



# Lithium and development imaginaries in Chile, Argentina and Bolivia

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## ABSTRACT

The world's largest deposits of lithium lie in brines found underneath salt flats in the desert between Chile, Argentina and Bolivia. Globally, lithium may reduce fossil fuel use by making batteries for cars and renewable energy storage more affordable. This article analyzes ongoing debates about lithium in these three countries to identