that occur with materials, companies, politics and people in the region. Often when mining occurs in Latin America, conditions for it remain under its colonised and authoritative pasts. This thesis critically examines how contemporary policies, prices and markets for metals are made when they encounter such legacies.

In order to speak about a thread emerging outwards from the Atacama Salt Flat and its materials, this thesis is inspired by supply chain studies. However, it does not follow a ‘chain’ perspective as occasionally approached in supply chain analyses. Instead, it focuses on analysing the lithium supply stages and their making as related to political and economic instruments as public-private agreements, joint ventures and calls for projects, and to market indicators as corporate equity shifts and sales. This thesis analytically unboxes stories about lithium materials for batteries – stories that form from social and economic events and experiences that are specific to and that derive from the Atacama Salt Flat in Chile. It documents lithium materials and battery technologies as socially devised by narratives on market and economic projections and speculations. By way of unpacking these narratives as social constructs that are often hegemonic, it recognises narratives as shaped by the market and economic environments they affect. Development and pricing strategies on lithium materials in Chile are here located and described to argue on the significance that narratives and images have on economic performances.

This thesis engages with economic sociology of supply chains and material trade, as presented by Koray Çalışkan (2010) on social studies of global cotton trade and by Donald Mackenzie (2009) on social studies of economic agents in markets. The thesis upholds anthropological perspectives on resource

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29 See Mohr et al. (2012) and Bazilian (2018) for discussions on lithium needs for energy storage demand expectations. Likewise, civil society and multilateral agencies estimate lithium requirements for forecasted energy storage technologies, WWF (2014) and IRENA (2017) exemplify this. Statements of lithium material needs for ‘excessive’ demand from electrification futures are likewise present in official Chilean government documents that regard the matter.


31 Several accounts describe interests on materials differently. For instance, Zapata (1992) describes materials as they related to the Pacific War that faced Chile against Bolivia and Peru, and as they today form political relations among those countries. Based on it, internal and external political relations spawn from histories of material pasts.

32 See Galeano (1997) and Mignolo (2005) for details on Latin American colonial legacies. Contemporary resource governance and politics in Latin America, and colonial trends that may be maintained therein, are presented in the work made and compiled by Riggiozzi and Wylde (2017).

33 See Souza (2014) for an overview of analytics on supply chains. Topik et al. (2006) discuss on the current modes in which Latin American commodity chains tend to be analysed.

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environments, as brought to evidence by Tanya Richardson and Gisa Weszkalnys (2014) on extended materialities of natural resources that demonstrate other networked physical and cultural components beyond immediate encasing natural features. An anthropological understanding of resource environments leads attention to “the complex arrangements of physical stuff, extractive infrastructures, calculative devices, discourses of the market and development, the nation and the corporation, everyday practices, and so on”.35 Hence, an anthropological perspective on lithium supply economics is employed through the chapters that compose this thesis and specifically on the strategies and discourses that underpin assemblages among components of a resource environment. That is, this thesis studies the relations among raw materials, technologies, places, people, industries and policies as value is sought to be obtained from lithium supply.

This analysis of lithium is largely built by observing two things: political histories and corporate equity. This draws attention to shareholdings of mining companies in the Atacama Desert at times when mining was commencing in Latin America and when equities were private and not publicly listed in stock exchanges. Private equities specific to the early stages of mining in the Atacama Desert are spoken and understood in the thesis as parts of the environments where lithium sits and moves, and ultimately as important shapers for the ways this material affects and interacts with society and economics. Contemporary economic strategies on lithium in Chile are here analysed and pinned to broader resource histories of the extraction areas involved for today’s lithium materials. The weight of these histories today then becomes visible when they are contrasted to contemporary Chilean lithium economic strategies and their actors. These histories are trenched with moments of corporate equity shifts and politics. Dynamics of equity shares show how corporate actors in the past of the Atacama Desert are related with those in present time. In the thesis observations, the corporate actors in the past of mining in the Atacama Desert are identified and linked to actors active in the area in present time. The discourses and economic settings around the materials that were extracted in the past are also recognised and compared to discourses and settings for materials extracted today in the same area. Specifically, Chapter 1 provides a chronological mapping of corporate equity shifts for the current lithium mining companies in the Atacama Salt Flat; Chapter 3 details the role of corporations in establishing the economic political governance features of Chile since its independence; Chapter 4 describes the discourses used in the Atacama Desert for copper and saltpetre since mining began in the region and contrast that to the discourses used for lithium in the area; Chapter 6 details the histories for copper and saltpetre in the Atacama Desert and relates them to the observations that the thesis collects and analyses about lithium mining and trade in Chile.36 The thesis argues then that images of materials for nation-making and economic development, and the practices employed for materialising these ideas, are transferred through materials in a way that is supported by

35 Richardson and Weszkalnys (2014, p.7).
36 The content of chapters is further detailed in the following introductory section. Chapters 2 and 5 address demand-side factors respectively being technology deployment and material purchasing for technology production.
the relations among corporate equity in mining firms. Specifically, when economic settings, shareholders and discourses for past materials stay as building blocks for mining a new and different material, current practices for mining and trade will be comparable to past practices employed for other materials mined in the same area.

Technology prospects for energy futures entail that further and possibly new materials will take economic roles which they did not previously have. These materials and their politics and markets, as they exist and as they are adjusted, may give further empirical understandings to theories of economic sociology of material trade, as well as to theories of social structures and constructions associated to resources and technologies. This work contributes to that end by examining corporate equity of lithium supply in Latin America.
**Anchors / Arguments**

This work is inspired by work that has highlighted the material bases for renewable energy systems. Particularly from appreciations that focus on natural resources for transitions to electrified futures beyond discussions of the resource that is transformed to generate electricity. Work that discusses an offshore turbine or a solar panel as connected to tin or silica rather than its direct relation to the wind or sun it is meant to capture. It speaks to audiences generally interested in extractive industries, Latin American social and political contexts, and how taken-for-granted objects are made-up economically.

The work carried for this thesis finds track from and is mainly located around critical thinking on resource governance, value pluralisms, commodity chain and finance studies, and anthropology of technology. It adds to contemporary studies about lithium mining and battery energy storage by moving with but aside to analyses of deleterious environmental impacts of lithium mining, geopolitics of lithium, and battery technology forecasts, to entangle lithium and batteries as a single object for enquiry rather than as separated entities. It therefore focuses on Chile as hub for contemporary lithium extraction and trade, and testing ground for battery procurement and deployment modes, places and shapes.

This work scrutinises today’s social and political productions in the Atacama Desert as devised by lithium supply and battery demands. It sets to think of a supply chain beyond points of observation conventionally employed in quantitative economic and market analyses of raw material supply from Latin America. The interest in observing factors unnoticed in supply economics is to argue that today’s material politics, and particularly those from countries that in development studies are termed as the ‘Global South’, are not thoroughly visualised nor understood by the modes and tropes in which markets and materials are framed and operated.

This project contributes to the body of knowledge on economic sociology of raw material supply and energy objects, specifically to work that addresses assemblages in social studies of markets as that from Michel Callon, Yuval Millo and Fabian Muniesa (2007) and to work that addresses the relational and ethnographic complexities of value universals as that from Anna Tsing (2005). The academic contributions in this work deepen the existing body of knowledge on cultural anthropology in economics of materials, as brought in valuation studies by Sarah Besky (2016 & 2017) and in ethnography of resources by Julie Michelle Klinger (2017). This project interjects mainly in energy humanities, addressing questions that span from enquiring what lithium as energy object does in society, and what does lithium in society show about the economics of material bases for energy futures.

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37 See Bazilian (2018) or Mohr, Mudd and Giurco (2012).
38 See Marichal *et al.* (2006), Arboleda (2016) and Hirsh (2016).
This work is formed by a thesis project that gathers points of enquiry on infrastructures, universals, and valuation and pricing algorithms for situated analyses of complex arrangements between resources and energy objects.\textsuperscript{40} Empirically, this project focuses on practices for material trade and pricing in lithium markets. In more conceptual textures, this project deploys three main concepts: market devices, assemblages and value chains – which encompass for instance objects, processes and meanings as economic agents in the making of relations among people in markets.\textsuperscript{41} These concepts are detailed here below.

**Main concepts**

*Devices*

Devices can be thought of as objects – from every-day mundane objects to large infrastructure. In specific contexts, devices are relevant for the outcomes in everyday life. Material contexts and their effects on shaping, impacting and configuring the human condition have been a central point of enquiry for scholarship on Science and Technology Studies.\textsuperscript{42} The impact of devices in making human conditions was firstly observed in laboratories where they have been studied as significant components in the contexts of knowledge production.\textsuperscript{43} Early work on the scientific laboratory context argued that artefacts and equipment are as central as epistemology in fact-making.\textsuperscript{44} Likewise, in the early developments of the study of devices in human conditions, the possibility to scrutinise infrastructures as an conjunction of things was in great length sourced from ideas of ‘technical devices’ – where a technology meets organisational work.\textsuperscript{45} From the concept of device – as an object that provides agency – critical scrutiny of material contexts enhanced the examination of infrastructures to enquire when infrastructures become infrastructural devices.\textsuperscript{46} Foundational works on the study of sociotechnical devices laid strong emphases on the politics behind and around every-day objects as they orchestrate specific and often excluding sort of operations in society.\textsuperscript{47} This foundation that held together a scholarship committed to ethnomethodological approaches, expanded notably to studies of cities, communication technologies and finance.\textsuperscript{48}

Devices in markets include for example objects like computers, telephones, desks, seats, headsets, keyboards, pencils, jars, containers, ships, trucks, storages, etc. Research has stressed how in some instances devices in markets are critical for the economic setting, process and outcome where people...
receive or alter agency in markets; we can think conceptually that market devices are devices in markets that affect markets. Devices turn into market devices in the extent in which they affect how people interact with markets and how they give someone or a group of people a specific behaviour or leverage with the market place or product. The concept of devices in markets allows to visualise that equipment and settings matter for the materiality of agents beyond individual psychology. Materiality here includes not just inert non-human objects but importantly the non-human constituents of human corporealities that form an economic agents.

Assemblages

The materialities of markets as constituted by market devices and economic agents leads to the concept of *agencement* – an assemblage of objects, humans, algorithms, metrics and other components that in their interlacing and networking acquire agency. Assemblage thinking is based on tracing associations and is a central piece of Actor-Network Theory. In Actor-Network Theory, the focus on understanding assemblages lies in unpacking the methods that produce a network, rather than continuing on previous scholarship that rather attended to the explanations of networks. Hence assemblages as concept regards just as much, or in some instance even more than, the construction of networks as it regards the network itself. This central trait of Actor-Network Theory is arguably similar to critical thinking that focuses on feminist material semiotics and histories of the present, respectively represented by work of Donna Haraway and Michel Foucault. With this background, patterns are seen to recur from analyses of methods for power, particularly in the networks that give agency to a way of existing in society and its materialities. Networks are noted to be far more actively constructed than systems, which leads to observe devices and agency as dynamically and unevenly constituted across society by the entanglements of components.

Studying and tracing an assemblage builds from the idea that actors are network effects. In social studies of markets and finance, the concept of assemblage has been central to underscore that the very nature of actors is constituted by the agencement where they perform. This is a sharp shift from behavioural-finance viewpoints that, despite recognising social alteration in individual rationality, conceive actors in markets as individual human beings somewhat unaffected in essence by the devices.
they need to interact in order to interact with the broader marketplace. Behavioural finance places the human (ir)rationality at the centre of markets while the notion of assemblage in social studies of markets locates the network that affects humans at the centre of market performance. With this concept, global markets are traceable by observing the networks that alter agency. Particularly in financial markets, the concept of assemblages has contributed to emphasise on the materialities that are as relevant for setting prices and orders as knowledge and information that circulate in said materialities and embodiments.

Value Chain

The concept of value in commodity trade draws largely from Karl Marx who discusses it as something that is not created alongside exchanges that make money but that depends on exchanges to be materialised –that is, value is not the monetary result from an exchange but it is at some register associated to capital exchanges. Value occurs relationally only, and does not reflect substantial attributes. The concept of a value chain then remarks the relational and networked properties of value creation in material exchanges, which is inherently contextual. Conceptually, a value chain is different than a supply chain, but it is often built in parallel. In supply chains, value is made, contested and negotiated from the outset of market devices that exist around material supply. Multiple sets of devices in different stages of supply chains entails that value can be perceived and interacted with in different and changing ways. Negotiations often tilt to value in monetary terms –that tend to dominate value appreciations- but monetary valuations are only dominant perceptions of value due to the assemblages that happen in global supply chains. A value chain concept remarks that dominant values are so due to the relations and network effects the hold most leverage in global material supply. The concept of a value chain is here used to denote more than monetary valuation changes in supply chain stages; specifically it represents the outcome on perceptions about worth. Perceptions about worth are thought as components of a ‘chain’ because they are formed and changed by the amassments of devices that sustain networks.

In supply chain studies, the notion of value is often placed in parallel to monetary gain in each supply stage. Pricing is a value indicator for assessing worth and is often interpreted as value per se. Focus on price increases in supply stages as materials advance from raw materials to end-use has underlined theories of underdevelopment rooted the paradigm of Dependency Theory. Dependency Theory

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59 See Wärneryd (2001), Black (1986) and Markowitz (1952).
60 Mackenzie (2006) and Besky (2016).
61 Marx (1867).
63 Çalışkan (2010).
64 Martinez-Alter (2001).
65 Topik, Marchal and Frank (2006) and Besky (2016).
66 Kenter et al. (2015).
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highlights the asymmetries of global economy integration between developed countries and less wealthy developing countries. These asymmetries result in the concentration of wealth and power in developed countries. From these theoretical bases, value chains in global commodity supply are seen as development models based on neoliberal governance and structural economic imbalances between raw material exporting peripheries dependent to industrialised centric manufacturers.

Dependency Theory is a critical position on the outcomes of a development strategy in Latin America called Import Substitution Industrialisation (ISI). ISI was implemented in Latin America after World War II; its inward-oriented economic and financial policies led to high inflation and lack of commercial competitiveness in the region, which resulted in economic and debt alleviation from international financial agencies under conditions to liberalise markets and open entry to foreign private investments in productive sectors for global commodities. Contexts of financial recuperation and aggressive market liberalisation fixed export-oriented economic models that have limited industrial development in material producing and exporting countries –this line of thinking on Latin American development has been termed ‘structuralism’. Structuralism was introduced in development studies to understand processes of unequal exchange in regimes of accumulation. Under notions of structuralism and dependency, the evolutions of domestic markets were tied to different responses of business cycles by primary exporters and by manufacturers. The notion of an industrial hegemonic centre and a dependent periphery was introduced to understand the international division of labour occurred in early neoliberal periods of Latin America. These processes by which peripheral exporters and centric manufacturers responded differently to behaviours of business and accumulation cycles include secular effects in higher wages in manufacturing regions and in the existence of oligopolies in markets for manufactured goods. Different evolutions in domestic markets favouring export prices from industrialised regions resulted in a tendency of deterioration for the terms of trade of primary exporting countries composing dependent peripheries.

The concept of value chains considers these theoretical backgrounds to study actions and actors in positions to value in supply chains. So, a value chain as concept recognises asymmetries in economic integration and emphasises the assemblages in supply chains and material markets that sustain and contest value and valuations in development.

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73 Prebisch (1949).
74 Love (2005).
75 Ibid.
Composition

This thesis has six chapters. Through them, an analytical portfolio suggests points for inquiring resources and their trade, their global significance and pressures, and the national strategies that make and respond to these. Each chapter tells and analyses events that expand from recent empirical findings on lithium mining and trade in Chile, see Exhibit 1. The diagram in Exhibit 1 presents the following: mining contracts (Chapter 1) coupled with technologies that use raw materials contracted for mining (Chapter 2) lead to objectives in places of extraction to obtain national value, define social value and add monetary value. In context of lithium trade in the Atacama Salt Flat, each value objective is taken forward through a main theme that is associated with an overarching action; national value is obtained by corporate equity (Chapter 3) which is targeted for competition control that aims to safeguard national economic interests, social value is secured by data scales (Chapter 4) that tend towards sharpened metrics that better suit dominant social values, added value is pursued by altering prices (Chapter 5) for industrialisation which is driven by narratives with changing meanings for tropes on value, price and modernity. Actions, themes and objectives for lithium in the Atacama Desert, and the devices that trigger them, are all affected by the economic settings that were in place for saltpetre and copper mining (Chapter 6) as they occurred in the past in the Atacama Desert. Concepts and arguments run through this composition of chapters to understand value and supply of lithium in the Atacama Salt from and economic sociology lens. Each chapter highlights salient components of lithium supply in Latin America. and are introduced here below. Chapters are tied together through a body-economy metaphoric conceptualisation that frames them into a concluding discussion of missed or hidden effects that lithium has in society.

Exhibit 1 – Thesis composition.
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*Mining production contracts*

The first chapter elaborates on the contracts for leasing land and producing lithium materials in the Atacama Salt Flat. These contracts are held between the Chilean government and the private mining firms that operate in the salt flat. These documents are the sources and results of controversies of corruption, secrecy, fines and amendments that are backlashes of a social organisation rooted in bureaucracy and notarisation. Contracts are presented as market devices in the conceptualisation of Michel Callon, Yuval Millo and Fabian Muniesa (2007) that reflects on the agency of objects to form market conditions and relations. The relations brought by contracts are however observed to be profoundly fractured but still operable because of contracts.

In the context of mining contracts for lithium extraction, contracts are seen to operationalise land into a specific sort of functionality. From there, documents are analysed under lenses that scrutinise resources as socially constituted and categorised into such, specifically exploring concepts from Gavin Bridge (2009) on the categorisation of materials into resources from non-human relational understandings. This critical view on resources is basis for the discussion of contracts and cadastres as objects that relate to land to make it into a specifically operable resource. In the analysis, contracts are also taken seriously on their lexicality to scrutinise them in the limitations that they pose to economies. A contracted economy is framed as one that shrinks and thereby reduces its capacities for manoeuvrability. This loss of manoeuvrability is unpacked on the signs that contracts carry onwards. For lithium contracts, batteries are signs of wealth that ultimately tie economic activity on lithium materials.

Beyond their pressures for making something out of lithium materials, mining contracts themselves become an image for the nation. Contracts as nation-making projects are seen empirically to emanate a vision for materials in political debates, which supports findings from Nusrat Sabina Chowdhury (2016) on materials and their signs as drivers for imperceptible politics. Further, the position of batteries in lithium contracts as visions of development contribute to what Javiera Barandiarán (2019) remarks as the socio-technical discourses of lithium in Latin America that legitimise mining. The chapter follows from these two points on the visions of materials from mining contracts to scrutinise not just how politics are hidden and how mining is legitimised but also to question which vision is pressed for the future of a material. So, the chapter follows points raised by Julia Elyachar (2012), who reasons on the visions of the past and from the past as potential forces that preordain the future when they are not understood in the present shape of imaginaries. Documents are thence analysed as shapers of future politics and economies providing their bases on practices, spaces and visions anchored in the past.

The conceptual debates deployed in the analysis on material images that mining contracts bring from the past to the future are faced to the resource-imagination notions from Elizabeth Emma Ferry and Mandana Limbert (2008). ‘Resource imagination’ is a concept that stresses the processes that bring value and desires to objects. The presence of the past in the very essence of mining contracts, that is in contracts as
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long-standing development instruments in time as devices to legitimise concepts and activities for materials, is ground for the argument that material legacies and experiences are reproduced and reimagined by mining contracts for lithium extraction.

Overall, Chapter 1 argues that glorified documents, often misunderstood and misinterpreted, reproduce economic strategies of materials in place and thereby move today’s extractive sectors into their current and changing shapes. In the body-economy metaphor, lithium production contracts in the Atacama Salt Flat symbolise treatment adherence loss, providing their role in increasing quotas, operationalising land to mining, and limiting commentary on the politics of battery use and finality. Thereby they are thought of as prescriptive factors that increase the intake of lithium materials in markets and that complicate end-use applications for in-ground energy needs.

Rapid technology deployment

The second chapter argues that battery deployment is going into what is here called an economy of haste, meaning an accelerated deployment of technology that blinds over its underlying effects on consumption and want creations. Empirically this is discussed in context of battery deployments for mobility in cities in Chile, and for grid stabilisation and operation optimisations in places of extraction in the Atacama Desert.

Following analyses by Michel Callon (1986) that explore how society is moulded by the objects it interacts with, behaviour change is empirically discussed in the chapter initially in context of passengers in battery electric buses. In this frame of behaviour towards batteries for mobility, the chapter explores further aspects of society that batteries sustain and stabilise, particularly those related to uneven urban development and ways in which people live and work in cities.

Increased battery deployment for cities is not seamlessly attained, however. Empirically, supply stages hardly meet in smooth alignment across raw material and active material supply sections of battery making, that is extraction, conversion and manufacture have disparate capacities and temporalities. Mines are thus targeted for optimisations which are increasingly done through batteries in automated electric machinery and in grid electricity supply. Seeing batteries in mines as responses to fractures across material supply serves to think through the arguments by Martin Arboleda (2020) on mines as machineries of extraction that span across the planet. The analysis in the chapter finds that mines are not planetary in the sense of their dissonances with other components of global material supply, and struggle to keep up with the material wants they have contributed to make.

It is argued in the chapter that, due to their hastened mode of deployment, batteries hardly sustain transformative changes in society when they are attached as components to existing infrastructures and ways of living and thinking of materials. Empirically, infrastructures are not built around batteries nor are battery uses in society a source of challenge for existing ways of thinking on materials. In the
appreciations of Heather Smith (2007) on how dominant epistemologies frame ‘global’ solutions to climate change, the chapter analyses the deployment of batteries to sustain dominant epistemologies of energy futures for climate change mitigation. These solutions do not alter status quos but instead stabilise them. So, batteries are discussed as devices that incite consumption and generate hype to the ideas of cleanse by the deployment of attachments to existing fixtures in society.

Sustained material consumption trends and increased wants as driven by batteries are analysed in terms that Timothy Morton (2016) presents for the meaning and practice of ‘dark ecology’. In this light, it is empirically evident in the chapter that consumers never really know what greenness in energy through batteries mean. The chapter then discusses the haste to electrification through lithium materials that pin ideas of greenness to specific geographies whose material bases make investments likewise aligned to motives of thought greenness.

In sum, batteries are analysed as market devices for extractivism. Batteries are discussed to empirically enable material extraction to become cheaper while they incite consumption. Notions from Peter Newell and Dustin Mulvaney on cheap energy as the basis for consumer culture sustains the argument in the chapter that batteries are hastened due to their circular position, meaning being situated in downstream and upstream segments of material supply, in cheapening electrification and thereby material extraction. Specifically, hastes to electrification in economies are analysed as forces that press for an increased intake of lithium-ion batteries. Thinking of lithium-ion batteries as medicine for stabilising grid electrical frequency and cleaning energy matrixes, hype to consumption of batteries is analysed as tipping point to an overdose. The thought of lithium-ion batteries as medicine is metaphorically reasoned in the content to reflect through the following sections on the effects of lithium poisoning in the body-economy.

**Corporate equity tracing and regulation**

The third chapter critically examines corporate equity in material supply from the standpoint of competition and nationalism. It looks empirically at the politics of equity acquisitions and competition regulation agencies and questions their weight-off in material supply outcomes. Equity markets in material supply are explored through a share purchase between two lithium mining firms. It regards explicitly the largest transaction experienced to its date in late 2018 in the Santiago Stock Exchange, which was the purchase of a considerable share of a lithium mining firm operating in the Atacama Salt Flat by a Chinese lithium mining firm. This purchase sparked multiple responses from general society, private companies and the State. Its analysis in the chapter follows the role of the State in equity dynamics as held in two main ways: first, the State as shareholder, and second, the State as market regulator.

The chapter refers to Miguel Rivera-Quiñones (2018), who addresses dependency theory in context of post-neoliberal governance in South America, to understand current tendencies of South American States that aim to ensure the presence of the State in the private sector. This theory allows to understand
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parastatal companies and increased State intervention in economy as method employed by States that had negative experiences in neoliberal periods in terms of unequal exchanges of value formed by the international division of labour that deteriorated terms of trade for peripheral countries. In the case of lithium extraction, this involvement in context of South American resource governance is empirically found to be motivated in making a nation through corporations. For Chile in particular, economic development has long followed a model where private companies are in control of material trade. This has been remarked by José Carlos Orihuela (2013) who stresses the aggressive private-market integration policies set in Pinochet’s military regime that remain since 1973 to this day. Further on Pinochet’s legacy, Marcus Taylor (2003) remarks the North American influences on this economic model, particularly from the famed ‘Chicago Boys’. However, despite the North American interests and affinities this model carries to date, as expressed further by José Carlos Orihuela (2013), this model is basis for European personification ideals through economic institutions. From this outset, the chapter frames the replication of this model for economic development as legacies that are attached to materials that in turn affect political institutions.

Through the chapter, economic competition is analysed in perspectives that Frank Knight elaborates on economic orders and social economic value scales. Following those discussions, the economic system is thus presented as a series of competing and incompatible wants pressed by different groups in society. Empirically, most competing voices in the lithium equity purchase case advanced in the chapter come from different entities that make-up the Chilean State and mining corporate heads. Discussions about economic orders in context of economic competition and State regulation follows from Arild Vatn (2005) who advances a conceptualisation of institutions as structures that constrain individual action. Arild Vatn (2005) refreshes insights from long-standing theories on economic behaviour from Douglass North (1990), on sociology from Jean Jacques Rousseau (1762) and Emile Durkheim (1895), and on economics from Thorstein Veblen (1899). The tensions that are seen empirically in the chapter to have come from corporate equity dynamics and competing desires on economic orders, remark that economic competition is not altogether understood as far as State actors attempt to modify the functioning of equity markets in fear of losses of nationally significant assets.

An empirical blur among nation-making, corporate equity and materials takes the chapter to discuss the relational dimension of corporate equity, to then frame corporate equity as device for nation-making projects. For that, the chapter draws from Anna Tsing’s (2005) ethnographically charged book to discuss equity markets in the production of nation-making as culture for development in context of Chile’s economic ties to material export and its background of structural deficiencies. Empirically, actors in the Chilean government see lithium as Chilean, so any company that engages on it is inherently close to the Chilean State. Understandably, there is then tension, when a private Chinese firm suddenly owns a part of the operations in Chilean ground. This tension is expressed as responses to material legacies on value
ideas in Chile. In the mist of that tension, competition regulation agencies are pressed not to defend a fair use of resources but rather to defend national sovereignty and identity as attached to materials and territories.

Martin Arboleda (2020), building on Adam Smith’s (1776) notion of the production of nature from capital and the nation, suggests taking the world-market, and not the nation-state, as analytical base for resource imperialism. From there and expanding on the role of competition regulation, the chapter discusses equity markets as platforms for resource imperialism and resource nationalism. Empirically, actors involved in contesting the SQM-Tianqi equity purchase identify imperialism not to foreign States but to foreign private firms. The nation as concept is then discussed to be implicated to its resources not to sustain economic trade vantages but to keep a national identity untouched.

Overall, equity markets are discussed in the analysis as relational spaces that conceal economic institutions that cannot be modified or cleansed by existing competition regulation agencies. It is then further argued in the chapter that today’s corporate equity dynamics, as understood by the rapid and unstable state of private shareholding purchases and capital merging, define material geopolitics, relations between the State and the corporation, and technology and commodity futures. In the body-economy metaphor, dynamics of corporate equity in lithium extraction and battery deployment are conceptualised as components and exchanges in the bloodstream of energy systems. Thinking of the symptoms of lithium poisoning as if it was occurring to energy systems, the bodies tasked to oversee markets see their capacities to trace and regulate components in its bloodstream as dysfunctional and atrophied. Equity markets surpass competition regulation agencies, particularly when dynamics flare from increased share expansions and exchanges. This is considered in the chapter to happen partly due to the nationally-bound design of regulation agencies and the multi-geographic scope of corporate equity exchanges.

Desires for data and resources

The fourth chapter analyses the concept of social value for materials by unpacking the resulting resource classifications that make-up preferred and dominant uses for materials. A material social value is understood as utilities given to materials in a specific time and space. The discussion from Thomas Narins (2017) on the social value of lithium is taken forward in this chapter to analyse how a social values of a material becomes prevalent over others. The chapter follows from the work of Gavin Bridge (2009) who explores the classification of materials into resources from their relations to other things and to exchange value. The chapter unfolds this point to discuss that heterogeneity in society will mean different understandings of how resources relate to things and value, and thereby multiple resources will be classified from a single material.
The distribution of water for crop differentiation in the Atacama Desert as detailed by Isabel Sepúlveda Rivera, Raúl Molina Otárola, María del Mar Delgado-Serrano and José Emilio Guerrero Ginel (2015) is faced with the differentiation of brine within salt flats as remarked by François Risacher and Bertrand Fritz (1991) to mirror effects on social utilities from resource quality arrays. From there, the chapter discusses resource-use distribution as practice for creating and placing labour.

Lithium materials are growingly being narrowed in their descriptions, from global-scale discussions on their availabilities to sharp brine-deposit composition analyses. The chapter finds that these new data increase senses of available quantities and thereby justify extraction. Morgan Bazilian (2018) explores the limits that energy transitions to renewable sources have, considering their reliance in ‘bottleneck’ metals like lithium or cobalt. This appreciation is also stressed by Steve Mohr, Gavin Mudd and Damien Giurco, by Duncan Kushnir and Björn Sandén (2012), and by Richard Moss, Evangelos Tzimas, Peter Willis, Josie Arendorf, and Luis Tercero Espinoza (2013). From discussions that centre on global distributions of metals, the appreciation of limited resources to feed the prospects of energy transitions is enhanced when materials are stressed as homogenous in their own rubric. However, when these materials are differentiated in grades and purity, the appreciation of available quantities increases. The chapter discusses this specifically in context of brine extraction, where new data on brine chemistries and increasingly specific markets for differentiated lithium materials leads to value previously disregarded salt flats and sections within them as commercially viable for feeding energy transition requirements.

Dean Hanink (2003) elaborates on the ‘technological treadmill’ concept whereby material processing advances are made to compensate for lesser resource qualities. But, empirically, data improvements are arguably more significant in making resources increasingly available. The quality paradox that Gavin Bridge (2009) brings forward to highlight better quality resource-finds made progressively as initial resource-bases are used-up, is thought through in the chapter as being largely dependent on data improvements by which ‘missed’ resources are found and categorised in increasingly specific metrics. In contrast, data lack is discussed in relation to deficient mobilisations of opposing views and to sustained patterns of poverty for politically marginalised sectors of society as noted by John-Andrew McNeish and Robyn Eversole (2005). The chapter then expands how data lack for positions of opposition leads contestation to be voiced with data products designed for sustaining dominant views on resources and their extraction, which invariably results in limited impact due to the affordances of data products used to legitimise extraction.

Excess and scarcity are discussed in the chapter as paradoxical experiences of lithium materialities that categorise water and brine in the Atacama Desert. The chapter frames in-ground responses to material experiences through the concept of thirst. Thirst refers conceptually to the desires to have a resource social value recognised over others. It is stressed that sectors of society that get conceptual satiation to
their thirst are those that tend to dominate through resource epistemologies, data and utility. Satisfying desires for social value dominance reflects obtaining rights to resources over competing desires to that resource. The legal structure in Chile in terms of water use in mining and the separation of brine from water regulation are then discussed as empirical exemplifications of devices that satisfy dominant social values. Explicitly, the chapter discusses that brine extraction has more utility to broad society than water conservation in the salt flat due to the data and metrics that stress this utility to society through the differentiations of lithium materialities.

Overall, Chapter 4 argues that dominant social values for materials are victorious on resource uses and on setting the language and metrics that frame views on their availability. In general, the chapter advances the geographic scales of resource availability to integrate the importance of nuancing and data specificities. In the body-economy metaphor, thirsts for data and resources from lithium mining are an analogy of bodily thirst as symptom of lithium poisoning. The body-economy metaphor analogues thirst as a symptom of lithium overdose in the body to the water requirements of energy systems and the craving of resources that renewable energies entail. An energy system reliant in mining is a thirsty one, and more so when target materials are liquid. Additionally, thirst can be understood as concept not just for water desires but broadly for resources and rights. So, in the body-economy metaphor that frames this piece, an energy system that becomes thirsty from increasingly intaking lithium-ion batteries, invariably symptomatizes contending desires for resources, data and rights.

Value added tropes and price manipulation

The fifth chapter explores the ideas and narratives of added value and pricing transparency from lithium. The chapter discusses value added tropes used by the Chilean government in its calls for projects to manufacture lithium-based products in the country. The Chilean government’s ‘lithium call for projects’ were essentially battery-making tenders that promised to give reduced prices of lithium materials to selected firms. The chapter focuses on the uses of value tropes as method to modify pricing structures for lithium supply.

The chapter is centrally inspired by the anthropological explorations of Sarah Besky (2017) on tea trading in India, particularly on the appreciations of moving closer to raw, unprocessed tea leaves as a method to increase value and improve the economic performance of tea supply as source of State revenue; a sharply contrasting approach to the value-added agenda of the Chilean State. The Chilean government’s discourse that equates development to moving forward in the value chain, entrenches development in making batteries rather than making lithium materials into commodities attuned to Chilean supply settings. The empirical use of this discourse in the tender is discussed in the chapter taking into account findings by Javiera Barandiarán (2019) on the socio-technical discourses in Latin America that associate batteries to lithium for national industrialisation possibilities that promise development. The imagination of wealth by these discourses is argued in the chapter to be not just about new ideas on
batteries but to be significantly formed from the legacies and tendencies in Chile to attempt to industrialise even if it means producing deleterious market and political conditions to its raw materials.

In the case of lithium materials sourced from Chile, the imaginations of value are profoundly tied to batteries as images of modernity. Walter Mignolo (2005) discusses modernity aspirations in Latin America as European enclaves in economic and social structures. The chapter critically reflects that this representation of modernity is well present in the empirical description of the tender by Chilean public officials. Pragmatically, the aim of the tender is to export products that sell for higher prices, but this is attempted to be done by decreasing the prices of raw materials to lure-in battery-making companies. The chapter discusses the relations among raw materials, end-use technology, prices and value through the concept of market assemblages.

The first battery tender is analysed by chronologically following the processes that were carried through it. These processes are recognised as politically charged even when they were framed by State actors as rigorously technical. The chapter reflects on material legacies in form of expertise regarded for assessing bids, specifically reflecting on the role of copper and foreign treasury public officials in the evaluation of value added by battery projects. The expertise-focused scrutinization of project-bid assessments draws mostly from John Law (2017) in his analyses of the role and position of technical authorities in ascribing visions of ‘what’ is valuable and why. The chapter follows to unpack the core of the failure of the first attempt to add value as linked to price manipulations and inconsistent definitions of value.

After the failure of the first attempt to industrialise battery-making in the country through price productions for lithium materials, the State continued with its intention to add value to its lithium resources by price manipulation. On the second call for projects, models for estimating value of project bids were slightly more explicit but remained inconsistent in their configuration and purpose. From there the chapter explores the empirical manipulation of prices in market and off-market contexts. An off-market context is referred to in the chapter to the sales of lithium products that mining firms hold with related firms. This context is empirically relevant for stressing the ways in which the Chilean government reacts to off-market sales, which is commissioning pricing assessments, and how that affects its understanding of price and value. So, prices take a role of information indicators for market conditions, but the empirical manipulation of prices strips this property from prices. Prices are thus analysed to be politically composed, for which the discussion builds largely from Jane Guyer (2009) who conceptualises prices as composed by narratives of creation.

The chapter then considers the loss of correlation between prices and market events due to price productions. For that, the chapter draws from the process of ‘tâtonnement’, initially discussed by Léon Walras (1877), which addresses the effects of price and capital allocation on the distribution of subsequent goods and their according prices. The chapter builds from refreshed analyses on tâtonnement by Jean-Philippe Bouchard, J. Doyne Farmer and Lillo Fabrizio (2009) and by Jürgen
Backhaus and Hans Maks (2006). From there, the chapter discusses produced prices for lithium materials as costs for contracted lithium material suppliers who would have to adjust their production and finances to meet the government’s value-added programme. The chapter reflects that the empirical effects from the battery tender and its methods to sell lithium materials in a manipulated cheap price would affect not just the price of resulting battery products, but likewise and importantly the price portfolios of the mining firms that were being forced to alter prices.

It is then argued in the chapter that nation-making is different than national development. The phrasing of development in the tender documents as an ‘externality’ is analysed in terms expressed by Joan Martinez-Alier (2014) about what externalities represent as separated and unaccounted systematic factors of economic activities. The disconnect between the tender as nation-making project and national development is further discussed following analyses from Fred Hirsh (1976) on the failures of Pareto efficiencies for effective capital distributions. Further on the essence of value-added tropes to press for nation-making projects, nation-making projects are argued in the chapter to define national identities through tropes.

Generally, the use of value-added tropes to affect pricing is seen as a representation of the unrest and mistrust that the Chilean State has in economic development through material extraction. Overall, Chapter 5 argues that tropes with multiple and often lost meanings are best equipped to justify control on material prices and supply, and consequential end-to-end paths from raw material mining. In context of the body-economy metaphor, the obfuscated search for overestimated monetary value mirrors weight gain and brain damage, which are symptoms of lithium poisoning.

**Oligopolies, export tax breaks and resource overvaluations**

The sixth chapter critically reflects on the material histories in the Atacama Desert. It does so to explore the replication of economic settings that intervene in the materialities of Chilean lithium market conditions. Explicitly, rationales and intentions to development through material extraction and trade of saltpetre and copper are mirrored in the chapter to contemporary lithium extraction in the Atacama Salt Flat. Thereby the chapter questions the replications and relations across material economic strategies. The chapter discusses corporate oligopoly, tax breaks and value overestimation as the economic settings that remained in the strategies for development through resources since the end of the Spanish colonial period in Chile.

Largely, the historical documentation this chapter draws from comes from Thomas O’Brien (1989 & 1982) on the Pacific War and the Guggenheims’ investments, from Francisco Zapata (1992) on the Pacific War, and from Eduardo Novoa Monreal (1972) on the Chilean copper nationalisation. From these historical recounts, coupled with the ethnographic description that Janet Finn (2001) carries on Guggenheim mining developments in the Atacama Desert, the chapter analyses a reproduction of social
structures for material extraction and discusses these as legacies that are attached to the exercise of mining in the region. Specifically, the visions for resources in the early times of copper expansions are discussed as comparable to those on lithium examined earlier in the thesis. This initial discussion on the ties across social structures, resources and companies is coupled with empirical findings in-ground in the Atacama Desert that highlight dysfunctions for expressing links among resources and corporate structures. From that, it is initially argued in the chapter that legacies are veiled in place.

The chapter analyses similarities among nitrate and copper production contracts and today’s lithium production contracts in the Atacama Desert. For that, the chapter follows historical recounts that Thomas O’Brien (1989) and Eduardo Novoa Monreal (1972) respectively address on the Guggenheims’ nitrate investments in the Atacama Desert and on the Chilean copper ‘contractual development’. Mining contracts as instruments to materialise visions of development are then argued to be other sorts of materials legacies that abstract and anchor development to documents. In that argument, contracts are further discussed regarding their political and technical designs which limit commentaries on strategies carried on other materials in the same area in the past.

The histories of copper and saltpetre show a loss of confidence on development through world-market material trade, and thereby a tendency to seek more value from resources than that available in market trends. The practices for reaching those expectations of increased value came then as it was mentioned earlier to be searched for through lithium materials. The chapter joins the desires that the Chilean State demonstrated for copper and saltpetre and that today replicate on lithium to argue material price control to be an image of economic development.

The chapter then examines the participation that the Chilean government has taken in private equity of firms that mine saltpetre, copper and lithium, that is specific to private entities prior to any listing of equities in stock exchanges. The chapter builds on the analysis that Martin Gainsborough (2010) takes on the place of the State in corporations through parastatal companies. From there, it is discussed in the chapter that nation-making strategies thread into corporate equity, meaning that links among corporate equity bind resources together and explain the replication of strategies and settings. The threads of private equity that join mining projects from saltpetre to copper and thereafter to lithium, that is specific to the times when mining started in the Atacama Desert and companies were not public, are discussed in the chapter as a particular empirical context that enables practices and material legacies to reproduce and importantly to have their ties among one another strictly forgotten.

The chapter then analyses the loops of settings to development through resources, and their conditions of being forgotten, as tied to private equities formed in the early stages of mining in the Atacama Desert. This follows discussions that analytically touch on circularity as replication, explicitly from Octavio Paz (1965) on symbols and analogies, from Gabriel Zaid (1979) on development and progress, and from Fred Hirsh (1976) on economic thinking and progress. Octavio Paz (1965) reflects critically on the ideas of
circular process that he elaborates from Arthur Rimbaud's (1873) analogy of the present as circular movement. Octavio Paz (1965) conceptualises circular process in symbols as immobility from agitation and as a stage of uniformity from plurality that does not unite consciousneses nor solve discord. On a similar note about development, Gabriel Zaid (1979) discusses Latin American conditions of progress as never arriving but constantly coming. Gabriel Zaid (1979) explicitly recognises the repetitive absurdity of measures that keep society at the edges of wellbeing. Likewise, but referring to the social dimensions of economy, Fred Hirsh (1976) discusses social progress as unattainable due to the essence of individual economic thinking on which its actions are based on. Octavio Paz's (1965) critical writings on poetry and Gabriel Zaid's (1979) discussions on development are joined in the chapter with Fred Hirsh's (1976) economic development arguments. These writings are analysed in context of lithium trade practices as enclaved in their material legacies of copper and saltpetre. The chapter thereby argues that mining legacies are a circular progress in terms of their repetition and conceptual stagnation. A circular progress is conceptualised as a replication of symbols for development that builds on negations of repetition. In the context of mining enclaves to development in Latin America, a circular progress enacts visions for materials that look at nation-making as the building of identities that revolve on Eurocentric modernity and industrialisation.

Chapter 6 overall explores material legacies as being reproduced in time and space by the lack of recognition of assemblages through materials and their imaginaries. It argues that different versions of the same symbols for resources conduce repetitions and forgetfulness of practices and settings for material extraction and economic progress. The replication of symbols and economic settings from other materials in the past of the Atacama Desert to lithium in the Atacama Salt Flat is analogised as symptom of lithium poisoning in the body, which affects brain functioning. In that analogy, it is stressed in the chapter that energy systems and its mining enclaves are experiencing memory loss, which is presented as the final symptom of the body-economy metaphor that is here used to understand effects of lithium in society.
Frame / Warning

A body-economy metaphor orders the chapters and is employed to think of economic constituents of end-to-end paths that materials take from mining to final use as interlaced among each other as parts of a single organism. Metaphors offer a wealth of entries to depict the world and importantly to structure it. Bodily metaphors have been used to explain society and have taken part in recent explanations of energy systems and extractive activities. A metaphoric explanation has then been proven to work for purposes of making ideas clear and transmissible to broader audiences than those specialised in anthropology, energy systems, resource extraction or economics. This metaphor follows work that has given vitality to objects, and that has ascribed it to the energy system to thereby represent it and its constituents as matter that run politically inside humans.

From its initial use by Auguste Comte, a bodily representation of economy and society rendered social and political matters that may seem arbitrary to be understood as predictive and unambiguous. The use of this metaphor is here not meant to advance or justify the analogy of society as a human body as set out by Comte, but rather it is meant to challenge an existing representation of batteries as enabling technologies. It does so by showing an already existing feature of lithium – its use in medicine – that invites thinking critically about its material uses and toxicities in economy.

The body-economy metaphor that frames this thesis is mostly inspired by work on body analogies to material extraction and use; specifically, those done by Matthew Huber (2013) on oil consumption, and by Michael Taussig (2004) on gold extraction. The following elaborates on how the metaphor here presented draws from and enters in conversation with those pieces of critical writing.

In his book on oil lifeblood in generic human activities, Huber analyses the place of oil in society through the everyday interactions of its consumption. He explores oil consumption through a metaphor of social addiction. Huber’s phrasing of an addiction embodies a material as encased in a bloodstream. This

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76 Lakoff and Johnson (1985).
77 Martínez-Alier (2009) work on the social metabolism to explain and analyse the distribution of conflicts and the search for economic growth underscores human societies as interrelated in the exchanges of energy and materials that are metabolically organic in economy. Thinking of economic and social activities through a metabolic appreciation helps to see the orders of society and economy in organic and thereby integrated ways.
78 This is inspired by Taussig’s (2010) ‘fictocriticism’, meaning the overlap of fictions and forms of documentary with fiction. Taussig remarks that “ideas work emotionally and paint a picture of the world on account of the way they are put into language.” (p.xii). Fiction is then useful to portray a picture of the world that is more easily understood as presented in the register of the strange than in conventional and sober registers of expression. Taussig underlines storytelling of extremes and fictions as a method to understand reality and importantly, through an anthropological thinking, to make reality through stories. Stories or fictions of the strange and exotic serve then to critique modes of being and thereby to place new avenues into being.
79 This follows from the work of Bennett (2010) who takes on the project to ascribe what vitality means in objects as their essence of their being as actants, and how can it be perceived and used by humans.
80 The analogy of society as a human body is mostly attributed to Auguste Comte who grounded the science of sociology through it by attempting to strip sociology from ambiguities and base its appreciations and prediction on positivism (Levine, 1995).
81 See Huber (2013) and Taussig (2004).
narrative of addiction to a material in economy gives a bodily understanding to the act of consumption to see its materiality inherently cultural and political. Huber goes further in the bodily analysis of the addiction to oil to stress that it can be ‘cured’ or ‘treated’ by ‘prescriptions’. Huber sees these prescriptions are shaped by political and behavioural pressures. Specifically, Huber notes that “the ‘prescription’ for ending this addiction requires a form of technocratic behavioralism”.

It is here considered that the prescription recommended by Huber would likewise act in the physicality of cultural and political materiality. If lithium is a technocratic prescription, it revolves in the everyday consumption that made oil prevalent in society. While lithium is prescribed to clean the oil addiction from consumption, it doesn't reduce consumption as social anchor to material realities, nor does it change the structure of economic activity. The view of lithium as ‘the new oil’ hints this root that the addiction will persist but just with another material; possibly a material that would at some instance clean the bloodstream from oil, but that in itself carries other toxic effects if ingested carelessly. Hence, the prescription to alleviate the addiction may cause other sorts of pernicious toxicities specific to the materiality of the prescribed technocratic behaviouralism, specifically to those linked to battery raw materials and their supply. Here, this point is carried forward and thereby enters into conversation with Huber's appreciation of the cultural and political materialism in energy objects.

In turn, in his book on artisanal gold mining, Taussig reflects on the cultural attributes of gold as it relates to cocaine in its use and in the human behaviours linked to these substances in their physical and spiritual materialities. Specifically on their use, Taussig remarks the links between gold artefacts and cocaine ingestion to together make reactions all the more intense as their presence in the body deepens: “among the most significant objects in the Gold Museum are its golden poporos, curvaceous containers shaped like a Coke bottle and used by Indians to contain the lime made from burnt and crushed seashells that, added to toasted coca leaves, facilitates the release of cocaine into the gut and blood-stream”.

Saliva, cocaine and gold all blend in the body. But Taussig doesn’t note the release of cocaine in the bloodstream by accident. The telling of the practices to extract gold in river streams brings a curious relation between materials while they relate to streams in nature and in the body. It is in the river stream that gold changes people as cocaine does in the bloodstream. Taussig remarks how women arch and bend to collect gold from the river beaches; they are successful only if their movement is in unison with the process that the river is already pacing. But the effects in the body from interactions with materials is not just related to ingestion, Taussig notes. He presents the bodily and mental responses to materials as they relate to risk, harm and ambition. In a way, these material symbols are impregnated into persons as they are in contact with materials. "Gold is legendary for driving men crazy", Taussig remarks that craziness comes from

\*82 Huber (2013, p.x).
\*83 Taussig (2004, p.x).
\*84 Taussig (2004, p.5).
gold being a guise for evil. Evil in Taussig’s view is the cause of reaction in humans and not the material. The essence of materials, framed as evil in Taussig’s gold-cocaine example is what remains regardless and just changes shape from gold to cocaine: “Like cocaine, perhaps even more so, gold has its seamy underside seething with danger, prohibition, secrecy, and hidden histories”.

Lithium, like cocaine, has been considered ‘the white gold’, and it should not strike that it is likewise contingent of hidden histories that revolve on the dangerousness and secrecy of the material as it makes men crazy. The reaction of the body to a material is related to what happens in contexts of ingestion and imagination. This work enters into that conversation of what makes humans crazy regarding materials whose ingestion and trade bonds into a response of mania and instability. Further, the streams that affect the human body, both in natural water streams external to the body and internal bloodstreams, enter in the world of lithium as this latter one presents another stream that affects the positions and shapes of human bodies: supply streams that are discussed to comprise downstream and upstream sections of trade. Streams of water, blood and trade all form the same bending effect in bodies and become then guises for money, power and, in Taussig’s view, evil and devil. Seeing and critically scrutinising bodies and economies as they bend around these streams, allows to further understand the materials streaming within.

Bodily analogies fit into multiple economic activities, for example the sense of the banking or finance systems having a brain or a heart is not difficult to understand and it makes a point on the functioning and vulnerabilities of the systems described. But in the case of lithium extraction and its trade, a bodily metaphor is not so much deliberate to explain lithium’s working but incidental to lithium’s use. Lithium has been a medicine before it was anything else in society. So, when the ‘function’ of lithium trade and its effects in economy are questioned, it is not so inventive to think of lithium as an ingested substance and as one circulating inside the human body. Hence, it is important to embrace the significance of the body metaphor, particularly as employed on addiction to energy substances and on ingestion of material symbolisms, respectively addressed by Huber and Taussig, for an analytic that expands from that through the portrayal of the energy system as the body ingesting lithium-ion pills and somatising its effects.

When the toxicity and benefits of batteries are questioned it is not unreasonable to think of lithium medical toxicities and benefits as other forms of expression for the effects that batteries and their materials have in society. For instance, during fieldwork for this work, a recurrent concern expressed inground were questions people I met had about the harms to health of being near lithium mines or lithium-ion batteries. Those concerns were sometimes followed by questions that wondered if any harm caused by proximity of mines or batteries had something to do with the properties of lithium as a medication.

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85 Ibid.
86 See for example Weston (2013) on credit systems as formed by flows of cash as if these were blood.
From there, it became clear that a health perspective of the effects of lithium as it is traded would be an anchor to explore and communicate the materialities and economic settings of energy systems.

The body is not external to anyone, neither is energy and its use. So, their use as interchangeable representations of one another can help reconcile toxicities that derive from material supply as shared with all the constituents of the energy system. This metaphor is then an exercise of empathising with the energy system and seeing its working and organic organisation in far more intricate and visceral ways. Observations from a somatic metaphor thus invite to understand energy systems beyond the mere operation of electricity generating, distributing and consuming devices, but likewise to include raw material markets that are made up to source and transform base metals for itself. When these are included in an organic representation of functioning, the finality of energy and material systems can be further scrutinised in critical regards. In a body-economy metaphor of the energy system being treated with lithium materials, where people bend to make value from the lithium supply stream, cumulative discussions on the market practices of lithium trade take each point further forward to embrace their joined analytical compositions. Explicitly, this metaphor suggests taking organic discussions of economics as intellectual direction for market and social studies of materials and energy objects.

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87 Appreciations of energy systems and flows as attached to material extraction and economies are presented notably by Martinez-Alier (2009) and Martinez-Alier and Walter (2016) who press the concept of social metabolism and 'sociometabolic' approaches onwards to understand material flows and their associated conflicts as part of an organic constituency.

88 Martinez-Allier’s work on social metabolism takes an important regard on the flow of energy and materials in society as a unified composite. The work he and his colleagues carry is inspiring to suggest further appreciations of economics in particular in such light to thereby enhance appreciations of markets as constituents of everyday interactions with energy devices and materials.
Introduction

Methods / Data

This thesis is based on an eleven-month period of fieldwork in Chile, from January to November 2019. During this period, I lived in the city of Santiago and in the village of San Pedro de Atacama and visited the city of Antofagasta and the area of Valle de Elqui. One year before, I prepared the work ahead by doing a preliminary research on Latin American politics, lithium production and trade, energy storage systems, anthropology of resources and economic sociology research methods. After fieldwork, another year lapsed mostly in Coronavirus lockdown to analyse and follow events and experiences. Generally, and detailed as follows, methods for data collection included participant observation, ethnographic transcriptions, semiotic analyses, archival analyses, interviews, mappings and schematisations.

Upon landing in Santiago in January 2019 I had a few days before my departure to San Pedro de Atacama. It was summer and the heat in the city was overwhelming. In these days I met with a director of a renewable energy corporate association and a head of a consultancy firm that focuses on energy sustainability. As a young researcher foreign to Chile, I was welcomed in these meetings with patience and openness. Being a man from a Latin American country certainly had some weight into this as those I met were Spanish-speaking men in high ranks of their professional sectors. These meetings gave me superficial but broad instruction of the current state of developments in energy policy and lithium politics in Chile. The country had been rattled recently by developments between its economic development agency (CORFO) and lithium mining firms. Names like Bitrán and Albemarle were linked to dispute contract, transfer price, solar committee, nuclear energy commission, clean energy institute; a bouncing between mining and energy that clarified a contemporary buzz of lithium and batteries. The Chilean government had likewise just updated its energy roadmap and was aiming to give further use and markets to energy storage in its electricity grid. The lithium supply chain and its market ecosystem seemed to be within reach of observation. But its actual making remained somewhat unclear. A disconnect to the actual lithium mines and the energy prospects in Santiago was evident when I spoke about planning to stay for some time in the Atacama Salt Flat. My intention to stay in San Pedro de Atacama was not thoroughly understood by those I met in Santiago as fully ‘relevant’ for a lithium-battery research: they wondered ‘why’ if ‘lithium and battery matters had more to do in the city’.

The globality of battery futures and of the lithium triangle was staring at me in the face, overwhelmingly abstract, multi-sited and shapeshifting. This globality was localisable in Chile but its geography went far beyond the Chilean territory while it was simultaneously concentrated in a single meeting room in Santiago. What would seem as an evident limitation to the localisation of lithium and batteries in a country or even in a meeting room rose: the rest of the world was not here. Initially into fieldwork, and particularly during the first days in Santiago, I was suspicious about whether the rest of the lithium world, meaning the developments on lithium markets beyond this geographic context, was far more relevant than what happened here. What if I could get more or better insights elsewhere? How could ‘I’ become
‘global’ and thereby see this matter in its planetary ‘globality’? I reconciled that maybe that’s what the planetary globality of lithium markets development needed in their appreciation and discussion: a sense of place. With this mindset on observing situated globalities, I realised that this Chilean situatedness in this particular time was key for focusing field site limitations as strength and data ‘uniqueness’ for understanding economic settings of material supply. Recent lithium-charged events in Chile and those that would happen shortly after my initial arrival, would soon justify the relevance of this fieldwork with specific context and entry points in its attempt to follow a global material. By avoiding comparing practices for lithium trade and battery markets and following grounded aspects, like the names mentioned in these initial meetings, the market practices that join lithium and batteries together became recognisable and subject to in-depth analytical work and questioning. Magnifying the constituents of global lithium supply was work of inquiring on the nodes and bits that joined and hinged lithium supply stages together and made in-ground globality possible. The view of the lithium triangle as a global layer hovering over localised geographies reassured not just the pertinence of an in-ground place-specific research method but likewise it gave emphasis that there are data on the making of a global layer that is only visible when this layer is looked from the ground that sits under it.

Raw material supply for energy objects is a global assemblage but the market practices that make it global may remain hidden from sights that look at the assemblage on its own, as if you try to understand a blanket without noticing what it covers. Perhaps that which is being covered are the bases that sustain and thread the cover itself. Empirical and ethnographic commentary on lithium in Latin America had until then regarded segmented parts of its globalised feature in development, for instance as socio-technical discourses, development imaginaries and geopolitics. Yet, concrete market practices and economic settings of lithium supply remained uncovered.

To grapple with the fictional images of the global, the realities of the places that sit under the global image have to be seen and felt. I left Santiago a few days later thinking of a phrase that was said in those meetings when renewable energy expected shares in energy use were mentioned: “Reality will surpass fiction”. What reality was this?

I landed in the Calama Airport later in January 2019. Some days before, I had received a telephone number of someone to whom I could rent a small cabin in San Pedro de Atacama relatively separated from its touristic centre, in Solor. This person had a contact that could get me a reasonable price for renting a car through one of the rental agencies at the airport. Upon landing I took the car and felt that my method had just received a great improvement: wheels. Powered by an internal combustion engine,

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89 This follows points made by Marcus (1998) and Çalışkan (2010) on the embodied globality in agents and on multi-sited fieldwork studies.
wheels gave me mobility, conversations and a closer feel of the bases of conviction for electric vehicles and their attached light lithium-ion batteries.

“Explore the car to learn more about how e-mobility works” – says a corporate website of a German chemical manufacturer of cathode active materials along its interactive product description shaped like a car. This phrase, that seems as utterly disconnected from how e-mobility really works, that is in its economic settings of trade, seemed incredibly meaningful when I took the car and rode it through the Moon Valley. As I passed in front of mines and in between colossal grid-scale wind turbines, I thought obsessively about this phrase. ‘Explore the car’ I kept thinking. Exploring the car there made sense and seemed possible as way to see how e-mobility works.

In Solor, I lived in a comuna, a household composed of detached indoor spaces where visitors contributed to the upkeep of the place and its day-to-day work in exchange of accommodation and company. Most of those in the comuna besides the hostess and her children were young travelling adults in between 22 to 30 years old. Older visitors might arrive, but these were rare and were usually there by themselves for a specific healing session that the hostess gave. People that lived in the comuna I stayed at were normally travelling in couples but occasionally by themselves or in groups of three or four friends. Latin American residents in the comuna held a greater sense of ‘belonging’ to the comuna, some had taken that place as base for their travels that became their way of life: go and return, go and return. Other visitors from other regions would be more temporary participants that, while friendly and engaging, struggled to form bonds as tight as those shared among ‘grounded’ residents. Women were a majority during my stay. Providing the context of machism in Latin America, I assume that a male-dominated environment in the comuna would have changed interactions, but I cannot generalise a broad normalised machism in the area to the way of living in the comunas of San Pedro de Atacama; still it is important to notice the strong divide that exists in Latin America between the lives of women and men. This divide certainly had some effects on the data I was able to get and the places I was invited to go to. I recognised a strong bonding environment where compassion, trust, care, sharing and love were present in any interaction in the comuna. My companions, and particularly the women, were evidently emotionally attached to Earth and took the comuna as a representation of that union. This was relevant for contrasting the interactions other people beyond comunas had with resources, particularly when I encountered the male-dominated labour forces in nearby mines and tour agencies. It also highlighted some limitations to my interpretations of resource cosmologies and visions providing my male gender and ‘western’ formal education.

Rapidly upon my arrival in Solor, a meal was set to welcome me in the comuna which included chants and jokes. The residents in the comuna were keen to learn something from me about the salt flat and its mining. I was surprised that I was considered as source of knowledge on it when I shared the same questions they posed to me. Participating on the daily activities in the comuna and its involvement in
town, particularly in times of destruction caused by rains and floods, gave me great understandings on how people in the village relate to resources and themselves.

I spent my days in San Pedro de Atacama getting around the multiple sectors that deal with lithium in some way or another. In San Pedro de Atacama I met with environmental NGOs, water service representatives, a water NGO, the Lickan Antay indigenous peoples counsel, tour guides and youth activists. The first days were spent going to each tour agency shop to ask about their relations with mining operations and how tours in the salt flat were handled considering nearby mining operations. Names were sometimes said pointing either an NGO or someone else knowledgeable on the matter, I followed those to further conversations. Through sessions about resource activism and lithium mining organised by locals I learned about some ways that people organise in the area, but the more informal gatherings for music and craftwork or mindfulness and meditation instructed how people felt and behaved towards mines and everyday interaction with resources. People were normally surprised to learn that I was staying in the area without any connection to a Chilean institution or university and that I was mingling with apparent carelessness.

One conversation in a tour agency shop with a former miner convinced me to go to Toconao. There, after several visits, I observed and interacted with what in San Pedro de Atacama people normally referred to ‘the other side’: mine campsites and employees. From Toconao I went to Peine where ‘the other side’ blurred with ‘the other-other side’: mine campsites and employees as part of locals and regular residents.

In May 2019 I moved to Santiago. Early on after arriving I went back to the north of the country for a conference on mining held in the city of Antofagasta. The conference was highly technical and pressed on showcasing machinery and processes to increase yields and productivity. The lithium hall showed a startling presence of energy firms. It included as well all presentations on energy developments and research. In this conference, lithium was analogous to energy. The conference provided options to visit mining activities for an additional fee. Through it I visited the operations of SQM in the Atacama Salt Flat and of Albemarle in its chemical plant La Negra in Antofagasta.

In Santiago I was invited to work on my research from the office of a water NGO who worked in San Pedro de Atacama and that I had gotten acquainted with during my time in the Atacama Desert. I normally spent two days a week in their Vitacura office. I occasionally contributed to their work by way of informal discussions on their projects. These conversations were enriching for staying up to date on matters that regarded governance in San Pedro de Atacama, politics of lithium in Chile and general events in the country. While in Santiago I met with battery companies and followed with the development of regulation updates to ancillary service markets to the electric grid. Through the contacts at the water NGO, I was able to get a swift response to meet with CORFO representatives and a former national prosecutor. The meetings with CORFO were instructive for expanding the base of archival review of lithium contracts and government documents. As in San Pedro de Atacama, following names and places from conversations
was a general approach. On other days I would normally revise and map the labyrinths of lithium contracts and their recent changes. I had taken the habit of looking at the paper every day to look for events relating lithium and batteries, I focused on political and economic events and on shareholding valuations of lithium mining firms, energy storage companies and other firms related to energy storage and lithium materials. This latter exercise proved immensely rewarding as at the time all ‘things lithium’ buzzed flagrantly.

Archival work on CORFO documents and meetings with battery companies were enriching on their own to learn about the contractual grounds for material extraction and technology deployment. Market practices on base metal supply were somewhat visible and linkable but data was not profound enough to show what lithium does in society. I then spent some mornings taking rides in electric buses and visiting the notaries where contracts and corporate constitutive acts for lithium mining companies were publicly set. I felt like I did in the Atacama Desert, where most conversations and physical surroundings had something to do with lithium. In the notaries I was attentive to the surroundings and modes of behaviour. People were surprised when they found out I would be visiting those places without any paperwork to deal with myself, and usually assumed that I was some sort of spy or private investigator when my initial response on interest on the place would not convince.

Lithium became all the more present in town as a famed global corporate conference on lithium supply took place to lay out the state of global supply and at least in intention address the matter of price transparency and materials standardisation. I attended this conference and found there a slightly higher enthusiasm to my mode of approach than that expressed in San Pedro de Atacama.

Finally, I visited Valle de Elqui where a contact whose family had been close with the overturned president Salvador Allende welcomed me for a short period. Earthquakes, pisco, morning heat, water springs, conversations about copper and Pinochet, and news reports on lithium and battery industries falling apart, all made the global of lithium trade tangible in its ruptures.

I left Santiago in November 2019 to amass data and analyse it. I followed with events on lithium supply and pricing from abroad while this manuscript was elaborated during another 14 months.
What does lithium as energy object do in society?

What does lithium in society show about the economics of material bases for energy futures?
Lithium in the body-economy

Lithium is a pharmaceutic used to prevent and treat mental illnesses associated with depression and dementia. Lithium was first used in the second half of the 19th century to treat manic patients, and remains today considered as the most effective mood stabiliser. Patients that are treated with lithium are normally diagnosed with manic depression, also generally known as bipolar disorder or mental unbalance.

Lithium is also part of the most marketed energy storage systems. Lithium-ion batteries are coined as devices that enable rapid decarbonisation for electric grids, transport fleets and passenger vehicles. Batteries are enabling technologies for renewable energy, and lithium-ion batteries are the most cost-effective grid stabiliser. In so, lithium-ion batteries stabilise growth trends for economies that suffer from electricity and fuel consumption disorders.

In medical practice, despite lithium's record for treating and preventing mental instability, lithium's side effects in the human body can be dangerous. In some cases, these include increased thirst and loss of treatment adherence. This side effect can lead to lithium poisoning. Lithium poisoning is rare but it can happen through acute, acute-on-chronic and chronic overdoses. Adverse effects from lithium overdoses can be life-threatening and normally affect renal, thyroid and parathyroid functions. Among other effects, renal insufficiency can lead to problems with removing waste and regulating blood chemistry, thyroid malfunction can cause breathing difficulties, depression and weight gain, and parathyroid deficiency can induce peaks in calcium levels which may interfere with bones, muscles, brain and heart.

Lithium can poison the human body when overdosed. This is here taken seriously as metaphor for understanding batteries and their role in society and economy.

It is said that energy futures are enabled by batteries. Understood technically by the prevalence of renewable energy systems and less carbon-intensive transport, energy futures are a key component of discourses of climate change mitigation. Grids and cars are not fully yet designed to sustain energy futures though. For instance, integration of renewable intermittent energy sources causes imbalances in

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92 Bauer and Gitlin (2016) and Malhi, Masson and Bellivier (2017).
94 IRENA (2017).
95 McKnight, Geddes and Goodwin (2017).
96 El Balkhi and Mégarbane (2017).
97 Bauer and Gitlin (2016).
98 Ibid.
grid frequency and voltage, and the uptake of electric vehicles can have adverse effects on grids.\textsuperscript{99} These are mediated by energy storage technologies that support matching energy supply with load.\textsuperscript{100}

Electricity grids as human minds require stability to work properly. An unstable grid and a highly emitting vehicle fleet are considered deficient, as a human body undergoing an illness is. Lithium-ion batteries are then the medicine for unstable energy systems. But the side-effects and toxicity of the lithium treatment can jeopardise the energy system altogether. Some bodily reactions to lithium poisoning are observable in a lithium treated energy system, as if this one would also have renal, thyroid and parathyroid functions.\textsuperscript{101}

These reactions are hereafter presented and analysed to critically examine the broad effects that batteries enable in economy. It thereby advances thinking on material bases for society by recognising the position of batteries as attachments that promise enabling, but that by their design to leave core structures untouched, both in technical and political terms, they do not challenge that which they enable.

\textsuperscript{99} Scherer, Zima and Andersson (2013) and Hu et al. (2016).
\textsuperscript{100} EURELECTRIC (2004), Rebours et al. (2007) and Hesse et al. (2017).
\textsuperscript{101} A short original essay on this metaphor was presented in Petrocultures 2018 conference in Glasgow though the panel of ‘Dark green, Energy Dystopias After Oil’.
If you would and could mine anything, but just one thing, what would you take?
medication

More. These pills do not cut it. They used to do, but now they just don’t. I don’t want to feel more, but I’m starting to notice a fade in the high. Call it a crave or deliberate desire, but I just don’t get the same fix from this mediocre hit. I need more. Call it tolerance, adaptation or mere resistance. It doesn’t matter. I need more. Otherwise, what? A stronger pill? Be serious, I’m getting the strong one already, I just need more of them and more often. How much is that? Certainly expensive, but I mean how many pills.

I liked the clarity. As if a fog would dissipate. Unmasking nothing in particular, but a nothing unmasked. Fervours and depressions cooled. Or warmed? Anyway it was, clarity remained. Episodes weren’t ferocious any longer. I like the clarity, but it seems to fade too soon now. Today it wasn’t even close at all, it just dissipated into its fog again before my precious nothingness could be perceived. Such a waste. I feel an itch, I know it just doesn’t do the work it should anymore. I know.

Call the doctor, change the prescription, get more. Upgrade me. Yes. But for how long? Imagine: a long-term prescription; prescriptions, I should say. mmmhhh... 20 years? More? Cheeky. It should include increasing dosages over time. Cheeky cheeky. At this pace I will certainly need more later if this happens again. Getting edgy. Alright, it’s settled: progressively more. Call the doctor, upgrade dosage. It’s reasonable.

On top, I do need more now. It’s that time of year now, stress accumulates and I need more clarity than before. To put it simply, it will get increasingly stressful. I need to cope to what comes ahead. I know that as certainly as I know that effects dim out faster now. Yes, so, progressively more.

Last week I started doubling the dosage. The prescription says ‘two pills every 12 hours’; I’ve gone to four. Twice a day, still, it’s alright. I called the medical practice today, said I lost them in a luggage. Easy. Now there’s more. But that long-term idea keeps me rattling, if anything is certain is that unbalances will increase. The doctor will understand, who follows prescriptions anyway?

Tolerance is a common side effect in lithium treatment. Tolerance in lithium treated patients is normally related to non-adherence to dosages. Efficacy of treatment is lost when dosages are tampered with for either interrupting treatments or intensifying these. Loss of adherence for dosage increase can lead to lithium toxicity which can be life threatening.102

Adherence loss

The further renewable energy systems are deployed, the effects of existing batteries on balancing electricity supply with load are proportionally lessened. More lithium materials are thus needed to stabilise an increasingly battery-tolerant energy system. Likewise, the increase of lithium materials available for a battery-tolerant energy system stresses the convenience of lithium-based technologies and locks technological preferences based on lithium non-adherence.

While ongoing, an overdosage begins to be taxing to the system coping it. As with lithium medicine, toxicity comes from the treatment, and not necessarily only from pharmaceutic manufacture or expired pills. Toxicity from a tampered dosage of lithium materials in the energy system may then occur regardless of mining wastes and batteries end-of-life. Reactions to this toxicity begin to be visible as analogous to bodily reactions. Metabolic reactions of energy systems to lithium toxicity constitute the making of raw material supply networks. In simpler terms, material supply responds to the drivers of tampered material dosage.

Lithium materials today are pressed for greater supply in Latin America mostly by long-term mining contracts and future-demand speculations. This section addresses those drivers and observes critically in them the bases for contemporary material metabolisms and provisioning systems.
Contracts

In Notary Sergio Rodríguez Garcés, the constitutive act of Sociedad Química y Minera de Chile S.A. (SQM) was set in 1968 as a public, legally recognised statute whose signees were verified by Chilean law.\(^{103}\) In that same notary, eighteen years later in 1986, Sociedad Minera Salar de Atacama Limitada (Minsal) was established as a limited liability company grouped among Chile’s Economic Development Agency (CORFO), Amax Inc. and Molymet. Eight blocks away and six years before in 1980, Sociedad Chilena de Litio Ltd. (SCL) was publicly set in Notary Raúl Undurraga Laso between CORFO and Foote Mineral Company.\(^{104}\) Closer to today and just a couple buildings from Notary Sergio Rodriguez Garcés where SQM and Minsal had their initial structures formalised, Notary Pablo González Caamaño saw Albemarle’s lithium extraction contract with CORFO being set in its modified shapes in 2016 and 2018 for mining in the Atacama Salt Flat. Likewise in 2018 but three blocks away in Notary María Soledad Santos, SQM and CORFO were settling a controversial State-placed lawsuit through a contract modification for SQM’s lithium extraction activities in the Atacama Salt Flat.

All these contracts and firms are intertwined together. The pasts of Chile’s lithium contracts sit closely to those formed in present days, as do the corporations involved today and yesteryear on lithium mining in the Atacama Desert. The alliances and breaks among corporations are perceptible in the contracts and so are they in the spaces that saw their making. As notaries have morphed to their present image, they dispel still the bureaucracies, its odours and sounds, that modernity cannot rid.\(^{105}\) Their buildings themselves display past times when halls and rooms, today partly vacated and partly covered in plasticky wallpaper, saw distinct attention but had not necessarily different agencies. Outside, the places where their host buildings lay give allures of the takes written in contracts. Walk from one notary to another, from where the first lithium corporations of the Atacama Salt Flat were signed into being to where today’s lithium mining contracts that reform the Atacama Salt Flat and the activities therein have seen their latest modifications, and the environment and signs suggests how do these times and contracts changed and relate still. The blocks that bond past with present resonate the distortions in views that corporations and the State have taken in lithium extraction. These blocks also hint on the fractures that have disassembled actors once amassed together through contracts. Walk again to the past of lithium contracts as the city of Santiago invites thoughts on the things that once surrounded the making of contracts, how these changed and remained to the most recent transformations of documents, and importantly how do

\(^{103}\) Documents from the Chilean economic competition regulation agency (FNE) on the Tianqi-SQM shareholding acquisition.

\(^{104}\) CORFO (2016).

\(^{105}\) The idea of modernity in Latin America as a European construct is elaborated by Mignolo (2005). Today in Chile, his writings as those from Moya (2010) which spell on the desire for modern ideals as Eurocentric visions of life and economy are well present particularly in State politics and policies.
these past and present hosting features are in the contracts themselves and in the purposes underlying them.

The most recent contracts on lithium extraction in the Atacama Salt Flat are but a transformation of the former ones. In their current form they remain closely related to their equity and material foregrounds. The relations across genealogies is noticeable and anchored in the notaries that gave first legal recognitions of the structures that would occupy the Atacama Salt Flat and extract its lithium reserves. These contracts and their predecessors underpin the making of lithium industries in Chile and in the region. Corporate structures morphed as they tend to do through equity acquisitions, and left but two entities in the Atacama Desert to deal with lithium: SQM and Albemarle. Today's lithium mining in the Atacama Desert as handled by SQM and Albemarle is rooted to the transformations of Minsal and SCL respectively.\(^\text{106}\) The actors that played in the making of Minsal and SCL have not altogether left the spaces where Albemarle and SQM dwell and as such are arguably as present as they were before. SQM and Albemarle do not operate independently from other corporate actors, particularly so not independently from the State which as in the past takes ambivalent forms of a corporation.

The oversight of CORFO on the operations in the Atacama Salt Flat goes beyond merely handling contracts with the State alone and links contracted firms to in-ground beneficiaries, State-selected clients, equity market investigations and end-use fictions. The presence of the State in waverings forms, ties today's mining firms in the Atacama Salt Flat together despite apparent fractures between them. These relations are observable through the contracts but importantly through the places where these documents were brought into being. The contracts as formed then and today in these close-knitted blocks of downtown Santiago alter the ways in which lithium materials are dreamed-of, produced, traded and priced. Seeing Chile’s lithium developments from the outsets of contracts and their materialisations unravels how these documents and their contestations matter heavily for any prospect of lithium materials in batteries, and for the trade of a material as made by companies, resources, people, value, futures and remembrances.\(^\text{107}\)

This chapter analyses what do contracts for lithium materials production in the Atacama Salt Flat do beyond framing mining activities. It sets out the relations across contracts in time to better understand the most recent turn of contract modifications as experienced in 2016 and 2018 for Albemarle and in 2018 for SQM. Through these recent contract modifications, the chapter analyses the images, roles and actors that lithium as resource has, and it questions how economies as affixed in lithium prospects, and vice-versa, are formed from contractual arrangements and their resulting economic strategies.

\(^\text{106}\) CORFO (2018c).
\(^\text{107}\) See Chapter 3 on matters related to companies, Chapter 4 on in-ground resources and people, Chapter 5 on value, Chapter 6 on futures, and Chapter 7 on remembrances. Contracts for lithium materials production in the Atacama Salt Flat affect each of these aspects and thereby link them together and in so modify the supply of lithium materials onto end uses in batteries.
The ways that industries and nations are made from resources are in significant forms limited to the devices that work to make societies and industries operable in place.\textsuperscript{108} Notaries in Santiago empirically capture this for today’s lithium extraction in Chile and more broadly for its societal functioning. The signs observable in notaries and their surroundings offer a wealth of entries to Chilean society and its enclave on mining and bureaucracy.\textsuperscript{109} Looking at those related to lithium-focused corporations invites thinking on the things and devices that were and are around lithium contracts and how do they affect today’s energy systems in scope of realising fictions and reproducing patterns of material overdosage.\textsuperscript{110} So, before unpacking the contracts themselves to analyse their role in lithium supply and their material politics, this chapter embarks across associated notaries and the lived aspects within them and in their surroundings. The images seen in and around the notaries that enlivened lithium resources and corporations are transduced to contracts themselves to thereafter take the analysis on contracts beyond their known controversies but onto the ontologies of materials, technologies and documents. The chapter then closes with thoughts on global end-to-end paths of raw materials as made by the places that enable resource extraction. Commodity value chains are then highly affected by corporate contracts on mining. The use and intent of these contracts in material supply leads to reflect on them as responses to unequal exchanges brought by international divisions of labour, and as drivers for increasing intakes of particular materials in society; as the piston that presses materials down a funnel or as the thumb that forces pills down a throat.

\textbf{SQM}

A clerk of the front register of what used to be Notary Sergio Rodríguez Garcés in 379 Teatinos street in Santiago returns to the desk with a small paper in which an address is written. This address is just a few buildings away and it’s the place where the ‘diligences’ of Sergio Rodríguez Garcés were taken to after his passing.

\textsuperscript{108} Devices are here seen similarly to what Callon, Millo and Muniesa (2007) remark as objects that gain agency through their nodal role in the configuration among actors.

\textsuperscript{109} For literature that serves as framework for this chapter’s semiotic analyses on mining see Chowdhury (2016), Cross (2014), Papadopoulos, Tsianos and Stephenson (2008) and Keane (2005).

\textsuperscript{110} On the difference between things and devices, it is worth noting that while Science and Technology Studies joins objects and things with representations, subjects, institutions and politics more broadly, see Law (2017), the notion of \textit{agencement} brought by Callon, Millo and Muniesa (2007), takes the agency of objects further to conceptualise devices as agents that gain weight in assemblages as far as they are nodes in relations. The separation of objects and devices is not always evident but can be drawn when enquiry on agency of things follows MacKenzie’s (2009) suggestion to look for the parts and effects of relations and material and human assemblages that are not that evident.
“Don Sergio died about ten years ago.”

He hands the piece of paper written by someone sitting in a pop-up office in the back of the room who answered his enquiry without raising her head nor interrupting her signing process. Her mechanised paper-signing paces to the sound of staplers, all running in unison to a somewhat accelerated rhythm fitting as a harmonious choreography.

Exhibit 2 – Entry to Notary Claudia Gómez Lucarez. Picture taken by the author.

Notary Sergio Rodríguez Garcés is today called Notary Claudia Gómez Lucarez. The place where SQM bound its constitutive act in 1968 is now spotless, covered with a blue diamond-patterned wallpaper and decorated with sheer-white plastic furnishings. A shaded glass door has been well into a hall frame that seemed to be open before, see Exhibit 2. The improvised door feels a bit awkward as it misfits the steps in the hall and as the threshold it creates is a space that does not feel designed for the hall. Beyond its door, the notary seems to have been ‘updated’ with changed design and furnishings and a dense workload.

111 Mentioned by an employee in the front desk of Notary Claudia Gómez Lucarez in 2019.
The notary sharply contrasts its building. Its plastic counter contrasts the fittings of the building as it does to conventional wooden counters found across notaries in Santiago. This gives a feel of a fast-paced adaptation, rushing from its time and space in unfitting ways. The brightness and cleanse in the surface are quickly caught as ‘faux’ when a careful eye notices gaps in between flooring and wallpaper, and precariousness of an apparently fixed but wobbly screen meant to divide the desk of a person from others making thus a tiny ‘office’ amidst the open-plan notary. These details badly attempt fixing and masking what lies underneath as the building where this notary is in, all to the doorway of the notary, seems to be rapidly deteriorating. Makeshift fixes pass and no further twitches are deemed necessary as long as the impromptu faux ceiling and glue holding panels and lights in place concealing pipes, wires and fractures do not fail today. Outside, the building is freckled with air-conditioners poking out of facades, suggesting not just the constant unbalances with the outside but how through time these buildings have adapted to changing perceptions of comfort, conform, every-day life and desires. These adaptations, like the wallpaper inside the notary are but simply attached to existing features without altering any of existing and underlying structures.

Much like a road that keeps getting concrete on it without gritting the old one away, the room for manoeuvrability is reduced every time an alteration occurs, halls look tighter, desks are placed closer together, buildings slowly but constantly take more volume making the streets below darker and ever more subjugated to the presence of unfitting features anchored one after and on the other. These refurbishments do not however modify the feel of deterioration that Notary Claudia Gómez Lucarez, its encasing building and the street outside have; they just seem to serve for a temporary fix to keep bureaucracies and societies attached to it in an ongoing pace of blinded due diligence. Like the notary, SQM’s contract for operating in the Atacama Salt Flat seems to be covered with changes without really modifying the role of the firm in the country, of lithium extraction in the area, or of the ontology of the contract itself.

The noise of papers ripping which today often clamours the rooms where SQM first bound its constitutive act in 1968 changes to an upbeat electronic music coupled with occasional beeping sounds from copying machines in Notary María Soledad Santos. There, SQM and CORFO signed an agreement in 2018 that modifies the leasing of land in the Atacama Salt Flat from CORFO to SQM to produce brine-related chemical products. In Notary Santos the operational behaviour is fast paced. The main counter is shorter than most notaries in downtown Santiago, making but a couple meters long. People are not visible behind the wooden counter, just a couple shiny copying machines are at sight in a small space bordered by a shaded glass with in an elegantly scripted ‘Notaría Santos’. Every once every often, a clerk makes way to the counter from an office next to the copying machines towards one of the persons sitting patiently alongside another glass panel that also serves as wall to the outside of the notary. The clerk either greets a person, instructs someone to take handed documents or points to proceed to one of the offices whose
doors are lined up in front of the sitting range. The lack of personnel at sight makes for impressions of reduced or even no procrastination or senseless paperwork. Contrastingly to notaries located in deteriorating and abandoned-looking buildings, in Notary Santos the furnishings seemed to have been located as planned with the space-design making things look all the more streamlined and purpose-built. The building where this notary is located is alive and active. Shown in Exhibit 3, its ground-floor is part of Galería Alessandri, a shopping mall that displays high ceilings and soft lighting and connects several buildings in downtown Santiago. One of the functions of Galería Alessandri is to work as a tunnel, populating buildings with footsteps looking of leisure, recreation and occasionally notarisation.
Outside, the street is wide and grand. Buildings lavish on stone engravings and metal detailing. Neighbours are not short in political status as the building rubs shoulders with the Central Bank of Chile that exhibits opulence with its large and flagrant bronze doors that span golden effigies for more than 6 meters high, sided by two large golden light-posts, each holding five large light bulbs roughly up 2 meters in height. Unsurprisingly, a surveillance camera hovers over the bank entrance and the street that hosts Notary Santos and foreign coffee chains.

The surveillance camera over the Central Bank of Chile and in front of the Galería Alessandri replicates within the mall and over the staircase leading to Notary Santos within. The high ceilings, elegant furnishings and the fast, mechanised handling of documents where machines are more visible than people, give somewhat the feel of what ‘modernisation and improvement’ means for the Chilean State. The 2018 contract between CORFO and SQM is an Exhibit of stark change for the image that the State holds for itself as supervisor that will not cope any longer with shaded practices and accountings that give way to and happen from collusion and corruption. It separates the State from the corporation.

Walk in the right direction in Santiago’s city centre and you’ll bridge pasts with futures. Just three blocks separate the places where SQM first signed its constitutive act in 1968 and where it agreed to a modified contract with CORFO in 2018. Walking from one end to the other takes one from key cutters and Chinese restaurants to the Moneda, Chile’s presidential building, and the Central Bank of Chile. This walk passes through what seems countless notaries all clustered in these blocks of Santiago. As the walk suggests, 50 years of notarised operations in the Atacama Salt Flat have not been a matter of a single change with sharply different environments and results, rather a series of nuanced and intricate alterations have occurred while relations are made from alliances and fractures.112

Fractures between the State and companies are relations and are made to work from contracts

Fracture does not constitute necessarily loss of relation. Thereby, Actor-Network Theory as presented by Callon (1980) and Latour (2005), and expressed in context of Science and Technology Studies by Law (2017), to analyse how actor are shaped in their relations, needs to consider disassemblages as constituents of relations and agencies therein.

The most recent agreement for SQM came after a couple lawsuits from CORFO against SQM in 2014 and 2016.113 These lawsuits were filed by CORFO due to the supposed breach of the 1993 contract that SQM

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112 As noticed particularly in chapters 3 and 7 relations are also fractures, and so assemblage and disassemblage equally evidence relations but do so on different stages of relational processes that can regardless still be in connection and articulation.

113 Sourced from archival work on FNE (2018b) documents on Tianqi-SQM shareholding acquisition.
had with said State entity where fees for exported materials had not been rightly paid for.\textsuperscript{114} Tints were far more political than a mere fee breach and resonated across Chile from 2015 onwards to today as collusion and corruption rumours spread quickly around the name of SQM and CORFO alike.

The change of contract in 2018 was a political symbol for the modernisation of lithium mining and the State alike in Chile and for an improvement of the benefits captured by the State allegedly to benefit broader Chilean society. As shown in Exhibit 4, this change looked at the 1993 ‘Atacama Salt Flat Contract’ by which Minsal would develop the ‘Potassium Salts and Boric Acid Project’.\textsuperscript{115} This contract was notarised along but in different notarisations to the equity sale of Minsal shareholdings from Amsalar and Molymet to SQM K, a subsidiary of SQM; then leaving CORFO and SQM K as sole shareholders of Minsal with respectively 25% and 75% share distribution. Likewise in the same day and at the moment of Minsal shifts, the same notary bound land leasing from CORFO to Minsal so it could carry on its project in the Atacama Salt Flat as per new shareholdings and project outlines. These changes overruled Minsal’s former land leasing and material extraction and production contracts established in 1986 between Amax, Molymet and CORFO. 1993 contracts signing and binding took place in Notary Juan Ricardo San Martín Urrejola.

\textbf{Exhibit 4 – Minsal-SQM equity and project threads. Elaborated by the author based on CORFO (2018c).}

\textit{“Eighteenth floor! Eighteen!”\textsuperscript{116}}

An elevator door from a range of three opens while a man dressed in an oversized white shirt and grey work-trousers pops his head out to scream the elevator’s destination. People waiting outside facing the

\textsuperscript{114} Ibid.
\textsuperscript{115} CORFO (2018c).
\textsuperscript{116} Screamed by an elevator operator at ground floor of the 83 Huérfanos Street in Santiago in 2019.
ground floor elevator doors rapidly amass towards him while he hinges to the rear of the elevator to allow the stampede to proceed in.

Notary San Martín Urrejola is not easy to find. Located several stories above in a building where not every staircase nor elevator stops at nor reaches every floor. Out of three elevators, only one leads to the 18th floor, where Notary San Martín Urrejola is located. Elevator and floor pairings are not visibly written, its understanding is but a tacitly acquired knowledge obtained after making several visits at 835 Huérfanos Street. The familiarity of people attending to the way of moving in the building remarks that paperwork may not be as effective and several visits are required, it also suggests that people bond to their notary in a relation build by social attachments to bureaucracy and hard copies; familiarity then takes a proper meaning to its lexical root as relations are made with rather tight bonds. For those unfamiliar with elevator workings in this building, a slight maze recognition is necessary.

An elevator door opens and a man inside simply says that it is not working. Another elevator opens but it does not lead to the 18th floor; still it must go somewhere. Reaching the 18th floor is even more challenging once within the building. As the elevator that is working but does not stop at the 18th floor advances and makes what seem to be programmed stops to solitary floors no one inside requested, attempts to reach the mythical 18th floor by staircases causes even more confusion to the unfamiliar wanderer. Elevators with half-mirrored half green-tiled walls, bright white lights and pale monochrome tiled floors feel oleaginous as they racket their way upwards. Those inside shush and avoid eye contact. This behaviour rapidly changes as doors open at the 7th floor, a reasonable place to switch elevators according to those inside. The first elevator and the way to the 18th floor is unusually elusive, only the other two doors open crowded with people in business attires pointing to the elevator on the right when one asks if this one stops at floor 18. What seems to be consultancy firms are not very popular as no one tends to exit at this floor. Exit at the 16th floor and things don’t change that much. There, staircases are alarm-set making them useless for moving in the building and away from elevator logistics. The first elevator might open but only to go to the ground floor where that same elevator would likely go back up to the 18th floor, a safer bet than alternatives at the 16th floor.

Notary San Martín Urrejola is like its building, gelatinous, crammed and maze-like. It occupies the entire floor and is arranged by a hall from which two wings span at the end. A wooden counter sized for two persons is placed at the left of the entry hall. Next to it, a digital queuing machine displays three options: sector 1, sector 2 or sector 3; these are divided according to the officer that people look for. Paperwork is appointed according to public servants and not to topics. Desks have stacks of papers on them as occasionally laughter emerges from behind one or nagging from another. The buttons in the queuing machine resemble the elevators where one option opens myriad alternatives that maze up to distinct officers all intertwined among one another but only reachable from a single entry. Press the wrong one and your target strains through all other alternatives.
Chapter 1

As with the modification of Minsal in 1993, things as they are today are dissimilar to the times when the notary was placed in that building back in 1988. Like Minsal, prior to its diligences arriving to that notary, its constitution was strikingly different, the only thing that would remain after 1993 was its maze-like structure and project orientations. Navigating Minsal’s constitution documents requires several visits that challenge even skilled observers to grip the programmed workings of its slurry buttons and stairs.

Minsal’s equity was fully acquired by SQM in 1995 following the auctioning of CORFO’s shareholdings. Slight contract changes for land leasing and project contract from those made in 1993 were likewise notarised in Notary San Martin Urrejola, but they were done so a week before the share auctioning making the equity acquisition conveniently more seamless to SQM. After 1995, SQM was the sole owner of Minsal and channelled its project into its own operation. Minsal’s tenancy in the Atacama Salt was transferred to SQM as was also Minsal’s brine extraction and transformation contract, thus blurring Minsal as label into SQM.

Prior to the 1993 equity distribution and the 1995 equity concentration of Minsal, this firm had yet an intricate step after its initial making in 1986 at Notary Sergio Rodríguez Garcés. In 1992 a brief change of participation occurred for Minsal shareholding. Then, Amax sold its equity of Minsal to Amsalar making the initial shareholding group as constituted by CORFO, Amax and Molymet to be CORFO, Amsalar and Molymet. This happened in Notary Raúl Undurraga Laso. This was an apparently irrelevant change in the mist of contract changes from Minsal to today’s SQM land leasing and mining contract with CORFO, but still it paved a tendency of equity and company changes around the Atacama Salt Flat.

“This is my notary; I have had many documents here.”

Notary Raúl Undurraga Laso is quiet. The elevator leading to it on the third floor does not exude a mass of people eager to get paperwork done. Like a metro station, waiting chairs are built into a single iron structure. A convex mirror used normally for traffic visibility in car-parks entries, tricky bends or roundabouts is placed above the wooden reception desk. This mirror is common in less saturated notaries in Santiago’s old downtown buildings. Its purpose might be to make the movement of people handling documents behind the counter visible, but it only reflects the ceiling. The devise to increase transparency seems to be perhaps unintentionally twitched to operate at reduce ranges. A large vault with a single rotative handle as a steer sits at the far-left end. The attachment of people to a notary or another could very well be due to the existence of these vaults holding documents that bind people and future diligences and paperwork to a place where their foregrounds are saved at. The mere existence of this vault and its fitting to the place as the welded chairs suggests that notaries are more than places to

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117 CORFO (2018c).
118 Ibid.
119 Ibid.
120 A man tells his male companion as they wait in Notary Raúl Undurraga Laso.
bind and sign documents, but they are also safes for keeping documents under the watch of mirrors and clerks. In this notary though, the conventional sign warning visitors that it is not a place to change currency is slightly more explicit by mentioning that no United States dollars are exchanged there; thus hinting on the close relation of Chilean economy with United States currency and value, interesting considering the presence of North American equity in the Atacama Salt Flat as concurrence and past to SQM.¹²¹

Outside Notary Raúl Undurraga Laso, the road is busy with cars in downtown Santiago. This notary is likewise three blocks away from Notary García, as is the place where SQM’s contract had its most recent change. Walking from here to Notary García, where Minsal and SQM had their first notarised breaths, or from the Central Bank of Chile that oversees the place of a new fee arrangement from CORFO to SQM, one may very well cross with an electric vehicle ridden by police officers going on around notary-congested streets towards the past of lithium contracts in the Atacama Salt Flat.

**Albemarlé**

Recent times however do not entail foregoing past places. Just a couple buildings aside on the same sidewalk as Notary Claudia Gómez Lucarez, formerly Notary Sergio Rodríguez García and foundation for SQM and Minsal in their first constitutive acts respectively bound in 1968 and 1986, Notary Pablo González Caamaño was witnessing in the settling of the contract modification between CORFO and Albemarlé in 2016 and a further alteration for Albemarlé’s operations through a different contract called the ‘efficiency contract’ in 2018.¹²²

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¹²¹ See Chapter 7 on equity threads that lead to SQM as it is structured today.
¹²² CORFO (2018a & 2018c).
Notary Caamaño has the same feel as Notary Garcés’ contemporary form. It might be more attuned to its building encase, shown in Exhibit 5, as the front desk, wall décor and desk line-up behind the front desk all feel as they have been maintained from the building’s prime times back in the 60s-80s. The contract that was modified here in 2016 and that which was made in 2018 have content-wise the same role as that which was enacted between SQM and CORFO in front of the Central Bank of Chile. As the street and building of Notary Caamaño suggest, it was just less relevant and visible for everyday politics as known by general society in Chile.

On their outset, both contracts held between CORFO and Albemarle and between CORFO and SQM in their current modified forms of respectively 2016 and 2018 do the same thing. However, only one serves as political instrument for changing the imagine of the State. SQM’s tale tells a better story for that matter. But that does not mean that the tale that led to Albemarle’s contracted form in the Atacama Salt Flat was in essence any different in light of the making and breaking of alliances with the State and its resources. Its story might be even more shady providing that what is spoken and politicised as Chilean was in the case of Albemarle’s foregrounds even less Chilean in terms of involved actors and interests than it was for SQM. United States shareholdings in the Atacama Salt Flat were currency for CORFO prior to its participation in Minsal equity.

In 1980 CORFO took part in the making of Sociedad Chilena de Litio (SCL) along with Foote Minerals Company.¹²³ Even if the name stated ‘Chilean’, shareholdings in SCL traced to Chilean participants

¹²³ CORFO (2018c).
amounted to 45% with the remaining 55% under a company based and formed in the United States. Nine years later CORFO sold its holdings of SCL to Foote Mineral Company making SCL, the ‘Chilean’ lithium society, entirely foreign, see Exhibit 6. While land records granted by CORFO partly remain today under the name of SCL, SCL turned to be named Rockwood Litio Limitada without this affecting at the time the full shareholding of Foote Mineral Company or the name of land tenant for CORFO’s property. Today Rockwood Holdings, for which Rockwood Litio Limitada is a subsidiary, is owned by and works under the brand of Albemarle from 2015. Thus, Albemarle took on the leasing of CORFO’s land as granted to SCL.

<table>
<thead>
<tr>
<th>1980</th>
<th>1989</th>
<th>2015</th>
<th>2016</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORFO + Foote Mineral Company</td>
<td>CORFO</td>
<td>CORFO</td>
<td>SCL</td>
<td>CORFO + Rockwood Lithium</td>
</tr>
<tr>
<td>Lithium in the Atacama Salt Flat Project Contract</td>
<td>SCL</td>
<td>Foote Mineral Company</td>
<td>Rockwood Lithium</td>
<td>CORFO + Albemarle</td>
</tr>
<tr>
<td>Creation of SCL</td>
<td>OMA Land leasing contract</td>
<td>SCL equity sale</td>
<td>Corporate rebranding</td>
<td>Corporate acquisition</td>
</tr>
<tr>
<td>Pablo González Caamaño Notary</td>
<td></td>
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</tbody>
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Exhibit 6 - SCL-Albemarle equity and project threads. Elaborated by the author based on CORFO (2018c).

By the time it sold its equity of SCL as it did for Minsal, CORFO did not look at salt flat operations in further need of nudging as the market was working on its own.\(^{124}\) So then its approach changed to regard operations as supply of royalties from land leasing and mineral extraction and trade. Its identity as corporation swivelled from private investor to landowner. Today CORFO is seeing to further modify the way it participates in lithium mining. The days of the silent landowner have gone and now it goes into meddling with, so as not to say imposing, products, prices and clients. This new persona is materialised by today’s contracts, but even if contracts exist the strategies to make them work have not gone beyond attempts.\(^{125}\) Regardless of its attempts being effective or not, its reworked intervention is done through the same mechanisms it used formerly: contracts for land use and material extraction.

\(^{124}\) Conversation with a CORFO employee.

\(^{125}\) While contracts place the economic strategies sought to realise expectations from resource fictions, the mechanisms that drain from them do not always manage to materialise ideas and dreams of development, see chapters 3, 5 and 6.
Albemarle’s contract modification in the backblocks of visible politics hints that recent times do not mean foregoing past places. But recent times then neither mean foregoing past practices. The link of these interventions to bloom life to other materials, notably copper, suggest as well that past practices are attached to materials in their place. Places are attached to habits. The stubbornness of materialising economic ideas and resources still through means that are arguably encased in abandoned buildings with sketchy faux ceilings can be envisioned as mines whose material relevance decays due to costs of production. When value increases are speculated in the horizon for other materials, the methods and interests of past spaces of extraction and spaces used to make resources, notaries included, see bursts of policies and paperwork.

The change on what further can the Chilean State take from its resources without engaging in equity came along with the look on batteries. Royalties it could get from its land were appreciated as low reaching. Envy and desires for overdosing both outer demand and through that themselves on amorphous value, grew. Ridding batteries was the way to policing modernisation and improvement just as police officers do in downtown Santiago, regardless of the ambiguities of its meaning and practice.

**Contract grounds**

The roles CORFO had taken in lithium supply prior to lithium demand growth in 2015 was initially that of a joint venture partner and then of land-use and product-sale fee collector. In both takes its contribution was land with raw material production potentials. To hold these land assets, CORFO had previous experiences with binding resources to operations through contracts and as contracts.

<table>
<thead>
<tr>
<th>Mining operations compound economic activities with conceptual functionality of land</th>
</tr>
</thead>
<tbody>
<tr>
<td>The making of resource from the mechanisms made to legalise land-holding and to make it operable are bound to visions of resources that serve a limited set of interests, see Nyamu Musembi (2007). The use of the word ‘operation’ builds from Latour’s (1987) notion of delegation to remark economic operations in their sense described by Hirsh (1976) as things that give abilities of functionality to the places where they ‘operate’. It is the activity of operation that operationalises land and makes it function to a purpose that is not often decided by those living in-ground.</td>
</tr>
</tbody>
</table>

126 Literature that speaks of lithium and broadly commodity prices rising in Latin America in and shortly before 2015 are for instance Narins (2017) and Arboleda (2016).

127 See Chapter 4 for further elaborations on staged multiplicity of place making and in-ground living in and around the Atacama Salt Flat. Chapter 4 expands this idea to see the distinct classes of relation of ‘usefulness’ from land in the Atacama Salt Flat.
Though its ventures with lithium mining firms started in 1980 with SCL and later in 1986 with Minsal, CORFO’s most relevant lithium undertakings related to contract binding go back to 1977 when it constituted mining belongings as its own land figure in the Atacama Salt Flat. Doing so, it got away by a very narrow margin for acquiring land rich with lithium reserves. Two years after it got this land, lithium reserves were legally forbidden to be bought, held or given as concession in Chile, excluding those formerly settled.\textsuperscript{128} Based on these land holdings, called OMA, CORFO has been contracting lithium mining and weighing in on lithium supply. Shown in Exhibit 7, OMA are not the sole land holdings in the Atacama Salt Flat, there are also SAL, SALAR and RIGO, apparent mistakes in cadastre documents that were later engulfed into CORFO’s assets.\textsuperscript{129} As shown in Exhibit 7, The large blank spots outlined in red in the middle of the figure and surrounded entirely by blue and green smaller landholdings compose the Atacama Salt Flat. Landholdings inside the Atacama Salt Flat are called ‘OMA’, see the large middle and bottom sections. Landholdings in the upper section are called ‘Rigo’, and the landholdings represented by the vertical stripe of blue square bits that cross central OMA landholding are called ‘Sal’ and ‘Salar’. Together, these landholdings make up the totality of the Atacama Salt Flat, whose large majority is OMA. SQM and Albemarle operations are enclaved in OMA, whereas SAL and SALAR are an awkward vertical thread with no operations and RIGO serves as ‘protection’ from any other operations in the northern part of the Salt Flat.\textsuperscript{130}

\textsuperscript{128} See Law 18097 from Ministerio de Minería (1982).
\textsuperscript{129} SERNAGEOMIN (2020) and conversation with a CORFO employee.
\textsuperscript{130} Ibid.
Landholdings and cadastres make land operable as resource

Resources as socially constituted is expressed by Bridge (2009) to remark the categorisation of materials into resources as far they become related to other things useful to society. Here, Bridge’s thought is seen under lenses suggested by Shankar, Hakken and Østerlund (2017) on documents and object studies to see these effects of resource making from a relational stance as revolving on objects as well and specifically then on documents as resources.

Seeing these holdings as the Atacama Salt Flat itself points to the importance of contracts. The Atacama Salt Flat, as most mining sites are, is then made as resource from its landholding certification and formalisation. This evidently counters in a sharp manner the views and relations that some people inground have with the Atacama Desert, for whom land in the Atacama Puna is anything but unified. Still resources for trade are made-up in law by the practice of contracting land and its use. The making of resources then happens in spaces like notaries that are well separated from the geomorphological events that have led to geological features like salt flats to exist in the first place. Contracts as intermediaries in this resource-making process across places are the most relevant piece in creating cadastres and thereby land. By being established prior to the law that categorises lithium as a strategic resource for national security, OMA were excluded from a red-lining regulation. The Atacama Salt Flat was thereby placed under different governance than the rest of salt flats in Chile and Latin America. The cadastre of mining concessions may then be interpreted as OMA layering above lithium law.

“The president signs the CEOL” 133

The rest of lithium resources in Chile are managed by the Mining Ministry who, after 1979, handles permissions to exploit lithium resources by ways of another sort of contract called the Lithium Operations Special Contract, known as CEOL. This contract has today only been given to the State company that carries most ghosts of copper pasts, the Copper Corporation (CODELCO). With this contract, CODELCO can produce lithium from its concessions in the Maricunga Salt Flat. However,

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131 See Argento (2015), Romero and Opazo (2019) and Chapter 4.
132 Chapter 4 expands on anthropological bases for geomorphology and place-making in the Atacama Salt Flat. Here, notaries are added to that discussion as places that construct contracts into market devices that make land known as ‘landholding’, which may come to matter more as resource than mere land on its own.
133 Expressed by a lithium mining executive close to Albemarle.
134 While the mining ministry manages the CEOL, it is the nuclear agency who grants final permission to mining projects on lithium due to its category of critical for nuclear safety uses.
135 The Maricunga Salt Flat is located further north in the Atacama Region. Like the Atacama Salt Flat, all of the salt flat is made-up of mining concessions. As expressed by a CORFO employee, 25% of Maricunga’s concessions are owned by CODELCO, 25% by Salar Blanco, a joint venture between the Australian mining firm Lithium Power International, the Chilean private company Borda Private and the Canadian mining firm Bearing Lithium, 25% by SQM, and the rest is fractured into smaller pieces owned by multiple other firms. Maricunga is spoken with great...
copper mining has little resemblance with lithium materials production. CODELCO is then using today its CEOL to partner with foreign lithium mining companies in the Maricunga Salt Flat and to have them develop their concessions via its CEOL. Evidently with a slice of profits forked then most rapidly to the State and to its copper. CEOL seems to be a strategic asset far more than concessions, since without it, production is not authorised. The management of the CEOL as CORFO’s handling of its land leasing and mining contracts seems to enliven legacies attached to nation-making, particularly when just one CEOL operates today.

CORFO, as the overseeing actor over its CEOL-free layer, is somehow jammed by its own strategy to manage its landholdings. Changing contracts is no simple task. While Minsal and SCL have morphed respectively to SQM and Albemarle, OMA concessions provided for preceding companies remain in the outer parts of OMA holdings where SQM and Albemarle have not physically expanded to. Despite of these tenant ghosts, the intention from Chile’s government to have private firms sourcing more of lithium materials from its territory and to have that channelled to State revenue is well nourished by new energy markets.

**Contract haze**

Ridding batteries was much of the narrative of the most recent contract modifications that the Chilean State pressed on to SQM and Albemarle. However, ridding batteries on its own was not the reason for which Chilean authorities had changing regards on their agreements for lithium mining and land use in the Atacama Salt Flat. Documented in and across the paperwork that governed and governs lithium extraction, making the nation and its resources came by making corporate societies. Contracts were the methods for attaining this and thereby they served as artefacts that device the nation from its resources. Contracts *per se* operated as the most relevant resource the nation had to place itself in broader corporate equity and trade environments. The places where these documents had been brought-up matter for the tones and purposes that contracts have as symbols for political relation making and fracturing. The things on which contracts focus can be appreciated by comparing their spaces of production and according constituents. Either for instance breathing life to ancient infrastructures or tightening loosened oversight and pricing, notaries and their surroundings suggest myriad approaches to the ontologies of contracts and paperwork as a whole.

As a resource that needs management, just as lithium in brine, contracts were given in 2018 their own supervisory group.\(^{136}\) This group, known as the Contracts Supervision Committee for the Mining

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\(^{136}\) As noted by CORFO (2018c), members of this committee are limited to five people comprising CORFO’s attorney, and four others proposed by the Minister of Economy, Development and Tourism and deemed to be ‘specialists’ on either contract management, economy, mining or corporate governance. The politics of what is considered expertise or specialisation and by whom is further elaborated in Chapter 6.
Concessions located in the Atacama Salt Flat, focused not on the making of what the contracts say *per se* nor why do they do so, but more on the correct handling of them in accordance with their politicised significance. As equations for value, contracts where left untouched and deemed as working entities whose modification would be unruly to the say of CORFO’s head. Few people challenge them and even fewer consider their politics as polarised form one contract to another or as existent altogether.

The way to obscure these politics had effectively been carried by ideas and narratives of renewable energy, electric vehicles and green mining. Ridding batteries as trope thus served partly and mostly for this political-veiling purpose. All the more, ridding batteries as intention came attached to specifically ride lithium-based batteries in ways that contradict ideas of ‘greenness’ and that actually entail excess and depletion of resources at once.\(^{137}\)

Contracts became more of a resource than what these governed on. Notaries in their stake of binding them, evidence documentation beyond what is locked in their vaults. Notaries on their own not just document the lawful making of contracts but importantly the tints and politics that led to and that remain in them. The tasks for the Contracts Supervision Committee as separated between the two documents at hand, one for Albemarle and another for SQM, testimony a stringent difference across politics attached to each tenant.\(^{138}\) Exhibit 8 shows the additional tasks assigned to CORFO’s contract oversight team for the SQM contract compared to the Albemarle contract. One could assume that difference just by the onlook of the places where final processes happened.

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\(^{137}\) Chapter 2 elaborates on the haste to bring lithium-ion batteries into making. See Chapter 4 for a discussion on the coexistence of scarcity and excess of resources and the pressures on both from climate change and new energy economies.

\(^{138}\) On top of the contracted obligations of reaching productions quotas, trading produced quotas, pay fees, pay minimum guarantee payment, deliver reports on mining landholding protection, as shared with Albemarle, for the CORFO-SQM contract the contract supervision committee is tasked to additionally oversee the fulfilment of obligations that relate to banning Julio Ponce Lerou from being in the directors boards of SQM and subsidiary firms, see CORFO (2018c) and FNE (2018b) documents on SQM-Tianqi share acquisition. See Chapter 7 for a discussion of political pasts of the salt flat and on SQM corporate governance.
While contracts take on in their content significant entries for price, market and trade alteration, all justified to battery futures fictions, the tasks for the Contracts Committee are oblivious to these points and focus on the due diligence of land use fees, production quotas fulfilment, production capacity expansions, and land use reports, all of which are invariably attached to the royalties of material sales.

The resourcefulness of these contracts, which dwells with altering material supply networks for using battery expectations as output for increased material exoduses, is kept out of sight even in the tasks laid for resource management groups. Lithium politics for contracting economies lay hidden imperceptibly in batteries.

**Batteries are signs of wealth for lithium in production contracts**

The thought where batteries are rendered as a sign of the fictional wealth and value of lithium only if actions are taken to make their lithium value fictions possible is inspired by Chowdhury’s (2016) remark that "slippages between materials and their signs are sites of unpredictable and 'imperceptible' politics" (p.89). Further on the visions of development through technology, Barandiarán (2019) analyses the socio-technical discourses that legitimise lithium extraction in Latin America from imaginaries of batteries in energy futures.
“[CORFO] is shooting itself in the foot.”

The battery wave incites nations to shorten global systems of raw material provisioning and transformation. Thus bringing material supply closer to places and methods of battery production and use. Economic development blurs with national interests and turns the purpose and discourse of batteries as enablers for climate change mitigation on its back. A device for planetary action becomes a source for nationally segmented fractures. This is so since in the sense of aiming to economically make and sustain ‘the nation’ by climate change mitigation devices as batteries and their making, battery narratives serve individual desires of wealth and value rather than planetary environmental and energy necessities. This particular discourse of climate change which frames it as catalyst for economic growth comes not through the idea of opportunity-cost reduction from enhanced ecosystem services but rather from calculations based on the expected money value gain from trading a product that is expected to be massively demanded by what in base-metal market-analytics is known as ‘new energy economies’.

From the lithium resource standpoint, closing-in supply is not however as straight forward as it sounds, not alone on its practice but mostly on its purpose. Contracts are being deployed to press supplying links closer together, but their effectiveness remains disputed. Initially as here seen and further expanded in the next chapter, supply alteration to bridge and shorten steps therein do not necessarily look to prone on end-use products, but rather it is often done so for purposes pertaining to raw materials and their idealised transformations. In Chile today, as cradle for lithium materials trade, the battery wave invariably places emphases on its resources. These resources are not necessarily just its lithium bases and the uses it may have for society, but significantly the devices, comprising contracts, meanings, metrics and processes, it has to make natural resources operable. Rather than following on the battery wave as momentum to couple politics and increase electrification measures in its economy, the Chilean State through CORFO prefers to go on to batteries to increase value of its resources; not just lithium resources but contract resources as well.

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139 A director of an Australian lithium mining company operating in Argentina tells about the Chilean government regarding its strategies to categorise, fee and oversee lithium materials as he explains ‘why Argentina’ rather than Chile as preferred investment for lithium mining.

140 For examples on this intention in Latin America see Fornillo (2015a) and Revette (2017) and Chapter 5. While efforts for this happens globally in countries that either export base metals for batteries or that manufacture them, more pragmatic steps on this are being taken by EUROBAT (2020) who promotes the closing-in of provisioning systems for battery industries in Europe and North America.


142 See Chapter 5 for the mechanisms on supply and value alterations that emerge from CORFO’s lithium contracts.
Chapter 1

Conclusion

*Production contracts are nation-making projects*

Nation-making conduces today's politics for lithium extraction as it feeds lithium materials in energy systems. In this part of the argument, limited to contracts in the Atacama Slat Flat, it is noted that nation-making is not to be misinterpreted with national development, though it is often done so in politics of material extraction. For literature on contemporary national development political practices in Latin American economies linked to extractive industries, see Arboleda (2016), Arsel, Hogenboom and Pellegrini (2016), Wylde (2018) and Grigera (2018).

Contracts are devices that structure and assemble economic activity in the restrictions, allowances and temporalities expressed and agreed to in them. However, the activities they operationalise do not necessarily match with economic growth nor national development. While they may speak of those aims, contracts function for the future politics of material extraction which are close to imperceptible to readings that don't think seriously about contract making and roles in today's political debates and conceptual conflicts. To look at contracts in full lenses it matters to see where these were formed and where are they formed now. What they do is here seen to go beyond what they say they do. Hence, contracts document far more than their mere words. Contracts for lithium extraction in Chile document alliances and fractures and their ways of working into relations despite assemblages or disassembles.\(^{143}\) The genealogy of documents tells stories about those involved and their control over its contents and effects.\(^{144}\) For lithium materials production from the Atacama Salt Flat and their trade, contracts play a medullar role in the future of its materials. The past of Chilean lithium contracts and its places as do the places used today enrich understandings of what the purposes are for lithium as a sociotechnical material lined for nation-making and material development.\(^{145}\)

\(^{143}\) See chapters 3 and 4 for further discussion on the disassemblages as brought, carried and evidenced by lithium contracts and their relevance for the relations that make lithium supply.

\(^{144}\) Shankar, Hakken and Østerlund (2017).

\(^{145}\) A discussion of lithium as a sociotechnical material is brought forward by Barandiarán (2019) who remarks the visions of science and technology to incite development in sourcing countries by linking raw materials with desires of in situ industry development.
Contracts project a vision for materials in political debates and conceptual definitions

Contracts constitute future politics for material extraction providing their roles in political debates and conceptual definitions and contestations. This comes from the point raised by Elyachar (2012) who remarks that today's political and economic imaginaries are shaped by political debates and conceptual conflicts. Providing that visions of the future are often preordained by existing and former imaginaries, she follows to say that these debates and conceptual contestations are necessary to be understood if the future is to be thought critically. This infers that the devices that carry political debates as contracts must be recognised to be paced from a singular vision of the past sourced from contestation and that thereby these devices have the agency to project the future according to said vision. As remarked further by Elyachar, when these debates are not observed nor understood "it can become too easy to project visions of the future along a path preordained by a singular vision of the past" (p.76-77).

Importantly, while these contracts revolved around lithium, they carried pressures to serve for other materials in the Atacama Desert, materials that are present in speculations about the future and that are in need of political trusts, like copper, and materials whose ghosts remain in ideologies of land and extraction, like saltpetre. Lithium contracts are then arguably not about climate change mitigation, lithium battery use, nor environmental resource safeguard or measurement. Rather, they were about themselves, a resource on its own which became independent from its source and altered it in turn.146 Contracts ultimately layered in significance over the materials they in turn governed.

An underlying motive for CORFO to modify its contract with Albemarle as it was with SQM was to increase the amount of allowed lithium materials to be produced while reducing the timeframe for it. The change of material quantity and its production timeframe led to adjustments of fee calculations and added value strategies, all attached to speculative battery futures on which Chilean lithium had to play a significant role for its making. Today's purpose of CORFO's lithium contracts is to thrust the battery wave by pressing massive amounts of Chilean lithium materials into it. Battery futures as envisioned in CORFO's lithium contracts do not place opportunities to enrich electrification measures and climate change mitigations in the country or its region. Rather, the Chilean State through its mining and economic development entities is riding narratives of climate change and renewable energy to justify increased metal extractions, amended mining fees, and base-metal supply interventions.

CORFO’s lithium contracts serve as well to test strategies that would be later applied in the Mining of Mining’s CEOL contracts for the governance of salts flats excluding the Atacama Salt Flat. Battery narratives as used in CORFO’s lithium extraction contracts do not regard measures to directly integrate renewable energies to mining activities nor to reduce anthropogenic emissions or overall environmental footprints of lithium material production. Instead, the link between lithium and battery markets is sought to boost the extraction of materials and its money value in the country.\footnote{Chapter 5unpacks the mechanisms that attempt to increase money value of lithium resources.}

\begin{quote}
\textbf{Contracts ascribe value to objects and set temporal changes for desires on objects}

The processes for ascribing value to objects, that emerge from CORFO’s lithium contracts follow with what Ferry and Limbert (2008) call ‘resource imagination’. Shankar, Hakken and Østerlund (2017) note that social uses of documents can be indicated by their location in time spectrums ranging from permanent to temporary. The case of contracts acquiring a temporal limitation hints that the social use of the material at hand, and thereby of the contract itself, is perhaps considered to wobble. It also hints, following Hirsh (1976) on the temporal progression of existent desires to new desires, that contracts are used to pace for desires for reworked value from resources as linked to fee collection from land use and material trade.
\end{quote}

The haste in which this is taken and spoken, which is expanded on the next chapter, frames much of the way in which battery economies and their base-metal mining are contracted and timed today. In the early joint venturing days as in the times where equity was fully owned by private firms, contracts with the State were timeless and bound only to reaching a limit of lithium material production. In their newest form though, temporality took part as threshold for contract end. This proves that the social uses of lithium and of the contracts that govern their extraction changed.

Thrusting lithium into battery fictions as purpose for CORFO’s lithium contracts comes from what they essentially do: to make land available and mobile. Thereby, the ontology of contracts in material supply as those made in Chile for lithium extraction in the Atacama Salt Flat is mostly that of being forces to make land, and to make it operable. Making land is strongly attached to making a nation.\footnote{In light materials for new energy economies see Klinger (2017). In the region, land disputation has been a matter of power from trade as evidenced by the ties of the Pacific War and the taking of guano among Chile, Peru and Bolivia (Zapata, 1992).} The processes and devices that make land come from spaces and moments where politics on material idealisations and legacies encounter and shape one another. For materials and in their market and financial appreciations, it is often the legacy that shapes the idealisation as the room for imagining futures is mostly constrained by experiences.
In the Atacama Desert, the legacy of what land ought to do dominates prospects of future uses for materials coming from its place; the legacies of copper and saltpetre in the area testaments this.\textsuperscript{149} Legacies affect the methods by which governance on land is made and how it is rendered legal. Contracts are part of such legacies. Artefacts as contracts that have been used time and time again to govern and make land are still reproduced to amend futures into the forms that resemble plenty more to the past than to radical fictions of economic wants, land productions and trade economy.\textsuperscript{150} Materials are expected to be enlivened into production by the contraction of activities. However, the use of such archaic devices limits possibilities for rapid and adaptive change, and so the contract may be a source for economic contraction in the sense of restraint and loss. Contraction in the sense of limitation of manoeuvrability happens when the structures underneath are kept while attachments are affixed as idea for repair. In that sense, CORFO’s lithium contracts as annexes to existing agreements contract economic manoeuvrability in the Atacama Salt Flat and its operations.

The overflow of a material will invariably entail the need for other materials that can be paired in demand if end-uses allowed them to. So, lithium through batteries is seen as the pivoting lever for increased and enhanced copper profits. The aim to overdose society with a material serves then more the prospects of increasing and sustaining other material demands rather than satisfying general wants from society. To put differently, inciting batteries to mitigate climate change is at odds to the use of batteries to satisfy wants for further material exports. The underlying ontology of mining contracts as devices for nation-making and resource legacies reproduction are at sight in the signs in and around their making but remain very well veiled by misleading allegations of brightness, cleanse and resource-austere futures.

\textsuperscript{149} See Chapter 4.

\textsuperscript{150} For historical perspectives on national development based on resource extraction and trade in the Atacama Desert, see Novoa Monreal (1972) on copper, O’Brien (1982) on saltpetre, and Zapata (1992) on tin and guano. These accounts note the use of contracts, but they don’t discuss them as precept of development.
Batteries

In June 2019, the city of Santiago purchased 200 new electric buses, adding to a total of 411 fully electrical buses to its fleet. With these buses, Chile takes the third position in global electric bus deployment per country.\footnote{See IEA (2019) and Houbbadi et al. (2019).} Out these 200, 183 are for exclusive use in Grecia Avenue, deeming it to become Latin America’s first ‘electro-corridor’.\footnote{Medel (2019).} This corridor however is made of more than buses; it is also composed of other physical components as alleys, concrete, screens, charging stations, surveillance cameras, data hardware, passengers, musicians, pastries –all assembled and augmented by prospects of batteries.

The most concentrated battery-based electrification of buses for passenger transportation in Latin America is happening today in Grecia Avenue in Santiago. Aside from some Chinese megapolis, it represents the largest number of buses operating in a single road. Its 13 km now use more buses than the entire city of Amsterdam in the Netherlands.\footnote{Amsterdam is a significant driver and proponent in Europe for urban transport electrification through new battery electric vehicles. The city centre of Amsterdam has 31 battery electric buses, accounting for 10% of the fleet in the city, and expects 69 more to be operational by the end of 2020 (Sustainable Bus, 2020). In individual electric vehicles, the opposite is evidenced in Amsterdam by the excessive range of Tesla electric vehicles lined in the taxi service of the Schiphol airport.} Why so many and why there would be reasonable to question. Grecia Avenue connects the districts of Ñuñoa and Peñalolén, see Exhibit 9. The corridor itself has 47 bus stations.\footnote{El Mercurio (2018).} This corridor was chosen for electrification because it is simpler to do so there – the road already counts with infrastructure to make development marketing. Peñalolén is a low-income municipality that is often missed from print media coverage in Chile besides notes on insecurity and informal housing.\footnote{Hölzl (2018).} Contrastingly, Ñuñoa is a municipality with higher housing prices, dense quantity of office buildings and agitated commuting.

To take the avenue to the ‘level’ of buses, stations are retrofitted to match the bus fleet. Such retrofit includes displays with scheduling updates and screens with adverts. These however are not yet fully in place and most stations just have large displays beaming a blinding white screen to waiting commuters. Like those screens, the haste of deploying vehicles doesn’t really appreciate groundings and fixtures. Still, improved air quality and novel devices are the experiences of modernity and enhanced services in a climate-friendly future. But the experience inside and around the bus may not be specifically modern nor improved in the sense of meeting European standards of transportation and urban infrastructure.
Looking at the bus itself in-place raises questions about other sorts of batteries, those in individual passenger cars, in houses and in electricity grids, and the accompanying physical components besides batteries that are augmented for each deployment. The view of electric buses in Grecia Avenue also helps to understand what happens when battery futures are pressed onto hastened existences in locations that while might seem simple for battery applications, do not offer the breaks of future enhanced living-qualities that might come in narratives of battery dreams to electrification. The unfolding analysis in this chapter observes the buses in Grecia Avenue to compare the assemblages brought into action when batteries are deployed in cars, mines and electricity grids. These seemingly different technology uses show cultural traits that are reflective of the purposes of batteries in economy. These cultural aspects are contexts of Eurocentric ideals of modernity and are made evident in the chapter by the way that assemblages and their composing devices are detailed and analysed.

This chapter looks at some experiences of electrification through batteries in Santiago and in the Atacama Desert. It looks at batteries working in transport, mines and electricity grids, and observes the effects batteries have on accelerating today’s resource use and deployment. It argues that batteries are forming an economy of haste, one where the rapidity of technology production and use limits commentary of its underlying legacies and effects as they operate in-ground and thereby limits applications for deep bottom-up restructuring of social conditions in rural and urban settings. ‘Economy of haste’ is here used as concept for an accelerated pace of technology deployment and investment that hinders transformative uses that energy devices and materials may have in society. A hastened economy does not question the purpose of devices in their agencies on structures of labour organisation and economic power. The chapter argues that the constituents of an economy of haste, in form of deployed technology, lose lasting impact for demand satisfaction as the essence of their deployment is to create needs rather than
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integrally mitigating them. In this argument, the chapter observes batteries being accelerated to match economic growth with climate-change mitigation strategies without really being designed for a type of development that decouples material use with climate change mitigation.

The chapter first addresses the use of batteries in buses and individual passenger cars as flags of urban modernity. Cars as expected dominant driver for battery use are discussed in terms of battery chemistry expectations and production realities. Batteries are then discussed as more directly employed to enhance material extraction to meet multiple metal needs for energy futures, particularly for battery futures. Prior to concluding, the chapter discusses emissions reduction from electrification through batteries and the place of lithium materials in enabling batteries to haste new energy economies.

Electrifying buses

Leave the racket and rocket of the subway at Irarrázabal metro station in Santiago to find outside an ever-greater buzz. Today however, things rapidly turn to the quiet side as a red battery electric bus that commutes through Grecia Avenue stops just a few steps from the metro station entry. Inside the electric bus shown in Exhibit 10, the driver booth is fairly similar to those in combustion engine buses in the sense of space and indifferent gazes therein, but what is not is the distribution of space for passengers.\textsuperscript{156} Space is remarkably wide with its inherent silence further adding to senses of amplitude. Noise might be the most remarkable trait in these buses, so much that it renders the widely reported USB-drive charging spots and furnishing textures rapidly unimpressive. It’s not the lack of noise that draws attention but the volume of sounds that remain once agitations linked to fuel combustion and decayed machinery are seldom or no longer present. The buzzle that remains is not remarkable on its own, but rather it is for the way it adapts and nozzles to its new environment. Passengers used to roaring places and vivid, rapid and euphoric conversations are caught in some remorse as discussions become ever more noticeable. Sellers and beggars have to tune in to scenes where shouting becomes unnecessary and rapidly shushed or scowled at. Musicians play large and loud as they swivel about leisurely in an otherwise constrained scenery. Besides these noises and their tunings, the bus itself is not free of sound. Remaining sounds as doors and stopping signals introduce further gasps and surprises. Reactions and adaptations of passengers and bus users denote the contrasts of the every-day with these mobile fragments of infrastructure.

\textsuperscript{156} The driver spaces in public buses in Santiago often have a screen meant to protect drivers from some violent and harassing passengers. As expressed by a bus driver in Santiago about the relation drivers have with passengers that are reluctant to pay: “If I tell them anything they will hit me”.  

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Society adapts to infrastructure

Adaptation to new technology includes changes in every-day interactions and in real infrastructural needs, as understood by the needs related to improve living standards and bridging socio-economic gaps across sectors of society. Anthropological appreciations of infrastructure, devices and objects as moulders of society are notably discussed by Latour (2005) and Callon (1986). Deleuze and Guattari (1984) take more conceptual notes to address sources being modified by what they emanate.

Behaviour may change inside the bus but outside things remain somewhat stable. While lively and buzzing metro stations and residential buildings sit in one end of Grecia Avenue, the other end is far more precarious. In the opposite side from Irarrázabal metro station alongside Grecia Avenue, in Peñalolén, tire shops, convenience stores and abandoned households seem to densify. As the built infrastructure decays and glooms, it also dwindles; for instance, the streets and alleys that contour the furthest end of the electro-corridor in Peñalolén have no sidewalks and some see dirt surfacing in what otherwise is
smooth concrete bound only for the battery route. This is due largely because urban development in Santiago has since Pinochet’s regime been characterised by privatisation and processes of liberalisation.\textsuperscript{157} Megaprojects in urban development in context of Pinochet’s privatisation strategies connect land speculations, real state productions and capital transformations.\textsuperscript{158} This mode of infrastructure allocation has segregated Peñalolén from higher urban standards in Santiago.\textsuperscript{159} Yet, despite infrastructure lack or the decayed state of some urban layout, the electric bus corridor reaches well into its poles, but it does so encased in its avenue, without breaking containment. From their cocoon, buses do little to change the areas they traverse through that have experienced the rougher negative aspects of uneven development. Ideas from proponents of the electrified corridor are that it would uplift overall standards of living. But little is it recognised that any infrastructure can and often does downgrade certain areas to the expense of building-up elsewhere.\textsuperscript{160}

It feels as though buses are moving as lithium ions from one pole to another without really altering charges in either end: a battery of buses undone by its own excess. The representation of buses as lithium ions sees this function in them: charging down somewhere to electrify elsewhere, only that the places that have been lessened in political charges and voices remain as such. This imagery also shows another trait of this corridor: it is the only way that buses are seen as effectively operable, encased by infrastructure without which they could not work efficiently. The need of a corridor hints on some of today’s hindrances of mobile battery technologies and their purposes, and thereby on the reason for their concentration in limited and specific places. These hindrances are namely attached to the matter of use-range for electric vehicles. Ranges in battery mobility introduces a need for certainty of charging stations but while stations could be located beyond a single avenue, infrastructure here is sought to create a visual impact. The image of the corridor clusters impact into a road and represents what happens inside city borders. Further, a corridor makes deployment more fast-paced as battery technologies don’t necessarily have to be weighted one against another according to chemistry compositions. Price and availability become the most relevant components in decision-making. So, higher battery-cell energy densities and range allowances can be easily discredited to cost-efficiencies of readily available technologies. A corridor allows for charging times and distances to be adapted to batteries rather than the other way around. Such adaptation of infrastructure to batteries hinders on the overall efficiency of batteries as it tends to do so for the encasing infrastructure itself involved. This happens since the system that uses

\begin{flushleft}
\textsuperscript{157} Höflz (2018).
\textsuperscript{158} Lukas (2014).
\textsuperscript{159} Salgado (2013).
\textsuperscript{160} For instance, riots began in October 2019 in Santiago as protest to increases in fares for metro services. These expanded to a national scale and they shortly became a social movement to address social inequalities. Improvements on transport infrastructure at the expense of every-day commuters testaments the ruptures through infrastructure and its financing against the needs and uses of services in-ground. As Harvey and Knox (2015) note, infrastructure for transport as roads are relations but these do not necessarily mean connection between those that make it, those that use it and those it works for politically.
\end{flushleft}
batteries prioritises them over its outsetting purpose. It simplifies decisions to directly equating more technology with more needs-satisfaction but in reality it creates wants as anchored to batteries.\textsuperscript{161}

Batteries and buses here are not designed to modify the need of commuting or the way of doing so. In so, the corridor is not built around batteries to modify mobility, but it rather deploys them to sustain existent patterns of transport. These patterns have segregated people in Peñalolén and incited gentrification in this district.\textsuperscript{162} Providing that Peñalolén is already at the frontier of the city, radical gentrification in it does not displace its most economically vulnerable residents to the periphery of the city but rather it displaces vulnerable households out of the city.\textsuperscript{163} Any change to set mobility patterns –for instance to be tailored for Peñalolén’s own internal dynamics of mobility– would most likely hinder such overloaded battery deployment possibly to the level of making it pointless. The corridor is arguably unable to improve the utility that segregated society in urban spaces obtain by transport. Peñalolén has upheld an image of unsafe and uncivil due largely because of its segregation in the city and within itself.\textsuperscript{164} By leaving internal dynamics untouched, the corridor seems to increase segregation patterns within Peñalolén and thereby enrich the imagery that it has upheld as unsafe and uncivil. These images of Peñalolén, as sourced by uneven development, are actant images that go beyond a representation of reality but turn to lead processes.\textsuperscript{165} Placing batteries in Grecia Avenue is about putting batteries in motion and in evidence of deployment, but they further processes that have segregated socio-economic vulnerable sectors of the city. As a lithium sourcing country, the deployment of lithium-ion batteries in its territory materialises discourses of improved use of its resources and enlivens a sense of mining going the right way towards modernity, even if that looks fairly like the past where it builds on.\textsuperscript{166} Electrifying transport in Peñalolén resembles intentions to modify value chains and industrialise economic peripheries to break from structural dependencies and unequal exchanges in global trade brought from international divisions of labour. However, it shows how industrialisation and technology deployment on its own may not be sufficient to alleviate structural deficiencies when the use of technology is misaligned with the needs of peripheral actors.

\textsuperscript{161} The deployment of infrastructure is normally assessed in terms of their technical attributes and not on the ontological tenets of development, see for instance Zini (2016) and Pollalis et al. (2012). Though these appreciations are necessary for leading sound decision-making on infrastructure deployment, it follows a simplistic view of what infrastructure does as it multiplies in quantity and efficiency.

\textsuperscript{162} See Hölzl (2018).

\textsuperscript{163} Hölzl (2018).

\textsuperscript{164} Salgado (2013).

\textsuperscript{165} Ibid.

\textsuperscript{166} The historic category of Latin America as a resource supplier is a source for desires to emancipate from resource extraction for foreign economies, see Moya (2010) and Arsel, Hogenboom and Pellegrini (2016b). However, the tendency to extract materials for domestic use does not mean a decrease on extraction trends nor does it ensure distributive nor procedural justices on economic gain and environmental damages, see Arsel, Hogenboom and Pellegrini (2016a) and Bebbington (2015).
Electrifying cars

In May 2019, the Santiago airport shuttle service had a new electrified image. This service is operated by a single company that uses a fleet of roughly five thousand vehicles. Out of those, roughly fifty are hybrid and fifteen are fully electric. The fifteen electric ones, that were initially twenty, are battery powered and use lithium iron-phosphate (LFP) batteries.

Getting a ride in one of them is a lucky event providing that logistics of car deployment have little to do with emissions reduction or client requests. Electric vehicles are not given priority of dispatch over the other hybrid cars or the ones with internal combustion engines. Unfortunate logistics and limited vehicle space at the airport arrivals car-lanes may have one walking towards the battery electric car for some ironic five to ten minutes. Regardless, getting to use a fully electric car gives an air of satisfaction to the shuttle driver while he shuffles a suitcase over cracks on the pavement. Satisfaction lasts only within Santiago though. Today in Chile, charging stations are limited beyond its capital city and even within it. This car is by no means sober-looking. Still, it needs two charges per day and would not reach the neighbouring city of Valparaiso without charging at some house or store in-between. The driver recognises in this occasion that ranges per charge limit his income as he takes in-clock time to charge the car. As solution, he would eagerly expect to see more charging stations and more electric cars in the shuttle service and road. The excitement he expresses at the steer is reproduced in the image these devices have across town. Battery electric cars are used here more as a marketing decoy than as an improved substitute for conventional petrol-thrusted cars.

The marketing for speed and sleekness is not solely on occasional sights of airport shuttle cars or some very few privately owned ones strolling in the pricy residential districts of Las Condes or Vitacura in Santiago, but also in every 2019 metro card edition where the E-Prix, the battery-electrified version of formula one car races, is flagrantly advertised by Antofagasta Minerals groups. In the card, a formula one car is formed by electricity as it moves in a copper wire. This image is meant to instruct viewers that...
battery vehicles and zero emissions are attached to copper; a metal that more than occasionally represents Chilean mining economy.

Just like this image, the shuttle taxi looks to pivot on such marketing as well: zero emissions as an attraction to ride and mine further on. This car has a green hood and green doors, the rest besides glass is coloured white. On its side, along with the company logo, the name of the partnering energy company makes a clear statement of the green electricity under the hood. This greenness, though, is limited to roughly 200 km per charge. It’s not as green as what batteries are expected to be: those with longer performances and much largely deployed than mere fifteen out of five thousand.

“One electric car draws as much attention as one hundred normal ones”

The larger share of expected battery markets is associated to cars. Today, the future of batteries in terms of market importance is mostly discussed around individual passenger electric vehicles and the expansion of the distance range they can cover with a single charge. However battery purposes and the future of technologies are built on end-use innovations and future-looking devices, discussions on battery futures simmer down to chemistries that enable longer ranges per charge. Batteries for electric vehicles with longer ranges per charge extend capacities per vehicle but they are not meant to reduce the number of vehicles needed. Rather they are in greater part meant to enable more activities per person and thereby to increase quantities of deployed batteries as further uses are satisfied and created. The extension of capacities per vehicle by longer-ranging batteries serves well for markets looking for an increased deployment of individual passenger cars. The future of batteries is looking precisely at the technologies that will further multiply the deployment of devices rather than contract these. This tendency for batteries produces what they are meant to do in society: generate a need for more of them.

The materialisation of this imagined ontology builds from investments on future-looking statements about the expected behaviour of persons and societies in the future. This person of the future notably refers to middle-class western European or North American labourers with increased aspirations of modernity that are coupled and measured by higher consumption capacities. In the future, passenger cars are spoken to be used for longer ranges and more recurrent trips, and in increasingly individual fashions, hinting regular commutes to distanced places. This ultimately leads to the needs for more batteries to meet and increase wants of better performance in more places and devices.

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170 Expressed by a Transvip shuttle car driver in a ride from the Santiago Airport to downtown Santiago in 2019.
171 Conversation with automotive industry analysts. Global light electric vehicle sales surpassed slightly 81 million units in 2020. Contrastingly, close to 50 thousand commercial electric vehicles were produced globally in 2020. In 2018, 251 thousand electric non-road mobile machinery were produced globally.
172 See Chapter 4 for contrasts of other sectors of society around and attached to mining that do not fit this representation of the person of the future.
173 This hints the image of a labour sector that resides in distance from its working place. This follows trends in increases in housing prices and widening gaps of acquisitive power between sectors of society particularly labourers to corporate heads, see Piketty (2013).
Batteries in transport sustain ways to live and work in cities

Batteries are devised to enable the labour sector to work as it does rather than modifying structural conditions for a production of goods that doesn’t increase societal inequalities. This resounds concerns from Martiskainen et al. (2021) on energy transitions worsening inequalities linked to transport. Further it invites thought on the links of energy devices with sustained limitations on capacity development to the labour sector, that Trentin (2016) develops, due to the way of in which people live and move in cities.

Along with the increased potentials for cars, buses and commercial vehicles, longer ranging batteries function conceptually to extend operations in and around raw material extraction. While conceptually batteries bring material extraction into making and vice-versa, they also function in-ground in places of extraction and around these. Seeing batteries in mines in physical operation allows to better visualise how they act in society.

Electrifying mines

In sites of material extraction, batteries work today to automatize operations. Automated machinery is rapidly developing along with advances on battery electric vehicles. Some developments of battery chemistries are purely being searched in context of equipping fleets of automated vehicles for commercial and heavy-duty purposes. Though they may not represent the majority of expected deployed battery-powered vehicles, they compose an important element for making mines less costly and thereby systematically higher-yielding.

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174 As the following chapters show, this function of batteries in society occurs in equity markets on material extraction, organisation of people in and around sites of extraction, changing perceptions of value tropes on materials, speculation and hedging on future trade of chemical variations of materials, and enlivening histories of material extraction in places that see in batteries the reproduction of mining economies and national development.

175 Activities that are automated inside mines are here understood to be comprised by the areas where materials are extracted and moved within closures of landholdings for mining activities.
Fractures across global lithium supply increase battery deployment in mines

The notion of mines as a planetary machinery is argued by Arboleda (2020) who points that mines may be appreciated as a such in light of labour organisations to capital in the XXIst century as analysed by Charnock and Starosta (2016) and Starosta (2010). However, corporate actors in battery businesses underline dissonance with supply. Motion might exist in between stages of battery manufacture, but it only does so during sporadic and unstable encounters. Mines are then brought as targets of optimisation through battery-powered automation. It is in their ruptures with other sectors of battery industries that mines press to accelerate the pace of technology deployment and as well to increase the number of devices wanted.

In mines, batteries are powering automated machinery that extracts and moves materials in safer ways. With automated vehicles, less people are needed in mining sites and those that remain are perceived by machineries themselves in greater precision and prediction, thus preventing human-made mistakes in extraction logistics. More safety equates to more production as costs associated to human-made mistakes are reduced. Less people translates to safety of operations as it does to certainty of them. Safety is equated with fewer people in mining sites working in-ground. Lessened human risks from automated machinery does not only come from fewer mistakes in mining sites but importantly from insurance that opposition from employees in the lower ranks of mining labour will not block operations in their entirety. Reduced risks of accidents and riots signifies sustained extraction and potentially in increasing rates. Given these implications, automated vehicles would invariably occur in mines regardless of machines being electric or not. Still, the development of batteries to electrify machineries and self-driven lorries hinges on market needs for automatization and accelerates its technological shift.

Batteries in vicinity of mines however seem to propel resource extraction in greater extents than what those enclosed in mining sites do. Batteries near sites of extraction source electricity to the places where materials are extracted.\(^{176}\) These batteries are large-scale stationary systems that are fixed to the electricity grid and are normally exclusive for supplying electricity needs of mining sites or to prevent them from being disturbed by electric-grid instabilities.\(^{177}\) In the Atacama Desert, battery energy storage

\(^{176}\) Sites of extraction are here understood to include mines along with their neighbouring places. As the chapters that follow show, the assemblage of a mine as constituted beyond sites of extraction is not seamless and whole-encompassing. On a much smaller spatial scale, however, the premise of a unified system of extraction holds and can be extrapolated to systems that attempt to work globally. Chapter 4 further explores the effects of material extraction and scarcity in sites of extraction. Here, the effects of extraction as experienced in mines and places around them are seen on the technology that responds to, enables and drives extraction in ways that entangle directly with raw materials.

\(^{177}\) See Chapter 1 for the visualisation of these attachments on contracts allowing for increased material extraction. Comparable to that, batteries as attachments to electricity grids allow for increased material extraction.
systems are purpose-built for increasing yields of material extraction. Batteries in grids allow to improve electric reliability by reducing costs of further supply. Namely they limit the need for transmission expansions and electricity generation. In sites where grids are not easily expanded, they provide certainty of supply.

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<th>Batteries in grids are attachments and not central components</th>
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<td>The structure of electricity grids with attached energy storage systems that balance out dysfunctions without necessarily changing the constituents nor the structures that form energy matrixes mirrors the politics of climate change mitigation. As remarked by H. A. Smith (2007), the ‘global’ aspects of climate change induce dominant epistemologies to ‘global’ solutions that as such sustain structures for thinking of the world. Structures and modes of technology deployment are maintained by the intake of new devices that do not take a central role in energy futures but become mere attachments to existing status quos.</td>
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Certainty of electricity supply brought by batteries is commissioned to by contracts. These contracts do not normally include human settlements as ‘contract parties’ even if these may take forms as civil associations to manage their resources. The priority for certainty is an economic and political matter that often tilts to the customer that would require more electric capacity, small villages are then regularly discarded. So, industrial sectors with intense resource requirements are those that are perceived by grid-scale battery companies as the only likely clients with whom contracts are profitable. A mine requires more energy than a small village, and so does it promise more national revenue and broader territorial use, so batteries are normally targeted to material extraction particularly for economies that have built their nation around extractive industries.

Today in the Atacama Desert, batteries do not work for villages that neighbour sites of extraction; villages whose electric infrastructures are often precarious, unreliable and dangerous. Batteries in those areas do not target energy conditions beyond mines. The scope for batteries in those areas is normally contracted according to forecasted energy demand of mines, which is only visible in metrics of long-term prices for certain power capacity amounts. These metrics do not weigh-in material traceability or

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178 See for instance Energy Storage Association (2020) and Globe Newswire (2011) on AES Los Andes battery energy storage project.
179 See Chapter 3 for recounts on weather-induced blackouts experienced in San Pedro de Atacama, and on demand overload in Peine.
180 Conversation in Santiago in 2019 with an AES Gener employee in charge of contract elaboration for battery energy storage systems employed in mining sites.
connection between batteries and mines. The lack of any traceability of materials even when their end-use is sitting just outside the raw material supply, reflects the way that battery industries work today. Their role is not to evidence which material is being used and for whom, it is rather to meet climate change mitigation targets while using more materials and propelling and creating further economic wants regardless of the needs around them.

The rapidity in which emissions need to be reduced from economies makes batteries as an ideal attachment to not only proceed with prospected technology deployments for vehicles and housing and national revenue from mining, but to extrapolate these. The way in which mines and cars are today working with batteries is to use them as enablers of existing structures. Energy futures for climate change mitigation might then look a lot like former stages of resource extraction and transformation.

**Hastening electrification**

Targets to reduce greenhouse gas emissions to mitigate climate change morph to distinct strategies and policies at industry level. These strategies are mostly based on electrification. Electrification is normally spoken to refer to electricity generation and use from energy resources that are intermittent and variable. Electrification as climate change mitigation strategy happens by stages and focuses first on industries that provide national income and identity. Transport, mining and energy are large focuses for energy transitions not only due to their resource intensities but also and importantly due to their political image and weight.

Government policies matter for the course of private industry but in terms of mines and cars, these industries move to electrification regardless of climate change narratives. Electrifying energy intensive industries with variable energy sources is not done seamlessly though. For them, batteries are used as patches to bridge fractured sections of electric lives, rising demand and variable supply. But batteries have been recently seen as potentially loaded with intensive carbon footprints from the materials they

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181 As per mentioned in an interview, an AES Gener employee working on energy storage contracts and speaking about the firm Fluence, a joint venture between Siemmens and AES Gener, stated that battery materials and chemistries are normally decided by teams that do not assess the use of batteries or location: “Technology is compromised by contract of capacity. Our hands are tied by that contract.”

182 See Hirsh (1976).

183 This is not to say that lithium materials may be simply considered as new oil in geopolitical power aspects, but rather that they sustain economic strategies based on material extraction for nation making.


185 Electrification means substituting energy needs from heat to electricity, i.e. opting for less carbon-intensive sources of energy. This however is in practice not detached from fossil fuels and today is largely achieved by facilities that generate electricity from either natural gas, biodiesel, water movement or pressure or intermittent resources as wind and sunlight. Electrification may at some cases signify the use of coal, oil or unconventional fossil fuels for making the devices that generate or store electricity.

186 Governments seem to catch up on early industry-adopters of improved environmental performance who are readily able to cope with State regulations once enforced. For example, the company BYD is today strongly set in the electric commercial vehicles industry due to their rapid advances in bus production well before emissions standards were set in Europe and North America. China remains as exemption as its State incentives for new electric vehicles have been to date the main driver of industry manufacture.
use and the resources needed to make and move them. For addressing this, two strategies can be observed, the first involves responsible sourcing of materials, and the second a contraction of material provisioning networks for making energy storage components; the second is arguably an effect of challenges to fulfil the former.

Regarding the first strategy, State-level climate change mitigation pledges in industrialised countries result in enforcing industry to use components of batteries that are not environmentally harmful in their making, for instance setting a threshold of emissions involved in direct, called scope 1 and 2, manufacture and mining of materials. Such initiatives of ‘greening’ components necessary for electrified futures are in turn mostly felt in material sourcing countries; in shape of responsible-sourcing commitments from the former. However, when a pledge is made to use certain materials in a condition of lessened environmental footprint, suppliers don’t necessarily comply rapidly.187

The mismatches between these two sections of material supply are often portrayed as a barrier for emissions reductions. Global networks for raw material provisioning are then envisioned as deleterious to emission reduction targets as further ample they get. Shortening them is thence today a recurrent conversation when ‘greenness’ of end-use products related to batteries is discussed. With or without government incentives, sanctions or guidelines, industry in vehicles and resource extraction looks today to shorten the networks of material supply they work in and with. Shortening global paths for supplying materials means in concept to reduce the geographic spread and distribution of segments of a material’s transformation to end-use products. In practice this entails product standardisation across places and equity acquisitions across companies. In the battery industry, manufacturing requires materials that are globally available, supply could be practically near providing conversion capacity in some vicinity.188

Pragmatically, supply is not near due to lesser costs from geographically sectioned areas where conversion capacity is more concentrated or where mineral reserves are cheaper to mine. Still, shortening global provisioning systems is described by battery and vehicle makers as method to rapidly decrease their emission rates and ‘greening’ their products. This is a strategy that beyond locking-in emissions reduction, looks to lock-away uncertainties of material supply and prices. Hence, raw material suppliers look to diversify their range of products and the locations where they operate.189

187 These sort of commitments are somewhat comparable to those on certified timber production or fair labour. These schemes of supply often fail to achieve their goals, or conduce complications for locals in-ground, see Nyamu Musembi (2007).
188 See Introduction, Narins (2017), Mohr, Mudd and Giurco (2012) and Bazilian (2018) on global availability of lithium. Statistics on global trade and reserves can be found at OECD (2020).
189 For an empirical detail on how this happens in corporate relations see Chapter 3.
Batteries when hastened are not compatible to green futures

Rapid electrification for sustaining energy consumption limits consumer awareness of market practices for energy futures. In so, economic activities that compose these practices can be more deleterious to society than advantageous. Greenness as flawed and unecological can be understood when darkness is discussed on ecological futures. Morton (2016) notes that dark ecology is “ecological awareness, dark-pressing. Yet ecological awareness is dark-uncanny. And strangely it is dark-sweet” (p.5) Morton follows to place ecognosis as that which is thought by dark ecology. "Ecognosis is like knowing but more like letting be known" (p.5) He then points regarding ecological loops and human interferences even with awareness, that “the politics of coexistence are always contingent, brittle, and flawed” (p.6) For Morton, ecognosis is always incomplete. Greening the darkness is then flawed, sectioned and possibly even darker.

Batteries are the result of processes for electrification and the enablers of these. Batteries in grids and vehicles are strongly supported by industrial agents as means to accelerate reductions in emissions in national scales. By its metric this reduction does not require decreasing consumption patterns therein. Rather it invigorates them making material extraction worthy for prospects of new energy economies. Mines and vehicles take thus images of greenness from their stake in battery use and production. Batteries are hastened necessary to enable renewable energies and low carbon transport in short terms. But batteries work also to enable mining-plant expansions and trade prospects that are necessary to keep certain mining industries and nations economically afloat. Climate targets of emissions reduction in the automotive sector is presented in metal supplying circles as drivers for more supply necessities, and importantly as a calendar constrained by a short schedule to do so. Never is the discussion on how to get customers to reduce consumption but rather on how to hasten consumption preferences. For those interests, lithium is more than a battery material but an image of rapid uptake.

Processes of electrification as formed by base metal extraction supply chains can be understood from what Tsing (2005) calls “the awkward, unequal, unstable, and creative qualities of interconnection across difference” (p.3).

In economic behaviour appreciations, pleasure for everyday consumers is not in contributing to consumption reduction, but on consuming something that gives more pleasure either that being a warm glow of environmental consciousness.

See Chapter 6 on the appreciation of worth on materials based on temporalities of value.
**Hastening lithium**

Lithium-ion batteries are technically preferred due to their flagrant innovation of being tailored in chemical composition to specified functional attributes. For and in places that extract and move their materials, they are necessary for value added. But what's more tangible as value from places of raw material extraction is the process of converting raw materials into lithium materials; taking brine, clay, spodumene concentrate or lepidolite concentrate to lithium carbonate, lithium hydroxide, lithium chloride or lithium metal, all in ranges of purities and grades.

The greater the diversity of their offering, the more relevant they become for battery markets. There are many types of battery chemistries, and a settlement on a single battery for the future is far from attained. Battery chemistries vary on chemical function and functional attributes. It is in the materials that inlay chemistry variations in where speculations and investments are largely focused on. For instance, as vehicles are pressed to longer range requirements, battery chemistries change to compositions holding lithium hydroxide. Lithium hydroxide can be paired with distinct arrays of accompanying base metals.

For longer ranging vehicles these arrays are preferred to be of high-content nickel. NCA or NCM chemistries are said to look forward and excite ideas of longer operation ranges in between charges for vehicles. These longer-ranging batteries focus interest on hard-rock extraction of spodumene or lepidolite mineral concentrates. Still, cost reductions in raw material extraction and conversion for chemistries based on iron keep lithium carbonate in expected market importance given other applications that look not at increased mobility per charge but instead at features as cycles increase, reliability or power. For instance, buses in Grecia Avenue and cars in the Santiago airport shuttle service use Lithium Iron-Phosphate chemistries just like the batteries in grid energy storage systems tailored to mining activities in the Atacama Desert do.

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193 The strategies to maximise value-added in places of raw material extraction for lithium-ion batteries is counterproductive for the economic performances of extraction industries. Chapter 5 recounts deleterious effects that State interventions for value-added politics causes in resource extraction and battery investments.

194 These battery chemistries refer to Nickel Cobalt-oxide Manganese (NCM) and Nickel Cobalt-oxide Aluminium (NCA). A cathode manufacturer notes that in 2019 LFP dominates due to safety and durability of battery cells, which makes them suitable for buses. He goes on to say that the growth rate for LFP peaked in 2015 and in has since slowed down but it is expected to rise onwards due to lower costs of today's LFP manufacturing for buses and energy storage systems. This same cathode manufacturer noted that NCM had a stable 50% market growth in 2019 that remains after its significant growth in the 2014-2015 period. NCM market shares have surpassed LFP. NCA is considered to be by most cathode manufacturers in China as closer to 'the interesting area' of NCM where cobalt content decreases and nickel content rises along with power capacity per battery cell; some challenges persist for NCA on thermal stability and moisture sensitivity.

195 Demand scenarios have expectations of energy storage systems to rise in deployment, see for instance IRENA (2017). Admittedly, vehicles will take a larger share of battery markets but that does not mean that LFP will be displaced as their use in buses and commercial vehicles is appreciated to increase by vehicle industry analysts and cathode manufacturers.

196 These batteries use lithium carbonate in their chemical compositions and provide market stability for lithium carbonate cathode chemistries regardless of expected market dominance of lithium hydroxide due to surge high-nickel lithium-ion batteries by 2030 and solid-state lithium-metal batteries beyond 2030.
Lithium carbonate is most easily produced from brine, but it can be converted from hard-rock resources and to lithium hydroxide in an appropriate facility. Raw material producers then look to diversify their portfolios by engaging in distinct locations and equities for material extraction and trade. This entails a set of corporate dynamics in equity markets that respond to the haste of battery deployment and the certainty of variable chemistry wants.

To reach the function of increasing wants of better performance in batteries in more places and devices, chemically, battery industries look in the long run to solid-state technologies for cars. In the shorter term, batteries that will improve ranges for vehicles beyond those today easily available are lithium-ion batteries with high nickel content, either nickel cobalt-oxide manganese (NCM) or nickel cobalt-oxide aluminium (NCA). Lithium-ion batteries with high nickel content use lithium hydroxide. Yet, today’s cathode active material manufacturers largely tilt for battery chemistries that use lithium carbonate, see Exhibit 11, mostly LFP or lithium cobalt-oxide (LCO).

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197 In Albemarle’s La Negra plant, which processes brine from the Atacama Desert, an employee refers to lithium carbonate as “their golden product”. A cathode manufacturer notes that lithium hydroxide converts back to lithium carbonate if poorly packaged and stored for long periods.

198 As elaborated in the next chapter, the haste of battery economics includes effects in equity markets to adjust product portfolios and spatial arrays of trade. These dynamics often show how equity markets work today for resource extraction and how these workings often surpass regulatory agencies on competition. Along with these effects on equity markets, and as expressed in following chapters, the haste for batteries induces changing and overlapping concepts of material scarcity and excess, economic strategies on value added, and temporalities of commoditisation, all which hinge on the creation of wants.

199 Industry analysts and cathode manufacturers do not expect solid-state battery technologies to be soon seen in individual passenger battery electric vehicles. Speculations that participants in lithium and battery industries make on the development and commercialisation of solid-state batteries using lithium materials are ambivalent in between 2025 and 2030. Most conservative statements delay the solid-state battery well into the 2030s; these are mostly based on existing conversion capacities for cathode materials for LFP batteries and on the surging expectations for NCM batteries.

200 Conversation in a conference on lithium supply and markets in 2019 with a battery maker in charge of material procurement.
Facilities that make components beyond those needed for LFP or LCO are yet skim and costly at best. More than raw material extraction, conversion facilities for lithium materials are expected to be the bottlenecks of supply to manufacturers of battery cells. China has made sufficient progress on material conversion to keep lithium as a key component for battery futures. But while that has advanced battery technologies, it has also concentrated facilities. So even if lithium is abundant in reserves globally, conversion capacities for lithium materials are not. The distribution of facilities that make cathode active materials used in battery cells shows what does a car maker can get in the geography it is based on. European Original Equipment Manufacturers (OEM) for car making are pledging for lithium hydroxide preferences for their vehicle designs but are somewhat restricted still to today’s decisions of cathode active material manufacturers. Many existing cathode active material producers still make cathodes with different chemistries than those estimated to be dominant in the market within five to nine years. The dominant view in market analyses is that batteries along with their purpose and use will move to technologies that promise extended ranges for electric vehicles; nickel-concentrated over iron-

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201 For instance, in 2019 China produced over 160 thousand tons of lithium carbonate and over 80 thousand tons of lithium hydroxide. China has the largest capacity of lithium materials conversion per country. In the first ten months of 2020 this production was roughly curtailed by one third of that in the previous year; still market analysts expect production to ramp up once more in 2021 providing better sentiments on vehicle deployment and price rises for lithium materials.

202 Conversation in Santiago in 2019 with a lithium industry analyst employed in a British commodity price reporting agency.

203 Lithium reserves here refers to lithium carbonate equivalent (LCE) reserves. These are estimated globally at 17 million LCE in 2020 by USGS. Global contracted supply between 2020 and 2025 is set over 2 million tons LCE. Conversion capacity is today estimated to be over 700 thousand tons LCE in China and expected to rise there to near 1.1 million tons LCE by 2023.

204 A car maker is referred on raw material supply chain and industry conversations as an Original Equipment Manufacturer (OEM).
containing chemistries. Still, it is uncertain if car makers are using one chemistry or another. More than what the car maker preferences might be, geographic origins of vehicles are stronger hints as to what sort of battery it carries.  

Mismatches among forecasts, realities and fictions in batteries simmer to chemistries. These disparities are as clear as they are among supply chain constituents. For instance, fractures are perceptible when lags in electric vehicle deployment are spoken by different participants of lithium batteries. Blame for lags in electric-vehicle industry growth is today casted by and spread among OEM, lithium materials suppliers and cathode manufacturers. Blame ambivalences and dissonances highlight the disassemblages that this industry experiences and the way things are made to work around fractures or to bridge them.

While OEM pledges may not align to what cathode manufacturers have financed, they do alter supply in more delicate and anticipated ways than direct battery use may do. OEM’s announcements about their cathode uses and prospects trigger investment trends on mining. These investments are mostly based on the sort of material product given by a mining firm, and on the resource and geography used for its production. Importantly though, the material product which receives most investments is not necessarily aligned with the idealised future technicalities of batteries and their components, but more on the economics of value and worth today. The haste for batteries and for longer ranging vehicles catches those in the insides of lithium supply chains in complete dissonance from end-use battery technology, cathode active materials, processed materials and raw materials.

**Conclusion**

Market-preferred batteries are not changing lives in resource-deprived regions nor are they balancing welfare. In contrast they are stabilising inequalities and making gaps in social strata more evident and wider. Batteries are pressing for more batteries without so meaning them alleviating the gaps they encroach on and widen. Those market-preferred batteries are largely represented by vehicles. Batteries in vehicles do not see for the future commuter but for today’s labourer moving still in the world of tomorrow. In so, they stabilise a way of life based on commuting which is built by housing prices, living costs, employment precarity and structural inequalities. New energy economies relish on ideas of metal supply for battery futures which are enlivened by electric corridors as Grecia Avenue, adverts of longer ranging and faster cars, and ideas of green electrified mining. This relation as seen from the battery side pressing on to induce further mining is ever more natural the closer one gets to mining activities; climate change reduction and increased material extraction, clean living and the need for more base-metal supply.

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205 For instance, the company Tesla looks towards to lithium hydroxide technologies but uses an LFP battery in their recent model 3 cars made in China.

206 See Chapter 5 on today’s appreciation of worth from lithium materials as seen to compete for battery realisations in short terms.
As in the corridor and the electric grid, batteries serve to propel mining more than they serve to reduce the intensity of the activity where they get affixed to. Battery buses in Santiago seem to be hastily placed to operate in sites not yet prepared to them and certainly not adept to capture any improvement as brought by batteries alone. Batteries in vehicles in the Santiago airport look to intensify the distances of every-day city commute and of people doing so. Batteries in racing cars in the metro card images incite ideas of sleekness, excess, wealth and mining. Batteries in the electric grid in the Atacama Desert spur mining expansions. Batteries become thus images of what mining can do, but they also directly ease costs for mining operations. Material extraction hastes batteries onwards to lessen their image of environmental mismatching with climate neutral and green living.

**Batteries are market devices for extractivism**

Solar energy systems used to power mining sites has coined deployment of new energy systems as ‘solar mining’, see SERC Chile (2020). While these systems are often supported as comparative advantages that align resource extraction to low carbon futures, it prioritises the use of technology improvements to mining over nearby settlements that, as Sullivan (2011) notes, are left without access to electricity either in grids or in distributed generation. Batteries for mines follows suit from that. The concept of ‘extractivist storage’ is thence here proposed to understand batteries in the wake of extractivism for energy futures.

Batteries are arguably but carriers of reworked metals supply in hastened economies of consumption. As seen in the next chapter the haste for batteries to mitigate climate change is in practice materialised by equity. Batteries are spoken as enablers of climate change mitigating technologies, which may give the idea that climate change mitigation facilitates and needs batteries to be into every-day life. But pragmatically, equity markets for metal bases are the devices which enable battery victors to materialise. Today in the economies of haste to batteries, climate change can be viewed to be in large potentially solved by equity alone. Admittedly, equity markets are not designed as method for solving climate change, but alternative methods are blurred away providing the structure of national development and identity around these markets and the haste to battery deployments. With a look that misses to build batteries as embedded in and as skeleton of infrastructure, and rather one that sees to deploy them as attached components to existing modes of being, the result is but a saturation. Like air conditioners affixed to building facades or faux-ceiling layering on decayed halls, smooth manoeuvrability is eliminated, and hastened and extended coatings are invariably called forward. Settled

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207 Materialising expected victors in future batteries accelerates dynamics in equity markets and commodity trade; on that see chapters 3 and 6. On that point, it is relevant to highlight Mackenzie’s (2006) remark that financial markets motivate and agence economic strategies.
structures continue with new materials that make it all work as it did before but only do so with a modern and shiny appeal. Adherence of any impact of new materials or what can be done with them fades and is only perceivable with the deployment of further attachments. As they are hasted into economies, batteries are limited by structures of supply to ever increasing needs, as such they lose adherence to their effects.

Batteries feed consumer culture

In a provocative piece on the justices of energy transition, Newell and Mulvaney (2013) note that “cheap energy is the engine of industrial economies and the foundation of consumer culture” (p. 135). Only that the objects consumed here are material extraction and trade enabled by cheap energy. The use of energy storage systems in mining can be observed as a backblock of cheaper energy that is meant to increase material wants in every-day life.

Batteries make metal supply turn to see its role in new energy futures as responsible for ensuring demand-side satisfaction. In so, supply networks are pressed to function in fractures and are thence constrained to reduce emissions, control technology designs and concentrate material profits. The use of batteries to hasten supply and to be attached to existing structures of transport and electricity limits their capacities to enable societal change. New energy economies that look to mitigate climate change while ensuring national growth and mining legacies to persist conduce then to bodily symptoms of lithium overdosage in the energy system.

In so doing, they translate new energy economies to agitated equity dynamics, increased material needs, price and value alterations, and worth estimations into the future. These components replicate legacies of former materials and nation-making strategies where electrification is hastened to fit into existing structures and to expand former ontologies of resources to future lives.
Seventeen times. It’s close to 10 in the morning and I’ve gone to toilet seventeen times. Just to see a few drops emanate shyly from me. I’m as embarrassed as my urine seem to be.

Does urine have feelings? Is it a bad day for mine? Did I make it angry? How do you apologise to your urine? ‘Please urine, get better’; no, too impersonal. Come on! it’s ‘my’ urine; why don’t I know how to talk to it?

Well at least today it doesn’t feel like ‘mine’, maybe from some shy bloated Lilliput, but not mine. We seem broken from one another. Is she in an alliance with someone else? A urine partnership that goes beyond my narrow human understanding.

Full bladder again, it’s probably not, oh urine, what’s wrong? If only I could trace you well enough and convince you to gush with your vigour we both know so well. But no, some burrow of yours keeps you hidden from my hound. With whom or with what, acting is out of my reach. In me and beyond me at the same time.

What is it that lurks inside you? Unlikely to know, clearly some burning companionship or pest. I feel it too, be assured dear urine. Your flame within is mine as well. We share this parasite.

Potassium and creatinine. It’s not just my urine but my blood that has gotten thick. Thick with potassium and creatinine. This explains the thirst. And the rash?

Kidney damage is regular in lithium-treated patients. Lithium exposure decreases urinary concentration and excretion from its effect in the renal system. Lithium toxicity can lead to renal failure, whereby the capacity of the body to locate and depurate substances is hampered. Bloating is a common symptom of this. The body is not only unable to ‘clean’ itself, but it is likewise limited in its function to monitor the chemical components in its bloodstream. Elevated serum creatinine and potassium levels in the bloodstream usually signify renal failure. Among other symptoms, renal failure generates increased thirst, dry and itchy skin and tiredness.\(^\text{208}\)

Renal instability

Tracing the origins and availability of resources, and the relations and markets among companies is often challenging. Resource bases and equity formulations are a key part of supplying systems of raw materials. But the lack of capacities to know what exactly happens with resources and with equities is arguably just as relevant to the shape that networks of material supply have.

As with lithium toxicity in the human body, an energy system overdosed with lithium loses track of the infrastructures and devices deployed to make battery and energy dreams all the more excessive. Lack of traceability in the energy systems is most often thought of for waste recognition and producer responsibility for end-of-use. While this trait is significant for making material provisioning systems coherent with purposes of increasing availability of products that are less damaging to the environment, it is not the aspect with higher stake in supply channels. Traceability is also limited in the scope of information available on equity acquisitions and corporate mergers that place a certain product over others. Not only may the understanding of corporate dynamics be limited by third parties but the agency that regulatory bodies have on equity dynamics is also precluded by the geographies of competence and involvement. The view on the constituents of energy systems and the depuration of toxic substances becomes impossible the more of these substance flow in the bloodlines of energy equity markets. A lithium-treated energy system by its intake of lithium materials fails to realise the amount of materials and infrastructures bound to battery making and importantly the equity structures and dynamics that, in their increasing buzzle, nozzle their joint articulations into invisibility. By its essence on mining and brine extraction, an energy system reliant on lithium-ion pills is by response a thirsty one. Thirsty of materials, value and, coincidentally, brine. As in a lithium intoxicated body, water is abundant in its swelling and scarce in its thirst and urine. Lithium materials supply douse in the multiple appreciation of its raw materials as simultaneously ever-present and broadly found, and equally rare, strategic and critical. Thirst materialises in the intentions to ignite desires of strategic supply and value and in the intentions to use-up areas rich in lithium-concentrated water. As in a body with renal dysfunction, confusion, thirst, inflammation, and inabilities to oversee and depurate industries, make today’s lithium supply in Latin America.

Equity markets are developing the bases for large-scale base-metal supply for renewable energy futures. Today, these are focusing on spaces that are geomorphologically arid and politically thirsty for voicing their say. The material and equity traceability is today blurred by the design of capacities meant to monitor and define natural and corporate environments. This section addresses those designs in the turn of competition regulation and responsible sourcing as pivots for global material supply.
Equity

In Chile, the national prosecutor is also the head of the economic competition regulation agency (FNE), the independent public body in charge of regulating Chile’s free economic competition and preventing damages to the country’s interests therein from corporate equity dynamics of firms located in its territory.

“Why do you want to get into trouble?”

Financial markets have been recognised to operationalise capital and society, mostly on the way in which they structure understandings and actions around profit and surplus. These actions and understanding are often multiple and incompatible. Actions and understandings as structured by financial markets are made-up mostly by responses and pressures from the State and the corporation, where ideas about resource control and imperialism vary in their appreciation and representation. Contrasting representations of resource control then entail multiple and often incompatible economic actions on, and understandings of, financial markets themselves. Multiple representations of a single object, also named as a parallax, possibly make and emanate from equity markets. The occurrence of a parallax here presented through an equity acquisition happens in ways that it does not somewhat demystify equity markets alone, but it does so in ways that allow fresh understandings of other impacts from equity markets on social orchestration on materials. This equity case drove the Chilean State and society to idealise lithium speculations and perils for the country’s national stability, hegemony and overall standing in material supply.

Its story allows to analyse equity markets beyond sights limited to effects on share value and dynamics, but on to the ways that equity markets detail legacies among materials, contour the imageries of resources, and shape actions based on and for the nation and its economic strategies. Based on the section of this story that looks from the involvement of a competition regulation agency, equity markets make-up as spaces that materialise the complications that today exist in recognising the spread and links of supply chains. Equity markets are then argued to be market devices that account for a significant weight of the modes in which corporate actors in material supply chains behave and relate among themselves.

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209 A former national prosecutor of Chile replies when asked to talk about lithium trade in Latin America.

210 Labban (2010).

211 Labban’s (2010) work takes the notion of parallax to oil, which invites to think of other objects in parallax. Here, it is stressed that the source of parallax in objects is just as intriguing and important; It is also stressed that equity markets have not been unpacked in such analytical appreciation.

212 Karatani’s (2003) analytical take of parallax, founded on Kant and Marx, is based on capital in its monetary forms as the object under multiple appreciations. Here, this conceptualisation is used to visualise the corporation itself as the multiply shaped capital, an object that is dually represented in physical and shareholding forms. Such analytical approach on multiple representations then invites to expand the idea of parallax to include and reflect on the perceptions that different actors have of these forms, and importantly what does a parallax do for a supply chain when the representations of a company and a material multiply due to equity and equity dynamics.
and with the State, ultimately affecting the thread to end use technologies. The observation and study of equity markets as such can enrich alternative understandings of what it means to own equity and how investments in companies go beyond shareholder value.

This chapter critically reflects on the story of an equity acquisition between two of today’s largest lithium mining companies: the purchase from Tianqi Lithium, a lithium mining and materials processing company initially formed in China and today operating as well in Australia, of SQM shares, the most prominent lithium materials supplier in Latin America, initially formed in Chile and today also operating in Australia. The story is told through the bit in which FNE was involved in the matter. As the story advances, the chapter elaborates on the role of competition regulation agencies in material supply chains and focuses on the weight of equity markets on material and technology ontologies or reasons for being.

This story supports the idea that the purpose for lithium-ion batteries is not necessarily or firstly to advance and improve energy storage technologies for brighter and cleaner energy futures, but rather to make and materialise politics and interests on world-market surplus. Equity markets, the state, the corporation and competition regulation agencies play a game of economic activity where interests and strategies meet in difference, which results in awkward arrays that are often visualised as supply chains. The chapter argues equity markets as hinges and makers of the nodes that connect stages across end-to-end supply paths.

To look at equity markets as the analytical base that precede supply assemblages, this chapter advances through the SQM-Tianqi equity story in two parts. First, the story commences to detail the link between equity markets and the nation. It elaborates on the play of equity markets reasons for being to make the nation and its materials and on how competition regulation agencies enter this grounded structure. Second, the equity story is followed to unpack what competition regulation agencies make-up within the economic game of equity dynamics. It stresses on conducts and relations between competition agencies with the State and the corporation to ultimately regard competition regulation agencies facing uncomfortable ambivalences on what ought to happen in equity markets. The actions of competition regulation agencies are here noted to include the forming of relations between the State and the corporation. Understanding equity markets under these aspects can better instruct how today’s economic orders around the world-market are multiple and not in harmony among one another. It can also point to whether this multiplicity of economic orders and wants somewhat causes the difficulty to trace and follow markets and their nudging on material lives and ontologies. This is presented by the effects perceived on and from equity markets from a share movement on lithium supply.

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Background – The SQM-Tianqi Equity Purchase

“In a word, this is a mess.”

Monday 3 December 2018, the Santiago Stock Exchange just experienced its biggest transaction in record to date. Close to 4000 million US dollars were exchanged for nearly a quarter of SQM series A shares. SQM shares are divided into series A and series B; with series A holding selection rights for the company’s directors board, and preferential dividends. The buyer, another major player in lithium supply, Tianqi Lithium.

An equivalent to 24% of Chile’s leading lithium producer was not acquired seamlessly. Frictions go seven months back, when initial complaints were filed to FNE. Opposition in formal complaints demanding an investigation came from public authorities voicing concerns about perils to national sovereignty. Filed complaints implicitly drew the dangers of letting a foreign competitor acquiring participation in a nationally strategic material. Complaints implied that a competitor of such size would be likely to deliberately encumber Chile’s geopolitical position in lithium markets either by frustrating SQM’s operations or acquiring knowledge on comparative advantages. These complaints blurred private firms with geopolitical frictions in a board-game kind of appreciation. This opposition from public authorities is surprising considering that at the time participation from the State on SQM was null. SQM itself was, in the origins of its operations in the Atacama Salt Flat, involved through SQM K with the Chilean State in a joined venture called Minsal.

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214 Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition. The word used in Spanish “enredo” is here translated to ‘mess’ providing the context of the conversation noting the issue to be disorganised, incomplete and sketchy while intertwined throughout it. ‘Enredo’ can also be understood as a tangle, a complicated situation, a mix-up, a maze or a mischief (Collins Dictionary, 2020).


216 FNE (2018b, p.1013). The separations of shares into two series, i.e. A and B, was first established in the firm’s corporate governance modification of October 1969 where preferential dividends were given to series A. The separation into series was then overruled in April 1977. The break of shares into series A and B was later brought again in the governance modification of April 1993 which established, among other points, the Series A shareholders’ right to select the board of directors. The details of the latter share division where however revoked shortly later in June 1993 to set the same division but with different conditions in which the most essential difference consists of a single director that is selected by series B shareholders among the effective eight directors.

217 See Chapter 7 for the history of the making of SQM as formed initially by CORFO and the Guggenheim siblings.
The involvement between foreign companies with parastatals have been recognised as projects for making the nation-state. The tendency of ensuring the presence of the State in the operation of companies is well described by Rivera-Quiñones (2018) as an impact of unequal exchanges of value in neoliberal periods, detailed by dependency theory, on post-neoliberal governance that aims to prevent structural deficiencies experienced in the wake of exporting economies in South America.

Historically and generally, the period in Latin America in which State presence in the market and in its identification as 'the market' was followed by deregulation and privatisation of state-owned companies; such effect was largely deployed in Chile during the Pinochet dictatorship. The divestment from the Chilean State from the joint venture it had with SQM happened in 1995, although SQM was a private company since 1989. Today’s response to Tianqi’s investment in SQM is thus not about protecting the State nor its firms. However, as SQM partly operates in land that belongs to the Chilean State, it is clearly a matter of resources, not companies, and oddly through that, a matter about the State as envisioned through resources. Still, equity markets are about firms, not resources directly.

Despite the image of Chile as a country with economic policies oriented to increase foreign investments, the behaviour from the State on this equity purchase contrasts sharply with the idea of the country as a welcoming environment for foreign capital. This is not to say that the Chilean State today usually behaves in such a way in face of foreign investments. Rather, this behaviour, if visible, is attributed arguably only to certain materials. The idea of the country as inclined to foreign investments is thus contested when foreign presence takes the shape of investments on lithium. Importantly, these complaints were not looking to protect SQM, rather they were evincing the fear that the State has on loosing grip on its lithium as ‘Chilean’, and through it on potentials for being a global force and direct beneficiary of electrification futures.

This equity purchase is described by FNE as an atypical case of corporate dynamics, one that is far more political than regular cases investigated by the competition agency. Along with the domestic political mesh this case implied, it was not spontaneously caused in a vacuum. The making of Nutrien, a large corporate group on services and products for agribusiness, allowed the SQM shares to be available. Nutrien is an entity formed between Agrium and PotashCorp and comprises the widest range of operations for producing fertilisers. In order to be allowed to form, China’s and India’s competition

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218 See Taylor (2006) for a recount of how were the relations between domestic and foreign capitals reworked during the Pinochet period.

219 CORFO (2018b).

220 Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.

221 Lazenby (2017)
agencies required PotashCorp to divest its SQM holdings.\textsuperscript{222} This led Tianqi to file an agreement with PotashCorp for acquiring the shares in question. PotashCorp handled 32\% of SQM, its full divestment from SQM resulted in Tianqi acquiring 24\% of SQM Series A shares.\textsuperscript{223} With such share amount, Tianqi would be entitled for selecting three of the eight company directors and would gain stake in a larger share of the lithium market, see Exhibit 12. This equity transaction sparked lively movements among actors in Chile’s corporate lithium environment as it detailed modes of existence in everyday economic control and observation in Chile.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{lithium_market.png}
\caption{Lithium supply market shares at the time of the SQM-Tianqi equity acquisition (Bloomberg NEF, 2018).}
\end{figure}

\textbf{Equity markets and the nation}

The news of the expected equity acquisition was quickly followed by a complaint issued in May 2018 by the head of Chile’s Economic Development Agency (CORFO), at the time Eduardo Bitrán, in name of the institution. Such complaint was later followed by another one issued by senator Guillier, shown in Exhibit 13. Senator Guillier was then running for president, his complaint was basically applauding Bitrán’s accusations without raising any new issues other than implicitly pressuring from a higher end of national politics. Several more congressman expressed concerns about this equity acquisition; mostly because there was a shared image among public officials that lithium was the \textit{thing} which would replace

\textsuperscript{222} India’s competition commission required PotashCorp to divest from Arab Potash Corporation, Israel Chemicals, Ltd. and Sociedad Química y Minera de Chile S.A. (Giles, 2017). China’s Commerce Ministry demanded PotashCorp to divest from Arab Potash Company, Sociedad Química y Minera de Chile S. A. and Israel Chemicals (Lazenby, 2017).

\textsuperscript{223} FNE (2018b). SQM’s corporate bylaws state that no more than 32\% of shares with voting rights may be concentrated by a single shareholder. The conciliation agreement that SQM filed to CORFO states that PotashCorp’s right to select three directors should never be hampered. The rest of SQM shares were acquired by the Chilean pension system.
An ancient present of the copper nationalisation was amidst a shared portrayal for lithium. The copper nationalisation was a traumatic event in Chilean politics and the figuration of copper as a strategic material seemed to be passed on to lithium. While the image of copper was shined on lithium, it was not the congress who would protect it now as it did for the red metal.

For lithium, and specifically for lithium equities, FNE was situated in Chilean politics as the mediator, or champion for some, for preventing foreign capital and interests to loot Chilean materials and their imagined values. It is striking that a country that prides itself for having an economic model that incites investments and regards itself as market-friendly would turn to its independent economic agencies to suppress some corporate actions that align with the model and its legacies and that operate within the frame of legality. FNE was then asked to lead Chile in this part of its battle for lithium regardless that FNE very well stressed that its role was not that of a resource or economic paladin, merely a public body.
that deals with free competition affairs.\textsuperscript{228} Chile is a Mineral-State that has mostly enacted active and strong State intervention as economic strategy against potential resource curses.\textsuperscript{229} It is then not surprising that an intervention comparable to that held for copper was expected by and from the public sphere on a matter that regarded a material considered as strategic for geopolitical power balances. What is surprising is that conducting an intervention was pressed on to an institution that is not designed for overseeing mineral and economic sovereignty.

\begin{center}
	extbf{Legacies of materials permeate economic development models and are visible in them}
\end{center}

| Orihuela (2013) describes the legacies of the 1971 Chilean economic model developed in context of copper and nitrate trade control by foreign companies in Chilean territory, to be spoken of by 'pro-Pinochet technocrats' in 1990 as “macroeconomic stability, aggressive trade integration, and business-friendly investment climate” (p.143); Taylor (2006) remarks this economic model to come from influences from the Chicago Boys on policies of Pinochet’s military dictatorship, which started after American copper companies had been fully nationalised by Allende’s government. Ahumada (1970) further notes the portrayal Chile had of its own economic model in regards to economic institutions; portrayals that touch on European personification ideals. Today those institutions remain despite moving from copper and nitrates to lithium. |

There was then a clear misunderstanding from some State actors on the bases of the country’s institutional framework for enclosing its resources and using them as levers for financial mechanisms, even if this had already happened through the forming of CODELCO and the Copper Rent Compensation Fund (CRCF).\textsuperscript{230} Such misunderstanding was evidently not only about the institution that should respond but also a misunderstanding onto what it should respond to. This was not a political feat to take lithium mining operations under public control, but rather to prevent a private investment on a private firm.

\begin{footnotes}
\footnote{228} This remark is made in allusion to Eduardo Novoa’s book ‘The Battle for Copper’ (1972) which details the agreement of all Chilean political parties to expropriate copper resources from American companies. This background is spoken by a former national prosecutor as the context in which current politics on lithium revolve in Chile.
\footnote{229} Orihuela (2013). Resource curses include but are not limited to negative effects from monetisation and changes in governability of resources. Examples of work that elaborate on this or use it as analytical tool are for instance Humphreys \textit{et al.} (2007), Bridge (2009), Mahanty and McDermott (2013), Spiegel (2014) and Kirshner and Power (2015).
\footnote{230} See Orihuela (2013) for an explanation from an institutional political view on the making of copper enclosures and their use as financial collateral for debt incurred by free-market price risks on material supply. His analysis, though arguable if whether the copper nationalisation is in fact a developmental success, builds on a comparative analysis between Peru and Chile on the making of their institutional landscapes, and touches thereby on the factors that allowed Chile to have institutions that allegedly somewhat prevented resource curse effects from its mineral wealth.
\end{footnotes}
Support from congressman and their statements were feats that characterised the pressures to drive institutional change for the copper nationalisation in between 1960s and 1970s.\textsuperscript{231} The pronouncement of congressmen for this equity acquisition testaments how ways of acting remain entrenched in everyday organisations of networks when materials symbolisms are reproduced and brought under the public eye. The social construction of market intervention for Chilean minerals draws on convincing and levering voices from public officials through professional-political networks. But the institutional frame of the times of copper nationalisation is not that which exists today in Chile for economic development and monitoring.

Today, FNE as a State entity on economic competition regulation takes a place that did not exist for control of concentration of economic activities in the times of copper nationalisation.\textsuperscript{232} FNE aims to safeguard the public economic order, but the meaning of this mandate can be misunderstood and placed out of context, and seems to be so for lithium. CORFO considered the investment on SQM from any big lithium competitor to affect the public interest, it even went to say that the equity acquisition negatively affects the world’s interest.\textsuperscript{233} As a public entity that has had an identity of a private firm, the interest of CORFO can arguably be considered as divergent than those held by broader public. Neither CORFO’s nor the world’s interests are under the scope of competition regulation agencies nor are the activities that competitors in foreign countries do. For FNE, economic concentration activities regard only matters that involve a single entity handling multiple activities of and in a single industry, say lithium-ion batteries for instance, in Chile.\textsuperscript{234} Multiple interpretations of what ‘economic order’ is, and for whom, created some tensions and network losses in Chilean politics.

\textsuperscript{231} Novoa Monreal (1972).
\textsuperscript{232} Economic concentration before the making of the Free Competition Defence Court in 2003, which established FNE’s current institutional shape and range and mode of practice, was normally amended by law directed to a specific industry or material rather than by public bodies commissioned to that effect.
\textsuperscript{233} La Tercera (2018).
\textsuperscript{234} Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.
Economic orders are made from competing value scales

There are multiple interpretations of what the public economic order is as devised by economic competition. Knight (1935b) explains that a competitive economic order works to operationalise a competitive economic system. According to Knight, the competitive economic system compares, equates and/or selects among the wants of the different groups and persons in society. Further, economic efficiency entails that some wants will be preferred over others, as the system has to select which and whose wants to fulfil (first), Knight argues. This wants selection and fulfilment determines the system’s social economic value scale. Knight goes on detailing that very different economic value scales may be formed as the methods to select, equate and combine wants are plenty. It follows for Knight that the system is also looking to be efficient in its resources for creating its goods, which is subject to how it sees values. Further, Knight notes that the system, through competition, is not only satisfying wants but it is creating them. So, CORFO’s and FNE’s take on what economic order and public ‘is’ may differ since how this order satisfies and creates wants is a matter of interpretation on the economic preferences and understandings that different persons and groups have.

The complaints on the equity movement did not call FNE to modify its statutes nor did they address desires to change governance structures for lithium resources, as what was somewhat pressed for copper considering the changes to copper ownership and legislation and the making of public bodies and networks exclusively purposed for copper affairs. So, despite symbol replications, the institutional restructuring and coordination that led to the copper nationalisation is not what those opposing the SQM-Tianqi equity movement pursued. The pressures from public spheres to FNE on this matter come not to modify institutions to prevent a resource curse scenario, but they certainly press for institutions to act in divergent fashions than their structures and designs are ought for. Considering institutions beyond public institutions as State agencies and more as ‘constraints on individual behaviour’ or ‘the rules of the game’, it is perceptible that the opposition to this equity purchase was seeking to amend the rules of equity markets while maintaining their use and deployment as economic institution. Not only that but the opposition was seeking to employ FNE as the entity in charge of doing so. Insofar that FNE was not designed to modify equity markets as economic institution, it was evidently not suited to act as opposers expected.
Economic orders are institutions

Economic orders as institutions do not just mediate game rules but they make them in favour to those whose value dominates in value scales. In context of a critical analysis on neoclassical economic perceptions of individual action, Vatn (2005) speaks on the role of institutions as structures that constrain individual action. This comes notably from North (1990) who expanded the philosophical aspect of institutions in social constructivism of economic behaviour and performance. Origins of these philosophical appreciations of the sociology of institutions in economics go back to Rousseau (1762), Durkheim (1893 & 1895) and Veblen (1898 & 1899).

Regardless of what was under the scope of FNE, the behaviour and wants of the opposers to the SQM-Tianqi equity purchase come as a replication of the ways of ordering action against the idea of a resource curse. But contrastingly to efforts against resource curses that focus on a company, an industry or a mode of governance, it was mobilising action to deal with an institution that is not amendable by material nationalisation memories nor economic competition regulation; that is, the desire to change or at least grapple with equity markets. These complaints were showing a clear discontent that political elites in Chile had to equity markets and their stake on strategic materials. The process that followed demonstrated not only that but also that the State bodies in charge of addressing equity markets cannot thoroughly follow equity dynamics nor do they have teeth with which to altogether clench on markets. Thinking that the copper-lithium imaginary link coordinated and justified desires to extend economic strategies and behaviours enacted on copper towards lithium while equity markets where taking the place of the American copper-mining companies as the thing that should be wrestled with is then not unreasonable. However, such thought requires further understanding on what equity markets are, how they relate to the State and what are the spaces for their interpretation and amendment when they involve material extraction.

Equity markets were not thoroughly comprehended nor observed in a full extent by the State regardless of having been a device that shaped parts of today’s operations in the Atacama Salt Flat.\footnote{See Callon, Millo and Muniesa (2007) on the concept of devices as assemblages that provide agency to their constituents. This phrase uses the word ‘device’ under that concept.} Company constructions on nitrate mining and their changing focuses in the Atacama Salt Flat where heavily grounded in share acquisitions and sales.\footnote{Backgrounds detailed in today’s contracts that CORFO has for leasing land to SQM and Albemarle show just such relevance of corporate ownership dynamics.} Before copper and lithium industries, nitrate pasts defined plenty of the mining identity and resource resentments that today exists in Chile as a Mineral State.\footnote{O’Brien (1982) and Orihuela (2013).}
Nitrate failures are embedded in lithium imaginaries, and speaking of nitrate means speaking of saltpetre. These memories triggered a desire to protect spaces and their intellectual groundings for resource making. The protection of spaces of extraction and resources often works as nation-making projects. This is well observed in the Atacama Desert, particularly in times of conflicts Chile had separately with Peru and Bolivia which ultimately transformed the Atacama Desert, and the Antofagasta Region where it sits, into Chilean territory.

In the early stages of the Atacama Desert as Chilean territory, landownership was largely retained by an oligarchy. These stages corresponded to Chile’s nitrate times when such landowners promptly placed corporate anchors that shaped Chile's social and economic patterns. In the nitrate times of Chile, there was some arguable blurring between making a nation and making a corporation. Bearing equity markets in mind, Chile's economic relations at the time were designed by luring foreign investments and corporations by marketing the image of the country as a stable and governable sovereign nation. A marketing effort that is still observable today. The resulting economic relations made the nation through corporate behaviours and images focused on assembling shares, much like what equity markets do when firms, industries and places are socially and economically defined and recognised through share mergers and acquisitions. The landowning elites that controlled Chilean economic relations in the wake of its development after the Spaniard colony partly did so by enclosing their spaces and using those enclosure as nation-making projects.

This time though with the case of lithium mining equities, a nation-making project came not from protecting a space as an enclosure of physical resources through bordering a place, but rather on protecting a company as an enclosure of corporate shares through banning an investment. Shares can be

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238 Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition and with a former SQM advisor hired to assist ion corporate direction and development.

239 On the effects that memories have on behaviour it is interesting to follow Kant; Deleuze (1963) reading Kant offers some points onto this. In this work he expresses that memories serve cognitively as a replication today of old events, as an ancient present differently perceived as how pasts are thought of. It is further elaborated by Kant that pasts work to shape ideas of futures for which there is no necessary need for experience, whereas memories are subject to an a priori that in Kantian terms expresses a link to experience. Deleuze then argues that the experience had and recalled in memories tends to carry along the behaviour enacted to that experience as it is not serving to form ideas of different events as pasts do.

240 Klinger (2017).

241 See Zapata (1992) for a political appreciation of the mineral relevance underlying the wars held in and that made the Atacama Desert as known today.


244 Ibid.

245 Narratives and imaginaries used by government officials and presentations in corporate events on lithium supply industries in 2019 testimony the replication of this portrayal of Chile as stable and as a sound location and partner for investments.

246 See Chapter 6, Hernández Cornejo (1930) and Levin (1960) for strategies enacted in Chile in the XIXth century.
thought of as resources themselves, some that shape national identities and that dwell with physical resources when materials are in the firm’s product portfolio. Going from this perception of shares onto equity markets, the latter can then be suggested as devices that shape countries’ economic relations and that encroach onto resources and land. This follows to say that equity markets allow place-making through the relations among shareholders. Which sort of shareholders defines which sort of place.

The start of Chile’s economic relations with the world economy through material exports shows this attribute of equity markets that is not often ascribed to them. In the wake of Chile’s nitrate industry, that is mid-1800s, there was a sharp development of joint-stock companies which turned out to be the common economic enterprise.\(^247\) These companies were not only making the first economic relations that Chile had with world trade systems, but they were shifting the domestic social structure through the making of grounded relations among landowning families. Through foreign and local families living in Chile, by 1850 no more than two hundred closely knitted among one another, Chilean society was driven to an export economy that largely drew on mining and nitrate products.\(^248\) Social ties among bankers, miners, merchants and landowners resulted in the shaping of companies and the distribution of shares as stakes of Chile’s economy and its ties with international trade and wealth. The making of a national economy and identity by relating to external economies was not a matter of a country reaching to another but of more of a person relating with acquaintances to shape, arrange and distribute economic leverage through equity.

\[
\text{Equity markets as nation-making spaces and devices form relations}
\]

This follows Anna Tsing’s work to think of equity markets as universals that produce nation-making as culture for development. Tsing (2005) stresses that universals, here equity markets, are “produced in the colonial encounter”(p.1) and have “enlivened liberal politics as well as economic neoliberalism”(p.1). Tsing further notes that culture, here nation-making, is co-produced in interactions she calls ‘friction’, that are “the awkward, unequal, unstable and creative qualities of interconnection across difference”(p.3).

For nitrate, even if growing markets for chemical fertilisers in Europe kept exports rising, it was the presence and dominance of foreign merchants in Chile that kept production and trade afloat.\(^249\) The drag


\(^{248}\) Bauer (1975).

\(^{249}\) Nitrate exports grew from 23,500 to 117,315 tons in between 1850 and 1867, even when Peru had easier access to fertiliser in the shape of Guano from its Chincha Islands (Hernández Cornejo, 1930; Bermúdez Miral, 1963). As suggested by Levin (1960), foreign merchants had better production skills and connections to trade nitrate than local entrepreneurs, thus pivoting fertiliser quality and reliability and product preferences from clients in Europe. Hence regardless of the availability of guano, nitrate strongly paved its way in fertiliser markets due mostly to workings of private firms handled by a few elite foreigners.
of nitrate industry in Chile, which has been attributed to a lack of local entrepreneurial skills to develop the nitrate industry and thereby the national identity it carried along, is not just a matter of what have been recognised as structural deficiencies. Foreign dominance over nitrate production and trade in Chile was not only due to local deficiencies on mechanical and material innovation wittiness, but most importantly due to the webs of relations that foreigners had and the instruments they employed to build companies and place these as central players in the making of the country's economy and industrial workings. Equity dynamics and their eventual marketisation where evidently one of the instruments that enabled relations to solidify and shape into companies and industries. Any drag that the nitrate industry in Chile encountered can be arguably attributed more to the misuse of equity markets from local producers and to their use by foreigners than to the structural deficiencies on technical manufacturing and material innovation; both however accounted for the set experiences around nitrate industries.

**Equity markets make spaces of extraction**

Structural deficiencies are not alleged to be irrelevant for the course of events. Still, it is here agreed with Arboleda's (2020) argument that spaces of extraction are not determined by dependency links but rather on the production of value and its relative surplus across the world. This argument is here taken beyond to put a lens on equity dynamics and markets as one of the instruments and mechanisms that give agency to spaces of extraction. As the uses of corporate equity by foreigners in times of nitrate mining are not spoken as factors that provided them with advantages in the territory and industry, it is here argued that equity markets should be stressed as forces as relevant as local deficiencies to have shaped histories of mining and development in the area.

The mixture of nitrate experiences in Chile along with bits of information that spoke of lithium necessities and foreign interests for lithium in Chile, formed expectations infused with emotion. For FNE, based on the reactions expressed to them by public spheres on lithium ideas, this case was entrenched by saltpetre memories that gave lithium an *El Dorado* psychological burden. The strategic position experienced

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250 Bauer (1975) speaks of structural deficiencies as the lack of local entrepreneurial skills which allowed foreigners to dominate export products. Bauer then unidirectionally links these structural deficiencies to cause pitfalls on the expansion and evolution of nitrate industries through capital, labour and technological enhancements. This is seen to reflect current loss of confidence on value chains and national development from countries with historical experiences with structural deficiencies brought by international divisions of labour. For further contributions on structural deficiencies in Latin America analysed through dependency theory, see Kay (1991 & 1998), Kay and Guadarrama (1993) and Gwynne and Kay (2000).

251 Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition. It is tricky to distil the expression of ‘el dorado’ as a burden. The tones of this phrasing in the conversation remarked a feeling of loss on something which was considered glorious but that not only faded without any grasp or comprehension, but also conditioned specific ways for gathering its wealth that would be as troublesome as they were gratifying.
with saltpetre replicated with lithium and posed that Chile should essentially be a rentier.²⁵²

Interestingly, the attribution of saltpetre pasts to lithium as warning to prevent foreign participation in lithium operations did not account for the fact that foreign participation in Chilean saltpetre was regarded in favourable light by the State given that it was grounding for any improvement of nitrate land in Chile and of the national identity and economic relevance once attached to it. Along with this, the benefits of equity dynamics to ease the nitrate industry in Chile are not dragged along the nitrate memories that posit some equity acquisitions and markets in lithium as malevolent capitalist workings in benefit of ‘those outside the nation’.

**Equity markets and competition regulation agencies**

FNE was aware of these social contexts bounded to copper and saltpetre. Realising that economic behaviours and images attached to other materials where being reproduced in lithium and produced for the understanding of new identities and ideas that entangled mining and clean energy futures, FNE proceeded with CORFO’s complaint. It thereafter enquired several actors involved with the equity purchase and with lithium industries and supply. This came initially to understand the making of the lithium and battery supply chain and industries through the corporate relations shared among people, companies and materials. Possibly, there has not been a larger attempt to unwind the corporate entanglements in contemporary lithium supply in Chile. However, all of the data that FNE can see makes up but a fraction of the *universe* of strategies, actors and orders and their tangles and ruptures in the lithium supply chain.²⁵³

²⁵² Ibid.

²⁵³ The term *universe* here refers to data extents made up by assemblages and disassemblages across provisioning systems as a way to take the notion of *planetary* connections to make commodity trade beyond ideas of seamless and matching interactions. For the eyes of FNE data access was somewhat hindered and for the public eye what is left is crippled at best.
Corporate equity holdings veil material ontologies through value ideas

It is here considered that the intention to find the ontologies of 'value', for which most efforts build on Marx (1867), inhibits the ontological concerns to reach beyond value and on to objects holding said value. Put differently, value ontologies should not be considered to extend to the ontologies of the things with value.

Supply chains are not usually observable as the sections that make up supply threads are normally difficult to follow once materials leave the exporting facilities as commodities or raw materials and turn thereafter into something else. However, the sections of supply streams prior to materials leaving export facilities is also very complicated to observe. When these are managed to be observed by competition regulation agencies, data and stuff gathered are normally further concealed and obscured.

Traceability across networks of material supply up to the plenty somethings that a raw material can turn into becomes even more complex as stages occur in supply networks. Not only are the eventual somethings as objects difficultly traceable, but their purpose and effect in broader economy are even more elusive.

Exhibit 14 – Scans of the compact disc and pen drive from Tianqi’s declaration to FNE (FNE, 2018b). Compact disc contained the recorded declaration of Tianqi directives, and the pen drive contained corporate reports and data provided by Tianqi’s legal counsel.

FNE was attempting to see what an equity purchase would cause in an industry, gathering and recording myriad confidential comments, see Exhibit 14. Evidently though, a competition agency is not designed to

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254 Topik, Marichal and Frank (2006) and Çalışkan (2010).
255 Data in FNE ‘public’ documents is shaded, blanked and macerated to great extents.
enquire on ontological and epistemological concerns about industries and their products and activities, that is asking what is the finality of lithium and batteries in consumer culture beyond technical aspects of energy storage markets.\textsuperscript{256} Given the fairly recent experience with competition law for economic regulation, such concerns on the product and practice ontologies would only matter for a competition agency in Latin America providing that they would affect concentration of economic activities.\textsuperscript{257} It seems that the view of FNE as competition agency is solely focused on limiting economic concentration activities and particularly, if not exclusively, concerned on monopolies and mergers.\textsuperscript{258} The structure and purpose of economic activities and policies, where the economic system and its order may be under more scrutiny, is not a matter that is intended to be observed, challenged nor amended by competition regulation agencies. Equity markets are then not structurally vulnerable to competition regulation agencies.

After several days of a pre-investigation phase, spanning for over three months, FNE considered that it did not had sufficient information to determine if the equity acquisition represented a risk to competition for Chile.\textsuperscript{259} This statement was perhaps essentially a political move to reassure governmental expressions of opposition to the equity acquisition that the issue was to be looked on greater depth. Despite an irresolute statement likely based on political reasons, FNE seemed to have already understood ‘what’ was happening and to and for ‘whom’.

The imagery of SQM that the Chilean State economic agency had at the time of it being an ‘Atacama Salt Flat presence’ limits a thorough understanding for the State of SQM’s equity participations and infrastructure investments in places beyond Chile. After all, Tianqi was not investing in SQM operations in the Atacama Salt Flat alone. This speaks of a misunderstanding and misrepresentation held by the Chilean State of the Chilean corporation and particularly of corporations that deal with Chilean lithium located under the Atacama Salt Flat. Clearly, SQM’s conceptualisation is profoundly rooted to the Atacama Salt Flat and to its role as a tenant to CORFO. Clashes between tenants and landlords are common and they were long present between CORFO and SQM.\textsuperscript{260} However, Bitrán through CORFO, after facing a strong contention with Julio Ponce Lerou, Pinochet’s son in law and SQM practical head, ended by joining him. The ambivalence by CORFO regarding its conduct with SQM as now one showing alignment and arguably support to Ponce was not comprehensible for FNE. Interestingly, CORFO chose to pressure FNE to restrict this movement rather than directly attempting to restrict SQM, who apparently was not looking forward to this equity purchase by Tianqi either. It seemed that CORFO would have preferred to

\textsuperscript{256} This is mostly evident on the overlaps and bases that economic regulation has with competition law and on the market-oriented purposes for economic regulation in Latin America (Dunne, 2015; Peña, 2012).
\textsuperscript{257} See Peña (2012) for notes on the contextual particularities of competition regulation agencies in Latin America.
\textsuperscript{258} See newspaper comment by Irarrázabal (2019) which hints such focus for FNE.
\textsuperscript{259} FNE (2018b).
\textsuperscript{260} Ibid.
have another State organism be accountable for foreign participation in resources categorised as nationally strategic.\footnote{The relation of the State with its independent agencies seems broken when material institutions and accountability is bounced back and forth across actors.} The prosecution was reluctant to enter the Bitrán-Ponce game.

“All of this mess of free competition, because it is a mess, spans from a lack of diligence that CORFO has had on its property, during many years and many governments.

This problem of who is the shareholder, can be resolved in two paragraphs [in the leasing contracts] ... as a landlord you should know and be concerned who your tenant is.

Why didn’t CORFO do this?

If CORFO are doing things wrongly, then it is their problem and they should fix it themselves, which is contractually.”\footnote{Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.}

Describing this equity acquisition as a ‘mess’ suggests the image of a disordered tangle where encounters pull in myriad directions, a tangle that is not accidental.\footnote{This sort of tangle and the interests and ontologies that ‘win’ the pulling and giving game around materials and end-use products fit into Tsing’s (2005) notion of friction for speaking about the characteristics of encounters where difference contends; see notes 176 and 246, this chapter.} Providing the context of property and leasing of the Atacama Salt Flat, the contracts between CORFO and its tenants are said to be the frame to prevent and restrict specific equity transactions. However, the CORFO-SQM contract had played an important role in the politics of cleaning the image of the State from militarisation, collusion and corruption.\footnote{See Chapter 1.} Thereby it had gained an exalted image that would be difficult contended by its authors.

The acquisition of SQM equity from Tianqi called attention to the doings of other State dependencies and to the expectations and histories attached to a material that provoked bitter reminders of past militarised interventions to economy and society in Chile. It was a matter that also made today's residues of militarised pasts visible and partly localisable in corporate structures and governance for mineral supply. The role of Julio Ponce Lerou as controller of Kowa, a corporate group that dominates the corporate governance of SQM, and as link between today's mining futures with dictatorship nepotism pasts, was now more than before brought to surface for its recognition and commentary from public spheres and broader society. FNE was not looking to strengthen Ponce's position in SQM and Chile's economy, which would have benefited from impeding the equity acquisition to happen.\footnote{Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.} Simultaneously, FNE was not entirely certain that the matter concerned free competition and economic regulation as it considered it to be rather emanating from a lack of administrative abilities from CORFO and thereby better, if not only, confronted through private-sector actions from CORFO.\footnote{Ibid.} This ambivalence hints that competition regulation agencies understand their weight in national politics and can in some cases leverage equity
markets to balance political relations to a particular end. FNE further expressed that the intention from CORFO to get an investigation going, regardless of any reworked alignment and alliance from the matter with Ponce, could have been devised to deter ‘the Chinese’ from purchasing the equity in stake. Tianqi is not a Chinese State company, but it was portrayed as such by most actors in Chile, particularly due to a common lack of understanding of the Chinese State’s involvement and control in the companies in its territory.

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<th>Equity markets are simultaneously grounds for resource imperialism and resource nationalism</th>
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<td>Basing on Smith’s (1980) notions about the role of capital and the nation on producing nature at a world scale, Arboleda (2020) suggests to take the world market, and not the nation-state, as analytical base for unpicking resource imperialism. It is here noted further that even when the world market is evidently a source for resource imperialism, most likely stronger than the nation-state on its own, its use may not limit the role of the nation-state in resource imperialism as the latter has been an active participant in the world-market. It is also suggested that regardless that the nation-state is not a base for resource imperialism as the market is, a response against market-led imperialism comes more strongly when the nation-state is thought of being involved in it, i.e. there is not an opposition to equity markets but to participants in them, and stronger opposition when a participant is portrayed as the veil of a foreign nation.</td>
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However, despite that the appreciations of foreign capital as nation-bounded are not thoroughly clear nor traced, the appreciation of what national capital is in Chile was even more difficult to clarify for its public sector. This notes that ideas about imperialist forces lurking through companies are present in today’s equity market environments. But along that it hints that competition regulation agencies may be perceived by themselves or by others as the bastions with which such sort of imperialism is to be deterred, or at least that competition regulation agencies may believe that others potentially envision them in such a guise. Thence the relations between competition regulation agencies and the State, here FNE and CORFO, are occasionally broken reflections of fears of imperialism and of ideas for its lawful mitigation.

Through the national prosecutor, FNE struggled to determine if a formal investigation should proceed, as it considered this issue to be a matter of material export. Under FNE’s focus on limiting economic concentration activities in Chile, lithium export does not seem to be a relevant source for potential

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267 Ibid. Tianqi is not a Chinese company insofar that, as expressed by its CEO and Chair, the Chinese government is not a shareholder (Durante and Capdevila, 2019).

268 Ibid.
negative effects to free competition in Chile or to its public interest. Though concentration of economic activities is often addressed as a source and cause of market failures, monopolies in Chile are not necessarily banned by FNE nor do they fall against Chilean law.\textsuperscript{269} Competition agencies in Latin America are rather askew into the breath of what they might intervene on.\textsuperscript{270} Events in equity markets that attend to operations and politics around materials may then be left with wider ranges of disregard or tolerance. It matters then if this behaviour by competition regulation agencies is either not causally intertwined to any external agent or if it is deliberatively fashioned, and if so if it follows and enables mechanisms for pressing or supporting a particular end or interest or for complying with their limited commission.

FNE has discretion to select which complaints are to be followed, based merely on its own judgment of admissibility to determine if a matter can potentially infringe upon the \textit{public economic order}.\textsuperscript{271} In the case of lithium consumption, the significance of lithium prices for Chilean markets affected by products with lithium materials which are mostly consumer electronics with lithium-ion batteries was considered negligible.\textsuperscript{272} The affected consumer was considered to be the international market and not the national market, as that at the time Chilean companies were not major lithium buyers.\textsuperscript{273} In addition to the perceived negligible effect on Chilean consumers, FNE considered that there was no risk of supply concentration as Tianqi had then no investments on other companies of the same industry in Chile. Still, FNE followed with a formal investigation as it considered that the obscurity of the lithium market and the lack of reliable traceability of global lithium reserves limited any legibility and understanding of the stake that Chilean lithium reserves had in broader geographies, see Exhibit 15.\textsuperscript{274}

\textsuperscript{269} Examples of ‘legal monopolies’ in the US were discussed in informal conversations with FNE hinting that US trade policies are seen as ‘good practice’ or at least ‘good for imitation’. However, FNE would not stain its image by explicitly striving for monopolies even if it would arguably might have been complacent to allow an equity acquisition that would signify material export monopoly in Chilean territory. The Chilean State is also wary about its image in front of condoning monopolies. For instance, CORFO expressed in conversations that such practice is not what is aligned with their view of a ‘healthy’ economic development while their amendment to potential lithium concentration activities in the Atacama Salt Flat is fairly recent. Legally, it can happen as Article 4 of FNE 211 Law Decree states that any monopoly in Chile can only exist if it was given by Chilean Law (Ministerio de Economía, Fomento y Reconstrucción, 1973).

\textsuperscript{270} Peña (2012).

\textsuperscript{271} An FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition stated that about 85\% to 90\% of complaints filled to FNE are dismissed, and over 90\% of complaints made by congressman to FNE are dismissed. These figures hint that the usual matters that are denounced to FNE do not correspond to FNE’s understanding of matters that pertain to its mandate and focus. Contrasting epistemological groundings for economic orders and regulation and competition law translate into contentions among competition agencies, the State and most likely with the corporation as well. See note 195, this chapter.

\textsuperscript{272} Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition. FNE calculated the percentage that corresponded to lithium in consumer electronics imported by Chile. This metric was the one employed to evaluate if Chilean markets are affected by lithium price volatilities or control, and thereby by equity markets dynamics affecting lithium supply.

\textsuperscript{273} Such a perception of the Chilean lithium market, one where there are virtually no national buyers, demonstrates the lack of understanding and communication with CORFO on its plan to internalise battery manufacturing in the country.

\textsuperscript{274} Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.
There is a geographic inconsistency, or multiplicity, of what competition regulation agencies may recognise as 'national'. FNE looked for affections to Chile but consulted to other countries that may have been involved in the matter. By doing so it evinced that economic geography of resources touch on stakes in equity beyond the nation. FNE consulted with India's and China's competition regulation institutions, understandably as these two where significant for bringing those shares into market, but it consulted as well with the United States competition agency. While the US competition agency certainly looked into this issue, FNE was surprised when nothing but an echo returned from the enquire for thoughts and expertise on what they considered to be an affair that mattered for large lithium consumers in the US. This lack of reply could have dealt with the geopolitical friction, or 'trade war', between US and China at the time, and with the place of the US government on Pinochet's dictatorship in 1971 and thereby on Today's control of SQM by Ponce, which could have affected the behaviour of the former on economic competition advisory. As equity markets are, the economic geography of a material is then not entirely visible to competition regulation agencies. National interests and spaces are then not just those affectated in the territory but those that are likewise in broader economic geographies of a resource that matter for the territory.

"One felt as if playing monopoly, caught in a corner, and all the rest were other countries"."
Competition regulation agencies are makers of the market insofar that they develop equity dynamics and incite conduct on equity movements as part of their commission. Further, their experiences and practices are used by other competition agencies, either emulated or studied and integrated into regulation methods. Their experiences and methods are in addition are analysed and used as market data by investors. As such, competition regulation agencies partly produce and define equity markets and relations between the State and the corporation in other and broader geographies. Still, equity markets far surpass competition regulation agencies in defining market dynamics. Company relations traceability is not possible if attempted to be done by today’s institutions that face equity markets. Equity markets seem to exhaust competition regulation agencies. FNE, looking at Chilean market geographies as those enclosed within Chile’s political geography, that is physically within the country’s territorial borders, ultimately filled an agreement with Tianqi to allow the purchase of under a quarter of SQM shares.

The ‘mess’ was arguably not solved then, as one of the directors appointed by Tianqi in SQM had previous experiences with Rockwood, Albemarle’s former corporate figure, putting thus further tangles into the picture. As well, the existence of the company Talison, a joint venture between Tianqi and Albemarle, yields further concerns for those that look at the company diversification in the Atacama Salt Flat as a mesh that joins and amasses today’s lithium suppliers operating in Chile into a single body.

**Conclusion**

Economic strategies on raw material supply in the national and corporate level are strongly rooted in equity markets. These strategies are seen as purposed for increasing world-scale surplus value. As ideas of value contrast across markets and participants, competition regulation agencies mediate investments in equity markets. Equity markets and competition regulation agencies play important roles in the ideas, contestations and frictions that set economic orders and systems. Equity markets are important for determining relations and behaviours associated to the making of nations, spaces of extraction, and material ontologies. In so, they shape supplying networks by bringing together nations, shares and materials.

The encounters made-up by equity markets modify relations and conducts between the State and the corporation as well their individual behaviours and modes of practice: foes can become odd bedfellows and allies may have misunderstandings. This ultimately shapes networks of material provisioning and their purposes. Relations and encounters across difference brought by equity markets are not stable and
keep changing.\textsuperscript{283} In the relations between the State and the corporation there is occasional blurring between them. By altering and making relations, equity markets ultimately affect and arrange the nodes that weave together global material supply. This chapter finds equity markets as relational spaces where people, material legacies and economic geographies, in multiple scales and from different times, meet and construct economic strategies on materials. Such constructions in the case of lithium supply are happening in ways that are not designed to be found, observed nor traced.

Equity markets, as the institution that shields corporate share dynamics from control and maceration, are not subject to structural change by the public bodies commissioned for economic competition regulation and oversight. The case here analysed suggests that competition agencies are not designed nor equipped for dealing with threads bringing together today's battery materials, while they are expected to in some cases. However, competition regulation agencies enable the role of market mediator to the public sector besides the previously established roles of market participant, maker and embodiment.\textsuperscript{284}

What equity markets are and what do competition regulation agencies do for material supply is here observed though the SQM-Tianqi equity story. This equity transaction shows that the behaviour of the State to foreign investments or those considered ‘beyond the nation’ is not always aligned with settled national economic strategies and policies favourable for foreign investments; particularly so when materials categorised as ‘strategic’ and ‘critical’ are in question. The SQM-Tianqi equity movement reveals how actors involved in Latin American lithium supply entangle with one another and how today’s equity dynamics interfere with and make economic strategies and desires. Modes of interaction with and appreciations of the corporation changed rapidly and relatively imperceptibly while this equity purchase materialised. Contrasting to previous equity acquisitions, this one proved to be increasingly relevant for public attention as it was for delimiting the ranges of interventions for public institutions on economic development and competition in face of equity market dynamics and processes.

This equity movement details some of the legacies that lithium has in Chile. These legacies blur the nation and the corporation in equity markets. Material symbols and images replicate from copper to lithium and forge the discourses that voiced oppositions from the public sector. The modes to organise against corporate actions is reproduced from copper histories to lithium today. However, material legacies in Chile show that equity markets are more than the infrastructures that operationalise ideas in the public sector about harmful corporate actions on materials. Nitrate pasts in the Atacama Salt Flat show how equity markets were a critical tool to device the country’s early and applauded economic relations and shaped Chile’s export-led development.\textsuperscript{285} Equity markets can be looked at in profundity. Looking at

\textsuperscript{283} See Tsing (2005).
\textsuperscript{284} States do not necessarily play all roles; these roles are however not mutually exclusive.
\textsuperscript{285} See O’Brien (1982) and Chapter 6.
equity dynamics beyond conventional discourses of growth, profit and productivity can help to critically view economic and geopolitical significance of places through their resources, it can help to understand cultural legacies in materials, it can serve to estimate the sorts of expectations and economic behaviours for future materials.

Chile’s competition agency took a role comparable to a lithium supply chain analyst. The SQM-Tianqi equity story seen through the involvement of FNE allows to unpack ambivalences on what is worthy of intervention and for whom. Competition regulation agencies may sometimes operate according to alternative understandings of public economic order. The multiplicity, handicaps and imitations in economic value systems sets the need for mediation of economic activities. So, competition regulation agencies keep the game of equity acquisition interesting. Handicaps and imitations in the game and its rules thwart the ways that competition regulation agencies face equity markets.

The way in which FNE was involved in the SQM-Tianqi equity purchase, as both focused on national affairs and with an ambivalence for the understanding of geopolities that affect and comprise Chile, suggests that competition regulation agencies are simultaneously multi-geographic and place-bounded. Inconsistencies in modes of action and geographic scales further reduce any potential abilities that competition regulation agencies may have on visualising and cleansing economic practices on material sourcing and trade. Moreover, the SQM-Tianqi equity story shows a broken communication between the State and the competition regulation agency. This affects the relation that the State may have with the corporation and thereby hinders on the bits that make up chain stages. A broken communication between the State and competition agencies may lead to misfits across supply chain stages. Supply chains are also affected by competition regulation agencies when these require divestments or tailoring investments. The result of such compliance with the rules of free economic competition alters the nodes that connect networks of supply, equity markets are responsible for those nodes. Due to equity markets, thence, sections of global material supply join and uncomfortably gear into motion.

Overall the impression of the lithium industry in Chile expressed by those involved with the country’s competition regulation agency is that of a dark and shaded industry, comparably impossible to track and oversee. Ironic as it is expressed by a body with a particular stance for gathering information. From the side of competition regulation, FNE attempted to act cautiously since it recognised that the ‘market power’ that lithium allegedly holds for energy storage could be easily striped from it.

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286 Knight (1935b).
287 This phrase is inspired by Knight’s (1935b) visualisation of economic activity as a game which is regulated as a referee would do to keep it interesting.
288 Conversation with a former FNE employee in charge of the prosecution to the Tianqi-SQM equity acquisition.
Chapter 3

“One just didn’t understand, it’s a market that is not understandable, very opaque, information levels were very macerated”.

The ways that society organised in the corporate and State level follow from this opaque and misunderstood equity arrangement. However, as the following chapter notes, such complication to trace and regulate lithium trade in Chile is also visible in other social scales that do not regard the corporation or the State but are in-ground amidst spaces of extraction. The lack of traceability of infrastructures and relations in lithium supply is also seen beyond the corporate and State equity market levels and grounded in the Atacama Salt Flat. These regard resource needs and ways of organisation in places bordering lithium mines, where the symptomatic effects of renal instability in the body, embodied by complications for material traceability and cleanse, are happening as well.

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Ibid.
Chapter 4

Desert Water

In the Atacama Salt Flat, lithium extraction entails pumping mineral-saturated water, called brine, and evaporating it. Pumping water from the most arid desert in Earth might mirror with resource scarcity, but depending on the metrics and categories for resources water and brine can be framed as excessively available features in salt flats.

Whether ideas of scarce or abundant resources dominate in the region is mostly bound to the social value around lithium, water and brine. Values for resources are pressed together into uncomfortable encounters where one tends to dominate over others. While visible mobilisations are either for water or for lithium, these represent the competing values of lithium’s materiality. For lithium in the Atacama Desert, the different values on water and brine are juxtaposed in places located in and near lithium extraction sites. There, social values condition ways to see and use resources and to mobilise people and ideas for giving traction to competing resource perceptions and uses. Social groups that either look to mine brine or to conserve water, all use technical discourses and narratives of scarcity and excess. Like technical discourses are, scarcity and excess are sides of the same coin in the Atacama Desert.

This chapter builds on the frictions, tensions and tolerances formed by the interactions between material supply with consumption demands. It looks at these from localised perspectives as experienced by people in and near upstream sections of global material supply. From in-ground perspectives of those in or near the spaces of supply, it unpacks the narratives and arrangements that compose ideas of purity, amount, availability and price for resources with contrasting categories and values. The chapter focuses on how changing narratives on a same resource idea affect the supply chain of a material by devising contrasting social value appreciations. Specifically in an empirical context that observes and analyses the desires that different social groups in the Atacama Desert have on the finality of water, brine and lithium from a stance on material data homogenisation and differentiation to bring different perspectives from a same material condition. Besides arguing about the competing nature of social values of materials, this chapter claims that the ways of organisation to give traction to a particular social value are the main cause for affecting a supply chain more than the according narrative or value-appreciation are. It therefore expands on the networks that are made for mobilising responses to resource scarcity, excess and

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290 See Introduction. Bustos-Gallardo, Bridge and Prieto (2021) provide a rich political ecology discussion on the production traits in the Atacama Salt Flat that make use of accentuating natural conditions in the area. Methods to avoid brine evaporation with solar heat regard the use of Direct Lithium Extraction and membranes to thereby concentrate brine.

291 This competition among values mirrors what Méndez (2021) discusses on technical discourses on water in the northern part of the Atacama Desert as holding a dominating position over other discourses on water since the nitrate mining times in the area. However, whether technical discourses dominate in the region, they are used in different narratives by multiple social groups to mobilise contrasting social values and perceptions on resources and their purposes in society.

292 Particularly following the observations on supply-demand interactions by Narins (2017) from lithium supply for battery industries, to which he refers to as ‘consumption-production imbalances’. 
stability. While looking at these networks, the chapter elaborates on how different and competing social values form and adjust them. *Consumption-production imbalances* as made by the interactions across poles in end-to-end paths for material supply and use are then suggested to be fashioned by value differences more than by quantitative misfits between supply and demand.

The social values of materials are posited to be the utilities that materials receive in a specific time and space. In the widest sense, technology and culture being the determinants of not only a material’s importance, but why and for whom. Materials when classified as resources have been located as relational understandings of non-human worlds. So, where relations between materials classes them as resources, the relation between people and materials classes them into sorts of resources. The classifications that are attributed to materials, for example as rare, critical, strategic or bottleneck, highlight societal aspects rather than mere substance features as intrinsic attributes or objective stock. When set, classifications are not shared by everyone. Multiple expressions and utilities of a material convey that it holds several social values that are constantly finding each other in difference. Still, resources are classified despite differences in resource appreciations. The ranking and appreciations of material classifications, that place for instance aspects of nationally critical and strategic over locally necessary and rare, also shows more about society than it does about material intrinsic attributes. The prioritisation of the relation that one bit of society has with a material over the relation that another bit of society has with the same material is most often the way by which a material’s social value sets across society. Life and economies in and near spaces of extraction are highly susceptible to the value of materials around.

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293 See Narins (2017). Specifically, Park and Allaby (2017) define social value in the dictionary of environment and conservation, in context of environment and natural resources, as “the non-economic value that society puts on a resource and that is recognized by most, if not all, people”. However, it is here taken that social value can stem from economic values and affect these providing that utility as an idea can be sourced from economic values as far as these are not necessarily the same as but sometimes related to monetary gain.
294 Bridge (2009).
295 Zimmerman (1933).
296 These encounters fit into what Tsing (2005) remarks of the colonial encounter as held through difference.
297 On that, Hirsh’s (1976) point on the effects on collective utility by individual actions resonates profoundly when extractive industries are thought of as devised by individual economic actions that affect mostly and firstly places of extraction.
Chapter 4

Materials in places of extraction have competing classifications

Zimmerman (1933) mentions that resources are relational understandings of non-human worlds. From that, Bridge (2009) analytically interprets that the classification of materials as resources comes from the way that materials are “related to other things, to knowledge, to the opportunity to realize value by exchange, and to other materials that can fulfil the same function” (p.1220). Here, also based on Zimmerman’s idea, Bridge’s interpretation is taken beyond relations materials share with materials and with non-human worlds to include the relations that materials as resources have with society. This relational expansion is meant to further provide understandings of non-human worlds. Therefore, the classification of materials as resources unpacks to subclasses that are given not only by the ways in which materials relate to non-human worlds but importantly to the human world. This leads to argue that non-human worlds, as relationally understood through resources, are significantly tied with society. Heterogeneity in society then provides myriad classes of resources from a single material as people and socio-economic groups do not normally relate similarly with materials.

This chapter explores the day-to-day life and economic strategies of people in and near spaces of lithium extraction in the Atacama Salt Flat as they experience scarcity and excess of resources related to lithium mining. The chapter builds on events and situations in San Pedro de Atacama and the Atacama Salt Flat where lithium, water and labour join in scarcity and excess. This chapter locates contrasting social values for a material as formed by different relations people have with a same material. It does so by digging into and unpacking the discourses used by people involved with lithium mining and battery industries, and environmental and social activists. Likewise, it analyses how other people in the same place but with contrasting and often dominant perceptions of what ought to be done with materials sustain and work with their social value over those opposing it. In-ground descriptions of and actions on resource scarcity linked to lithium mining are used to elaborate on contrasts of social values for lithium in the Atacama Salt Flat.²⁹⁸ It sees notions of resource scarcity as often not just about material depletion but more about excess. For instance, in the Atacama Desert and relative to lithium extraction, mining firms contest scarcity by segmenting materials into nuanced parts thereby creating abundant resources and market niches. Further, chemistry differentiation of abundant material amounts leads to perceptions of scarcity

²⁹⁸ Particularly following from Narins (2017) on lithium scarcity nuances, this chapter discusses nuances in scarcity and its ambivalence with excess to contribute to work done by Hirsh (1976) on the economic philosophy of human behaviour that hints on material social value.
as for instance, in everyday interactions with water in the Atacama Desert, conditions of scarcity are often coupled with excessive amounts of liquid but in chemistries that are not usable for desired purposes. The chapter first elaborates on the effects and perception of excess of resources related to lithium extraction in the Atacama Salt Flat. Resource excess is pinned to scarcity in and around the places of lithium extraction to understand the interchange and play between both concepts. The chapter then elaborates on the idea of thirst to conceptually understand what is really searched for when people speak and organise around ideas of water excess and scarcity. Thirst serves to frame competing desires for the resources that uphold the materiality of lithium, being water and brine. In so it serves to highlight how does a social value gets preference over another in society and politics. By looking at thirst conceptually, the chapter locates that the thirst for value dominance is a matter that in Chile regards law and legacies of mining in national economy. The chapter concludes by addressing the importance of scales and metrics to speak conceptually of material availability and thirst for water, lithium and rights in San Pedro de Atacama.

_Foreword – Thirst amidst abundance_

Resources sometimes exist where they are not thought to be, in places considered void and vacated of life and materials. In so doing they modify the place where they sit proving it with perceptions of natural richness, oases and abundances amidst depletion. In places considered from the outside as hostile and inhospitable, resources also gain senses of rarity. Such is the case of _ayllus_ in San Pedro de Atacama. _Ayllus_ are places where people and resources softly proliferate within an otherwise arid and void space. _Ayllus_ are forested settlements isolated from one another by arid spaces, that together compose villages in the Atacama Desert. Possibly described as frontiers, _ayllus_ juxtapose what deserts are and how people live and organise in places that are simultaneously rich with and scarce of resources. _Ayllus_ in San Pedro de Atacama show the struggles among social values for resources that are disputed across the Atacama Salt Flat. From these oases, the richness of the Atacama Desert is visible

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299 The existence of resources is largely drawn by what society considers a resource to be, as it also depends on the time when a resource gains economic and political traction, see Bridge (2009). The work from Tsing (2005) and Klinger (2017) captures the interplay between resources and places idealised as vacated to obscure anthropological experiences and understandings from resources and locations under competition by internal, external and in-between actors.

300 Social and physical rarity of resources and services from an economic perspective that sees this condition as produced by social contexts of growth and penury is notably thought through by Hirsh (1976). His concepts are a medullar take across this chapter.

301 San Pedro de Atacama is composed of 20 _ayllus_: Cuchabrache, Suchor, Bellavista, Guachar, Tambillo, Catarpe, Quitor, Conde Duque, Solcor, Yaye, Larache, Checar, Séquito, Coylo, Tular, Vilama, Solor, Cúcuter, Poconche and Beter (Sepúlveda Rivera et al., 2015). _Ayllus_ where initially formed by the distribution of families across farming land with river access in the Atacama Desert; in town meetings as in literature they are often referred to as ‘desert oases’, see González Pizarro (2000).

302 In the many representations of Quechua and Aymara communal forms of Buen Vivir in the Andean region, García Linera (2016) frames _ayllus_ under Marxist socialist perceptions to recognise them as collective social enclaves that function as insurrectional seeds for universal decolonial productive unity.
and locally contested. Their contestations for resources are not just a matter of local resource use but of global resource understandings and rights.\textsuperscript{303} Their globality is most evident as their cadastre and mapping, shown in Exhibit 16, is located as a layer simultaneously embedded in and overlapping with mining concessions. As such, they sit in upstream sections of material supply chains for the resources extracted and mobilised in the Atacama Desert.\textsuperscript{304} This relation with the material needs of the outside from local resource use brings the politics and values of ayllus to expand to and contest with other communities. Particularly with the neighbouring indigenous communities located across the Atacama la Grande region, they share in difference the human conditions brought by material supply chains.\textsuperscript{305} Ayllus and indigenous communities in the Atacama Salt Flat are thus consistently struggling with and placing consumption-production imbalances of contemporary supply chains sourcing materials from the Atacama Desert.

\textit{Exhibit 16 – Distribution of Ayllus in San Pedro de Atacama (Sepúlveda Rivera et al, 2015).}

\textsuperscript{303} Arboleda (2020). Specifically, as discussed by Méndez (2021), the categorisation of resources from global and external knowledge has hampered access to water for inhabitants in ayllus.

\textsuperscript{304} Political ecology conflicts from mining experienced in ayllus and replicated in other communities in the Atacama Salt Flat are described from spatial-cultural views by Romero and Opazo (2019).

\textsuperscript{305} Other communities beyond San Pedro de Atacama that endure what Tsing (2009) notes as the difference in labour in supply chains are the 18 indigenous Lickan Antay communities that are comprised by the Indigenous Lickan Antay Community Council (CPA).
Chapter 4

Excess

Exhibit 17 – Toconao-San Pedro de Atacama road in flood. Picture taken by the author.

“Each year the drought is harsher and now [that rain comes], well, you can see.”

In February 2019, thunders were visible over the volcanos making the skyline in San Pedro de Atacama. By the middle of the month in 2019, this was a recurrent image in San Pedro de Atacama where for the past two weeks each afternoon the Licancabur volcano showed above it a set of dense clouds blistering electricity in a far but ever approaching distance, see Exhibit 17. This meant that the late afternoon will be damp in town. The only days where this routine is interrupted are those where clouds that funnelled below the mountain ranges have been reluctant to clear at sunrise, giving an unusual feature of day-long drizzles in town and its ayllus. The ‘Bolivian winter’ is clearly present and attested by the lacerated desert holding a strange mixture of blossoms and mudslides. The most arid place in Earth is exceedingly rich with water and accordingly dependent systems. Streams, lakes, conifers, bushes, deer, flamingos, donkeys, guanacos, foxes, birds, insects and reptiles are found effortlessly throughout the muddy plains that make-up the landscape across the desert during the Bolivian winter. Human life, however, does not welcome such increased abundances similarly.

306 A local fruit and vegetable merchant laments reduced stock and sales during the rainy February-March 2019 period. As generally expressed in town, the intensity of water discharges is just over what would be advantageous and turns instead to be detrimental for crops and agriculture distribution yields.

307 50 to 80% of yearly precipitations in the Atacama Desert occur during the austral summer due to a set of meteorological pressure systems in the Bolivian Altiplano that cause rain in the Atacama Desert (Romero, Rivera and Fernández, 1997). Locally, this event is called ‘Bolivian winter’, see Introduction.
This year in 2019, the Bolivian winter has brought unusually destructive floods.\textsuperscript{308} The most robust road in the San Pedro de Atacama commune, \textit{Paso Jama} to Argentina, is washed away, see Exhibit 21. Along with it, commerce between Chile, Bolivia and Argentina is partly interrupted. A line of lorries permanently faces the Andes range while an alternative pass to circumvent a crevasse is built.\textsuperscript{309} Collapses are replicated in other local, smaller scales where roads and water meanders are more precarious and sinuous.

Most of the complications experienced on the day to day in and around San Pedro de Atacama during the austral rainy period are not only due to in-site rainfall but also and more importantly due to the amount of water that falls in the slopes of the volcanoes that range the border between Chile and Bolivia, from Licancabur to Tocorpuri. In between the volcano slopes and the dips in valleys adjacent to them, most of the rivers that feed the Atacama Salt Flat are born and named. \textit{Ayllus} in San Pedro de Atacama feed from the San Pedro and Vilama rivers that source from such origin.\textsuperscript{310} Due to effects from the Bolivian winter far over the volcanoes, the San Pedro and Vilama rivers are today overflooded and threaten day-to-day life down stream in San Pedro de Atacama.

When floods happen, irrigation to the \textit{ayllus} is interrupted due to sediment excesses.\textsuperscript{311} Irrigation within the \textit{ayllus} of San Pedro de Atacama is normally done by channelling water from the San Pedro and Vilama rivers.\textsuperscript{312} These rivers have historically seen their streams reduce while moments of increased flow become more deleterious than advantageous.\textsuperscript{313} Although they make up but a fraction of the amount of water available in the salt flat, these rivers are lifelines to the \textit{ayllus}.\textsuperscript{314} Today there is a greater reliance

\textsuperscript{308} Moments of highest water flow in the San Pedro and Vilama rivers correspond to February and March in an otherwise dry year (Oyarzún, 2002). Today’s experiences and expressions in ground show that this trend persists but that drought and flood periods are intensifying each year. Grief is perceptible with words that equate flood with drought. Just as people in town acknowledge the dry periods to be increasingly severe each year, growing intensity of the Bolivian winter is also a common description of the evolution of the rainy summer time.

\textsuperscript{309} Even during less severe weather, early mornings in Paso Jama display a line of lorries, caravans and passenger vehicles waiting for custom authorities to allow transit. Halts are normally placed due to road icing above 4000 m a.s.l. Vehicles, including tourist tours attempting to visit Uyuni from San Pedro de Atacama, normally move before or around 8 am. Longer interruptions are caused by mudslides and sinkholes.

\textsuperscript{310} The San Pedro river’s initial springs come from the Putana volcano, while the Vilama river forms from the Turipite thermal springs and the effluents from the Sairecabur volcano. The initial water course that turns downstream into the San Pedro river is named Putana river. This is subsequently enriched by streams from the Jauna and Salado rivers, which emerge from different nameless dips in between San Pedro de Atacama and the volcano range (Sepúlveda Rivera \textit{et al.}, 2015). Water emerging from dips in the valley beneath volcanoes is likely to be likewise sourced from water that permeates from the volcano slopes.

\textsuperscript{311} González Pizarro (2000) and Sepúlveda Rivera \textit{et al.} (2015).

\textsuperscript{312} See historical accounts by González Pizarro (2000) and Sepúlveda Rivera \textit{et al.} (2015) on crop irrigation through surface-water channelling.

\textsuperscript{313} From 1940 to 2013, the surface flows of the San Pedro and Vilama rivers have declined respectively by 44% and 59.5% (Sepúlveda Rivera \textit{et al.}, 2015).

\textsuperscript{314} As expressed in a speech given in a local anti-mining event by an environmental NGO representative that leads advocacy efforts for banning mining in the Atacama Salt Flat: “Without the San Pedro river and without the irrigation canals this [place] would not exist, the river would just go through there (points at a horizon opposite to the volcano ranges) and this would be dry.”
to irrigation canals as water wells are increasingly being constructed in town and mines. Ideas of scarcity come from reduced streams coupled with increased welling in town and in surrounding mines.\(^{315}\)

**Water chemistry**

“For us [indigenous peoples] all water is one, for them it is not, it is a business.”\(^{316}\)

Penury in San Pedro de Atacama is not induced by reduced streams alone but as well and more importantly by chemistry. In town, channelled water from the Vilama and San Pedro rivers is distributed proportionally among *ayllus*, but each *ayllu* gets its supply from one river or the other. As a result, some *ayllus* have limited crops due to the contrasting chemical saturations between rivers. Vilama, Poconche, Beter and Tulor *ayllus*, who get water from the Vilama river, only grow lucerne, a few varieties of corn, chañar and carob due to the river’s high boron content.\(^{317}\) Contrastingly, the rest of *ayllus* are served with low-boron water from the San Pedro river and can therefore farm wheat, fruit trees, corn and several vegetables, in addition to lucerne, chañar and carob.\(^{318}\)

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<td>Sepúlveda Rivera <em>et al.</em> (2015) speak of water distribution and its effects on crop differentiation as a way in which the <em>ayllus</em> that farm with the Vilama river have been ‘sacrificed’. It is here noted that such crop differentiation not only did it separate <em>ayllus</em> into classes but also it differentiated labour based on amount and sorts of water in each <em>ayllu</em>. Smith (1980), Smith <em>et al.</em> (2001) and Arboleda (2020) attest effects here likewise observed of labour differentiation through selective diversification and distribution of nature and resources.</td>
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</table>

Among *ayllus*, water is relatively accessible; what matters most is which water you want, and recently, what water can get you beyond what can be produced from its direct use. Beyond assigning crops separately across *ayllus*, water distribution provides political leverage for funding infrastructure and salaries. As the emergency status was imposed in 2019, limiting a majority of economic activities in San Pedro de Atacama, civil society active on water management organised with political parties to apply for government grants on infrastructure and rural development for areas under ‘emergency environmental

\(^{315}\) For instance, SQM has 3314 functional wells as stated during a visit to SQM Salar in May 2019. This infrastructure resonate for local residents as sources for imminent depletion.

\(^{316}\) Interview with a CPA representative that is established in San Pedro de Atacama and manages the monthly meetings between CPA and Albemarle.


\(^{318}\) Ibid.
status’.\textsuperscript{319} Excessive amounts of unsolicited water occasionally hinders agriculture, tourism and mining operations, but it has contrasting effects on other labour sectors. Resource crises provide grounds for increased funding available for projects that regard crisis category. Water as a destructive force turns into source for rural development funding.\textsuperscript{320}

Water excess equates in the San Pedro de Atacama \textit{ayulls} with excessive water salinization due to sediment washing and transportation by floods. During floods, water is not of the same sort as that which is available during the rest of the year. Water in excess is then a different sort of category chemically. This saturated chemistry enables labour differentiation and ultimately excess of speculative economies.\textsuperscript{321} In San Pedro de Atacama, multiple civil organisations and private entities find use of resource chemistries and disproportions as categories to suit business models and economic strategies. Beyond times of natural disasters, water-based funding and according projects in town are not about securing access to water but about amending and working with chemistries.\textsuperscript{322} An irregular array of water chemistries creates spaces for niche labour.

\textbf{Brine chemistry}

\textit{"You might get a lot, but it's not really what you want."}\textsuperscript{323}

Similar to drinking water arrays and the according social processes for ensuring its distribution and chemical treatments, brine chemistries differentiate the sorts of lithium products available and the technical and social processes needed for their production. Salt flats in the Atacama Puna have different brine among one another.\textsuperscript{324} Within each, brine reservoirs chemically vary across a single salt flat.\textsuperscript{325} Comparable with the experiences in between \textit{ayllus}, water chemistries depend on where you stand. Across the Atacama Salt Flat, brine compositions vary resulting in dispersed concentrations of chemical

\textsuperscript{319} In San Pedro de Atacama, public services as water supply, wastewater treatment, electricity distribution and grid maintenance and waste management are handled by residents through civil associations. Resulting entities, as the San Pedro de Atacama Rural Drinking Water Committee (CAPRA) and the San Pedro de Atacama Electricity Committee (CESPA), are not managed through public functions set as State-purveyed obligations. This enables in San Pedro de Atacama an increased networking between public service committees and their according projects and financing; for instance CAPRA has about 40\% property of CESPA.

\textsuperscript{320} See the special issue on disaster aid and development by Sawada and Takasaki (2017) for critical contributions on the financing of disaster-based development.

\textsuperscript{321} A similar take from benefits following natural disasters was observed by Park and Wang (2017) looking at the Wenchuan earthquake in China. Their findings on household income increase from disaster aid subsidies are mirrored to the effects of floods in the Atacama Desert where civil society organisations profit and are created from increased government spending on disaster support projects.

\textsuperscript{322} Interview with a water NGO representative that operates from Santiago and has received funding from government and mining companies to work in several ayllus in San Pedro de Atacama.

\textsuperscript{323} Conversation about carob trees with an environmental NGO representative that opposes mining in the Atacama Salt Flat. This perception is also given by directives in lithium mines about brine and the resulting products.

\textsuperscript{324} See Ogawa \textit{et al.} (2014).

\textsuperscript{325} Sieland (2014).
elements.\textsuperscript{326} In a single brine deposit, there are places where lithium concentrations fade and others where they amplify.\textsuperscript{327} This narrows specific areas in the salt flat to be best equipped to produce lithium materials. Ideal brine is the most concentrated one in terms of lithium content purity, but this does not mean that each salt flat exclusively comprises a single lithium concentrated area nor does it mean that the rest of a salt flat beyond its most concentrated segments is unprofitable. Mining companies that work in salt flats have found ways to turn nuances of material concentration in brines as factors for increased production as opposed to it being a complication for business models. Exhibit 18 shows an evaporation pond whose size is testament to the large brine production in the Atacama Salt Flat regardless of concentration variations. The knowledge on patterns, places and shapes of concentration gradience in salt flats is used to catalyse abundancy from limited places with preferential concentration.

\textit{Exhibit 18 – Brine evaporation pond in the Atacama Salt Flat. Picture taken by the author.}

\textsuperscript{326} The water table in the Atacama Salt Flat is roughly composed of a brine nucleus bordered by a mixing zone that meets an external groundwater body (Marazuela \textit{et al.}, 2019). In a sampling study across the Uyuni Slat Flat, Risacher and Fritz (1991) found a soft but relevant dispersion of lithium concentrations in the salt flat's brine. The confirmation of lithium concentration dispersions in the brine nucleus of the Uyuni Salt Flat and the geological detail of its hydraulic dynamics by Sieland (2014) suggests that, given the shared geomorphologies and structural geology in the Andean Altiplano formations as shown by Seyfried \textit{et al.} (1998), Kay, Ramos and Dickinson (2009) and Evenstar \textit{et al.} (2017), characteristics of brine heterogeneity in salt flat brine nucleus is a shared trait in the salt flats comprised by the Atacama Puna.

\textsuperscript{327} Sieland (2014).
Narrow resource differentiation increases senses of available quantities

Broad scale analyses of global distribution of resources for batteries and energy transitions, as presented for instance on lithium by Mohr, Mudd and Giurco (2012), Kushnir and Sandén (2012), Moss et al. (2013) and Bazilian (2018), stir expectations on geopolitical importance, price change and economic development that are visible in turn in reports done by Fornillo (2015b), IRENA (2017), The World Bank (2017) and MacDonald (2018). Today, contrasting to global-scale resource discussions and interpretations, relevant investment data from brine studies is that which is tailored to precise hydrogeological and geochemical surveys for companies in ground. This is a change from data scales that are normally used to highlight nations or global markets and technology trends for development banks and multilateral organisations. For Latin American lithium resources, these newly relevant data regard a careful look inside broad resource estimations to outline reserve chemistries in higher speed and with increased nitidity and precision on the spatial and temporal variabilities across a single brine basin. These new data enable other formerly disregarded segments of salt flats and salt flats as a whole to be now eligible as sound investment proposals for actors eager still to finance and ride the lithium wave.

Perceived struggles for lithium production turn the possibility for companies that assist mining operations to find increasing utilities for comparative improvements on precision and speed of brine data. Mining companies subcontract geological firms specialised in brine services to find where to pump first and what to do if pumping happens elsewhere. Other pumping spots beyond known lithium ‘hotspots’ in salt flats are sought for with great attention to better seize chemical and hydraulic variabilities as sources for increased yields. Focus on getting the best of brine and the best from available brine has not reduced the amount of lucrative brine to a small proportion within salt flat nuclei. Rather, most sorts of brine are becoming financially attractive as processes to find, depict and purify them become increasingly relevant, sharp and affordable.

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328 As evidenced during a visit to SQM Salar in May 2019, along with its 3314 operating wells, SQM has 3146 spots for hydraulic tests. During this visit it was also evident that most operations in SQM Salar are subcontracted to firms that specialise for instance in exploration, loading or remote sensing and monitoring.

329 Narins’ (2017) remark that technological advancements on lithium processing to compensate costs of reduced-quality resources happens on the intentions to process sea water to produce lithium materials. While accurate, this purification advancement to profitably work with less-quality lithium resources is here considered less relevant than the technological advances for material conversion from lithium carbonate to lithium hydroxide and on increasing purities of lithium materials to 'high purity' grades.
Data outweighs material processing for resource increases

Hanink (2003) explains the concept the ‘technological treadmill’, whereby technological advances are needed to compensate costs associated with processing resources of reduced quality. However, in today’s economic strategies to make brine available, the technological advances are not only designed to offset costs of worst quality resource processing, but also to locate more resources with enhanced data and understanding regardless of their processing costs. The quality paradox elaborated by Bridge (2009), who mentions that increased quality resources are often located after initial resource finds, supports this idea of the technological treadmill going beyond processing costs and also including advances in observation.

Lithium carbonate, the flagship product from brine in the Atacama Salt Flat, is finding price and market conditions that make less lithium-concentrated brine and advanced chemical processes profitable. Social and technical processes to locate brine make use of ideas of penury of lithium-concentrated brine to find monetary and labour resources from mining firms to finance studies and salaries. Labour increases from brine diversity are comparable to water chemistry variations and saturations in ayllus leading to niche and proliferating labour sectors for civil associations on water management and geochemical understandings.

Lithium materials chemistry

Further down the stream of lithium material production, companies have also differentiated to growingly more specialised firms that devise business models suited to uncertainties of market preferences for lithium and cathode materials and to penuries of highly concentrated and pure lithium materials. Innovations in battery technologies are consistently shifting to compositions that use high-purity lithium hydroxide, a material that is not directly produced from mines that today extract brine in the Atacama Salt Flat. Companies that provide purity enhancements and chemical shifting for materials used in cathodes for lithium ion batteries are being growingly relevant for a sector where both material supply and cathode demand are variable and diverse. These sorts of services take the conventional metrics that distinguish between either battery or technical grades for lithium materials beyond to greater nuances within these categories; they develop metrics of high purity, where purity grades range on the number of decimal ‘nines’ in materials with over 99% purity, and of converted materials for cathode

330 Interview with an Albemarle employee working as operations assistant at the chemical refinery plant ‘La Negra’ in Antofagasta.
331 While technological advances today allow material conversions, lithium carbonate is normally made from brine or clay processing whereas lithium hydroxide is normally made from hard-rock spodumene or lepidolite conversion processes.
332 See for example NanoOne (2020) and Chengdu Chemphys (2020).
manufacturing. Lithium producers working with brine processing therefore have begun to engage with mining operations and ventures beyond salt flats, plan chemical-plant expansions and constructions and hire firms that specialise in lithium material conversion and purification. Lithium materials in battery cathodes are under constant debate today for what will be the prevailing material in future technologies.\(^{333}\) These trends drive and are driven by responses of mining firms to give diversity and flexibility to their product portfolios.\(^{334}\)

Whether to choose lithium carbonate or lithium hydroxide, each with respective nuances within, is a persistent question mark for cathode and battery manufacturers alike. Evidently, this concern dwells with the possibilities to develop coupling materials as high purity nickel or fairly sourced cobalt. However, novel lithium materials are not seen today as substitution threats for settled market statuses held by lithium carbonate in cathode materials.\(^{335}\) General lack of substitution competition among a growing number of lithium materials is rooted to the ways in which end use technologies keep diversifying for distinct purposes.

Battery types, including marginally different ones for same technologies, require specific cathode materials.\(^{336}\) Even if new developments in cathode materials in lithium-ion batteries shift to one trend that phases the closure of former battery types, say NCM over LFP, that is shifting from lithium carbonate to lithium hydroxide containing cathode active materials, lithium materials remain relatively safe as chemical conversion from lithium carbonate to lithium hydroxide, and vice versa, is feasible. So, the effects of technology closure are not at hand when material chemistries can be swapped from one to other according to end-uses ambivalent preferences, or when new technology developments are not meant for replacing former technology uses; i.e. longer ranging batteries using NCM cathodes are not meant for replacing LFP battery technologies in buses that have higher charge-discharge cycles but lessened range per charge, see Exhibit 19.\(^{337}\) Evidently still, it is costly sound to foresee technology futures to avoid unnecessary conversions and device brine processing plants to a lithium material or another.

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\(^{333}\) Evidenced through conversations held in Amsterdam in 2019 in a conference on battery materials with heads of electric vehicle OEMs and of companies involved in lithium-ion battery cathode materials.

\(^{334}\) For example, Albemarle's lithium products from brine processing in the Atacama Salt Flat are lithium carbonate and lithium chloride; the joint venture Talison formed between Tianqi and Albemarle produces mostly lithium hydroxide from spodumene mineral deposits in Australia. On the other hand, SQM produces lithium carbonate from its Atacama Salt Flat operations; it also produces lithium hydroxide from the joint venture with Kidman in Australia.

\(^{335}\) Battery metal analysis firms and cathode manufacturers show that market forecasts build on the constant diversification of battery materials well into 2030 coupled with persistence of precursor material generations. This is argued in corporate spaces to be due to uncertainty in battery markets. Actors in cathode industries attest scepticism homogenisation homogenization of cathode materials for lithium-ion batteries by 2030 and well after that.

\(^{336}\) Cathode materials that today make up commercial lithium ion batteries are lithium iron-phosphate (LFP), lithium cobalt-oxide (LCO), lithium manganese-oxide (LMO), nickel cobalt-oxide aluminium (NCA), and nickel cobalt-oxide manganese (NCM); see Chapter 2.

\(^{337}\) For social analyses on technology closure see Postigo and O'Donnell (2017).
The ability to source for a wide set of preferences leads brine producing companies to adjust to client requests and to adjust client requests. To cope with growing numbers of cathode manufactures and thereby with a larger range of specificities in material orders and provided pedagogies, lithium mining companies in the Atacama Salt Flat take subcontracting as a practice that underpins day to day operations and on which efficiency and innovation is largely reliant on.

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338 In an interview, an SQM head in charge of environment and technology mentioned that clients don't always know what they want, suggesting the role that mining firms have in providing pedagogy to clients and instructing about cathode material and battery type possibilities and preferential paths. Lithium mining clients are however not groping around blindly. As it was stated during a visit to Albemarle's chemical plant in Antofagasta, clients come forward with very specific characteristics for the lithium material they require; still, this product specificity regarded only lithium carbonate. This follows in line with the understandings expressed by Knight (1935b) that economic activity is a game that satisfies and makes wants.
Chapter 4

**Scarcity**

"Atacama resists the water looting."\[339\]

Midway a dirt road in Yaye, an *ayllu* in San Pedro de Atacama somewhere in direction to Séquitor from the town centre, a ‘peña’ is taking place in the early afternoon. Shown in Exhibit 20, this peña showcases artwork that calls for resistance to lithium mining. A *peña* is an event that can be placed in-between a bazar, a symposium, a canteen, a live-music venue and a party. This one joins people that reside in the many *ayllus* that make-up San Pedro de Atacama. Passing visitors, the sort that avoid franchise hotels and toured crowds, or at least seem to do so, also join in. This is a place for the interchange of crafts, food and a few varieties of bottled water and beers. The tone of this gathering is that of a space for post-capitalist thinking on subaltern economic and social organisations rooted in the voluntary and sharing modes of social existence.\[340\] The image of community living in *ayllus* is a backbone for many of the attendants’ ideas of ‘how the change is possible’. Still, capital in its money form and value is the basis for interchanges, setting thus bizarre social interactions within late-capitalism to forge post-capitalist ideas.

\[339\] This phrase is written in a local gathering in San Pedro de Atacama beneath a caricature of what looks like a warrior with folkloric Andean traits. Besides the warrior, a box that somewhat resembles a water pump is drawn burning while green money bills fly away from it; the letters ‘SQM’ are noticeable on it amidst the fire and bills.

\[340\] See the work done by Jameson (1992) on initial conceptualisations of modes of life in late capitalism.
This *peña* circulates around a ‘*conversatorio*’: a moment where attendants mixed-up in different activities are invited to listen to and then participate in a conversation proposed by few speakers. The *conversatorio* is not really a conversation, it is more of an explanation to an audience which then in turn is requested to ask away. Levels of engagement and understanding are nuanced and so the *conversatorio* seems a bit like a lecture. As the *conversatorio* starts, the folkloric and loose social environment changes towards a contrasting feeling of pedagogy for social mobilization. This pedagogy guides the creation of antagonisms to the *economic order* of things in San Pedro de Atacama, antagonisms lectured as necessary. Microphones are lit and struggle to eclipse the sounds of other activities bustling still around. Some drums carry on, only gentler, when the lecture begins. An audience is slowly amassed by those who turn their heads with diligent gazes and silence. A few lulled "*bravo*" softly meander their way forward from somewhere in the far back to greet the speakers as they sit in chairs facing a small but present audience laying in the ground.

“We all know [about] the lithium boom.”

The topic of the *conversatorio* is water but the way to talk about it involves lithium. An introduction to the water issues experienced inside San Pedro de Atacama quickly turns towards lithium extraction in the Atacama water-basin. Geology and water are brought into discussion. This talk does not stress on hydrogeology, rather it unpicks geology and water as grounding for drawing-in and enabling mining. Geology and water, separate. From the outside, the salt flat is identified as an arid landscape, one that is made as such providing the few yearly precipitations that mostly occur during its austral summer. From the inside, the salt flat is described as a leaking place, one that is made as such due to the two lithium miners in it. Lithium mines are spoken in parallel to meteorological events as if mining facilities where grounded geological morphers comparable to the evaporation rates from solar irradiation and the Bolivian winter and its rain discharges. SQM and Albemarle are described in the *conversatorio* as mining features of the salt flat and are pinned to the geological description of the place; an image where mines are embedded in-ground to the extent of morphing onto the geology of the place as naturally occurring features. Their presence as salient as water shortages and uncertainties in town gives a sense of impotence noticeable in the audience.

Contrasting to other geological morphers, lithium mines are said to be creating a hydric imbalance in the desert. As spoken in the *peña*, the hydric imbalance is formed by the amount of water made available to mines. One day water oozes from the faucet, another it doesn’t; local inhabitants are then surprised as to why is the faucet in the mine always running. The basis from which scarcity is then expressed in-ground

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341 The first phrase of a geological introduction to the environment of the Atacama Salt Flat builds on lithium demand.

342 Mentioned water issues comprise reduced streams from the San Pedro river, increased well constructions and water pumping from hotels, limited recharge rates for the water table in the Atacama Salt Flat, and crop loses and irrigation hindrances due to floods.
comes from the contrasting amounts of extracted water between towns and lithium mines in the Atacama Salt Flat.\textsuperscript{343} Despite data supporting deleterious effects of water extraction presented in forums, as movement from one place to another of lagoons that circumvent the salt flat, loss of endemic species and time sequences of environmental features degradation, locals struggle to point that water scarcity is caused by lithium extraction due to missed insights on the chemical variations of brine and water and on the overall environmental modelling of the water basin, nor can they prove that scarcity is a reality in the salt flat. Impotence is triggered by a lack of knowledge of the extent of geological affectations that lithium mining causes in the salt flat. Without data, opposition to water extraction fails to effectively ground claims of depletion or scarcity.

\begin{quote}
\textbf{Data-lack links to resource penuries}

Available data from which lithium mining opposition in San Pedro de Atacama is based on regards rates of water extraction compared to recharge rates from rainfall and it does not elaborate on existing and available water quantities. Those who struggle to mobilise resource perceptions of depletion in the Atacama Desert have no evidence or data to fully model the water table. The failure to access data for the most poor resounds with the point made by McNeish and Eversole (2005) on the patterns of poverty in regards to indigenous peoples as politically marginalised sectors of society.
\end{quote}

Still, data-lack is not the only source for impotence on resource scarcity. Social categories between indigenous and non-indigenous locals limit the perception that groups have on their roles and possibilities for contesting mining and water use in the Atacama Salt Flat. Indigenous communities are spoken by non-indigenous locals at the peña as ‘those with a lot to do’, contrasting to the actions available for non-indigenous locals and activists.\textsuperscript{344} Impotence among locals in the peña is then also largely attributed to the social category of ‘non-indigenous’ that most attendants share. The disconnect between non-indigenous and indigenous peoples, felt in the social separation and fear and reluctance to 'outsiders' in ground in San Pedro de Atacama, Toconao and Peine and noted in indigenous rights Chilean law, limits

\footnotesize
\textsuperscript{343} Interview with a CPA representative that is established in San Pedro de Atacama and manages the monthly meetings between CPA and Albemarle. Rates of extraction used in opposition forums in San Pedro de Atacama were gathered and analysed by the Non-Metallic Mining Committee of CORFO, the report states yearly averages of 6810 l/s for recharge and a variation between 8442 l/s and 8842 l/s for output; no geophysical prospection on reservoir size and capacity state was included in the report. The CORFO-based committee was discontinued with the entry of the governance in CORFO that also reworked the contracts for lithium mining in the Atacama Salt Flat. The closest civil society has come to updated data on water extraction from mining firms regards the agreement held between Albemarle and the Peine Indigenous Atacameño Community association. Based on this agreement, Albemarle shares data with the Peine Indigenous Atacameño Community association regarding the amount of water and brine they extract.

\textsuperscript{344} Conversations with local non-indigenous residents in San Pedro de Atacama.
the perception of agency that non-indigenous locals have on the breath of actions available for their activism to be effective. Some indigenous groups in Chile do negotiate with mining firms in their territories but their say is not altogether what goes.\textsuperscript{345} The dilemmas of indigenous peoples to mining is expressed by government officials of Chile’s Economic Development Agency (CORFO) and corporate heads as a complication and often portrayed as barrier to economic sovereignty of the country. The place of indigenous communities to face mining in their territories gives some political strength and difference contrasted to non-indigenous locals who at times perceive themselves to be pressed by never-ending ‘colonial cycles’ without having any judicial resources for themselves to face the State or mines.\textsuperscript{346} Even, among non-indigenous locals there is some perception that indigenous communities are not necessarily well equipped to negotiate with what are perceived as slick and partial agents.\textsuperscript{347}

“I am not indigenous, so I cannot take actions like them.”\textsuperscript{348}

Not all is disconnection between indigenous peoples and non-indigenous locals. Forums with academics, indigenous community representatives and advisors to indigenous communities are held to mobilise thoughts on water extraction in San Pedro de Atacama. While connecting participants, fractures among and within them remain visible. Where academic speakers present data mostly focused on global electric vehicle expectations, spoken as ‘the problem’ for Chile, indigenous participants elaborate on local environmental features and legal actions carried to contest mining.\textsuperscript{349} In local forums, electric vehicle market predictions on global levels and brine extraction trends are somewhat correlated. The aggregation of these data motivates mining growth estimations in the salt flat as causally brought about by battery and vehicle futures, where masses of batteries based on lithium materials are seamlessly realised. There is a feeling of abstraction for battery production and deployment and according brine extraction; mostly due a lack of data on the environmental features of the salt flat and on offtake agreements for battery manufacturing and deployment.\textsuperscript{350}

For academics external to the salt flat communities, water expositions in local forums tend to be about batteries. But whose batteries is never discussed. Additionally in those forums, despite the connection among participants, local social conditions are simplified to being only reliant on livestock.\textsuperscript{351} Contrasting

\textsuperscript{345} See Arboleda (2020). Indigenous consultations stated as mandatory by the Chilean Indigenous Law can be derogated by the Chilean Constitutional Article 66.

\textsuperscript{346} Conversation with youth activists and a social NGO representative in San Pedro de Atacama.

\textsuperscript{347} As mentioned in a conversation held with a participant of a youth activism group: “[I am not indigenous] but I am more connected to Earth than them who take payments to give way to mines.” Allegations and concerns about inclination of indigenous communities to seek monetary and political benefits were also expressed in the Yaye peña and in conversations with tour agency employees and environmental NGO representatives.

\textsuperscript{348} Conversation with a youth activism group in San Pedro de Atacama.

\textsuperscript{349} Sourced from attending a lithium seminar in San Pedro de Atacama organised by groups in opposition to mining.

\textsuperscript{350} For instance, battery deployment for electricity supply in mines in the Atacama Desert is not discussed in local forums. Batteries are generally considered ‘wants’ of the ‘outside’.

\textsuperscript{351} See Bloch (2016) for an analysis on the needs and effects of looking into anthropological understandings from a perception from the ‘outside’ and as one from the ‘inside’.

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to abstracted and simplified views of battery businesses and local life, indigenous actions look to expand knowledge on the ‘health state’ of the salt flat. Indigenous communities through the Indigenous Lickan Antay Community Council (CPA) devise research capacities by contracting environmental advisors.

The work from CPA focuses mostly on judicial complaints against the State and mining firms. The ambiguity of interactions among civil society, indigenous associations and academia is remarkable. For instance, academics in the region are normally accused by civil society and indigenous groups to be bought to generate research and data ‘loaded from behind with a component of interest’ providing that as much as ‘90 or 95% of research done in San Pedro are financed by Albemarle or by SQM.’ Likewise, civil society is perceived by some indigenous communities to be tainted with funding from mining firms and interests on tourism and businesses. The State is somewhat involved in these accusations as it is perceived by locals to be in alliance with mining firms. In forums where different oppositional voices to mining meet, dissonance seems to be the common ground.

Data is expressed in ways of dominant resource appreciations to contest them

Debates on the integration of indigenous ways of knowing in environmental management is a rich ground for understanding that dominant epistemologies negate the place of indigenous and autochthonous knowledge in environmental governance. Work by Purcell and Onjoro (2002), Jenotf, Mindle and Nilsen (2003), W. D. Smith (2007), Berkes (2012) and Martinez-Alier (2014) is instructive on efforts done to understand and integrate indigenous perceptions in resource appreciation, use and valuation. Still the integration of dominant ways of expressing data, that is through graphs, statistics and models, in subaltern resource understandings for the use of and interaction with nature is a process that while less discussed remains significant for the ways that dominant epistemologies sustain their power over others, see Haraway (1988).

The fractured connections among indigenous peoples and non-indigenous locals as pressed by these forums is evident on the reliance on dominant epistemologies from western science to protect cosmological visions of politically marginalised locations. It is now a common way in San Pedro de Atacama to mobilise activism based on quantitative positivist data. This speaks on what sort of data is considered relevant for authorities, including authorities with alternative values. The dominant sight of

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352 Interview with a CPA representative that is established in San Pedro de Atacama and manages the monthly meetings between CPA and Albemarle.

353 Conversatorio in the Yaye peña.
mining as source for economic growth is contested by using comparable metrics and ways for observing resources.

The ways in which indigenous Lickan Antay people organise in CPA and deal with other locals and mining firms is a base for fracture among indigenous people and communities. Complications to organise among themselves affect their agreement on terms for mining tolerances and resistances. Resulting decisions, for instance on the ways to equitably distribute compensation payments that may come from mining firms, lead some members of indigenous communities to mistrust the work done by CPA. There is then less willingness to engage with CPA from other members of indigenous communities. However, it is not just the ways of organisation among indigenous peoples that create some scepticism and reluctance to engage by otherwise participants.

Among residents of San Pedro de Atacama, the fear of the ‘outsider’ permeates to a common behaviour among locals; as if settled powers materialised as mines and the State where lurking around looking to destabilise postmodern modes of life and value pluralities. A usual refrain and suspicion to engage with unfamiliar faces as with those that are known to be dynamic voices in town is part of social interactions in San Pedro de Atacama. Secrecy and personal barriers are commonly enacted when locals with activist profiles engage with one another. The sense of community goes strong when people regard themselves as inhabitants of San Pedro de Atacama, but it is arguable when activism for social mobilisation happens as ruptures among and within local groups.

A reluctance to engage with ‘outsiders’ in places near extraction is also shown by mining employees and heads. Locality is defined by the participation in and commitment to the mine and its values. The category of outsider is thus transposed by the mine. Mines become spaces that enclose its specialised labourers and excludes locals regardless of their involvement in the mine as employees. Members of indigenous communities employed by lithium mining firms have endured heavy discrimination by ‘the industry’. When employed, indigenous peoples are generally lacking access to casino, dinner and collation, and

354 As described by a former advisor to CPA, the places where their monthly meetings are held tend to be “in the most concealed and clustered locations” as if “to deter outsiders, which includes inhabitants of San Pedro [de Atacama] and indigenous communities [that] are considered as potential spies and snoopers”, from knowing what is being discussed. To contrast these suspicions and internal fractures, the Colla Indigenous Peoples near the Maricunga Salt Flat where spoken by the same former CPA advisor to have more inclusive and less secretive ways of organising themselves in regards to other local inhabitants that are not members.

355 CPA states proudly the ‘victory’ of monetary compensation delivered by Albemarle, where 3% of the firm’s profits from its Atacama Salt Flat operations are divided among CPA and the 18 communities composing it. However, as expressed by an environmental NGO representative, this payment is a source for breakdown.

356 An environmental activist and tour guide in San Pedro de Atacama mentioned wariness and secrecy in her day to day: “People here want to know what I say to other people.” This feeling of fear was perceived generally in town. Finn (2001) elaborates on how Chile Exploration Company established controlled dissidence from unions and communities in the Atacama Desert by establishing the archetype of diligent workers in the early days of the Chiquicamata mine, the largest refined copper source since its making. These social mouldings on diligence and fear permeates today in the Atacama Desert as legacies of past copper histories.

357 Finn (2001).
using different clothing than employees coming from Calama or Antofagasta regardless of their role in the workplace.\footnote{Interview with a CPA representative that is established in San Pedro de Atacama and manages the monthly meetings between CPA and Albemarle.}

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**Materials in the Atacama Desert have legacies of fragmented community building**

The perception of what ‘locality’ is within mining sites in today’s operations in the Atacama Salt Flat aligns with those constructed in 1900s by Chile Exploration Company in the early days of community building in Chuquicamata, the copper giant of the Atacama Desert; see Finn (2001) for details on how society was constructed and separated by provenances and roles in and around copper extraction in the Atacama Desert. Locality as made by mines favours those aligned with dominant resource perceptions.

Inside the casino and diners of lithium mines and chemical plants, some long tables provide spaces for short chats and anecdotes among those sitting closely, meals are listed on calendars pinned to self-standing boards, and walls have few decorations other than an occasional poster reiterating the engagement of the firm to fair labour and harmony of practices with local wildlife and culture. Missing these conversations, meals, scheduling and adverts would invariably alter how people speak about the firm, its employees, the food they had, who they shared it with or just how maybe the firm and its heads might be thinking of having some alignment with local society and environments. Just outside the casino, the intensity of the sun and the infrastructures for chemical processing and material loading are not inviting for calmness and leisure. Far away from the casino, the community itself might also be an uninviting place for those working in the mine.

Reticence from indigenous community members, as formed by residents within the communities cadastre that identify themselves as ‘local’ and indigenous, towards miners employed in and living near the salt flat is more directed to ‘outsiders’ that are settling inside the community and not in the mine’s camp-site. Community members that become employed by the mine are normally not discriminated in communities around the Atacama Salt Flat. Information held by CPA about working conditions from the inside as experienced by local employees means that there is a living communication between indigenous employees and indigenous opposers and that these categories are not mutually exclusive. It seems to be a common understanding across the community that employment choices from locals that tilt towards the mine are normally based on the need for revenue in face of scarce alternatives. However, empathy may not be likewise felt towards ‘outsiders’, as defined as non-indigenous mining workers with different social values on lithium and salt flats.
This categorisation of and treatment to ‘outsiders’ is often reciprocal in indigenous communities to mining employees, particularly to employees that are not indigenous and that do not share the community's social values on resources and their penuries. Although these tensions have been addressed through legal agreements between indigenous communities and mining firms, frictions persist due to incompatibilities in values between the social categorisations of ‘locals’ facing ‘outsiders’. Still, while these agreements partly eased, among several points, the thirst for just labour conditions and knowledge on water extraction, the overall balance of resources, people and rights remains unnoticed to this day.

**Thirst**

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359 Impaired labour conditions were worked through initially between Rockwood and Peine’s community by an agreement signed in 2012. As it transitioned from Rockwood, Albemarle formed another agreement with CPA in 2016 based on the Rockwood-Peine agreement, then called Albemarle-Peine agreement, where fair labour conditions are addressed for indigenous peoples hired by Albemarle. To this day SQM has no agreement with indigenous communities located near the Atacama Salt Flat.

360 Interview with a CPA representative that is established in San Pedro de Atacama and manages the monthly meetings between CPA and Albemarle. Particularly there is not attention to gender in today's ‘solutions’. Gender is elusive even to indigenous associations making it tricky to be observed and then to be soundly approached to.
Chapter 4

The most arid place in Earth is remarkably wet, flooded with potentials for both growth and destruction. Lithium is broadly viewed by society in global scales as critical for the incarnation of electric vehicles.\textsuperscript{361} This abstracted view on lithium is seen by people in the Atacama Salt Flat as cause for either problems or salaries. Lithium as an enabler for battery futures is scrambled for, despite of its known abundant availability.\textsuperscript{362} In the Atacama Salt Flat, global scrambling for lithium translates in-ground for desires for water. It is through water and devices to pump it and monitor it, through for instance subcontracts or quests for data making that the materiality of lithium in the Atacama Salt Flat as socially constituted by brine and people around it becomes visible and understandable.\textsuperscript{363} Chemistry variations in water under the Atacama Salt Flat are making of lithium’s materiality a source for contested social mobilisations, including speculative economies and resistance.

The organisation of labour by the differentiation of nature is increasingly growing in and around San Pedro de Atacama. Based on labour and firm increases, lithium and water use rise in excessive levels. The increase in labour and economic strategies to make most of lithium’s social and temporal utility have led to the expansion of lithium availability and its understanding in the Atacama Salt Flat. Increased availability and knowledge of materials in and around the places of extraction has in turn become an arguable source of the same social value it builds from. Quality and amount continue to increase thus posing that the growing search for extracting more materials does not cause detriments to pernickety material requirements and ideas.\textsuperscript{364} The finality of such endeavours in the Atacama Salt Flat may not necessarily be to mitigate climate change, but rather to harness consumption-value rapidly. This may not be the first time that the finality of mining follows such value-increase desire, but it could serve to point and pin that same finality for climate change mitigation.\textsuperscript{365} Questioning the finality of consumption leads to understanding that economic choices are often devised for individual gains.\textsuperscript{366}

\textbf{Satisfaction}

Water consumption in the Atacama Desert consistently rises.\textsuperscript{367} Water in the Atacama Salt Flat becomes available to satisfy resident needs, provide and expand hotel and restaurant services, fulfil and create crop locations and yields, accommodate leisure swimming places, extract minerals and evaporate brine. The amount of water needed for these tasks is consistently growing, thus creating further wants that are not designed to be satiated. The search for satisfaction is more about the search for further and unmet

\textsuperscript{361} Narins (2017).
\textsuperscript{362} Ibid.
\textsuperscript{363} See Richardson and Weszkalnys (2014) for conceptual notions on resource environments and materialities.
\textsuperscript{364} See Bridge (2009) on the paradox of increased resource quality after initial ‘best’ resources are extracted.
\textsuperscript{365} See Hirsh (1976) for discussions of the ‘finality’ of economic activities as centred in consumption.
\textsuperscript{366} Hirsh (1976).
\textsuperscript{367} DGA (2020).
desires rather than the fulfilment of desires. 368 With increases in water satisfactions and desires, a search for further sources, transformations and uses for water underlies most economic activities in the area.

The possibility to build wells and develop economies from an otherwise apparently self-drying place is mostly linked to political leverages for infrastructure and labour building; leverages and voices that seem to escape indigenous peoples' interests, views and social conditions around water. In views of indigenous peoples and mining opposers in San Pedro de Atacama, pumping causes river-water shortages, whereas people in other social sectors place most emphasis on climate change effects that can be outwitted by pumping. The growing possibilities to satisfy requests for water by increasing pumping and by amending and working with chemistries has led to an appreciation of disproportions across the satisfaction of wants. Amount uncertainties of welled water mobilises claims of disproportionate abundance and squandering. While the balance and variances of the water table of the Atacama Salt Flat is contested today, the amount of extracted water from mines and the necessary infrastructure for it in times of growing penury in San Pedro de Atacama is a widely used image across ayllus to visualise imminent depletion. Expressions of penury linked to water-induced destructions, specifically linked to floods, are comparable to that which is attributed to felt inequities between amounts available to mines in the desert.

While water use grows, proportions are not equally distributed for each purpose. Some wants seem to be disregarded and others enriched beyond strict fulfilment. Economic models based on satisfying some consumption demands induces and builds on resource rarities. 369 While it is unclear that water is scarce as in physically limited, the procurement of water, brine and lithium for satisfying a specific bit of society leads to an ineffective distribution of water data and rights to the point of these latter resources becoming rare.

**Law**

"They have the water rights in the salt flat and near it." 370

Material yields from lithium mines in the Atacama Salt Flat are tied to production quotas and water rights. These are held through separate agreements with the State; explicitly with CORFO for production quotas and with the Mining Ministry and the General Water Authority for brine extraction and water rights respectively. Water rights are provided separately following the Water Code set by the Chilean Justice Ministry. Brine extraction is not included in the Water Code and is instead approved by the Mining Ministry through evaluation of environmental permits rather than it being considered as production criterion. As lithium is produced from extracted brine, it is unclear how production quotas on lithium materials and limited water rights interact. Brine rights are not regulated by the Chilean Water Code,

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368 Hirsh (1976).
369 This attests Hirsh's (1976) insight that consumer demand is not always a good guide for determining the most effective model for an economic activity.
370 A representative of CPA laments the difficulty to "get rid" of the mines while water rights remain as their property.
making its extraction less rigid. Likewise, the relation between underground and superficial water does not include brine as being part of water tables. So, the interlaces with reservoir availability are blurred and do not account for the effects of brine extraction. Aside from brine, mines douse in softer regulations for water use. As per the Chilean Water Code, acquisition of water rights for mining industries is differently handled than for other social and economic sectors with different water uses and finalities.

In Chile, private property rights surpass social welfare rights. It is the law at the level of the constitution to keep property protected and traded over social collective needs. As water rights for mines are preferentially dealt with, mining water rights surpass individual private property rights and thereby social welfare. While growing certainties of brine chemical arrays are being devised, data for fully understanding and regulating the Atacama Salt Flat is missing; specifically, the Chilean water authority does not require nor give statements on reservoir capacities and volumes, but merely addresses rates of extraction, phreatic levels and where necessary rates of reinjection. Moreover, without grounds for proof of damages or depletion, granted rights may become permanent.

Due to water upholding the materiality of lithium in brine, water rights equate to either satisfying thirsts for lithium production or for mining restraints. By today's distribution of water rights in and near the Atacama Salt Flat, the preferential use for water is to have it realise its lithium contents for national economic growth. Overall, the social value of lithium as held by the Chilean State and its laws seems to outweigh alternative social values of its liquid shape in the places where lithium becomes initially mobile.

Conclusion

Water, lithium and rights are intimately connected in the Atacama Desert. Beyond conventional links between mining and water use, lithium mining in the Atacama Salt Flat upholds water use and extraction in different stances as it is the extractable target material for lithium production. There, water turns to a commodity as far as it materialises lithium and as well as it can be traded as a private asset by Chilean law. The characteristics of commodities is a major determinant for social mobilisation in places of extraction. From their relations, material characteristics can permeate into the characteristics of one another and thereby affect their perceptions. So, along with the characteristics of commodities being

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373 Donoso et al. (2004).
374 Senado de la República de Chile (1980, Art 19, num 24).
378 Haslam and Ary Tanimoune (2016).
379 Zimmerman (1933) and Bridge (2009).
influences on social mobilisation, the characteristics of accompanying resources are also influences on social mobilisations.

In Chile, water is differently regulated than brine but water for mining is differently marketed than water for other uses. The framework for mining lithium in the Atacama Salt Flat is the same as other materials in the Atacama Desert which receive preferential juridical treatments. But on top of those preferences to mining activities, existing mining operations in the Atacama Salt Flat are excluded from the regulation that frames lithium as not eligible for concessions. Due to the rubric of water regulation under which it operates, lithium mining brings forward memories of copper mining and its hierarchy over other uses and perceptions of places. This is seen by the attribution of characteristics and terms as ‘critical’ and ‘strategic’ that have also been previously employed for driving copper and saltpetre economic strategies. So, accompanying materials, whose characteristics permeate into the ones of commodities in question, are not necessarily just the ones simultaneously in place but also those whose legacies are maintained in the place of extraction.

Water and brine through their differentiations and aggregations superpose perceptions and thereby underlie distinct trends in social mobilisation. By either being joined into one or separated from each other, they are simultaneously spoken of as scarce or abundant. Inside each, the same variation of description occurs when they are found as homogenous or constituted by difference.

The paradox of excess and scarcity occurs in multiple ways

Bridge (2009) notes the paradox between scarcity and abundance as resources become more available as best quality sources are depleted. In addition to that, it is found that the paradox of scarcity and excess occurs today as well by: i) the creation of resource excess by the differentiations of scarce resources: as when data becomes more clear-cut and resource base descriptions expand; ii) the creation of social resource scarcity when resources are physically excessive: as when floods limit access to drinking water and economic activity; iii) the perception of scarcity in trends of excess: as when local resident worry about the amount of brine extracted by mines and fear water depletion from that practice; and, iv) the prevalence of excesses regardless of qualities when scarcity occurs: as when water consumption grows inversely proportional to surface water levels.

The characterisation of brine and water as being both scarce and abundant is done by looking into their chemistries. In San Pedro de Atacama, availabilities to choose crops and to produce lithium materials are

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highly determined by water chemistries. Chemistry and its tracing take an important role in the Atacama Salt Flat to mobilise people to perceptions of scarcity or excess. Chemical variations across water and brine allow to depict distinct resources and thereby to devise different strategies for their uses and values. Though chosen separately one from the other, that is mobilising for brine or for water, an economic strategy on one affects the utility of the other. Importantly, decisions on a resource or the other are carried without weighing in the penury effects on and from the other.

The availability of lithium materials supports perceptions of the material to be sound for solving energy futures. Despite ideas of scarcity, and arguably because of them, lithium becomes growingly available. The view of lithium as easily obtained and as cost-convenient for battery technologies is pressed to modes of life across society. Recently, prices dropped for lithium materials until end of 2020 suggesting that availability increases as well as their relative scarcity.

For the case of lithium, in-ground discourses of resource scarcity are often made by realities of excess, likewise discourses of excess are made by realities of scarce but differentiated materials. Discourses of scarcity employ homogenisation of resources, whereas discourses of excess employ nuancing on grades and types within a resource. Distinct understandings of terms and realities polarise strategies on the same material stock. For instance, it is seen in the Atacama Salt Flat that mining proponents use discourses of excess to justify mining actions, mostly by differentiation of materials. Likewise, material processing creates excess from practices of nuancing. Contrastingly, civil society and indigenous community associations, specifically the Lickan Antay indigenous peoples council (CPA), use discourses of excess to oppose mining by making scarcity visible through locating excesses for some bits of society that exclude them. Scarcity and excess of resources are bedfellows in the lives of people that press of mining and of those that oppose it. When people mobilise to ideas of scarcity in times of growing availabilities, whether said mobilisation looks to make resources more or less available, it is not necessarily about responding to physical depletion, but to socially devised penuries. Though mobilisations aim to make a scarce resource more or less available, depends on the view that people have not only about the material’s value but also about whose value it is.

A perception of a material gains prominence over others based on the pedagogy it employs to instruct metrics and uses. These perceptions usually carry along hints of mobilisation to either look for mining or to oppose it. Whether it is to mine materials, to build hotels or to conserve places, competing strategies for resource uses in the Atacama Desert are based from different understandings of resourcefulness of water as material. However, all strategies base their view on resources as that which materialises values perceived in a material. Beyond foundational Marxists critiques on value and exchanges, work on

381 Particularly following Hirsh (1976) on notions of resource rarity amidst abundance brought by collective choices.
382 See Katona (1975).
environmental economics and political ecology has broadened value understandings on environment and society.\textsuperscript{383} In these notions, values remain highly contextual and bound to social interactions for value sharing and transmitting.\textsuperscript{384} Value concepts, from views on capital to those on culture and society, often meet in difference and assemble into processes that define, contest and alter values.\textsuperscript{385} Value as concept and imaginary can note that certain relations reproduce when society envisions it similarly through time and space.

The emphasis on thirst is placed to observe not just the discourses on excess and scarcity that make up the views that society has on lithium and its social values, but importantly to show how does society in places of extraction respond to these views and values in competing ways; there is a thirst for materials, for rights and for social value dominance.

Understanding how contrasting narratives on lithium are used has served to better realise the ways in which society has generally come to view lithium and what does that mean for energy futures and the use of batteries as imagined solutions for climate change. For lithium, narratives in Chile have been recognised to be largely framed by socio-technical discourses used to legitimate extraction.\textsuperscript{386} The views that society has on lithium generate the social value of lithium.\textsuperscript{387} However, for that, alternative views are to be ignored. The setting of a social value is largely drawn by the tensions, fractures and tolerances that occur among people in and near places of extraction more than by end-use wants. In fact, it is suggested that end-use wants are highly susceptible to the outcomes from social value contestations and prioritisation in and around places of extraction.

\begin{center}
\textbf{Dominant social values are victorious on resource uses and language}
\end{center}

In its language and knowledge bases, a mobilisation is already favoured over another one, as MacKenzie (1978) showed on statistics being moulded for favouring specific interests. A message is then more easily adopted if transmitted in a language that wouldn't be ideal for a competing message. From there, end use preferences adjust accordingly; this statement expands points made by Neumann (1998), Bridge (2001) and Peluso (2011) that a triumphant resource imaginary over others makes resources as they are. It is here suggested that it is not only resources that become but also end-use and conceptual ‘finality’ of the resource become as made from value prioritisation in and around spaces of extraction.

\textsuperscript{383} Martinez-Alier (2001 & 2002), Chan, Satterfield and Goldstein (2012), Kenter et al. (2015) and Elrick-Barr et al. (2022).
\textsuperscript{384} Kenter et al. (2015).
\textsuperscript{385} Martinez-Alier and Walter (2016).
\textsuperscript{386} Barandiarán (2019).
\textsuperscript{387} Narins (2017).
Misalignments among competing social values are not necessarily sourced from disassemblage alone, meaning complete separation between social groups, but also and more often from fracture, meaning incompatible interests that are still made to function. For fracture there must be rupture of an existing relation. Rupture does not constitute disassemblage, as those that have broken relations still relate with one another, as for instance shown in the agreement that Albemarle and the Peine indigenous community have established to seek fair labour for community inhabitants. Quite the opposite to full disassemblage, in rupture there are tears but not necessarily full separations. Tears are evidence of past assemblage, which, as seen through material legacies, matters for today’s memories and thereby for the forming for behaviours, strategies and networks of material supply. As in geological features, tears leave gaps that are often filled with the means and bits through which fractured parts meet again while conserving their distance and difference, like calcite crystals formed in a broken geological contact, or an igneous body inserted through a geological fracture. Ruptures in social mobilisations, each in search to satisfy their respective wants, are evident in the ayllus of San Pedro de Atacama.

The manipulation of social values modifies how materials are perceived and how people mobilise to contested or shared uses and purposes. When changing a social value, other values are as well altered accordingly. Added value and price value, for instance, are also modified by the narratives and terms by which a material’s generally shared social value operates and is expressed by. The responses in places of extraction to the values and views on lithium are important constituents of resulting views and values. The making of values for materials is then largely reliant on the alignments, fractures and modes of organisation in and near places of extraction. The economic aspect of social values turns evident as dominant social values amend not only competing social values but as well other values as use, exchange and monetary values. The ways in which economic values are modified is evidently not a mere correlation with social value alterations and contestations, hence the next chapter looks into other ways that economic values are modified, mostly looking into price control and attempts to jump stages in global material supply and transformation.

Ayllus in San Pedro de Atacama, indigenous communities in Atacama la Grande, and lithium mines in the Atacama Salt Flat exemplify the thirsts in today’s energy systems. This analogy is pinned to what social mobilisations in and near places of lithium extraction in Chile bring to light: thirst for data, thirst for sovereignty, thirst for monetary wealth, thirst for salaries and labour, thirst for water, thirst for resources, thirst for rights, thirst for value and thirst for value recognition. Social mobilisations in San Pedro de Atacama around the Atacama Salt Flat and inside lithium mines, show how lithium moves an

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388 Manipulating social values in the places in and near sites of extraction modifies activities down the stream of supply; largely due to limited options from a set technology and infrastructure, see Chapter 2.

389 Deleuze and Guattari (1984) mention that an object emanating from a source can ultimately modify its source.

390 On that point it is important to remark previous work done by Martinez-Allier (2001), MA (2005), Büscher (2010) and Chan et al. (2011) on multiplicity in value appreciations of nature.
economic system thirsty of materials and rights. Social groups in these places, despite their material social values and desired finalities for lithium materialities, all experience excesses and scarcities, both bringing problems and promises. Those with unaccomplished desires of chemical understanding and material use are mostly those whose material imaginaries and metrics lose in the resource-making game.
Symptom 3

Can food become more nutritious over time? Less? Not the same food but food in general. Obviously a banana rots, but bananas, do they change for a person? How long is long to measure that change? Not a youngster compared to an elder, but a person. I want to know about sudden change. Boom! 20 calories more per banana, something like that. I’ve never heard of it, but I don’t understand food either.

Calories. Simple enough to standardise all food to caloric variation. Yes, that’s the measure. Can I take more calories from this banana compared to that other? Seems like a puzzle solver. No famine with just dropping over some value-added bananas from a craft. Yes, nutrition-value-increased bananas. I looked into a nutrition book. Nothing about changing nutritional values of food over time. At least not of food on its own. It seems to happen to me that way; same meals, more weight. The nutrition-value Midas, I’ve become.

Can I control the nutritional value of my meals? Would the banana choose less calories? Does my value desire go against nature? Value-lessened bananas; An un-resilient nutritional-value. What value would I choose for this meal here?

What about the future? A round future: either cyclically round or voluminously round. Certainly voluminous, I’m not sure about cyclical just yet. Can it be both? What’s the future calorie like?

Adverse effects on the thyroid gland by lithium toxicity are complex and not thoroughly understood. The thyroid gland is in the front of the neck and regulates energy use in the body. Studies have found lithium-treated patients with increased risks of developing thyroid malfunctions resulting in goitre and hypothyroidism. Hypothyroidism represents an under active thyroid. In hypothyroidism, iodine intake in the thyroid gland decreases due to the lithium-iodine competition in the cell membrane. In so, lithium toxicity limits the intake of iodine into the thyroid causing lithium accumulation in it. A lithium saturated thyroid loses its ability to regulate energy use properly and leads most generally to weight gain, depression, exhaustion and muscle pain. Very rarely, hyperthyroidism may occur in lithium treated patients, but it is generally short-lived and conducive to long-term hypothyroidism.391

Symptom 3

Thyroid instability

In raw material supply, pricing shows and determines cost realities and preferences for a technology over another. For material exporting countries, price is at the same time a driver of wealth accumulation as it is a critical point to influence streams of material supply. For sourcing firms, pricing can become a comparative advantage and bargain chip. The hype over a material and technology leads to impressive efforts to generate and accumulate wealth, often through obfuscating price strategies. Energy futures are not exempt of this.

Wealth accumulation does not always come from market and business savviness nor from holding supply bases of a material that is undisputedly supreme over alternatives. Rather, it may come from the creation of ideas of worth and the manipulation of value in time and place. Lithium intoxication in the energy system increases the weight of sourcing countries and battery industries. Particularly, energy futures present possibilities for material holding and exporting countries to fatten from wealth accumulation. The worth of batteries leads to desires and strategies for lithium sourcing places to manipulate value and price in often confusing and counterintuitive ways. Pricing strategies then become a central point to modify and bring more value to lithium materials and thereby to increase capital accumulation. Value added agendas for lithium respond to ideas of economic profit from altering structures of material supply. As in a lithium saturated thyroid, a lithium saturated energy system represents weight gain in monetary terms for sourcing companies and countries. However, a malfunctioning thyroid from lithium toxicity can lead to depression when plans on value may not materialised as dreamt. Articulations don’t feel as they would with a healthy non-lithium-saturated thyroid, pain and exhaustion is inevitable from the strategies that seek value added. The monetary value of batteries and the overflow of lithium materials seeking to make a profit from battery industries expands to financial markets of commodity trade; all in line of profit seeking on energy futures from battery expectations and lithium production stressors. The symptom of weight gain from lithium toxicity is perceived in an energy system that leads to the commoditisation of materials and the making and trading of their financial derivatives. Lithium overdosage in the energy system causes weight gain, depressions and pain in supply articulations.

Prices for lithium materials are today being altered in Latin America to add value. In addition, lithium is on the brink of having its first futures contract as initiation into derivatives trading. This section explores these two components that revolve on the use of idealisations and meanings of value and time to control structures of global material supply. The section chapters look at the tropes and models used for amending pricing and networks of material supply.
Chapter 5

Price

“The sad reality is that Chile doesn’t have a battery industry.”

Batteries in the view of the Chilean State are objects that beyond conducing renewable energy futures into realisation they amplify value for its metal resources. Ideals on materials and development strategies that have been carried on other resources once coined to the Atacama Desert remain and are close to desires on lithium today. These ideals are visible in the value appreciations and descriptions that are brought into policy and thereby into finance and manufacturing. These are tropes of value. Value tropes for lithium in Chile are closely attached to price and supply chains. Their use enables supply chain alteration by ways of producing prices for raw materials. Value tropes and the strategies that follow to alter prices of raw materials are employed to tilt and channel finance and realise batteries in Chile; not for their use in Chile but for the export of lithium in a shape that sales for a higher price. Value tropes press for the enclosing of the supply chain from lithium to batteries all within the Chilean territory, but still with intentions to provide them for the outside planet where batteries are most speculated on. Price production is then justified as channel for adding value to lithium. There, value tropes offer a glimpse on price as an anthropological subject. To look at it as such, this chapter looks at interventions on lithium supply prices to amend the role of Chile in global battery supply.

This chapter presents a case of direct intervention in supply orders through price on raw materials. It explores what do pricing interventions can tell us about perceptions of value on raw materials today. By searching this, it details what do energy futures matter for in base-metal supplying places. This tells us more about processes that alter prices beyond supply-demand equilibriums. For this, the chapter follows the first tender that the Chilean government held for manufacturing batteries in Chile with lithium materials produced from the Atacama Desert. After a brief background of value in time for lithium from the Atacama Salt Flat the chapter follows with the thread of the call for projects. This call for projects is divided into two sections. First, one that details the process for selecting companies that bided to the tender, from the reception of bids to the selection of winners. The selection process brings forth the multiple meanings ascribed to value as trope. These simultaneous and sometimes contradictory conceptualisations of value allow to partly unpack value chains in material supply. This locates the ontology of batteries as seen under narratives of value and material development that reflect loss of confidence on positions in the periphery of industrial centres. Secondly, the chapter follows through with how selected firms dropped their projects one after the other. There, the backlashes of price production and their according contentions are ascribed to inconsistencies of value understandings and to the mending and making of economic concepts at will. In this, the chapter discusses the politics, economic

392 Conversation with a leading member of the Chilean industry association on renewable energy ‘Chilean Renewable Energy and Storage Association’ (ACERA) which integrates the majority of renewable energy and hydrogen companies in Chile.
strategies and social arrangements that tropes of value assemble on raw materials. The chapter closes by recalling the events and highlighting their dashes about social arrangements in nation-making projects, economic strategies for price production, and politics of technology devising.

This chapter explores price in the mist of strategies employed to define and device ideas of value that sustain and breathe new life to material legacies in the Atacama Desert. Lithium is not priced as an indexed commodity with derivatives trading. The price of lithium as formed by few entities is here beginning to be contested as its temporality of physical delivery goes through important breakthroughs to what might look like steps into futures pricing and markets for lithium.

Foreword – Amending price to add value

In July 2017, 12 companies bided to Chile’s Economic Development Agency (CORFO) for manufacturing lithium-based products in Chile. By the end of July 2019 selected bidders dropped their projects, leaving Chile’s first battery tender deserted.

In its attempt to move towards what it considered as forward from raw materials export for lithium industries, the Chilean government through CORFO had a call for projects aimed at companies that would produce goods in Chile supplied by the country’s lithium reserves from the Atacama Salt Flat. Not just any good but ‘value added’ goods: goods involved in batteries and electric vehicles. Companies were lured in by promises of comparably low prices of lithium materials. Prices they could get for up to 26 years and for up to 25% of the lithium materials produced from Chilean brine reserves by Albemarle.\textsuperscript{393} Selected bidders would be offered their required lithium material amount by Albemarle to a price equal to that lowest in market parity of the Chilean export price.\textsuperscript{394} CORFO labelled these prices as ‘preferential price’ and spoke of it as flawlessly desirable for battery materials industries.\textsuperscript{395} However, this price was murky insofar that it was not a single definite one and that its wording and method concealed elusive pricing methods and ambiguous and changing purposes. CORFO and Albemarle were unclear about the ‘preferential price’ pricing method and had some unsettled disagreements about its concept. Complications arose to determine it. So, tendered projects along with the entire lithium \textit{value added} agenda lost grip to the point of slipping from realisation.

\textsuperscript{393} As stated in the CORFO-Albemarle contract, preferential price would be available from 2017 until end of the Albemarle’s leasing in the Atacama Salt Flat in 2043.
\textsuperscript{394} CORFO (2016).
\textsuperscript{395} See contracts CORFO (2016 & 2018b) holds respectively with Albemarle and SQM, detailed in Chapter 1, and see CORFO (2018c) documents for lithium tendering through preferential price.
Value added for material supply is symbolised by either moving downstream or upstream

Besky (2017) elaborates on how moving closer to raw materials in supply chains favours pricing, economic and political conditions from supplying countries. This perception is shared by The Scottish Parliament as expressed by O’Connor (2018) who sees more value as industries get closer to raw material supply. CORFO has a contrasting approach and instead views moving further apart from raw materials and closer towards end-use devices as a strategy that better economic conditions for its materials and the State. End-use technologies are represented in Latin America as objects that increase value to raw materials and thereby on the focus that industry should take. Symbols of value are thus contrasting according to materials and industries. Literature on the semiotics of material politics here come handy to unpack the misaligned views on lithium across State and corporate material supply participants, and thereby the concepts for its development. The semiotic culture of materials as presented by Chowdhury (2016) is here taken to the ways in which lithium strategies, that become their signs in politics which Papadopoulos, Tsianos and Stephenson (2008) call ‘imperceptible politics’, are subject to symbolic processes whose reading is grounded to unsettled imaginations.

Material price setting for inciting battery manufacture was considered as a means for the country to capture more value from its lithium. This strategy, however, posed risks brought by the usage of the concept of value in multiple ways and its application to different ‘market actors’. Value was equated to price but lexicalised to technology making. As shown in Chile’s battery tender, value does not address an objective representation of a term but rather it serves as trope that morphs and turns into multiple ideas at once.

However the value-trope adapted and morphed, the essence of the tender as a mechanism where prices would be accorded in time, remained. Despite being the main anchor across changing purposes and narratives for value, the way in which pricing structures were fixed and disclosed was ultimately cause for discomfort to tendered value added projects, more than speculations about value meanings would be. CORFO was composing price as far as it was affecting the ways in which Albemarle did so. CORFO was engaging on ‘price production’ rather than ‘price fixing’ providing that preferential price would be set to

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396 The wording in italics of ‘value’ and its tropes, e.g. value added, value chain and preferential value, is here used to denote multiple meanings and conceptualisations, and to bring attention not to the word itself but to the obfuscation of narratives and words to serve political ideals and wants on materials for economic development.
the lowest selling price, which could variate according to market volatilities, orders and clients. Price production as strategy somewhat clarified what the tender was about, but the way it was carried by CORFO limited commentary on the politics and morals of worth. Such lack of commentary was ultimately the demise of the call for projects.

<table>
<thead>
<tr>
<th>Politics compose prices</th>
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<tbody>
<tr>
<td>The idea of prices as ‘composed’ comes from Guyer’s (2009) work that conceptualises prices as composites. Guyer analyses prices as fictions composed by “narratives of creation, addition and subtraction” (p.204). As composites, prices are composed of multiple policy, economic and social factors that amass into a figure. Price production is then reasonably seen for the selection of a range out of a price portfolio. Following Guyer (2009), it is here seen that the idea of value is heavily ascribed to worth which is then veiled by price ideologies that serve to avoid political and moral commentaries.</td>
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**Background – About value added in time**

The public rhetoric of batteries as enablers for renewable energy systems is important to understand what did CORFO stepped on as shade for its underlying view of what batteries truly enable and when. Supply chain studies have demonstrated that struggles to financialisation and thereby to distributed price discovery accompany strategies for material control, market enclosures and supply restraints. Moving closer to batteries by ways of amending price for raw materials served in part to sustain ideas that speak of ‘lithium for Chile’. Promoting batteries was not for supporting distributed says on battery futures based on global finance instruments on raw material selection and pricing. This was about doing price production now for cloistering material supply for a future where batteries would be far more ubiquitous than they are today.

The Chilean lithium call for projects looked to ensure future material delivery for technologies viewed by the Chilean State as spewing higher value for the country and the resources therein. The exercises of future material delivery are often done by price discovery as enacted in futures markets, but rather CORFO did so through attempts of price production. While the State amended calculations for price production, prices remained controlled by the supplier of lithium materials who saw its pricing measures

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397 The idea of public rhetoric of macroeconomics as holding marks of social orientations to temporal horizons and sensibilities comes from Guyer (2007).

398 Notably referencing to Besky (2016) who noted that numbers for commodity pricing can speak for themselves when participation in material production is distributed and coupled with limited actions to induce price figures. As Besky follows, rather than cloistered expertise for price determination that occurs for materials amended to fit in downstream stages of material transformation to end-use and intermediary products, opened markets entails the application of technological change in global finance for price discovery.
considerably affected in time. As further ahead lithium materials production entered in time, more would have had to be delivered in lower prices rendering operations less profitable and thereby likely conducing price to overall rise. Price discovery for later stages in time would need to consider this effect as a cost component and adjust to scenarios of rising prices. There is then a link between discovering a price and producing it. Price production precedes the relations that are made for price discovery based in modelling scenarios. New kinds of market relationships are necessary to implement scenario modelling.\textsuperscript{399} CORFO testaments this with the changing relation it drove with Albemarle and some of its clients, but as well with the ways that it configured the compositions of prices and their relation to value tropes.

In the battery future rhetoric, CORFO was underpinning temporalities conducing lithium to batteries and thereafter batteries to copper. In batteries, time scales for raw materials coming from Chile where easily sketched out. But the State wanted more than that: in the short term, the need to lure investments to make Chile a country that produces batteries rather than mere materials for these; in the long term, not just devising a future where energy storage technologies use Chilean materials beyond lithium, but setting temporalities that constitute the making of value for raw materials based on favouring certain technologies into the future.

The idea of moving up the supply chain was channelled as the means to enhance value for industrial operations in Chile providing that batteries sell for higher prices than those for lithium materials. However, such rationale for value-making is arguably working against Chilean interests as far as producing less-easily standardised products has been linked with reducing value potentials and fixing colonialised production in quests for modernity.\textsuperscript{400} Interestingly in the Chilean case of its first lithium call for value added projects, the quest for breaking neocolonial ties brought by current structures of material export and transformation abroad, and thereby to drive nationalist agendas, relied on enhancing foreign involvement in material industries, much similarly like the former copper nationalisation strategies.\textsuperscript{401}

**Calling batteries**

This call was the first out of two. Both were somewhat of a star child from the head contracts CORFO separately made with Albemarle and SQM for producing lithium materials from the Atacama Salt Flat, respectively in 2016 and 2018. In those contracts, the intention to ride the lithium wave towards batteries was clearly phrased. It seemed that the Chilean State saw this wave as formed by battery futures rather than by materials needed for those technologies. While head contracts framed the production of some lithium materials, the Chilean State saw a problem in established trade flows out of Chile, shown in Exhibit 22. To solve this problem of apparent loss in revenue potential, the State desired batteries and

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\textsuperscript{399} Besky (2016).
\textsuperscript{400} See Besky (2016 & 2017).
\textsuperscript{401} See Novoa Monreal (1972) and Finn (2001).
saw in them the only way ahead to harness *value*, rather than focusing on the material it had readily at reach. The contracts for lithium production were then Chile’s first stroke on its way down the stream of lithium supply to battery technologies. Not because they framed the corporate, judicial and human conditions of and around lithium materials from the Atacama Salt Flat, but because they placed the link between lithium materials and battery industries in Chilean territory, or at least they attempted to do so.

The idea to create and reproduce the entire stream from lithium materials to intermediate goods, was through a rather ambivalent attempt to modify and lock price calculations. While it was not by design a call to find lithium price but to bring battery dreams into reality, ultimately it became a quest to settle what price could do and for whom. The questioning of price calculations is a sign of clear unrest.\textsuperscript{402} To think that CORFO was unsettled by the price of lithium is then reasonable to consider.

**Calling to add value**

2016 marked the start of CORFO’s race to batteries. Through its contract with Albemarle, CORFO had just to choose Albemarle’s clients according to what it considered to be ‘*value added* producers’. CORFO would select clients limited to a changing fraction of Albemarle’s production supply. A fraction that would start at 15% and would thereafter rise for 2.5% a year until reaching 25%. The first percentage signifying 16000 tons/year of lithium carbonate and 750 tons/year of lithium chloride if available in 2021.\textsuperscript{403} The selection of the clients that would receive a part of this percentage, or all if just one bidder was selected, was based on which sort of technology it was expected to produce in Chilean territory.

\textsuperscript{402} Thompson (1971).

\textsuperscript{403} CORFO (2018d, point 25).
This however was not all that explicit in CORFO’s wordings and was rather framed as how much value added could a bidder give. The amount of value added was correlated to ‘productive complexity and sophistication’. It seemed that the furthest away from lithium materials the product was, the better. The rest of criterion beyond how complex the technology was expected to be were just reasserting the relevance and misconception of value added. For instance, criteria as experience in ‘value added industries’ or as technological capacity on ‘value added products’ did nothing but contribute to the blur that CORFO carried along its haste for value added.

Despite value and want obfuscations, on 7 July 2017, the day that marked the end of bid receptions, CORFO counted 12 expressions of interest. A somewhat successful call for project interest seemed to stumble call organisers as the evaluation commission was formed after bids were received. The Chilean government was not planning ahead of its selection methods prior to seeing the breadth of alternatives upon which criteria would be assessed; that is, bids were received and thereafter committees and methods for assessing companies were conceived in ways of reaction rather than planning. The hiring of a consultancy firm to assess the bids was followed by the amassment of a committee focused on politics deemed ‘strategic’ on national policy. Who should evaluate bids mirrored what the call was looking for and what understanding the State had on value added from lithium. This commission was composed of civil servants linked with copper, energy, foreign investment and treasury. Technicalities for calculating value added for lithium in Chile are strongly linked to energy and copper. This posited what the perception that Chile had on what the main purpose and ontology lithium, it encased ideas and decisions on what should lithium be and what should its extraction do for the country as its national image and project.

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404 CORFO (2018d).
405 Expressed by a consultant that advised CORFO on their Albemarle Lithium Call.
406 CORFO (2018d, point 19).
Material legacies are visible in expertise for material development

Looking at the composition of evaluation commissions through Actor-Network Theory (ANT) and Science and Technology Studies (STS) allows to unpack how do the very result of their assessments takes form from the rationales that each participant brings into concern. As an exercise of semiotics, ANT tells that divides are broken as far as relations mesh and produce entities, see Law (1999). Lines of thought on the sociology of scientific knowledge are useful to unravel how ‘technical’ authority shapes what ‘ought’ to be (Law, 2017). As further mentioned by Law (2017), ethnographic regards on the formulation of expertise invites critical thinking of how cultural and social aspects of knowledge construction shapes truth, see also Collins and Evans (2007) and Collins, Evans and Weinel (2017) on that point. Mining sites imply territorial control and as such they create the nation and its image (Klinger, 2017). The link of copper expertise to lithium mining development hints on an ANT perspective what type of knowledge and economy is desired to be developed by lithium mining in Chile.

It is important to recognise that finance reacts to behaviour. Here, the behaviour on investment confidence on a project or another and on the financing of uses for lithium materials, would be affected by the results given by this commission. Finance of batteries in Chile would be formed as per the politics of the evaluation commission constituent members would say. Value added seemed to be a place to amass distinct political views into one rather than as a single and independent economic indicator. This is contrasting to a project evaluation method where the constituent members of an evaluation commission are missioned to regard the purpose of the call alone and not their individual and mandated political views rooted to their professional position in government. As formed by the constituents of the evaluation commission, shown in Exhibit 23, results would then be closely attached to narratives of development as instructed by copper, energy and treasury expertise. The selection of competences for evaluating projects would invariably alter ways in which value is to be selected. Value for copper may not be the same as value for treasury as it would for energy.

Neither expertise on Gross Value Added (GVA) nor on lithium trade and supply was included, nor were persons detached from to public roles and involved with economic development, labour or technical battery development. Value from and to lithium was considered by expertise as selected by CORFO; that is copper, energy and fiscal revenue. These expertise aligned to CORFO’s interests deliberated on

408 See O’Connor (2018) for a technical policy brief on Gross Value Added (GVA).
matters that regard the idealised use for lithium, its ontology and what its value may be. Ways of knowledge external to GVA assessments weighed which project would seem as the most complex, intricate and thereby modern and valuable. Still, congruency on cost preferences and justification for decisions were largely missed; for instance, stipulations that high investment amounts imply likely financing barriers have no references nor data support. The evaluation of bids and according companies was roughly based on conjectures without analyses pertaining to the core terms used in the call, such as value added or batteries.  

The evaluation follows to overlay concepts of lithium production and cathode production as constituents of a single chain, where each arguably holds its own ‘chain’ independent from the other. Detailing of the evaluation process handled by the evaluation commission feels more like a read of conclusions where transparency is deliberately hampered in fear of recognising biases in methods. Along with ambiguity in value added concepts, terms as financial profitability are not altogether clear as to what they mean. In the detail of evaluations, there is an indistinct use of ‘productive chain’, ‘supply chain’, value chain and ‘value added chain’ for lithium; this resonates as a lack of vision and understanding of what each of these terms are, and thereby what is pursued through the call for projects and particularly for lithium as national industry.

**Improving to add value**

The bid analysis yielded in August 2017 seven companies as prequalified to become each a ‘specialised producer’. One month later from prequalifying its specialised producers, CORFO followed with a process said to improve projects. These improvements aimed to take the ‘high value added projects’ to ‘greater

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409 CORFO (2017a & 2018d) and conversation with consultant that advised CORFO on their Albemarle Lithium Call.
410 See Tsing (2009) on the global expansion of supply chain as forms of contemporary and evolving capitalism.
411 In conversation, a consultant to CORFO expressed that there is an entrenched sense of fear in Chilean State politics to method transparency.
value added’. To carry out project improvements, CORFO emitted and followed what was named ‘specific norms’.\textsuperscript{412} The project improvement phase was assisted by a ‘technical support committee’, which would advise on changes to projects to better suit these to the intentions of the call. The creation of this committee was not disclosed nor who their participants were; addressed as CORFO’s personnel, it is difficult to depict if members were attributed to CORFO’s governance or to technical specificities. In the ‘specific norms’ details of what matters, how components are weighed and where to get further information are anything but specific.

“’[Value added’ is generated when products] advance in significant ways in the ‘value’ chain, taking into account greater sophistication or complexity of the developed product in regards to the used intake, and when it is projected to use local services.”\textsuperscript{413}

However, this value added definition stated in the project-improvement phase that upholds sophistication and complexity as significant constituent is countered in a following project-component list where value added is separated from process complexity and technological sophistication, which are analysed as other project evaluation criteria.\textsuperscript{414} Complexity is perceived as a positive attribute and stated to be directly proportional to the diversity of processes and products.\textsuperscript{415} Technological sophistication on the other hand is attributed to mature technologies that are ‘advanced in the value chain’.\textsuperscript{416}

As stated in evaluation criteria descriptions, not only is value added raised proportionally with ‘higher’ stages that products take in value chains, meaning for CORFO closer to end-use technologies, but it is also increased in products made up with more amounts of lithium materials, and sold for higher prices, see Exhibit 24. Cheaply priced products with little amounts of lithium would thereby be assessed as low value-added containing.\textsuperscript{417} This is counterintuitive to the characteristics of today’s most sought after lithium-ion batteries, made up of growingly cheaper cell packs composed of cathode materials that use increasingly less quantities of lithium hydroxide. Other battery technologies that employ less quantities of materials than lithium-ion batteries according to specific energy, measured in Wh/Kg, are lithium-air batteries whose anodes are composed of lithium metal.\textsuperscript{418}

\textsuperscript{412} CORFO (2017c).
\textsuperscript{413} CORFO (2017c, p.5). Apostrophes introduced as per mention in note 402 above.
\textsuperscript{414} CORFO (2017c). There, placing the first as a fundamental criteria and the latter as a complementary one.
\textsuperscript{415} Ibid.
\textsuperscript{416} Ibid.
\textsuperscript{417} CORFO (2017c, p.11)
\textsuperscript{418} Chacon (2017).
Chapter 5


In the improvement phase, companies were required to provide annual economic appraisals about their projects from submission to 10 years into the future. For such appraisals, companies were asked to draw largely on temporally punctuated estimations for costs, product price and lithium amount per year. These components were necessary for CORFO as it wanted to use them to calculate *value added*. At this level of evaluation, *more* was looked in better esteem by CORFO. However, the *value* concept as linked with complex and sophisticated technological processes for manufacture does not necessarily fit with measures of surplus in price, costs and required lithium materials into the future. Sophisticated and modern technologies would not necessarily mean higher prices of resulting products, nor would they invariably entail increases on costs and lithium quantities.

Ambiguity in *value* tropes seemed to veil interests beyond GVA for lithium materials. It was somewhat implicit that CORFO was in fact after products that would simultaneously hold higher prices, higher lithium use, and that would be further down the stream of global lithium supply to battery technologies; components that can at times be arguably contradictory among one another.

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419 CORFO (2018d) and conversation with a CORFO employee that was in charge of the contract supervision committee. CORFO expressed in documents and in conversations that these components were each directly proportional to *value added* increases.

420 GVA is an economic development indicator that "gives a picture of the state of economic activity from the supply side perspective" (O’Connor, 2018; p.4).
Evaluating to add value

Following the process to submit and improve projects, by 11 December 2017, CORFO had six bidders left.\textsuperscript{421} Again, CORFO designated the members of the evaluation commission following the receptions of projects bids. For the evaluation of projects in early 2018, the evaluation commission was maintained as formed by the former member institutions, representing foreign investment, copper, treasury and energy, only now including economy.\textsuperscript{422} The evaluation limits explanations on decision making to state that selected companies obtained without method description either a ‘good’ or ‘satisfactory’ level in value added and financial capacities.

Two companies, Gansu and Jiangmen Kanhoo, were ruled out as their financial capacity was considered ‘insufficient’.\textsuperscript{423} Gansu and Jiangmen were said to be involved in ‘less profitable businesses’ regardless if their proposals are comparable with other selected companies in terms of expected product.\textsuperscript{424} CORFO’s ideas about what investment is in terms of business ‘profitability’ suggests that the evaluation of financial aspects were solely made by eye among participants in the evaluation commission, which was not endowed with technical econometric specialised personnel. The evaluation commission was not really evaluating bids but commenting on a bid evaluation commissioned to a consultancy firm. Selected companies were Molymet, Fulin, Posco-Samsung and TVEL; Only TVEL requiring lithium chloride while the rest sought lithium carbonate.\textsuperscript{425}

There were just enough lithium carbonate materials from Albemarle to either supply Posco-Samsung alone or Molymet and Fulin jointly.\textsuperscript{426} Meeting all demand would be possible if Albemarle managed to expand its chemical plant as expected. At the time of bid evaluation, the scenario for plant expansion from Albemarle was likely but not fully certain. So, following the selection of bids by what looked to be tacit methods of project evaluation, CORFO had to decide if it would follow with either Molymet and Fulin or with Posco-Samsung. TVEL was the only one requiring lithium chloride, so it was discarded from this process. To compare options, CORFO assessed again value added for each project.

\textsuperscript{421}CORFO (2018d, p.4).
\textsuperscript{422}CORFO (2018d, p.4), and CORFO (2017b, p.3).
\textsuperscript{423} CORFO (2018d, points 21.1, 22 & 23). Financial capacity assessments are not disclosed. These are referenced to an ‘Act’ which is nowhere to be found or traced to. The commensuration of financing levels to debt only is as well not justified nor referenced.
\textsuperscript{424} Ibid.
\textsuperscript{425} While Posco-Samsung was looking to build cathodes based on lithium hydroxide, it was said by a CORFO employee in conversation that they understood that such lithium material was not available and that Posco-Samsung had expressed intentions to build as well a conversion plant to process lithium carbonate supplied by Albemarle into lithium hydroxide. Amounts required by companies and available amounts were not disclosed in previous documents than that expressed in CORFO (2018d) in points 25 and 26 which details selection of improved bids in December 2017.
\textsuperscript{426}CORFO (2018d & 2016) and conversation with a CORFO employee that was in charge of the contract supervision committee.
Value added was weighed differently in this stage in contrast to how it was defined and approached to in previous sections. Value added was assessed by estimating Net Present Value (NPV) of the value added, named by CORFO as ‘net added value’. NPV was calculated to 25 years based on the estimated sales and costs for each project. NPV works by ways of adding capital value that gets depreciated in time. Conventional NPV calculations were there amended by integrating the electricity which was expected to be generated to provide for each project. Results were as follows: Molymet, 1,989 million USD; Fulin, 1,662 million USD; Posco-Samsung, 3,006 million USD.

Despite the ‘net added value’ calculations leaning towards the combination of Molymet and Fulin projects, CORFO considered Posco-Samsung to be the best bet as it upheld the demand for lithium hydroxide to be more relevant than for mature cathode technologies as LFP that use lithium carbonate. Fulin’s project was based on LFP production, which despite being considered by market specialists as the cathode material in the highest selling battery type, it was considered by CORFO as not as profitable as competing and emerging cathode materials. Though arguable, the inconsistency of the selection method is striking as it started considering mature technologies and higher lithium content per product as better for generating value added. The conversion from lithium carbonate is not explicit in the evaluation document which pretty much gives for granted a rather elemental part of the Posco-Samsung bid. Providing limited amounts in Albemarle’s production for preferential pricing, CORFO would select both Molymet and Fulin only if the conversion from lithium carbonate to lithium hydroxide from Albemarle or by Posco-Samsung would not be resolved. This indicates that at the time of selecting Posco-Samsung the reliability of lithium carbonate conversion to lithium hydroxide was uncertain, specifically considering the complications for making material conversion profitable in times of dropping material prices. Still, as Albemarle’s planned expansion of its chemical plant ‘La Negra’ in Antofagasta would provide 12,500 tons/year in addition to its 16,000 ton/year, all three bidders for lithium carbonate were selected.

CORFO’s document about project improving hints that TVEL follows on and is the sole demander for lithium chloride thus exempting it from the new method for weighing out value added among shortlisted bids. However, the modification of Albemarle’s contract in early 2018 complicated TVEL’s continuation in the call for projects. In its contract modification, Albemarle included possibilities of producing lithium metal from its lithium chloride. As this was essentially the project proposed by TVEL, CORFO had to drop TVEL from the selected group as it would imply competition to Albemarle which was not

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427 CORFO (2018d, point 27).
428 CORFO (2018d, point 28). Formulas and models for the NPV results are not explicitly detailed nor referenced by CORFO in its Albemarle call, Chapter 6 elaborates on NPV models as expressed in the following SQM call.
429 CORFO (2018d).
430 CORFO (2018d, point 31).
431 Albemarle’s contract modification resulted in a different contract called ‘Efficiency Contract’ celebrated with CORFO (2018a) where royalty fees were reduced.
432 See CORFO (2018a).
permitted according to the head contract. Strangely, it is not until the end of the bid shortlisting document that Albemarle’s product adoption is notified as approved on the same day, 9 March 2018 thereby discarding TVEL’s bid.\(^{433}\) Selected firms from those shortlisted resulted to be Posco-Samsung, Molymet and Fulin.\(^{434}\) However, news reports on the matter state that the tender for preferential price was awarded on 8 March 2018, that is one day before Albemarle’s contract modification was authorised along with its prospect to produce lithium metal.\(^{435}\) Striking that the deliberation of shortlisting came in the first part of a document that later indicates that that is not so, that TVEL is hinted as likely to pass even when Albemarle’s lithium metal intentions are known before that, and that news reports contradict firm-shortlisting to be one day before. Inconsistency in dates testament the operation of transparency and data disclosure in which CORFO operates and handles its evaluations.

Prices and value added drops

“[Preferential price corresponds to the] lowest market parity price for the Chilean export Free on Board (FOB) price.”\(^{436}\)

It was not until 9 March 2018, that it was stated in the call for projects how would ‘preferential pricing’ operate: to get their favourable price, selected companies had to develop a contract with Albemarle to formalise the ‘preferential pricing obligation’.\(^{437}\) The preferential price was supposed to be the figure allegedly respective to lowest of market parity of the Chilean port, see Exhibit 25, but the concept of ‘market parity’ and the figure attached to it was however not understood equally by CORFO and Albemarle. Winning companies were caught in between the misunderstanding CORFO had with Albemarle, without any certainty that the price extended by Albemarle was in fact ‘lowest of market parity’.\(^{438}\)

\(^{433}\) CORFO (2018d, point 35). See Chapter 1 for political commentaries on head contract and the secrecies of the Chilean State as rooted to the Copper Conventions.

\(^{434}\) CORFO (2018d, point 2).

\(^{435}\) See for instance El Mercurio (2018) on the date when awards were granted.

\(^{436}\) Clause 8 of the CORFO (2016) contract with Albemarle.

\(^{437}\) Said obligation would last as long as the contract Albemarle has with CORFO for operating in the Atacama Salt Flat remains; that is until initially 2043. This would mean some form of unfixed, in terms of price variability, physical delivery into the future. While CORFO states the length of its contract with Albemarle as the timeframe for the ‘obligation of preferential pricing’, it references this to the head contract instead of expressing closing date. This builds on and to the ways that communication is handled in labyrinthic ways.

\(^{438}\) Conversation with representatives of a winning firm.
"The Obligation of Most Favourable Price just mentioned, shall be formalized through a contract held between ‘Albemarle Limited’ and each of the companies and/or company associations that have been selected ‘Specialized Producer’.

In said contract, parties shall establish reciprocal rights and obligations, specially, Albemarle’s Obligation of Most Favourable Price to offer its lithium products at the lowest price in parity to export (Chilean FOB) of the last six months, and the obligation of the ‘Specialized Producer’ to use the lithium products acquired from Albemarle only for value added products; the expiry of the Obligation of Most Favourable Price as taken by Albemarle in the Base Convention, that can only effectively held while the quality of Specialized Producer is maintained; the adjustment mechanisms to the quantity of lithium products affected by the Obligation of Most Favourable Price, if applicable according to what CORFO had informed; and the guaranties that parties may pact for the fulfilment of their obligations and, specially, for the fulfilment of the Obligation of Most Favourable Price; among other dispositions.

(…)"

Exhibit 25 – Excerpt from on assignment of preferential price to selected bidders. Elaborated by the author based on CORFO (2018c).

To this point, it was not explicit with whom should selected companies deal with for price assessment and regulation. Mismatches on value understandings along with lack of accountability from CORFO affected trust from bidders on process congruency, but they were highly detrimental to the relation CORFO had with its tenant in the Atacama Salt Flat.

“In that discussion, about which price to apply, is when everything tangles up.”

For CORFO, the ‘preferential price’ should be the lowest price recorded on Chilean FOB databases in the last six months for Albemarle’s exports regardless of volume. This was not the way that Albemarle saw it. This perception from the company coincided with a change in Albemarle’s governance where the head of lithium business left as did the country manager in Chile. These two persons were deemed as ‘key’ by CORFO providing they were those who signed the 2016 contract for lithium production in the Atacama Salt Flat. Their replacements had other understandings for what ‘parity’ meant and what did it entail for calculating preferential prices. Albemarle’s lowest prices would normally be given to related firms who at times could amass more than half of Albemarle’s supply. These sales are not indicators of spot market prices and were considered by Albemarle to be left out of preferential price calculations. It depends on

439 A CORFO employee that was involved in the Albemarle lithium call and that was in charge of the contract supervision committee regrets when referring to the complications that arose when even with the full disclosure of bills from Albemarle to CORFO, there was reluctance from both ends to compromise on the meaning of ‘market parity’ for setting preferential prices for CORFO’s specialised lithium producers. He further adds: “We both [CORFO and Albemarle] have all [bill information], the thing was which price to apply”.

which sales are ‘market sales’, and then what ‘market party’ is, to thereby define ‘parity’. The inclusion of related firms and the exclusion of objective market parity for determining the preferential price was the root of problems as related firms can be considered ‘off market’.\textsuperscript{441} The practice of selling low to related firms to avoid high commission fees would backfire for Albemarle as up to 25% of its stock could go to a non-related firm selected by CORFO for the lowest of its price range.

The dispute on what did the contract between Albemarle and CORFO meant for preferential price was not resolved and threatened to be carried on in the International Chamber of Commerce. Negotiations started to attempt to ease matters, but these only turned to ultimatums by CORFO.\textsuperscript{442} December 2018 was stated by CORFO as deadline for consensus. December passed as the deadline extended to January 2019.\textsuperscript{443} By the end of January 2019, CORFO and Albemarle reached an agreement on price calculation.\textsuperscript{444} Passing this impasse resonated across Chilean politics. Applauses and somewhat rejoice where shared across those who followed the affair; particularly among those for whom lithium represented copper ideas of richness and unfairness in global political economy and supply chains. The resolution of this pricing matter sparked hopes of what was phrased in Chile as the ‘industrialisation of lithium’.

Applauses went a little too early on, though. Albemarle and CORFO did resolve matters on price calculation, but such resolution was not disclosed leaving ideas of ‘preferential price’ further concealed for anyone other than CORFO and Albemarle. Selected bidders with value added lithium projects were also left in some bizarre information gap where despite being informed about the pricing arrangement between CORFO and Albemarle, all they received was a figure without any realisation of what did this represent for market prices and for Albemarle’s price and product portfolio.\textsuperscript{445} Also, this preferential pricing agreement meant little to what price selected bidders would receive. Preferential prices were ultimately bound to an agreement that had to be negotiated between Albemarle and selected bidders, leaving thus further uncertainties of price volatilities.

June 2019, the complications and skewed settlements and conceptualisation begin to materialise. Initially they do so with the forfeit of Posco-Samsung from their tendered bid.\textsuperscript{446} Spokespersons from Albemarle and CORFO pinned this drop to mismatches between requested products by Posco-Samsung and

\textsuperscript{441} See Cárdenas (2018).

\textsuperscript{442} First hints of an arbitrage by the International Chamber of Commerce where given on October 2018, when differences in the understanding of clause 8 of the CORFO-Albemarle contract, which states the obligation of selling up to 25% of its products at a preferential price, where spoken by CORFO to the Chilean Senate, see Flores Fierro (2018) and El Mercurio (2018).

\textsuperscript{443} De la Jara (2018) and Pérez-Cueto V. (2018).

\textsuperscript{444} Nogales Toledo (2019) and AmCham Chile (2019).

\textsuperscript{445} As mentioned by a CORFO employee that was in charge of the contract supervision committee, following the settling of the new pricing agreement, CORFO instructed Albemarle to send said agreement to selected bidders. This stage was not confirmed afterwards as was expressed by Molyment employees that what they got from Albemarle was a mere figure without any clarification from its method nor its data sources.

\textsuperscript{446} Sherwood and Chung (2019).
available ones from Albemarle that complicated the provision of lithium hydroxide to Posco-Samsung.\textsuperscript{447} Evidently, it is not the case that CORFO tendered a project blindly regardless of the requested product.\textsuperscript{448} It was not a matter about product specificities as Posco-Samsung had intentions to build a conversion plant in Chile to obtain lithium hydroxide from lithium carbonate.\textsuperscript{449} What caused the project drop from Posco-Samsung was price and its management.

Simplifying the reasons for a project drop to a mere mismatch between requested and available lithium materials highlights how neither CORFO nor Albemarle wanted to admit what was facing them: that their new pricing agreement was somewhat unappealing and ill-suited for CORFO’s plan to industrialise battery manufacturing in Chile. The way that mishaps are managed affect how far on they affect further. Choosing to veil what had really happen might have improved the public image of CORFO’s management, but it could lead to further problems if it would increase perceptions of internal communication issues and intrinsic secrecy. Investment risk would reasonably rise for those close to embark on long term supply agreements involving CORFO, its transparency and a recent strange project drop.

Molymet followed to forfeit its project a couple weeks afterwards in July 2019. This time lithium materials were by not a likely reason for leaving the call. The prices Molymet received from Albemarle along with its view of the CORFO-Albemarle contract were growingly ambiguous and could have arguably been the sole reasons for stepping out.\textsuperscript{450} Things looked grim for CORFO who had by then already begun with another value added lithium call based on its contract with SQM, the other tenant neighbouring Albemarle in the Atacama Salt Flat. It didn’t improve though when its last specialised producer, Fulin, dropped its project likewise in July 2019 soon after Molymet did so.\textsuperscript{451}

In context of these project drops, CORFO was rolling out its second lithium call with SQM’s supply –in June 2019 a few days prior to the loss of all projects involved in the first call. Value added was defined as the final production without intermediary goods –essentially only considering capital and labour as the intermediary goods deducted from final value– and also as the payment to capital and labour.\textsuperscript{452} Both concept of value, however contradictory from each other, have the shared characteristic that they do not commensurate with the idea of ‘moving up’ in a sequence of steps necessary for making a technological device. Another important feature that they share is that they alter the depreciation of value by setting a

\textsuperscript{447} Sherwood and Chung (2019) and Vergara P. (2019).
\textsuperscript{448} A CORFO representative indicated that Posco-Samsung decided to drop its project since they “realised their desired market was focused on Asia rather than Latin America”.
\textsuperscript{449} Conversation with a CORFO employee who met with Posco-Samsung to discuss product availability from Albemarle’s supply.
\textsuperscript{450} See Olivares (2019). Expressions on the ambiguity of the CORFO-Albemarle contract and on the ways through which prices were notified by Albemarle to bidders selected by CORFO were noted in a conversation with Molymet representatives.
\textsuperscript{451} Barrientos Dörner (2019).
\textsuperscript{452} CORFO (2019b, point 3.5.1.).
low and standardised discounting in the formulations suggested from CORFO to project proponents. Expected value was then potentially overestimated, all the more with discontinued projects flaring news reports.

**Price production and equilibriums**

In 2017, over 50% of Albemarle’s sales were attributed to related firms. In the third quarter of 2019, a comparable concentration happened for SQM sales. ‘Related firms’ in CORFO’s appreciation mirrors intercompany sales that gloat from lower prices. Lower prices would mean less fiscal revenue for the Chilean State. Resenting this, CORFO has a mechanism for overseeing and acting upon it. When sales concentrate, CORFO hires external advice to assess spot markets and estimate the price for non-concentrated sales to non-related firms on which CORFO’s fee is to be calculated as representative of spot markets. Sales and price concentration to related firms would mean that fees to CORFO are calculated by external assessments of what is the market price of lithium products. These sort of price determinations are common as sales concentrations for lithium materials from the Atacama Salt Flat are usual practice.

“Are they scamming us?”

Contemporary sales practice of lithium materials suppliers from the Atacama Salt Flat is to at times contract products largely to a single client or two or tops three. This seems to occur simply due to the intentions to reduce sale-price fees, hedge price volatilities and work with the occasional reduced set of cathode manufacturers or material conversion firms that choose to supply from Latin American lithium

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453 CORFO (2019b).
454 CORFO (2017d). ‘Related firm’ is defined by CORFO (2016) in context of lithium trade as “an entity, a natural person or entity, that controls, is controlled by, or is subjected to the common control of the first entity. To which ‘control’ is understood as (i) the ownership of more than 50% of shareholdings with right to vote in an entity, or (ii) the amassment of sufficient power to direct or to generate the direction of management and politics of an entity, that being through contracted or any sort of relations.” (p.13) Likewise, ‘related firm’ in stated in the same document to exist “when companies are (a) controlled by or influence on the development of business of persons in common, or (b) form part of a same corporate group, or [...] when (c) a third [party] provides a credit to the company or associated group, and the payment of such credit is realised by the sale of products produced by RLL [Albemarle] and/or through preferential prices.” (point 6, p.13). point (ii) arguably overrides point (i) where less than 50% of shareholding with right of vote may be sufficient to weigh in in the direction of management. This would possibly imply that Tianqi’s shareholding acquisition detailed in Chapter 3 would make it a related firm to SQM. Likewise, joint ventures for instance Talison as formed by Albemarle and Tianqi could also be discussed as node for placing the three as related firms; also considering point (b). Also, as for (a) for which no temporality is given on how long do persons in common remain as such, the assignation by Tianqi of a former director of Rockwood, today Albemarle, in the director’s board of SQM, could further relate them all. This chapter however does not look at the legal nuances of soft and ambiguous writing in CORFO’s lithium mining contracts in the Atacama Salt Flat; see Chapter 1 for that matter.
455 Conversation with a CORFO employee.
456 CORFO (2017d).
457 Conversation with a CORFO employee that was in charge of the contract supervision committee.
458 Expressed by a CORFO employee on the suspicion that the State agency has when it suspects that concentrated sales are devised to trick and manipulate fees contracted to CORFO by lithium miners in the Atacama Salt Flat.
459 Ibid.
materials than from other raw materials purveyors from Asia, United States or Australia. Lithium materials from the Atacama Salt Flat are traded most often by off-take agreements. The price in off-take agreements for lithium products is normally not radically distinct than spot-market behaviours, shown in Exhibit 26. This is however not the case for prices in sales to related firms where prices tend to be off spot-market levels and incline normally to lower figures.

Price portfolios for non-related firms are mostly bound to the lowest level according to costs. Demand fluctuations are then not the only nor exclusive price makers. Variations on lithium material prices are most normally due to difference in chemistry and respective costs, and not only nor exclusively due to trade negotiations and bargains. A more intricate material will hold higher price providing its comparable rarity. Offering the cheapest price for a specific and better quality seems counterintuitive if Chile is looking to keep lithium supplied from its territory to be best placed in the lithium and battery marketplace. Preferential prices affect prices beyond those directly involved. Prices for Albemarle’s products along with its overall price portfolio would invariably change towards a concentrated shape to reduce losses brought by this contracted obligation. Price production without fixing figures in time alters tendencies to equilibrium in raw material trade. Price alterations might lure clients in but that is not necessarily beneficial to material supply if conditions for them are not based on cost margins. Increased and forced low-priced supply would behave as cost thereby raising the levels of low prices; levels that could be deleterious altogether to visions of cheap lithium supply from Andean brine.

Exhibit 26 – January 2016 to September 2021 lithium spot prices (Benchmark Mineral Intelligence, 2021).

460 Conversation with an investment banker close to lithium materials in Latin America.
461 See Hirsh (1976).
462 See Shiller (1989) and Bouchaud, Farmer and Lillo (2009) for discussions about the interiorisation of socially devised price alteration on market equilibrium and theoretical price efficiencies.
Produced prices modify equilibrium prices

Bouchaud, Farmer and Lillo (2009) and Backhaus and Maks (2006) address processes of \textit{tâtonnement} elaborated by Walras where capital and its price allocation has a serious impact on the distribution of further goods and according prices. Thinking of \textit{tatonnement}, price interventions alter prices beyond what supply and demand would do and it inevitably alters information streams which in turn affect price dynamics. Thereby, the lowest figure of market parity would follow to set in new figures as supply equilibrium would be altered by a forced demand met at a price dissonant to an amount contracted by conventional market dynamics. The ways in which prices set and oscillate is a highly rich debate with contrasting views on the role of information, supply and demand. Knight (1935c) remarks that demand contributes to prices. However, In the case for lithium materials, this is contested by the proportion of lithium industries in technology and raw material markets. Demand in the lithium sector is yet not as large nor as economically relevant to conduce such supply pivoting. Hence it is cost alterations for the larger suppliers, including price productions, that make-up most of price oscillations. Price is often compared to marginal cost for modelling purposes, particularly so for New Keynesian modelling which brings measurements of markups to be largely based on the fluctuations of the latter two; see Nekarda and Ramey (2013) on markup behaviour by demand and technology shocks on costs. The idea from Knight (1935c) that price is more significantly determined by demand rather than costs offers some debate to such markup considerations but it still recognises markup to be in some fraction drawn from demand and technology shocks.

CORFO equates higher price to higher \textit{value added}, yet simultaneously costs are perceived by CORFO as directly proportional to \textit{value added}; though no relation between these two is suggested by the State agency. Still, it is not explicit how price and costs are captured by the Chilean State aside from fiscal revenue. In that regard, any obsession to harness more \textit{value added} products seems to shade any positive view that may have been had to lithium mining as geopolitical and economic asset for Chile. CORFO then seems to be solely interested in collecting fees and it seemed to have its eye on products selling for higher prices, calling these: \textit{value added} products.\footnote{See Romero and Opazo (2019) on social configuration in the Atacama Salt Flat and on economic strategies respective to distinct salt flat geographies in the Lithium Triangle.}
The intention of the call was not foremost to support lithium material producers to secure demand. Instead, through some detriment to lithium material producers in the country, the Chilean government looked to assist the installation of facilities involved in later stages of lithium material transformation, leading from lithium raw materials to lithium-ion batteries. CORFO was definitely eager to make something out of lithium beyond lithium materials themselves, and it seemed to be realising that selecting clients for Albemarle could be a way to not only do so but also a way to incentivise the use of other metals embedded in its territory. However, Albemarle had found a way to prevent a large proportion of its products from being sold to the cheapest price, simply to produce further down the stream as it did with the option to produce lithium metal.

Price productions and contestations invariably affect the behaviour of demanding and suppling parties encountering in figures. Prices can at times be mirrored as devices that hinge fractures between groups with opposing views of price-setting rationales. This is shown in the misunderstanding between CORFO and Albemarle about how to make their contracted pricing arrangement operational. This matter certainly weighed in risk assessments of the companies who were about to engage with not only both CORFO and Albemarle but also with the apparently crumbling relation held between them. Pieces of the CORFO and Albemarle relation were looking to be sorted back into their place by price, or at least fixed onto places where their joint apparatus would keep mechanismising onwards. However, the agreement for determining the preferential price seemed to cause further crumbling of value added projects, providing that its classified setting between CORFO and Albemarle likely affected investor engagement.

**Trope obfuscation and pricing certainty**

Battery projects were deemed to add value to the country, far more than an export of lithium materials would. However, the concept of value added was never clear. It carried plenty of components and thereby seemed to change within and across documents. The variety of components that make-up what value added ‘is’ leaves plenty of uncertainties as to decision making rationales when these might counter one another. For example, as lithium-ion batteries move to technology generations that use lithium hydroxide, the quantities of lithium materials decrease as price rises. Price rationale would mean the project is elevated in value added, while lithium content would say otherwise and would then incline for products with lithium carbonate in cathode materials. Still, regardless of which terms, components and valuations it was attributed to value added, the Chilean State’s focus on seeking entry into battery business was consistent.

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464 CORFO (2017c).
Material legacies affect national development discourses and tropes

Barandiarán (2019) remarks that discourses employed in Latin America to carry lithium ahead in political agendas namely legitimise development imaginaries of material extraction and trade from technological advancements on batteries. These forms of imagining wealth from materials are comparable to ways that copper and saltpetre were spoken of and how society organised around their extraction in their respective times of world market proliferation in the Atacama Desert, see O’Brien (1982) and Finn (2001).

The race for batteries carried many dashes of a race for new copper dreams, both materialised through nudges on copper by lithium, and portrayals of copper in lithium. The intention to increase consumption of other metals is somewhat visible in the definition of value added used during the project improvement phase. Metrics and standardisations where then moulded apart to what technical conventions held but instead to factors tied to conceptualisations of materials and trade from legacies of copper and saltpetre. What lithium ought to be in the appreciations for economic gain and nation-making had altered the understanding and application of objective economic notions for its valuation. When copper, energy and treasury are making definitions of value for lithium, these definitions are attached to the politics and the histories of these sectors in Chile. As with copper and saltpetre imaginaries and sociotechnical discourses, tropes were carried though political hierarchies, and with that they carried a reluctance to change or dispute them as they funneled down through vertical structures of power. This mode for channelling political ideals and to keep them somewhat in secrecy, is not new and has been documented notably for developmental projects anchored to copper.

Value chain as concept for CORFO is a mere representation of increased value as further downstream products are located in global material supply. For the purpose of this call, batteries are carriers of augmented value than what can be encased in lithium alone. Value added follows this idea of the product’s location in the ‘value chain’.465

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465 CORFO (2017c, Table 1).
Ideas of increased value in downstream parts of global material supply mirror exchange-value notions

Marx (1867) remarks that material exchange takes place in processes of making money. Here, this exchange signifies the transformation of capital to batteries where the idea of profit is thought to be increased as more exchanges occur. Karatani (2003) discusses what Marx called ‘the leap of faith’ of commodities as the moment that occurs when they are traded to increase their value through consumption. Karatani remarks that ‘the leap of faith’ creates a change in the representation of objects. This is perceptible through the value-added agenda where value is given as further exchanges occur thus changing their representation from cheap raw material to expensive end-use product. The intention be located closer to the end of exchanges, that is at downstream sections of supply, empirically reflects that the most valuable exchange occurs as linked to prices of end-use devices rather than to the usage of said devices.

“*In the tradition of Chilean public services, they [public officials] have a lot of fear to transparency.*”

Despite this idea that tractions through the initial call for projects, and thereafter in their respective improvement and evaluation phases, the misuses and abuse of tropes for *value* caused more complications than it would ease understandings. Lack of clarity in documents is not just a matter of the words expressed therein, but as well of the stream of processes and methods. For example seen in the labyrinth to know about time frames of project proposal and modes for confectioning with government and lobbying. This came to the detriment of value alignments with participant companies, provided arguable ex-post effort to keep clarity away from concepts and transparency from processes. Overall, documents on the process of evaluation of bids where more of justifications and safety nets for CORFO rather than a detail of how processes and methods proceeded and were devised.

**Nationalism, development and foreign capital**

The intention to harness *value* might have nationalist intentions to drive Chile further down the lithium supply stream, but it seems to do so in ways that could be arguably rooted in neo-colonial structures of infrastructure financing. Specifically, expressions used to orient bid construction suggest that CORFO tailored content to lure in foreign participants and capital. Such duality in nationalist targets through

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466 Expressed by a consultant that advised CORFO on their Albemarle Lithium Call.

467 For example, CORFO (2018d) stating that “according to what is laid out in document RE1193, time for receiving bids was extended from 1 December 2017 to 11 December 2017”, while said reference document CORFO (2017c) does not mention any date.

468 Expressed by a consultant that advised CORFO on their Albemarle Lithium Call. About the bid evaluation processes and the lack of transparency to evaluation processes, he questions: “why should you do that if the process was well made?”
foreign participation has come as developmental and economic strategy from most resource extraction in the Atacama Desert. Imperialism as brought by State intervention is a matter of capital investment frenzed on by the State who selects but does not delegates industries.

What value added can give to the country is not related to development targets pertaining to poverty eradication and social fairness. The value that lithium can give to the country, and which is allegedly increased by batteries, is higher State revenue and energy consumption. Projects are not evaluated to produce technologies and processes that will attain to needs in Chile for infrastructure and basic needs for politically and economically marginalised parts of society. Factors evaluated in bids as knowledge production or generating research and ‘development’ are spoken to be ‘positive externalities that will be valued’ – meaning here assessed by valued. When development is discussed in the tendering documents, it is solely focused on the immediacies of projects. The contribution from batteries to the development of Chile is held separately than what their value added is and for whom.

**Value added is not a trope for development**

The purpose of bids to generate economic gain at national scales over attaining to needs of marginalised sectors of society remarks a divide between nation-making and national development. Framed as externalities in official documentations of bid processes, components for development are discarded from core constituents of value added. Externalities are a priori non-intended and unaccounted in balance sheets. They are thus successful cost-shifting as expressed by Martinez-Alier (2014) who referred to environmental harms brought by economic activities. Hirsh (1976) hinted to this notion of systematic ‘cost-shifting’ by locating the positional sector as a "systematic externality" (p.131). However, the ruling out of external costs that are imposed onto others in the market situations on which individuals are confronted to is seen by Hirsh as a market failure and not necessarily so as wittiness as suggested by Martinez-Alier. The case of value-added agendas for lithium materials in Chile flips these notions of externalities where they are no longer unaccounted costs for production but rather components of people-centred development. National economic growth could be argued as base for development, but insofar it builds in a Pareto-efficiency, it fails to accomplish capital distribution effectively (Hirsh, 1976).

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469 See Chapter 7, Novoa Monreal (1972) and Bermúdez Miral (1963).
470 CORFO (2018d, point 27).
As developmental image for the management of lithium reserves of the Atacama Salt Flat, batteries are conceptually an object that encases capital in the shapes of energy consumption for its manufacturing and of fiscal revenue from its sales. This image of capital for revenue to the State as pivot for development is framed in large part by the figure of prices. Value added came to be this figure, prices over intrinsic function. Batteries are thought as more valuable than lithium, not because of what they do in-ground as functional energy storage devices, but about what they do as objects with value. The Chilean State was not looking for batteries but rather for the value of batteries. The country, as anchored to mining, didn’t perceive its development as somewhat in need of batteries to through them enhance its energy and transport system, but it saw its development as in apparent need of value, in any form.

Based on this call, it is compelling then to think about what the political and economic designs of batteries are. Batteries equated to price, which became metric for development in context of raw material extraction. Interestingly, to get at hold of rising prices, others had to be manipulated to lower levels, levels that could be counterproductive to sustaining value from its lithium reserves. Along in the quest for value, there was the continuous search for a changed identity; one that would lead away from mining and into end-use technology. Under the lens of value as seen by CORFO, the selection of projects would weigh in the identity Chile could make for itself as a battery-making nation more than one that spoke only of lithium supplier.

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<tr>
<th>Nation-making projects define national identities through tropes</th>
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<td>Observations on identity desires in the Atacama Desert from raw material transformation, for instance from Barandiarán (2019) on lithium, Finn (2001) and Novoa Monreal (1972) on copper, and O’Brien (1982) and Hernández Cornejo (1930) on saltpetre, have marked the importance of visions and idealisations of resources through tropes, being these socio-technical, political or economic, as bases to the strategies of extraction and trade. Value for nation-making in Chile has been attached to ideals of removing identities of being a raw material supplier since saltpetre times, see Bermúdez Miral (1963) and O’Brien (1982), as it has followed thereafter for copper, see Vicuña Mackenna (1883) and Novoa Monreal (1972). While these visions have not materialised into the territorial deployment of industry beyond raw material extraction and processing, it has paved the way for searching a reworked, modernised identity of a country attached to its projects more than its realities. Hence it can be argued that tropes matter more than the uses of territory to form national identities.</td>
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Conclusion

CORFO selected a fraction of Albemarle’s clients according to the use of lithium materials it considered to be better for the image and revenue of Chile and to the association of modernity that technology-making would give. While looking to get more value from its lithium, the Chilean government was effectively stripping value from it. The only two lithium materials producers in the country had to eventually provide for a quarter of their annual production sold to the lowest figure in their price portfolios. Practically and further detailed in the following chapter, production percentages given under this scheme is attained from increasing proportional bits added in a yearly basis from a baseline of 15%, that is 2.5% annual increases in four years. In the Albemarle call there was no specificity to the value considered as ‘lowest’ which implied the lowest figure from bills of last six months. Essentially, the Chilean government was looking to sell batteries rather than lithium materials alone. To do that, it decided to modify the price of lithium materials coming from its reserves and doing so as catalyster to ease the material to change shape into cathode materials or assembled batteries or even full vehicles, and thereby adding value to its lithium and copper reserves.

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<th>Modernity desires in Latin America equate downstream industrialisation with value added</th>
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<td>The production of colonial pasts that made the Latin American region into the globalised form it has today are discussed by Mignolo (2005) in terms of modernity aspirations being based on ideals of European economic and social structures, and by Moya (2010) in terms of colonial categories in global social orders. These aspects of modernity resonate with the intentions to break from raw material economies and to transform raw material into end-uses. It envisions the nation as distinct than its past, but it follows with aspirations set in the past that were rooted to the structures that anchored the region in colonial structures of global raw material supply.</td>
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However CORFO pressed for the pricing of lithium materials for value added, it seemed to be over its head when selecting meanings for value added and strategies to follow on this. Government public officials commissioned to distinct sectors than batteries or value added, altered value added calculations from their conventional takes on economic development. Specifically, when consultancy on value added from raw material innovation was provided to State agencies, methods based on econometrics were questioned and thwarted by public officials to integrate factors as energy use and resulting technology type to balance out results differently.\(^{471}\) Politics meddled in the development of value evaluations. In

\(^{471}\) Conversation with a consultant that advised CORFO on their Albemarle Lithium Call. Technical advocacy to CORFO was fairly aligned to the concepts and methods for value added calculations as described by O’Connor
contexts of political change, technical appreciations changed. Besides change and obfuscation in the desired projects and value, there were also crossed understandings on the ways to lure such projects. This latter misunderstanding wore down its relation with both its raw material and the supplier attached to it. The misalignments about what preferential price meant was ground for legal dispute between the two, which deteriorated investor confidence and nudged companies expecting preferential pricing to drop their intentions of engagement in the country.

“No one understood about this, no one.”

The use of sustainability narratives to promote more consumption underlies efforts to not just manage to transform the value of a resource but doing so by increasing the use of other resources in ground, specifically energy and copper. Higher price, higher consumption; all by the fast-paced coupling of lithium in the energy system. This brings on the thought of the energy system as a body under lithium overdose whose thyroid system is deficient leading to an increase in fat contents, saturated due to consumption as opposed to use.

Actions to bring desired battery futures into being are enacted in ways that are deleterious to their base materials’ present. Chile’s value added agenda and the methods for it does not seem to have conscious anticipations of the effects that pricing alteration through political distortions will do both for lithium resources and tentative battery projects in the country or abroad. This leads to ambitious ideas of gloating on what is seen as a small window of time to profit in ever larger extents from battery hyps; but just in the measure that it does not lead to a standardisation of products and prices.

The overvaluation of projects is a source for expectations that speak of eagerness to realise dreams of industrial development and economic turnover from raw material transformation further ahead in stages of global provisioning systems. Ideas that are visible in lithium as a sociotechnical material. But importantly ideas that come from saltpetre and copper legacies. Examining prices as anthropological subject results in understanding that the making of expectations and valuation models in the Atacama Desert is then somewhat anchored to valuations and economic expectations formerly held in other materials. Looking then at material histories in places can clarify which legacies are passed onto other

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(2018) who refers to GVA in material extraction as increasing closer to raw supply; this is comparable with the approach of India on the financialisation of tea leaves pricing, as analysed by Besky (2016). A consultant close to CORFO expressed in conversation: “The problems [of the tender] lie in that the process for higher value added in mining, in all mining including lithium, is always the extraction [of materials], more than that there isn’t.”

472 Mentioned by a consultant that advised CORFO on their Albemarle Lithium Call, referring to CORFO’s lack of comprehension about the process tendering, bid evaluations and the purpose behind it.

473 The pricing of copper in world price indexes was recently a source of anxiety for Chile’s national economy as refined copper prices plummeted in financial markets in 2019 making operations tricky for State-owned producers in the country. Then the idea in the State that commoditisation is best to be avoided.

474 See Barandiarán (2019).
materials and importantly how will the risk of their production and economic strategies is considered in the present and extrapolated into the future.

Given the timing of project drops from the first call, as CORFO took on its ‘roadshow’ to advertise its second call in Europe, CORFO was left in a blank spot while holding two calls for projects that were seemingly worthless all the while saturated with value labels. Investor risk was perceived higher due to a poor management of lithium and battery industries.475 This was coupled with the change of direction and governance in CORFO. For an institution whose technical views and decisions depend largely on administrative structures, a lack of head resonates as lack of thought.476 With contexts of projects dropping, institutional heads changing and confidence on the second process sharply reducing, CORFO’s view of what value added is came evidently on sight. Lithium value added is not about industrialisation related to either increase or decrease of expenditure in intermediary consumption goods, nor on moving closer to batteries and their carrying devices, but rather it is about giving new life to copper legacies.

As expanded in the next chapter, former copper value dreams coupled with altered prices for increasing State revenue without regarding use-value in the country led to wavering national economic reliance and performance on said material. There is a tendency to forget that is part of making expectations.477 A focus in making markets without regards to needs and uses of associated products in the country has led to discomfort from society on the government’s strategies on raw materials time and time again.

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476 Conversation with a consultant that advised CORFO on their Albemarle Lithium Call.
477 As remarked by Katona (1975) on past developments reproducing providing the inclination to them from people in political and economic control, it is sound to guide expectations on the future based on past events and who was and is in power and the structures where they sit and operate. Past developments then may be good guide for judgements of the future, but for that the note from Shiller (2019) on economic behaviour that “there isn’t much popular attention to the process of forgetting” (p.x) is fitting for mineral extraction histories and legacies of materials in place.
When I was little, I was scared of the dreams I didn’t remember. See how some dreams blur as soon as you wake? You never think of their fragile permeance while dreaming, but then they're gone. You know it was there, clearly it was a dream, but recalling anything is futile. Not just futile but known to be futile. You ‘know’ you will never know that dream. But you know it was there.

Now that I’m grown, I am frightened of the days I won’t remember. Some days have turned into that. Like those fogged dreams whose contents dash away from a hasty wakening, a hasty leap into the next day. No recognition of what happened. None. Just a vague knowledge of a day that happened. Am I having the same day? Dejavues make me anxious.

There’s this book, a fiction, that mentions a disease in which people forget how objects around them are called. It starts slow, with just a few things like forks and plants, it then expands to their own names and identities. The disease spreads fast and decimates entire villages. Some villages fight it successfully, with just a few inhabitants left in a limbo. Some villages don’t even see it as all memories scatter away as if chased after a cataract. What if I have that? Is the limbo blissful? How long until I become just a shell? Am I contagious? Will I remember that I have the disease – like a blurred dream comforted by the idea of later reminiscence? Do people forget their forgetting-disease also? I think that could be better: forget to have forgotten.

There might be a point where Sisyphus forgets. It’s not that he’s been touched by the forgetting disease, but his loops just seem countless to him. ‘What’s the point of counting or remembering if the task remains?’ - he must think. Also, what would you say to a forgetful Sisyphus? - ‘Hey Sisyphus, you’re in a loop.’ - It wouldn’t change his loop, it’s Sisyphus. Another book says to ‘imagine Sisyphus happy’, as in aware and ever-improving, and liking it. But maybe he’s happy like the forgetting-disease-decimated-village inhabitants.

Lithium toxicity causes disorders in the parathyroid glands. Located behind the thyroid gland, the parathyroid glands act to increase calcium levels in intestines and to decrease them in bones when plasma calcium levels are low. Lithium in excess in the human body overstimulates the parathyroid glands to produce hypercalcaemia. Hypercalcaemia causes many symptoms out of which some common ones are osteoporosis, renal stones and fatigue. In acute cases, hypercalcemia affects the brain and leads to memory loss. Hyperparathyroidism may continue after lithium-treatment discontinuation.478

Symptom 4

Parathyroid instability

Supply streams of different materials may hold similarities in the strategies set to accomplish them. These similarities come occasionally from relations across materials in symbols and companies. While satisfying different wants and industries, a material carries legacies of spaces, relations and politics. Material legacy ties matter for the course of a decision on technology and its use in society. These ties are also forgotten as new dreams are made up hastily for a material suddenly poised as societally and economically disturbing.

Energy futures may promise a break from long-standing environmentally harmful industries and fuels. However, they are yet to satisfy a desire to think of resources differently than in economic terms. The machineries that make resources into commodities are not just pricing and commoditisation, but they are ideas and visions. A replication of visions for materials can represent a replication of strategies. Particularly so when innovation is placed on technology and material transformation and not in the assemblages of material supply. A focus on making lithium materials widely available in a fast manner to meet the technological requirements of battery futures and their innovations, leaves sufficient space to lose sight of histories of material supply in their spaces of extraction. Lithium overdose in world markets seems to be at the brink of such repetition of modes of trade and supply. Like a human body with a deficient parathyroid, the energy system would act without a correct use of its brain. An energy system saturated with lithium may fail to remember the experiences that have happened to its sourcing places and how has that affected networks of material supply as they exist today.

Memory losses on material sourcing limits improvements on supply strategies. Amnesia may be intentional in so to replicate a way to source materials and to materialise their economic potentials and render them commercial. This section looks at the histories of spaces and their material symbols as forces that reel networks of material supply in the way they are thought of and materialised today. It explores through lithium supply in Latin America the extent of how networks of raw material supply are made by legacies of companies and imaginaries.

Remembrances

It’s 1st August 2019, no one leaves or even budge in the 8th floor as the corporate building in Vitacura, Santiago swivels ever increasingly. No one from other floors seemed to have done so either. As it moves, the only mention relatable to the building nearing violent shaking is not about what is happening now but what occurs regularly in the nightly shakes in Vicuña, a region far north from Santiago.

Earthquakes are common in Chile, but more so are efforts to veil fear and nerves. Reactions of passivity and blindness are expressed in situations that do not necessarily include earth shakings. Address the past, and people often nudge into stillness as if sounds were not being made, an earthquake ongoing without interruption nor reaction. When the earth moves in Chile, people tend to remain as if nothing serious is underway. This does not mean that fear is not present nor that the seriousness of the situation is not raging through the minds of most of those petrified in indifference. Mention a correct word and closure appears, similar petrification until the movement is over then things go on as they did. What lingers is only the thought of quietness during disturbances, and importantly repetition as that present from amnesia. Talk about the Guggenheims and Pinochet or saltpetre and copper, and things go suddenly still apart from the rocketing building. This August shaking is not the first in town and more seem underway.

"The future will be like the past."479

In the Atacama Desert, the experiences that touched saltpetre, copper and lithium seem fairly similar in the symbols that resources carried for the nation and its place in global supply. These experiences regard articulations of strategies in the Pacific War, investments of Guggenheim Brothers, creations and dismantlement of State joint ventures, nationalisations of metals and fertilisers and the creation of Chile’s Economic Development Agency (CORFO). Saltpetre, copper and lithium, what do these materials have in common? Has that been forgotten? In time, imageries in materials replicate and create an overall imaginary of the desert and the nation. To materialise the imageries replicating through resources and time, strategies for sovereignty are introduced by the intervention of and in foreign capital and investments. An imperialism from within takes place to harness nation-making.480

Each of the materials that have taken centre stage in the Atacama Desert have had and retain a significant weight in Chilean economy and in the symbolisms that resources take for the country. In this chapter each material represents a cycle in the loops that compose the place of the Atacama Desert in material supply chains. Each cycle in resources is intertwined with the others. Even when resource cycles might have been over in terms of commodity price cycles, their symbols are still being affected by developments

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479 Robinson (1973, p.262). This statement in its origin refers to economic equilibrium can be understood likewise in human economic behaviour and post-human ecology, see for example Elyachar (2012) and Morton (2013).
480 See Arboleda (2020) on imperialism beyond the West.
in other resources in the desert. These symbols, as they change and mirror, affect the replication of strategies which are visible in lithium as analysed from fieldwork in 2019. Saltpetre and copper relate to lithium in the lack of memory towards their political and economic constituencies and their contexts that framed respective material conditions, failures, benefits and purposes. They thus become structural allegories for each other. This chapter discusses what can the relations among materials in the Atacama Desert tell us about the behaviour to a material and the current strategies and desires around it. It discusses so under the appreciation of analogies that reflects on different versions of the same symbol and its analogy to reality as a signification of a change and replication in time and societies.481

Little recognition is given in today’s assessments, critiques and conversations in Chile and in lithium industries to the assemblages across resources to make up today’s strategies, behaviours, and figures on lithium valuation and industrialisation attempts. This chapter focuses on that and explores it through an interest on the constituents of nation-making projects and a questioning of their forgettability.482 The Chapter first addresses the conditions that existed before and after the war between Chile and Bolivia and Chile and Peru that by which the Atacama Desert was incorporated to Chilean territory. Then, the chapter expands on copper and saltpetre industries in the desert and contrast them to today’s experiences on lithium materials extraction and trade. The chapter then follows with the institutional and equity links between material legacies and today’s practices on lithium in the Atacama Desert. The chapter closes discussing similarities across resources and symbols and remarking the cyclical aspects of progress in the desert.

**The Pacific War**

‘Caliche’ resounds faced and juxtaposing concepts of power and impotence. It refers to the ground of most of what is today northern Chile, southern Peru and western Bolivia. Disputes among those countries over the exportation of *caliche* from one of them to the other caused five years of armed conflict, and tensions that remain today. What was named the Pacific War occurred in between 1879 and 1884.483 It elevated what had since the colonial period been nation-making projects from resources; projects that involved tax breaks for exports and joint-venture oligopolies often crushed by world price volatilities.

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481 This appreciation of analogies is introduced by Paz (1967).
482 Forgettability is mostly drawn from notions of Paz (1965) on the replication of symbols and of Katona (1975) on the reproduction of past events due to the inclination to them from people in power.
Prior to the Pacific War, wheat export had been the source for most income coming in and out Chile. The economic enclave Chile had on wheat was established since the Spanish colonial period and continued well after it. After the independence from the Spanish empire in 1816, the liberalisation of trade gave established wheat merchants an oligarchic position in the country’s politics.\textsuperscript{484} Thereby wheat was not taxed until the break of the Pacific War in 1879.\textsuperscript{485} Since then, the presence of joint-stock companies started to be commonly developed in the area. These companies where normally formed by the close-knit families of landowners that at the time blurred in corporate and blood ties with miners, bankers and merchants.\textsuperscript{486} Chilean economy flourished by the wealth these families held and shared among one another in clientelist forms.

Following the end of the Spaniard colonial period, American, British and German companies installed in the area duly welcomed by governments eager to broaden trading prospects. From then on, the Atacama

\textsuperscript{484} Bauer (1975) and O’Brien (1982).
\textsuperscript{485} O’Brien (1982).
\textsuperscript{486} Bauer (1975). See Chapter 3 for a discussion of this in light of equity market developments and national histories.
Desert has taken a role of salvation for economic projects that touched on economic stability, credit and nation-making. Migration of workers among countries that shared borders in the Atacama Desert, see Exhibit 27, was then inevitable as were the concerns of labour shortages and wage increases. Settlement companies from local elites explored ways to maintain a profit margin while keeping their spaces of production as branches of the State who in turn saw European and North American investments as State revenue and bargaining potentials.

The nation as concept was slowly anchoring to the interplay among joint ventures, foreign capital, material price and duties, and State equity interventions on private capital. These turned into symbols for the nation and its progress. Their making created networks of relations that turned into the fabrics of institutions and structures for political and economic operation. These fabrics were anchored to forward-looking expectations for materials and their place in society. As these symbols touched ground and materials, the places where these lay became allegories that blurred abysms that separate the real to the imaginary.

While Chile's political structures after the Spanish colony came from a wheat economic enclave, those from Peru came from an enclave on guano. The Peruvian State oversaw guano trade and acquired revenues from duties on European commission houses. Peru formed its entire State financing from guano, financing that was mostly extracted by its elite. Guano prices dropped along with its availability and quality. Peru turned its attention to its nitrate rich area of Tarapacá where Chilean and British caliche-refining companies had settled. Even with the dropping prices of 1875 that placed even the most financially stable producers in risk of closing, caliche became a better alternative for the fertiliser markets than guano was. Focus of world commodity trade was placed largely on nitrates for fertilisers, bullets and bombs. The price drop pressed established indebted suppliers to increase production in attempts to make their losses less intense, bringing companies from Europe and Chile to settle mostly in the nitrate-rich caliche of Tarapacá.

With the focus on caliche extraction, processing and trade, the area had taken infrastructure mostly from European investors. What was once considered irrelevant for the State now promised to rescue the nation. Peru embarked on to expropriate nitrate refineries in 1875. This expropriation was not as it sounds, it essentially offered to buy already depressed facilities without engaging with the management of their operation, that is giving purchase contracts to operators who sold to the State without a rising

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488 Paz (1967) explores the nature of allegories as connections that cross the abysms that separate between the real to the imaginary.
489 O'Brien (1982).
490 Ibid.
491 Ibid.
492 Ibid.
493 O'Brien (1982).
494 Ibid.

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duty as set in purchase agreements. Production contracts at the time represented for the State a mechanism for setting quotas and hopefully limit the competition that nitrates posed to guano.\textsuperscript{495} Contracts were given almost exclusively to the influential as the expropriation did not regard smaller companies. Still, contracts were given to amount levels that compromised the very profitability of sales.\textsuperscript{496} A poor management of contracts and what they entailed for prices was evident, and arguably remains since.

The partial expropriation of nitrates in Peru was politically concluded in 1876 but still pressed on for a couple years more to lure in specific foreign producers that did not follow with the State purchase of facilities. Chilean companies were those unfavoured and so those that looked elsewhere in their territory where export taxes would not be in place. Resulting conditions were those of a concentration of production by a handful of European companies who not only traded most of the nitrate output but additionally had purchased most of the certificates issued by the Peruvian government in their attempts to expropriate without really engaging in so.\textsuperscript{497}

The Chilean state followed with attempts to reconcile its nitrate regions with the needed infrastructure to ease extraction and trade.\textsuperscript{498} These long-hauling projects were not fitted to solve the economic depression that lured the country due to wheat and copper price drops.\textsuperscript{499} Conditions for altering the fiscal system and thereby to reduce dependences on mineral exports were blocked by the oligarchy who still enjoyed exemptions of direct taxation. Taxation breaks was seen by the wealthiest Chilean nitrate producers as the only path by which nitrate industries could survive.\textsuperscript{500} Alongside it, the societies that at the time depended largely on mining ventures on copper to endorse traditional countryside hegemonies blocked any attempt to modify the ways in which the export sectors reinforced political structures grounded on long-established landowning elites.\textsuperscript{501} Since then, a strong centralised state favoured tax breaks for joint-ventures that grappled the correct last names, last names of estate owners.\textsuperscript{502}

Chilean companies had likewise settled in Bolivian territory in the Atacama Desert as an agreed tax-free zone for twenty-five years from 1874.\textsuperscript{503} This agreement was a condition for Chile recognising a border in the Atacama Desert that limited Chile to the very southern edges of the desert. More than easing frictions, it showed the tense relations that Peru, Chile and Bolivia had over territory. While in truce, Peru and Bolivia had closer relations between them than with Chile. They formed an alliance in secrecy to Chile

\textsuperscript{495} Ibid.
\textsuperscript{496} Ibid.
\textsuperscript{497} See Table 3 in O’Brien (1982, p.40).
\textsuperscript{498} O’Brien (1989, p.12) hints dependency theory in the economic take to nitrates in Chile.
\textsuperscript{499} O’Brien (1982).
\textsuperscript{500} Ibid.
\textsuperscript{501} Ibid.
\textsuperscript{502} See Vicuña Mackenna (1883), Bauer (1975) & O’Brien (1982).
who played along silently with suspicion and uneasiness. Bolivia broke its accord with Chile in 1878 by setting an export tax to a private firm with Chilean owners: the Antofagasta Nitrate and Railway Company.

Along the Peruvian expropriation of nitrates that left Chilean interests in elevated tax conditions, company heads pressed government where they had sittings to counter back; the Antofagasta Nitrate and Railway Company was very influential in that sense to its government. The relation and overlapping of State officials with wealthy joint ventures enabled a response from the Chilean government to declare war to Peru and Bolivia. With this, the grounds for future economic approaches to corporations in the Atacama Desert were being consolidated. Patriotism blurred with private interests; the nation blurred with a corporation; the place of Chile in the Atacama Desert was symbolised with the equity of Antofagasta Nitrate and Railway Company. Chilean naval forces seized the port of Antofagasta in 1879 as response to threats from Bolivia to embargo said company. The Pacific War begun.

The secrecy of tensions between Chile and Peru and Chile and Bolivia erupted as a building crashing down with its occupants inside calmly waiting still as grounds shacked ever strongly. Conflict over caliche was more about equity and export commission than it was about financial and extractive infrastructures in ground. The position of Chilean company heads in government ranks simplified this view over caliche. Shown in Exhibit 28, the war resulted mostly in land acquisitions for Chile who got Tarapacá and Arica from Peru, Antofagasta from Bolivia, and occupied Tacna until 1928 when it was defined again as Peruvian territory.

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505 Mayo (1980).
507 While conflict is per se considered to have ended in 1884, the culmination the Pacific War is marked by the Treaty of Ancón held between Chile and Peru in 20 October 1883, and the Treaty of Peace and Friendship held between Chile and Bolivia in 20 October 1904 (Zapata, 1992). As described by Zapata, monetary payments accompanied land cessations as balancing or complementary parts of the agreements. Tax breaks on material exports were also at hand in the agreements.
Exhibit 28 – Borders separating Chile, Bolivia and Peru after the Pacific War (The Economist, 2019).

The most praised acquisition at the time was Tarapacá whose nitrate richness mirrored salvations to State finance and to economic victory of some constituents of congress. To secure its position as leading source of nitrates and thereby as focus and collateral respectively for foreign investments and loans, the Antofagasta Nitrate and Railway Company was charged for the assistance it received from military forces to prevent its embargo. This was not the nation going against itself, providing that Chilean private equity in Bolivia and Peru had until since been considered as branches of the nation. Rather, it was the nation as composed by equities going on economic games of competition. Chilean investors in Tarapacá had merely more political voice in congress than those in Antofagasta. Hence, Chilean nitrate policy following the Pacific War was that of a homogenous export tax to nitrates. Such measure made nitrate projects in the south of the Atacama Desert uncompetitive.

Export tax became the weapon by which a part of the nation dominated over another. The nation as concept is not homogenous and thereby nation-making projects related to resource extraction vary in their scope and geography. Both parts of the nation were in this case private equity battling within the

508 The Antofagasta Railway and Nitrates Company was located in the area of Antofagasta which represented a threat to Chilean nitrate producers of Tarapacá, who were also very influential in and to the Chilean government. The State wanted to protect its most precious acquisition from price variations brought by production beyond Tarapacá which led to crush were possible the companies that did not fit with the newer version of symbol for the nation. See O’Brien (1982).
government which comprised and blurred the State and the oligarchy. Much like effects today, an enemy becomes an ally in context of corporate equity protection within a government.\textsuperscript{510}

Gaining Tarapacá however did not represent an influx of wealth and prosperity from the symbols that nitrate and nitrate abundance carried. Peru had left the territory with its constituents set as mortgage for bondholders of Peru’s large folded debt.\textsuperscript{511} Chile had now the burden of dealing with bondholder’s demands for the respect of previous arrangements that entitled them with nitrate production certificates and guano ownership. Europe was still an important source for loans and war-effort financing, which brought the nitrate and its infrastructure to private mostly-European ownership to the ease of bondholders of Peru’s folded debt payment.\textsuperscript{512} Forces of corporate equity beyond the nation and its heterogeneity of corporate interests therein proved to have strong levers. British nitrate houses were pivotal to get the conditions that enabled foreign firms to dominate the export and to sustain favourable conditions for production.

With its nitrate policy set and the territorial control of the Atacama Desert, the Chilean government when into cycles of nation-making attempts and economic strategies to alter global supply of nitrates and copper. These all encompass a few set of companies and demonstrate how the current practices on lithium allow to have a glimpse on the behaviours that Chile has had on materials in the Atacama Desert. This hints on the trends that materials beyond lithium encounter. It shows as well how global material supply coming notably from Latin American depended largely on competing nation-making projects and material symbolisms that are brought from fiction to press on favourable technology prospects, hypes, contracts, value and futures.

\textbf{Copper and saltpetre}

Copper in Chile had until then had a different experience with export tax. In contrast to the foreign demographic that dominated Tarapacá’s nitrate ventures, copper was mostly produced by Chilean private firms. These latter had long enjoyed feeble export taxes, and close to none by the time the Pacific War commenced.\textsuperscript{513} Being mostly Chilean producers that extracted, refined and exported copper, the metal had practically not seen export tax since its initial dominance in world supply around 1850s. By the end of the Pacific War this tax was nearing to null, the share of supply from Chile was however likewise plummeting.\textsuperscript{514}

\begin{footnotesize}
\textsuperscript{510} This regards notably what is mentioned in Chapter 3 on the alliances that are made between CORFO and Julio Ponce Lerou to face an equity acquisition of SQM shares by Tianqi.
\textsuperscript{511} Nitrate land and guano revenues comprised the debt mortgaged to Peru’s debt bondholders (O’Brien, 1982).
\textsuperscript{512} Guano revenue was shared with the Chilean government while nitrate production was brought back to private ownership of the certificate holders (O’Brien, 1982).
\textsuperscript{514} O’Brien (1982) and Novoa Monreal (1972).
\end{footnotesize}
As with nitrates, the production structures based on intensive labour and rigid control left copper industries without room for innovation. Price rises kept the labour-intensive ventures safe from their stagnant production practices. When prices fell before the Pacific War due to cost improvements elsewhere, the country was severely hit as over 60% of its exports were copper products. Prices continued to plummet going down by 33% by 1878. The Pacific War and the promise of nitrate richness in Tarapacá sustained fiscal structures and the role of tax as weapon to foreigners only. This further blocked intentions to innovate material outputs by means of improved copper extraction and refinement technologies. It seemed to be the same condition as with nitrate. For nitrate however, most pressure to levy taxes and production quotas came from Anthony Gibbs, the head of the leading British nitrate commission house in Tarapacá. In the case of copper, miners at the time were tied to the oligarchy by civil and religious unions, and corporate financing. Output from copper mines depended on high concentrated ores which were rapidly decayed after the Pacific War. Welcoming thus foreign investments to compensate for the stagnant state of capital from domestic copper producers. Elsewhere, copper production had incorporated technologies that enabled profits from lesser quality ores. These techniques not only initiated a transformation of metal mining, but they ultimately led to the corporate structures that today persist in the Atacama Desert.

“A tale of two companies.”

Today, ‘Guggenheim’ is a name that is not precisely spoken out with ease among Chileans knowledgeable of the role that the Atacama Desert had in Pinochet’s former military financing, and that which it has today on his relatives’ wealth. It names not just the last name of the wealthy mining family but also the memory of what is considered in the country as the failure of nitrate and copper. Symbols of nation-making overlap with those of depression, impotence and collapse. Still, in Chile today, collapsing buildings are not spoken of with ease as earthquakes return and as those shaking grounds today seem not to dim out just yet.

In 1910 the Guggenheim brothers bought the land that a few years later would be the largest open pit copper mine in the world; status it holds still today. This place, in the northern sections of the Atacama

515 Investors at the time did not make substantial profits by inciting innovation but rather by cornering producers to delay supply until prices had risen (O’Brien, 1982).
517 Ibid.
519 A director of an Australian lithium mining company that has operations in Argentina phrased this to compare Chile’s CODELCO and Brazil’s Vale. In his tale, CODELCO failed to reach the promises of progress by copper as Vale did with iron due to a failure to engage and operate as a publicly listed company. Here, this phrased is used to note the relevance that Chilean State has taken to equity acquisitions without understanding and using financial markets on equity fully. This phrase also notes the conditions of oligopoly that existed when the State got involved for nitrates with COSACH and COVENSA, for copper with Anaconda and Kennecott, and for lithium with SQM and Albemarle.
Desert in Chile, would take onwards the name of Chuquicamata. Chuquicamata was however not the first venture the Guggenheim family had on copper nor in Chile. The Guggenheims had from 1888 been involved in innovation applications for improving output of metal mining.\textsuperscript{521} Their focus on smelting technologies, coupled with means to capture vast amounts of financial capital made their mining investments in Latin America rapidly profitable.\textsuperscript{522} Prior to their incursions in the Atacama Desert, the Guggenheims formed the Braden Copper Company after providing financial backing to William Braden who had acquired the Rancagua mine in Chile.\textsuperscript{523} Braden Copper later owned another colossus of Chilean copper supply, El Teniente mine.\textsuperscript{524} Still with Braden under the sleeve, it was really Chuquicamata which turned copper markets with its low cost and high output dominance. Chuquicamata mine was owned by Chile Exploration Company, a subsidiary of the firm Chile Copper Company which was owned by the Guggenheim siblings. Chile Exploration Company set campsites and social structures in the Atacama Desert that resemble greatly to today’s social balances around resource excesses and scarcities in the salt flat.\textsuperscript{525}

\begin{quote}
Social structures emplaced for material extraction remain as legacies of materials

The social structures of Chuquicamata in times of Chile Exploration Company are described and discussed by Finn (2001). Her appreciation of the transformations incurred to sustain a divided labour force between foreigners and unspecialised locals, and orders of ‘adulthood’ and ‘citizenship’ remarks policies that blurred corporations with State politics. The Guggenheim disciplinary regime or those produced by the firm’s ‘welfare programmes’ calls to question today’s visions of resources in the area and the social organisations around these visions. It also calls to observe if former regimes are present today and if so if they are recognised and spoken about. Chapter 4 presents those enquiries empirically by the multiple appreciations that resources take in the Atacama Salt Flat today and how people organise and mobilise. In this chapter it is noted that the histories of the legacies remain today veiled in place.
\end{quote}

Enhanced techniques for smelting and faster non-selective extraction brought copper from Chile flowing intensely to world markets. By 1918, prices declined as the share of foreign interests accounted for over 80% of Chile’s copper output.\textsuperscript{526} The focus of the Guggenheims however soon moved to Chilean nitrate.

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{521} This notably involved methods for non-selective mining and ore smelting (O’Connor, 1937; Hoyt, 1967).
\item \textsuperscript{522} O’Brien (1989).
\item \textsuperscript{523} Ibid.
\item \textsuperscript{524} Novoa Monreal (1972).
\item \textsuperscript{525} See Chapter 4 for discussions on today’s social conditions enclaved in mining in the Atacama Salt Flat.
\item \textsuperscript{526} O’Brien (1989).
\end{itemize}
\end{footnotesize}
From the end of the Pacific War, nitrate markets were controlled by associations of producers from mostly Tarapacá who manipulated prices to keep them in high figures, a practice that was welcomed by the Chilean government whose revenue depended largely on nitrate export taxes. Highly manipulated prices limited production optimisations from competitive standards. Still, even with synthetic alternatives entering supply, natural Chilean nitrate benefitted from a growing world demand which kept Chile as leading supplier.

The Guggenheims conceived a new nitrate refining process and sought to develop a trust with the leading supplier at the time, Gibbs and Company. Since then, the Chilean State had encouraged foreign joint-stock firms whose image was welcomed as catalysers of nation-making, resource extraction and State revenue. Even with the proposal to Gibbs failing from occurring, the Guggenheims followed onwards based on expectations of consolidating the nitrates supply by reducing costs of production. Decreasing costs from synthetic producers in Europe pressed the government on welcoming any tentative to save its nitrate in world markets. Hence, the Chilean government was seen desperate enough as to eliminate export duties for nitrates.

Windfall profits loomed in the nitrate industry speculation around 1922 causing what was termed the ‘nitrogen rush’. As today’s ‘lithium boom’ narratives press for more supply, the nitrogen rush expanded output tripling world productive capacities within nine years. This was not separate to the Guggenheims ventures who developed mining capacities. The Guggenheims used financial markets to acquire nitrate properties and capital for developing production and processing. Financial markets became the dominant way through which mining industries developed in the area and have done so since.

The Chilean state, as advised by the American president Herbert Hoover, felt at ease with developing a joint-venture with the Guggenheims and thereby to profit while export taxes were eliminated.

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527 See Hirsh (1976) on the effects of the categories of goods as luxury and elitist symbols by their price, and on how changes to luxury products don’t tend to occur until they become sufficiently accessible for a larger share of society.

528 Chapter 3 shows how this is still present in perceptions of corporate equity on lithium. Any form of restraint to joint ventures as pressed by politicians demanding competition agencies to ban a certain share purchase or merger does not signify necessarily a change of such imagery. Rather it often comes as a reproduction of a nation-making project through a specific and preferred equity and venture, i.e. domestic rather than foreign.


530 Ibid.

531 See Chapter 2 on the expected increases of conversion capacity for lithium materials. See Table 2 in O’Brien (1989, p.138) for figures on the expansion of nitrogen output from 1922 to 1931 as caused by speculations of demand growth, and efficient material processing.

532 Hoyt (1967).


534 North American interests to limit foreign monopolies on raw material supply is today perceptible with intentions to constraint lithium supply networks in the United States and Europe under the discourses of critical materials and strategic supply for low carbon futures, see Chapter 2. Strategies to attain this through market making and price manipulations are comparable to former ones regardless of discourses of climate change mitigation from global material supply.
Compañía Salitrera de Chile (COSACH) was then formed between the Chilean government and the Guggenheim brothers in 1931. COSACH was committed to pay the government a fixed annual sum in exchange of no export taxes. While each party had 50% equity, one third of its directive board were government representatives. Even if the government would from here onwards participate in corporations, it would not take management roles when private equity would be involved; likewise for copper, the first joint venture the State participated on in copper was formed after the suggestion to do so by American interests.535

COSACH acquired foreign production interests by issuing stock, making it essentially under control of the Guggenheims. These stock valuations exaggerated the contributions made to compose COSACH.536 The same experience happened in the Peruvian expropriation of nitrates by which particularly Gibbs and Company got an overpaid payment for the value of its holdings in Peru.537 Contrasted to the nitrate expropriation in Peru, COSACH was on its own an attempt to monopolisation partially for State interests. The overvaluation of assets was in order of an overestimation of the industry, the place and the nation. With nitrate prices plummeting, payments to the government, bonds flotations and dividends were not at hand. With the First World War ending, prospects for COSACH looked dimming.538 It would not be until the Second World War that iodine and nitrate would again bring light to Guggenheim ventures in the caliche rich areas of the Atacama Desert.

While nitrates collapsed for producers in the Atacama Desert, tendencies of export tax elimination, custom flexibility, oligopolies, partial nationalisation, nation-making with colonial tints and overvaluation of resources and assets did not stop. The strategies and agreements that the Guggenheims had had with the Chilean government remained as far their interests were still anchored to copper in Chile. Chile Copper Company, the firm established by the Guggenheim family to run the Chuquicamata mine by its subsidiary Chile Exploration Company, was sold to the American mining firm Anaconda Company in 1923. This sale coincided with the nitrogen rush, arguably induced by the Guggenheim’s investment planning, and with a downturn in copper world prices. This sale did not mean any significant withdrawal from copper for the Guggenheim siblings, they still controlled a significant a share of

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535 See note 618 this chapter, point four.
536 Purchase prices for nitrate-rich land were valued to their prices when industry was in its most prosperous phase since the acquisition of Tarapacá by Chile, see US Department of State (1932). The equity acquisition discussed in Chapter 3 shows the continuing of over-estimation of value of corporate equity of lithium industries in the Atacama Desert. Disproportionate valuations were today contested as a condition of lithium and SQM alone and not one of either of Atacama Desert as place, or of legacies of saltpetre and copper.
537 See O’Brien (1982).
538 Summarising from Hernández Cornejo (1930), Fernandez (1981) and González Miranda (2011 & 2014), Méndez (2021) lists the reasons for nitrate failures in the Atacama Desert after the first world war to be “technological backwardness, inadequate economic administration of the mines, decrease in ore grade, high transportation costs between Tarapacá and the consumption centres in Europe and United States, and most crucially the arrival of synthetic nitrogenous compounds to the fertilizer market.”(p.114)
Chuquicamata and owned Braden Copper Company as a subsidiary of their firm Kennecott Copper Corporation.

Export taxes on copper made a slow but consistent return in Chilean politics, as they did so when economic development politics wanted to put a leash in foreign equity in the country without holding it too tight. New export taxes calculated on selling prices did not represent major complications for the American firms as the practice of intercompany sales of raw materials at low prices was at the time well established. American copper companies in Chile made great financial returns from their establishment. The Chilean State saw in them its development and developed consequently more intricate contracts for copper extraction, processing, export and sales. This strategy in Chilean politics was coined in the 1960s as ‘contracted development’ and led to a particularly lax take towards the industry until 1971, one that was awfully like experiences with nitrates.

These contracts had for purpose increasing material output, integrating its industry to the national economy, refining in Chile as much material as possible and ensuring the participation of the State in corporate equity and marketing to world markets. Aside from State participation, these objectives look


540 The stages towards the nationalisation of copper in Chile can be divided as follows. First, an attempt to directly control and operate copper sales by a decree in 1952 to have the central bank as purchaser of copper produced in the country and as the seller of it to world markets, see Novoa Monreal (1972, p.18). Second, the New Deal of 1955 which followed the collapse of State copper sales due to client control by the American companies and the North American government. The New Deal aimed to make conditions favourable for foreign companies by for instance relieving them of fiscal obligations, providing generous accelerated depreciation rates, conceding control on sales and lax customs oversight. Third, the ‘Chilenisation’ of Copper through the Copper Conventions. The Chilenisation of Copper started in 1964 and attempted to make joint ventures between the State’s CODELCO and the American subsidiary firms operating Chuquicamata and its near ing sites, El Teniente, Salvador and Andina mines. Fourth, the making of Sociedad Minera El Teniente from the acquisition of 51% of Braden Copper Company in 1967. Sociedad Minera El Teniente was part of the Chilenisation of Copper but it happened per suggested by its parent company of Branden Copper Company, Kennecott Corporation. See note 612 which remarks American suggestions to form COSACH between the State and the Guggenheim siblings in the times of the ‘Nitrogen Rush’. El Teniente mine was bought for an extreme overvaluation of shares, see Novoa Monreal (1972, p.35 & 43). Fifth, the making of Andina Mining Corporation in 1967 between Cerro Corporation and CODELCO to operate the Andina mine. As part of the Chilenisation of Copper but not to its equity target as CODELCO owned 35% of shares and Cerro Corporation the remaining 75%. Electric supply improvement was done by State without increases in dividends or shares (Novoa Monreal, 1972). Sixth, the making of Exotica Mining Company in 1967 between Anaconda and CODELCO to operate Exotica mine. The joint venture was likewise part of the Chilenisation of Copper. The mine located in the same mineral base as Chuquicamata and used Chuquicamata’s refining facilities and trade channels but held as a status of a new corporate society to benefit from the tax breaks of the time to new copper companies (Novoa Monreal, 1972). Seventh, the Agreed Nationalisation Convention of 1969. The Agreed Nationalisation aimed to get higher selling prices to the State by purchasing 51% of equity of Anaconda’s subsidiaries Chile Exploration Company and Andes Copper Mining Company at firm book prices of the time in instalments until 1981. The remaining 49% of shares were set as a purchase option for the State paid according to utilities factored to the lapse of payment (Novoa Monreal, 1972). Eighth, the full nationalisation of copper in 1971 (Novoa Monreal, 1972).

541 Novoa Monreal (1972).
fairly like what today’s lithium contracts explicitly attempt to do. This lax take to make the nation through copper took the name of ‘chilenisation’ of copper.

<table>
<thead>
<tr>
<th>Legacies of materials are visible in the use of mining contracts for development</th>
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<tr>
<td>The times of copper ‘chilenisation’ were intensely reliant on contract rollout by the State (Novoa Monreal, 1972). In some empirical reflection to the times of contracted development through the copper conventions for the ‘chilenisation’ of production facilities, Chapter 1 discusses on the place of contracts today in lithium. Abstracting and anchoring ‘development’ to documents is not new and is here seen to be mostly if not only implicated on prices and production quotas.</td>
</tr>
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In the chilenisation of copper, price variability of commodities was not considered, which essentially anchored the nation and its economic progress to market volatilities. The rise of prices for copper at the time placed the State as failing to grasp as much economic gain as it could, and thereby as failing to materialise what copper signified for nation-making. Not too far into the future, falling copper prices would put the economic stability in peril and bring again a break between the ever-present symbol of copper as national development and the State as failing to capture value from it. Copper price rises in the latter half of the 1960s caused difficulties among Chilean politicians to coincide with the idea that development should be contracted to material sales by foreign parties. There was then agreement across all political parties that the State should handle sales, as it attempted to do with nitrates thirty years before. The matter was not what sort of copper was being sold or by whom, but it turned on to how to manipulate sales so that the State would benefit from the highest prices available in world markets. There was a praise and an anguish towards world prices and their indexing. A comparable praise and anguish that today is expressed among Chilean politicians to equity markets for lithium industries. Copper material standardisation and world prices were perceived by Chilean politicians as instrument to materialise sovereignty by going aside the quotations that the foreign companies in Chile would allege for their sales. At the same time, these were considered as the demise of sovereignty if progress was anchored to contract-laws with foreign private interests that were not looking at the materials as symbols for nation-making and economic prosperity for the sourcing territory.

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542 See chapters 1 and 5 on the extraction allowances and value added agendas that CORFO’s 2016 and 2019 lithium contracts carry forward.
543 Zapata (1992, p.112) discusses that period of copper industrialisation attempts in Chile as part of the Import Substitution Industrialisation (ISI) political practice of Latin America.
544 Novoa Monreal (1972) and Álamos Junemann (1948).
545 See Chapter 4.
Material prices and their control are images of economic development through resources

Market variances and the negation of trends that do not fit continued rise in prices create a hinged sight of what is future value today, particularly for saltpetre who saw its price plummet with the introduction of less costly synthetic fertilising alternatives, or with copper who saw an increase of supply from Chile when the Guggenheims' Chuquicamata mine cut costs drastically compared to sources in the United States of America to later suffer from world market price decreases from increased supply beyond Chile. For both, the strategies of the State searched to gain more value regardless of macroeconomic and market conditions, which ultimately damaged the national economy in greater extents. These responses to price is present for lithium today as shown empirically in Chapter 5.

The game of sales was again one of secrecy of clients, quotations and agreements. Copper trade from the big players looked outwards while circling the Chilean territory, keeping inside the projects for nation-making that materials might incite. Secrecy acted like a collar that was only oiled in its buckle to tighten further. Silence today resonates the muted desires to make the symbols of copper and nitrates work for the intentions of nation-making, regardless how multiple these may be. Like a force continuously contracting from the inside, big copper mines were crushing those left within as a collar of clientelist competition and export dependency with tax breaks would, a collar that had been placed well before the Pacific War.

The Chilenisation of copper companies entailed the making of a state firm, the Copper Corporation (CODELCO) that would purchase the equity of the main mines under the control of the American firms.546 The equity acquisition would be divided in a purchase for initially 51% of the equity to the book value of the dates of purchase in payments that would extent to end of 1981.547 The remaining 49% of equity would be paid after the initial equity had been acquired, and would be valued to an intricate conversion factor of annual utilities from 1970 onwards with a higher conversion figure the sooner the purchase option was taken.548 As with COSACH and the Peruvian expropriation, valuations were tied to times of rising commodity price cycles, exaggerating corporate book values based on utilities rather than investments. As long as the American companies retained 49% of equity, they still controlled operations, leaving little ground for the new shareholder to oversee what was happening to its assets and how would the idea of a prosperous full ownership might dim out.

546 See note 612.
547 Novoa Monreal (1972, p.58).
548 Ibid.
When Allende’s government ordered the full delivery of assets to CODELCO in 1971, it was clear that there had been a strategy to obtain the richest part of deposits without care for conditions of the remaining, to maximise short-term utilities and the entailing purchase payment. The Chilean State seemed to have pressed the course for the deterioration of its resources, leaving the child of the nationalisation, CODELCO, with a heritage of ruined caliche. The times of joint ventures with CODELCO left among great utilities to the firms and passive frustration for Chilean politicians a legacy of irregularities in the export of by-products that did not make it to customs declarations. The full nationalisation took place in 1971 leaving CODELCO with a way of operating and understanding the mechanics of copper markets that were intricately based on the legacies of the formerly established foreign companies.550

The gaze of surprise and appal with which people today in Atacama and Santiago respond to the SQM case, that includes missing custom declarations and omissions in declarations that do exist, is striking when hardly no one seems to acknowledge the modus operandi set by copper trade, export and effects from CODELCO participations. These unspoken politics are often the bases for awkward moments when enquired, as they represent the power structures that have shaken the country form its root from times on end, ever more aggressively and frighteningly.

**CORFO and lithium**

The behaviour among Chileans to earthquakes today shows a response to anxiety, impotence and memories. Not to any memory but to those linked to moments of social discomfort, doubt and peril, most of which have had to do with natural resource excesses and scarcity, economic strategies on development, and military authorities. Responses to earthquakes are akin to responses to questions on investments on lithium and on the power and economics that lay under the Atacama Salt Flat. The response to the deadliest earthquake that has struck Chile laid the foundations for the structures that today persist in the Atacama Salt Flat. Structures existed in legacies of past materials but needed a catalyser for materialising them once more and in a more solid and anchored way, a catalyser that would make material legacies structural per se.

In 1939, the Chillán earthquake killed over 24 thousand people and devastated over fifteen cities.551 Housing and buildings were massively destroyed, and electricity and communication services were halted. To face the disasters brought by the earthquake, the recently elected president Aguirre Cerda create two State agencies: ‘Corporación de Reconstrucción y Auxilio’ and ‘Corporación para el Fomento

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549 Novoa Monreal (1972, p.60)
550 This is due to the relations that linked COLDELCO with the nationalised firms during the Chilenisation of copper, see note 535 this chapter. Nationalised assets included only the facilities of what was considered as ‘the big copper mining’ and was indemnified by payment of the original value of assets discounted of obsolescence and depreciation (Novoa Monreal, 1972).
551 Cooperativa.cl (2019). The Chillán earthquake caused more deaths than the Valdivia earthquake that killed over 1600 people and is known as the most intense recorded earthquake to date, see National Geographic (2020).
a la Producción'; the former for rebuilding and assisting, and the latter to promote industrialisation.\textsuperscript{552} The latter would then onwards be known as CORFO and would essentially act as the State's economic development agency. These agencies were not just solely formed from the need to act to face a catastrophe brought by a natural event, rather they had been brewing since the nitrate industry and copper prices had been shrinking in the early 1800s and 1900s to the point of making Chile’s export economy unstable and precarious.

Much like the way that finance and people organise today in the Atacama Desert from emergencies and alerts from natural events, the Chillán earthquake enabled to rapidly finance projects that attempted to keep the national economy from collapse.\textsuperscript{553} In 1939 and during the first phase of CORFO, these projects involved making a State shareholding entity that would control State companies. With CORFO, Chile's previous relations and disappointments with private equity in the early stages of mining the Atacama Desert would take a different turn. This time the State was the corporation to whom export taxes were withdrawn and who monopolised industries, or alternatively the one who developed industries by ways of oligopoles or constrained competition. In its first steps, CORFO created and managed companies that provided electricity services, manufactured and traded steel, produced and traded oil, and refined and traded sugar.\textsuperscript{554} Tax breaks for exporting materials and lax customs were still common when joint ventures were set with the State.

With an office in New York set in 1940, CORFO would follow to make credit negotiations based mostly on export agreements that had in yesteryears been handled with European and North American foreign offices. The nation as a corporation was clearly the image that CORFO took onwards and outwards with its take on national development symbolised by resource export and trade. The companies that CORFO created linger on today and shape the politics of services as electricity and water supply in their shapes of private companies or civil associations. CORFO likewise followed the thread of former resource idealisations in the Atacama Desert. It took ownership of the Atacama Salt Flat to thereby oversee the extraction and trade of the materials that came from its resources.\textsuperscript{555} CORFO however took root in the Atacama Salt Flat when former joint ventures between the State and foreign private firms where already in place. The transformation of these allowed CORFO to participate in the nitrate economies while starting from a playing field with set game rules.

COSACH, the result of the Guggenheim’s nitrate investments, transformed into the Chilean Corporation of Saltpetre and Iodine Sales (COVENSA) in 1934. COVENSA did not take equity from the firms that

\textsuperscript{552} Biblioteca Nacional de Chile (2018b).
\textsuperscript{553} See Chapter 4 on the uses of status of emergency and alert from natural events to channel financing to political and economic agendas to bring projects and salaries into being.
\textsuperscript{554} Biblioteca Nacional de Chile (2018a).
\textsuperscript{555} See Chapter 1.
composed COSACH nor did it participate in the management of these and their operations.\textsuperscript{556} Rather, it merely took 25\% of the sales profit. Export taxes were left untouched for nitrates and any resulting by-products, which by then had begun comprising lithium materials and brine. Oligopoly remained as COVENSA was only composed of two production units in the late 1950s, one of which had come into management of subsidiaries owned by the Guggenheim siblings. This structure gave way to CORFO to follow the ways of a settled gameplay. The bankruptcy of the other non-Guggenheim constituent of COVENSA placed CORFO as owner of an indebted saltpetre production facility within COVENSA.

COVENSA corporate statutes held it existing until 1968. Then, without a renewal from the State, Sociedad Química y Minera de Chile (SQM) was formed between CORFO and the Guggenheim’s Compañía Salitrera Anglo Lautaro, with 37.5\% and 62.5\% equity ownership respectively.\textsuperscript{557} CORFO would then follow to build another corporate society to produce lithium materials in the Atacama Salt Flat laying thus the bases for today’s equity structures for lithium supply from the Atacama Desert. More than pivoting industry onwards, it replicated the legacies that precluded State involvement and bargain with private interests for nation-making.

\begingroup
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\begin{tabular}{|p{\textwidth}|}
\hline
\textit{Material legacies and nation-making strategies thread into corporate equity} \\
State ownership of private equity, that is equities that are not publicly listed to trade in stock exchanges, has been used a development practice in multiple contexts. Multilateral development agencies even produce toolkits to instrument state owned enterprises on development matters, see for instance \textit{World Bank} (2014). However, as the participation of states in private equity is not necessarily anchored to build companies that provide fundamental services for citizens, it can be as well a means to create revenue and power for economic growth. It is here found that private equity catalyses material legacies when shareholdings thread across resources. Private equity becomes thus a medium for the replication of economic strategies when companies that focus on distinct materials are close-knitted through shareholders. Private equity also employs the figure of the State to participate in the making of trade and production policies and material imageries. As mentioned by Gainsborough (2010), when the State sells its shares it doesn’t necessarily represent a retreat of the State nor on the place of the State in the methods of rule on economy and resources. \\
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\textsuperscript{556} Álamos Junemann (1948) and Aguirre Aguirre (2004).
\textsuperscript{557} Galaz-Mandakovic (2018).
The essence of development through material export, exemplified with copper exports in Exhibit 28, did not change but what did was the shareholding figure that the State took. Symbols from resources were also unaffected despite changing from nitrates to copper to nitrates again and finally to lithium. The earthquake continued on and kept responses to memories passive and frightened of crumbling under the same intact structures. CORFO did not nationalise resource much like the Peruvian expropriation and the copper chilenisation likewise didn’t. They were rather a partial way to reduce export taxes and to use these as weapons for bargaining and for consolidating oligopolies. It is then striking that today’s voices for opposition for such conditions speak of them as practices that do not fit with Chilean interests. If anything, the Chilean State and private interest, blurred in their fog, have arguably consistently kept those conditions in time and place.

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (Million USD, FOB)</th>
<th>Physical supply (Thousand metric tons of fine copper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>611</td>
<td>582.9</td>
</tr>
<tr>
<td>1967</td>
<td>664</td>
<td>631.8</td>
</tr>
<tr>
<td>1968</td>
<td>694.3</td>
<td>635.9</td>
</tr>
<tr>
<td>1969</td>
<td>937.2</td>
<td>656.4</td>
</tr>
<tr>
<td>1970</td>
<td>856</td>
<td>668.8</td>
</tr>
<tr>
<td>1971</td>
<td>707.8</td>
<td>684</td>
</tr>
<tr>
<td>1972</td>
<td>663.9</td>
<td>630.8</td>
</tr>
<tr>
<td>1973</td>
<td>1,035.6</td>
<td>656.5</td>
</tr>
<tr>
<td>1974</td>
<td>1,676</td>
<td>858.2</td>
</tr>
<tr>
<td>1975</td>
<td>920.7</td>
<td>787.8</td>
</tr>
<tr>
<td>1976</td>
<td>1,292.6</td>
<td>981.9</td>
</tr>
<tr>
<td>1977</td>
<td>1,250.2</td>
<td>1,007.8</td>
</tr>
<tr>
<td>1978</td>
<td>1,343.9</td>
<td>977.5</td>
</tr>
<tr>
<td>1979</td>
<td>2,179.7</td>
<td>1,010</td>
</tr>
<tr>
<td>1980</td>
<td>2,422.7</td>
<td>1,045.3</td>
</tr>
<tr>
<td>1981</td>
<td>1,917.6</td>
<td>1,038.1</td>
</tr>
<tr>
<td>1982</td>
<td>1,833.9</td>
<td>1,210.9</td>
</tr>
<tr>
<td>1983</td>
<td>1,993.4</td>
<td>1,251</td>
</tr>
<tr>
<td>1984</td>
<td>1,689.9</td>
<td>1,219.9</td>
</tr>
<tr>
<td>1985</td>
<td>1,853.4</td>
<td>1,355.7</td>
</tr>
<tr>
<td>1986</td>
<td>1,835.9</td>
<td>1,376</td>
</tr>
<tr>
<td>1987</td>
<td>2,317</td>
<td>1,369.4</td>
</tr>
</tbody>
</table>


Death by collapse spurred CORFO, death by violence transformed it. In 1973, a military dictatorship was established in Chile through a coup d’état. Augusto Pinochet ruled for 17 years in what has been considered the most repressive and dark time for Chilean society. In the mist of tortures, disappearances, surveillance, secrecy and plotting, the State morphed to better serve the interests of the dictatorship and
its sponsors.\textsuperscript{558} Resources then changed as well. The purpose of natural resources moved from making a nation to make profit that would build the nation. For that, the State changed its economic development agency to withdraw from building companies and industries in form of joint ventures with the State but rather in form of private capital working for the State. Among other privatisations, CORFO’s SQM was handed to Pinochet’s son in law Julio Ponce Lerou.\textsuperscript{559} With it, lithium supply from Chile would thrive without any export tax nor custom control. Later after the military authoritarian period, Ponce Lerou would be antagonised only to find common grounds with the State to prevent foreign equity into lithium national spheres.\textsuperscript{560}

\begin{center}
\textbf{Economic development through resources is often about their utility to foreign customers}
\end{center}

Resources as made by human appreciations on utility and uses is discussed by Bridge (2009). Fieldwork findings discussed in Chapter 4 adds to this understanding by discussing on the multiple metrics and categories that are found in resources and their making from human appreciations. The change on political interventions to resources is partly bound to whose utility of resources can provide a greater advantage and progress to nation-making, this is exemplified here by the shift from nudging industrialisation in the initial stages of CORFO to the one of renter today. In both stages, materials are resources as far as they provide utility but the purpose of satisfaction from said utility is changing from providing coverage of basic needs to providing economic gain in form in production fees and export taxes for external uses of resources.

While CORFO’s role with lithium supply became thereafter one of a landowner looking over its two tenants with a suspicious gaze, the position it held as forefather for the structures that exist remains. On CORFO, there is likewise the background of a former oligarchy making decisions for the nation’s industries and its symbols, an oligarchy whose ghosts are present in the resources that vibrate today in the Atacama Desert.

\textbf{Conclusion}

Talk about Pinochet and Ponce, and impotence resonates to the point of shattering windows in a rocketing building. Ask about what brought them to own what they donated one to the other, and the same impotence resonates with higher vigour. The latter impotence is not an expression of power imbalance necessarily, but more of a fogged memory. Fear seems to have blurred that memory to the

\textsuperscript{558} See Kornbluh (1999) and Taylor (2006) for remarks on US intervention in times of military dictatorship in Chile.

\textsuperscript{559} See Galaz-Mandakovic (2018).

\textsuperscript{560} See Chapter 3.
point of it being an ancient present. Ask if the repudiated practices of Ponce are traits of the past and get
the same response of silent angst. The cycle seems to go on but today in Chile a revolt is aching in the
insides the shaking buildings. Rattling bodies move out to the streets.561

Conceptually, in Chile today the impotence and fear to its economic model for nation-making over
development remains anchored to resource and their abstracted place in society. Talk about privatisation
of resources and services and see anger rise. Follow the passivity to fear to its brink and see discontent
surge. Ask what is new here in the chaos brought to make a constitutional reform away from Pinochet’s
heritage, and look at the perplexity of being in the same ground. Look at the *caliche* beneath as it shakes.
The earthquake today does not come from telluric movements but from society demanding new symbols
for its day to day. Legacies persist but their catalysts are being challenged. Will normality of nation-
making projects persist as it seems do so with lithium? Or will the cycle enter a different loop? All that
may remain is the certainty that novelty is not yet in the response to the awkward question. Fear remains
but passivity is being lost. What ‘national’ means and how it is symbolised to and from resources could
be attempted to be defined again, but the relations across resources and their symbols are yet to be
acknowledged fully. Legacies of power in supply chains have long continued from strategies for making
the nation, these symbols of resources in time and place matter then if economic strategies are to be
moulded in the shape that alternative social organisations roar today for.

Saltpetre, copper and lithium. The riches of the Atacama Desert have been in time not the resources but
their value. They relate with one another through symbols and corporate equity. For each, conditions of
oligopoly, export tax exclusions and weaponisations and lax customs have significantly made way for
industrialisation. Contractual bureaucracy, speculative demand, resource scarcity and excess, equity
acquisitions and joint-ventures, value exaggerations, and commoditisation, all replicate in the uses these
resources take for nation-making. As this chapter details, nation-making in each resource cycle is not a
homogenous movement. In any case though, resources are the leap of national identities and trade and
financing channels. What ties the materials of the Atacama Desert stronger together though is the lack of
recognition of their assemblage in symbolisations and practices.

As nation-making projects morph in economic strategies for capturing more value for those that
represent the State and its allies, resources are tilted in the symbols that relate across them. They are not
sought for their inert and individual properties. Nor are they sought individually. They are in themselves
and together the idea of progress for the nation, territory for the State, money for companies,
forgetfulness for the opposer. Resources strip place from its chronology insofar that political and
corporate actions loop from one to the other. Historical perspectives seem obfuscated when described
through time rather than through materials. Observing places through materials and their symbols

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561 This refers to the riots that started in Chile in 14 October 2019.
allows then to better understand the places and causes of finance, companies and the State in the dwell for value and power in world prices and supply chains.

**Mining legacies are a circular progress**

Circular progress as concept is here inspired by the idea from Paz (1965) on ‘circular process’. Elaborating on Rimbaud’s (1873) poetry that speaks of the present as an infernal or circular movement, Paz explores ‘circular process’ as a journey from no place to nowhere: a social state where “daily novelty ends up to being repeated and agitation results in immobility” (p.44). In his appreciation, circular process is evidenced by a state of no change, where “plurality resolves in uniformity without suppressing discord among nations nor divisions across consciousnesses” (p.44). This circularity of processes can be tied to progress when considering critiques on economic development by Zaid (1979) who takes a Mexican autocritique, as that from Paz (1950) which resonates to other identities and places to the point of becoming universal, to remark the absurdity of progress that keeps a large part of population at the edges of a better life. Zaid elegantly clarifies the repetitive absurdity around progress by stating that “the heaven that progress has promised for us, never ceases to arrive. [...] No one will stop progress.”(p.13); heaven by progress is here and it is not. For the purpose of this chapter, it is likewise important to mention Hirsh's (1976) notes that progress is not only unattainable by the very essence of progress but more so by the essence of social actions towards it that render it collectively and individually unattainable, even while it occurs on and on. Zaid’s critiques from humanist appreciations are brought along with those of Hirsh from economic philosophy understandings to meet Paz’s conceptualisations from lenses of poetry. These scholarships are brought to talk to one another and join into the notion of ‘circular progress’: an unproductive and socially cyclical progress.

The Atacama Desert evidences ‘circular progress’. We are already in another time, rediscovering a feeling that has accompanied those that were here before.\(^{562}\) Here, different versions of the same symbols are in each resource. The commensurability of resources in their imagery affects behaviour to them as symbols can attach responses to previous events; as fear has seemed to entail silence and passivity and closure in

\(^{562}\) See Paz (1967, p.37).
Chile. There is a negation to the replication of symbols and to the relations these have with humans. Symbols persist, but they now affect humans more than humans once did to symbols. That is perhaps when oblivion starts, when the producer is but a part in the flow that is created by what it created. The danger of the analogy of the nation is such, to forget that between the real and the imaginary there is a separation, and to forget on which side of the analogy one stands, in the real or the imaginary. Experiences in Chile around lithium for contracting its economy to greater value show this loss of touch with reality. An oscillation between the real and the imagined in an analogy that dominates the view of resources leads to a fogged mind. Remembrance is lost to produce materials in an ancient present of the structures set beforehand. A structure that on its own forms by the relations of symbols to people. Eternity in that structure is no less evident than its change. The past is no longer past when it is forgotten as linked to a future.\footnote{Deleuze (2017). Deleuze likewise differentiates of memories from past as the former being an ‘ancient present’.} Then it folds into its own as symbols press society onwards into another blinded loop bound to be forgotten.
“Meaningful offer creates its demand.

[But] it is easier to create means of payment than a meaningful offer” Gabriel Zaid
Conclusion

Lithium mining in Chile is a benchmark for the lead times to market for lithium materials used in battery energy storage. Lithium resources in the Atacama Desert are among the higher quality sources in the world and the country has built a regulation designed to support and encourage mining ventures from the private sector. Chile is then important for meeting rapid deployment of high quality lithium-ion batteries to electrify transport and cities. What happens in Chile is then highly relevant for decarbonising energy-intensive economic sectors through lithium-ion batteries. However, the possibilities that exist today in Chile to mine high quality lithium materials come from previous structures set since the 1800s in the Atacama Desert.

In Chile, saltpetre is a backbone for lithium in terms of threads among infrastructures, investments and politics. Saltpetre production in the Atacama Desert happened since the Spaniard colony in Chile and is closely tied to the Guggenheim family, to the history of copper nationalisation, and to struggles over market control. When Latin American lithium was commercially introduced to broader markets, it carried histories and narratives from saltpetre and copper onto its own ones. Corporate subsidiaries and share dynamics in the Atacama Desert link stakeholders for lithium, copper and saltpetre and evidence the relational background that formed lithium mining companies in the Atacama Desert. The thesis claims that along these relations, political and economic images and strategies to raw materials were carried from saltpetre and copper to lithium. The reproduction of histories and strategies from saltpetre to copper and lithium is argued in this thesis to be a coherent whole characterised as a continuum of legacies of mining in development where materials alternate chronologically throughout unchanged political strategies and economic aims.564

This thesis carries concepts for observing and joining the factors that enable lithium-ion battery technologies to thrive in the way they do. These concepts are market devices, assemblages and value chains. When applied to examine the uptake of lithium-ion batteries for energy storage, these concepts join demand-side factors favouring small and rechargeable electrical devices, with supply-side attributes and events of base metals chosen and used for such technologies, which includes cost and political structures of raw materials supply. The concepts used in this thesis show us that technology outcomes are not only a matter of objective features of intrinsic material efficiency and efficacy, but also and more importantly a matter of networks and social preferences based on political and economic perspectives and plans that determine mining and pricing of materials.

564 As often portrayed in analyses that focus on commodity booms, see Arboleda (2016), the imagery of a commodity boom is regularly close to a representation of commodity booms as defined by price rises in a specific material, i.e. a charted bubble. Still, this portrayal may indicate price loops as independent from one another and importantly as disconnected from past events and speculations respective to other materials.
Conclusion

The concepts used in this thesis intertwine with the notion of ‘agencement’ – the property of agency given by networks of market devices. Seeing agencements on and around lithium-ion batteries follows with observations that consumption is not exclusive of supply-side events, nor is it of demand-side speculations and behaviours. Events in the Atacama Salt Flat and their relation to global paths to electrification highlight how technology and material consumption choices are somewhat restrained to available options that are more than often affected by upstream costs and actions, which in the case of lithium in Chile are bound to politically devised economic strategies and images. From an agencement perspective, Images on materials become actants and hold agency. Images with agency become critical for mining ventures. Understanding the images associated with lithium and their founding factors is relevant to fully understand power dynamics and struggles underlying a technology whose presence in society seems at the surface inevitable.

Why do we need a new metaphor for batteries?

The dominant perception of batteries today is that they are enabling technologies for a transition from fossil fuels to renewable energy sources. Based on that, batteries are logically described and visualised as part of a good-natured use of energy and technology. This visualisation is notably employed by development banks, as The World Bank or the Interamerican Development Bank, Non-Governmental Organisations (NGOs) in conservation, as WWF and Conservation International, energy development agencies, as IRENA and IEA, national governments of developed countries, individual companies and industry associations working with renewable energy and decarbonisation, and companies working with battery materials. Notions of ‘greenness’ via batteries are increasingly being related with politics and wealth. For instance, WWF Australia calls to build Australia into a "battery nation", The UK government frames its critical metal strategy around battery manufacturing for “resilience for the future”, the United Nations states that “Li-ion batteries are one of the keys to unlocking the green potential” of transport and energy generation, IRENA refers to batteries as a “key solution” that “can enable greater feed-in of renewables”, the European Commission discusses batteries as a “key enabler of a low-carbon economy”,

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565 Callon, Millo and Muniesa (2007) regard the term agencement as the relations that give agency to people and objects and that essentially depend on multidirectional, dynamic and flexible causal relations. Thinking in terms of ‘agencements’, both supply and demand realities and fictions for a material gain agency and affect economic strategies, material supply and end use technologies. This thesis caries that theory into the empirical observations for lithium and batteries.

566 See Hirsh (1976) for notions of the ‘finality’ of activities as regularly contrasting to the perceived end-use purposes but rather attached to meeting production and supply ideas for ‘value’ creation. Hirsh further elaborates this by hinting on the practice of setting a demand for a specific supply rather than supply to a demand. The philosophical foundations of this latter point are attributed to Knight (1935b) who spoke of the economic presumption, where people produce to consume, is often inverted in reality to setting a consumption for producing. This point is key for the analyses that this work takes ahead. Beyond its contribution of facing economic philosophy and economic sociology literature to speak to one another, this work also contributes to give new empirical light to Hirsh’s economic philosophy theories.

567 This representation of batteries is used by civil society and agencies that promote renewable energy transitions, see for instance REN21 (2018) and WWF (2014).
the European Battery Alliance highlights that “batteries are a strategic part of Europe’s clean and digital transition”, even mining and oil company Shell speaks of batteries as “one of the enabling technologies we need”. These statements and the way they discuss batteries are influential to everyday appreciations of batteries, and they are also displayed by other people involved in battery supply chains. In those sectors grounded to raw-material mining, the perception of batteries as enabling technologies is attached to other forms of value besides energy transition.

As recounted in the chapters of this thesis, multiple actors in Chile refer to batteries as elemental for the lives we need to have. Overall, the main dominant narrative on batteries, as presented by the multiple proponents of batteries exposed in the thesis, is a narrative that presents batteries as being enabling technologies for myriad forms of value. For example actors in government in Chile refer to batteries as necessary for the progress of the nation, mentioned in the description of mining contracts for lithium mining in Chapter 1. Evocations presented in Chapter 2 of the experiences of electric-taxi drivers and musicians playing in electric buses both mention batteries as improvements for the attractiveness of their services. As evidenced in Chapter 3, employees of competition regulation agencies and State senators refer to batteries and associated industries as pillars that need to be protected for the nation to thrive. Hotel owners and mining heads in the Atacama Desert, whose voices are displayed in Chapter 4, see benefits of electrification to ‘clean’ their image and enable business to be compatible with green ideals that customers have. Finally and back to government actors, employees of the economic development agency in Chile also see batteries as carriers of value and enablers of industrialisation for the country, as discussed in Chapter 5. These are the main and relevant social actors identified in the thesis that talk about batteries as actors benevolent to broader society and as allies for economic prosperity.

With this supporting evidence as background, the statement ‘batteries are enabling technologies’ is critically understood in this thesis as a linguistic conjecture that arguably supports a metaphoric conceptualisation of batteries as benign participants. From there, the thesis identifies that an enabling battery is not only an agent but most importantly an ally. In the evidence described above and in the thesis chapters, batteries are thereby hardly conceived as adversaries. This realisation became a core concern for the thesis and led its analytical work to highlight that the actions and networks that are required to make batteries and to maintain them under a lens that observes nothing but positive value are yet unmasked in energy humanities studies. By highlight this gap in knowledge and proceeding with a rigorous attention to political and economic aspects of contemporary lithium mining in Chile, this thesis takes a step in removing the veil of positive imageries for batteries. A main assumption for proceeding with the intention to demystify battery conceptualisations is that skewed idealisations thwart observations and comprehensions of social realities, and that they also make conceptualisations structural when the purpose is no longer to describe but rather to orient and modify societal
engagements and behaviours. This way of thinking about the linguistic components that orient behaviours and preferences is used to explore the statement ‘batteries are enabling technologies’, to identify the social actors that think of batteries in such a way, and to examine the consequences that their actions and drivers bring to society and economy at large.

Metaphors may be at times the only way to mobilise epistemologies, realise futures and assign an adequate weight and coherent organisation to aspects of our experiences. So, a correct and coherent representation of batteries through a new and reworked structural metaphor –one different than a reduction of batteries to ‘enabling technologies’– may thence not only demystify batteries and the legacies carried by their raw-material bases, but pave the way for economic actions that adjust to the realities it projects. What happens if you substitute the idea where batteries sit for another one? One that levels the conceptualisation of batteries as enabling technologies with the differing meanings that batteries have as enablers and disablers. That is done in this work through a metaphor that includes the qualities that lithium pharmaceutics have as mental stabilisers, to metaphorically address lithium as medicine for grid stability. As elaborated in the section that follows and in the thesis chapters, the stabilising and poisoning effects from lithium in the human body mirror those that battery energy storage triggers in post-oil electricity grids.

Lithium supply in Chile viewed through a body-economy metaphor

The experiences in economy from lithium supply from the Atacama Desert are discussed in the thesis to result from two market devices: production contracts and demand forecasts. In practice, these devices are not designed together in lithium supply and battery making industrial spheres. They are however intertwined in the ways that one affects the other. Conceptually, these two market devices deploy agency to people that interact with them as mediums to broader market components and actors.

The first section of the thesis addresses contracts for lithium extraction in the Atacama Salt Flat to discuss today’s drivers of battery materials supply. In medical lithium treatments, the magnitude and outcome of toxicity risks depend on the acute or chronic characteristics of lithium dosages. Section 1 lays then the start of acute lithium intake into energy systems. Production contracts however do not look to mitigate climate change rapidly through the intake of lithium materials into the energy system. They are significant on their own as means to get more revenue from greater production. In the conceptual frame carried in this thesis, contracts create networks from obligations to price and trade in specific ways that assemble different devices and actors on lithium supply. The ideas of value that contracts deploy, which

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568 The assumption that social realities are constructed in great extent by skewed idealisations of people, objects and every-day life is drawn from the work of González García (2012) on metaphors and power.

569 Lakoff and Johnson (1985).
are namely focused on monetary gains from sales of higher priced products manufactured with lithium raw materials, are likewise dominant in the making of lithium trade to battery systems.

Battery futures in lithium production contracts in Chile are abstracted in global scales and are not seen to be grounded in Chilean territory. Explicitly, the first chapter details how lithium production contracts praise electrification through lithium-ion batteries without linking the availability of lithium materials with roadmaps for battery-based electrification in Chile or referring to Chilean State agencies involved in electricity markets and energy policy. Climate change mitigation is to happen elsewhere but enabled by metals sourced from Chilean territory—in that sense, projections of value are replicable to dependencies on external development. Value concepts on development from lithium extraction are justified in contracts by the contributions that lithium materials posit to sustainability. The evidence discussed in the first chapter shows that contracts deploy pricing and industrialisation mechanisms that are not aligned with the value propositions that established lithium suppliers hold, thereby negatively affecting the actual value that mining companies perceive from mining lithium in Chile. Contracts then alter relations with value in the search of new assemblages to benefit nation-making. The haste to incorporate more lithium into climate change mitigation for the finality of a political nation-making project is then deleterious to the environmental and value performances of mining operations.

Through the second chapter, Section 1 explores practices in battery deployment that don’t alleviate energy poverty and trigger long-term endurances for settlements where globally-defined battery types are not adequate. For instance in bus corridors that don’t modify the economic integration of marginalised urban sectors or in mining sites that don’t improve the electrical settings of nearby villages. The cases presented in the second chapter about experiences with batteries in buses, cars and mine sustain the argument that when batteries are sought to be concentrated for reaching modern visions of development that are linked to increased technology deployment, they lock-in mismatches with in-ground local infrastructural needs and visions. Specific to sites of battery operations, infrastructures sustain status quos in society by favouring technological deployments to sectors of society and industries whose value contribution better aligns with nation-making projects. Batteries are discussed to be attached to existing infrastructure and conceptually to existing ways of living and working without altering the core of settled social dynamics. The second chapter brings its cases and discussions on some battery deployments to argue that a deployment design based on superficial attachments loses on efficacy for societal change from reduced electrical and satisfaction precarities.

In the current mode of deployment as presented by massive amounts of busses into one single avenue leaving places with precarious services untouched, or into mines to propel ever increasing yields without alleviating blackouts of nearby villages, the amount of lithium needed to stabilise the energy system is only expected to increase along with the risks of negative side-effects. Negative side-effects of lithium supply are not solely of battery manufacture or end-of-life waste, rather they also can come from the use
of batteries in society and the dosage of lithium into energy systems. Conceptually, the treatment of lithium to clean fossil fuels from energy matrixes can be a source for poisoning. The chapters in sections 2, 3 and 4 explore the experiences around the energy systems where lithium treatments show negative side-effects through analogies of bodily symptoms.

The first symptom from lithium poisoning explored in the thesis is kidney failure, also called renal insufficiency. In the human body, renal insufficiency means deficiency to clean and trace components in the bloodstream. Chapter 3 in section 2 contrasts this to imagine corporate equities as the components in markets that are aimed to be traced and controlled by competition regulation agencies. In the case of rapid growth of mining companies involved in lithium supply, corporate equities are shown in Chapter 3 to be difficult to track and observe. An untraceable corporate equity market dynamic conceals not just corporate shares and their concentrations but likewise relations. From the concept of assemblages deployed through the thesis chapters, equity markets on mining are evidenced as relational spaces that join people, legacies of mining in economy, and geographies. Complex corporate equity markets weave networks of supply by ordering value negotiations. In the case of a lithium share purchase presented in Chapter 3, the Chilean competition regulation agency is evidenced to be placed as market regulator and protector of the nation’s interests for economic development. Competition regulation agencies are mostly mandated to safeguard equity markets in the specific territory of their operations from concentration of economic activities. However, the case presented with lithium mining shares in Chile evinces that political actors in Chile expected its competition regulation agency to protect lithium as the senate protected copper in 1966 and 1967 for nationalising Chilean copper. A dissonance between the State and its market regulator is then analogous to a renal system that is burdened to the point of collapse. A renal system fails when it is asked to do too much, the symbols of nation-making and geopolitical power that Chilean politics ascribe to lithium resources pressed the country’s competition regulation agency to the point of overwhelming their capacities and limiting its actions to its mandate. However, even when it leaved asides intentions to use lithium mining equities as political projects, the breath of the lithium market and its changing industrial landscape was too complex to have a clear view of how was such an industry possibly regulated from economic competition standpoints. As detailed in the evidence provided by the Chilean competition regulation agency expressed in Chapter 3, the economic regulator is not equipped to supervise the lithium market, even when State actors may want it to.

A failed renal system in the human body causes thirst. This symptom is explored in Chapter 4 in Section 2 through the water use of lithium mining in Salt Flats. The energy system is shown to increase water consumption for mining the metals needed to transition to renewable energy sources. Thirst is conceptually used in Chapter 4 to highlight social value conflicts. Thirst is then conceptually understood for water, value, rights and voice. Sectors of society that get their thirst satisfied, mould material supply into their favour. Different in-ground experiences with lithium mining at the level of mining sites, for
instance experiences in local settlements where water is scarce or in mining sites where brine is continuously pumped, lead to different ways to categorise lithium and water as either scarce or abundant. Dominant social values that favour mining are successful in leveraging their visions of increasingly available lithium resource quantities through the data products that are used to categorise brine, water and lithium materials. Chapter 4 finds that people that favour mining use data products that segment and nuance environmental features to justify greater material quantities, whereas people that oppose mining use narratives that homogenise resources to argue on material scarcity. The data products that are used by proponents of mining tend to be the same that are available for people that oppose mining and whose narrative is built from data products that don’t favour their arguments. An energy system with increased focus on mining is in great part the result of certain values at upstream stages being prioritised. Chapter 4 concludes that the values that are favoured in a mining intensive energy transition stabilise status quos attached to base metal mining and nation-making.

Lithium poisoning in the human body causes weight gain. In Section 4, weigh gain is thought of as analogy for the search of added monetary value. Chapter 5 in Section 3 goes through a case of value added strategies pressed by the Chilean government to industrialise battery manufacturing in Chile for exporting purposes, and to modify the selling price of lithium materials produced in the country. For governments in Latin America, ‘value added’ in visions of development from mining is generally a synonym to increasing export price. Contrastingly, as evidenced in Chapter 5, the mining companies that produce lithium materials in the Atacama Salt Flat have inter-company sales at prices below market floors to increase liquidity and reduce export duties. This in turn leads the State to attempt to nudge industries that sell higher priced products – as battery cathodes or assembled batteries – into settling in the country. Downstream processes, are equated in raw material extraction places in Latin America to more value. However, the means deployed in 2019 to attract downstream industry for battery manufacturing in Chile is shown in Chapter 5 to be have resulted ineffective due to the eagerness to add value without a concrete definition of ‘value added’ terms.

In the human body, weight gain from lithium intoxication is often accompanied with effects in the brain that lead to incoherence and confusion. Tropes on ‘value added’ deployed by Chilean government officials for battery manufacturing industrialisation are discussed in Chapter 5 to be confusing and incoherent. In the Chilean State’s intention build a nation that is closer to batteries than to raw materials, value added tropes were abused to the point of losing sense. Chapter 5 carefully details the times when these tropes were deployed by the Chilean government and how their meaning changed in each use. Importantly, in the case presented on Chilean battery industrialisation, adding value through battery manufacturing and exporting implied a detriment to value positions of lithium mining companies in the country who had to lower the prices of a considerable share of their output. Adding value to lithium served in a way to make the downstream industrialisation that was not accomplished for copper and saltpetre. Chapter 5 argues
that failures with past industrialisation goals brought desires to jump downstream in lithium supply and locate the nation in an industrial and value sphere separated from mining and regarded as more ‘modern’. It is highlighted in Section 3 that what mattered most from battery industrialisation was a higher selling price for exports. Chapter 5 in Section 3 argues that the concept of value added for lithium materials as part the Chilean government’s intention to industrialise battery manufacturing in the country was a transformation to higher export prices and State revenue, not a matter of domestic use or satisfaction. In conclusion and as evidenced by the failure of industrialisation attempts of the lithium value added agendas of the Chilean Government in 2019, obfuscation of tropes for value and alteration of prices for nation-making in Chile stripped value rather than enriched it.

Lithium poisoning in the human body causes memory loss. Section 4 addresses this symptom by examining the economic settings for mining that have preceded in the Atacama Desert. Chapter 6 in Section 4 argues that past economic settings on saltpetre and copper mining in the Atacama Desert are not remembered when contemporary development policies and economic strategies related to lithium mining in the Atacama Desert are planned and implemented. This final section claims that settings and symbols in Latin America that have resulted in negative consequence from development through mining reproduce when they are forgotten. Section 4 identifies that the symbols that are reproduced from saltpetre and copper to lithium are nation-making and power in world-scale trade. Further, Section 4 identifies that the economic settings that reproduce for saltpetre, copper and lithium mining are oligopolies, export tax exclusions, lax customs and overvaluations. These settings have framed experiences in the Atacama Desert to the point of becoming legacies to materials. These legacies affect how people interact and form networks for supplying materials at global scales. Chapter 6 in Section 4 discusses these settings through the key events that drove supply frenzies for saltpetre and copper, for instance guano for fertilising industries, saltpetre for weapons and copper for construction and electricity transmission. These histories are contrasted to the drivers for lithium supply, as electric mobility and small rechargeable electronic devices, to locate the economic settings that have been in place at each supply cycle for saltpetre, copper and lithium in the Atacama Desert.

Chapter 6 in Section 4 claims that the lack of recognition of symbolisms and imaginaries that replicate on resources from histories of mining enable economic settings to be effectively reproduced. These settings are discussed to favour economic status quos on mining to be untouched, for instance because saltpetre mining companies become shareholders of copper mining companies and thereafter shareholders of lithium mining companies. This thread of shareholding relations among saltpetre, copper and lithium is detailed in Chapter 6 and discussed as the result of symbol replication across these resources. Memory loss on the settings for mining in the Atacama Desert is then argued to work in favour of the value of mining companies in the area. Through the analysis of past economic settings in the Atacama Desert, Section 4 revisits practices that had been observed, detailed and discussed earlier in the thesis chapters
specific to contemporary lithium supply. In so, it highlights similarities and brings the reader to the central claim that material legacies are formed by the interactions between corporate equity with States and resource bases, and they detail important aspects of the economics of material bases for energy futures. Saltpetre and copper mining legacies and the way they are reproduced ultimately answer that lithium as energy object in society enables the construction nation-making projects and value chains that come past symbols of resources in development and economy that favour mining.

The symptoms of a lithium overdose that are compartmentalised by the thesis sections are in this way lenses to scrutinise effects that go beyond lithium and account for the economics of value and supply that involve mining in Latin America and particularly in the Atacama Desert. To conclude, batteries might enable renewable energy integration in a specific place but in other places they may also disable market oversight, water access, fair labour and industry inclusion, spatial and cosmological integration, insurgent politics, infrastructural independence, trade and pricing transparency and resource-fantasy dismantlement. Still, if the disabling characteristics of batteries may be outweighed by the contributions batteries make to bright green energy futures, it is important to note that enabling energy futures is not limited to energy systems alone. The enabling role from batteries spans from renewable energy systems for climate change mitigation to political projects for nation-making, infrastructure deployment, and trade and financial structuring. Batteries thence stabilise not only clean energy grids but also status quo for extractive and trade sectors. The metaphoric appreciation of lithium’s stabilising and overdosing properties in the energy system encourages us to question batteries and observe the lithium environment in a wider extent than what the linguistic conjecture ‘enabling technologies’ does.

Batteries enable renewable energy, but they may as well poison energy futures.

**Epilogue**

This research explores lithium as one of the materials that has generated great hype on future energy technologies. It enquires how it has come to that position in society and markets by looking critically at the economic strategies and settings that are employed in Chile, its leading exporting country. Coming from a country whose economic development has been historically attached to mining and export of raw materials, lithium evidences some aspects of global supply chains as colonial and broken but still operable. For instance, this research finds that lithium supply in Chile has a background of foreign-owned companies that mined saltpetre and copper, and that its current political debates in the country regard processes to resolve conflicts between the State and lithium mining companies. The thesis focuses on experiences that highlight relational problems among people involved in lithium supply. For instance mining contracts that result from lawsuits between the State and lithium mining companies, battery

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570 See Law (2017) for a science and technology studies perspective on how different things can be materially shaped by a same object.

571 This point follows from the concept of ‘resource environments’ from Richardson and Weszkalnys (2014).
Conclusion

deployment that neglect in-ground needs of most vulnerable settlements in cities and villages near mines, State investigations on corporate equity acquisitions between lithium mining firms, data products used to justify mining extraction and contest narratives that speak of water depletion in mining sites, and political programmes to alter raw material prices and attempt industrialising battery manufacturing. These aspects of lithium supply in Chile highlight the economic settings that persist in its supply, and are used to discuss market devices, assemblages and value chains for material supply. Inquiring raw material supply in the ruptures that are generated across mining and trade suggests a rich ground for expanding Actor Network Theory because it highlights conflict and unresolved tension as a component of networks.

This research offers a glance into veiled politics and unspoken economics of lithium supply. Its chapters scrutinise experiences to supply lithium, to price it and to speculate and create markets for it. Each chapter individually contributes to current debates on economic sociology and science and technology studies on value, objects and materials. As the chapters in this work show, the sections of systems of provision that considerably define material supply are sections where value is altered and defined. For instance contracted value as presented in Chapter 1, use value as presented on Chapter 2, equity value as presented in Chapter 3, social value as presented in Chapter 4, added value as presented in Chapter 5 and symbolic value as presented in Chapter 6. The different forms and meanings of value for raw materials are found in the course of this work to be intimately tied to private equity. Private equity, in the sense of corporate equities that are not publicly traded in stock exchanges and particularly in context of the private companies that initiated mining in the Atacama Desert, is scrutinised in the ways it underlines mining and locates materials and technology outcomes as enslaved in its own perception of value.

The theoretical contributions that this thesis provides to lithium supply studies regard the use of concepts of market devices, assemblages and value chains to understand contemporary supply chains in lenses of economic sociology. These contributions on scholarship that regard lithium supply are suggested to be taken onwards through two main approaches. The first is to expand on the analytical portfolio to material supply as brought by the chapters composing the thesis, particularly to the prospects of sourcing battery materials in developed countries. The second dwells with looking at other materials that are necessary for renewable energy systems and for lithium markets. How would the market structure for lithium supply look like when Europe sources a share of lithium materials? How would the corporate equity landscape look then? Would colonial threads and Latin American States still participate in new sourcing spaces? What about nickel, cobalt, manganese, tin, antimony and vanadium? What about other odd bedfellows as natural gas and coal? What is their place in the value of lithium and batteries? A rich entanglement across materials –in their technical assemblages, value constructions, histories in place, and private equity pasts and shareholding threads– could converge networks of raw material supply into trends of legacies and politics that together make up new-energy economics.
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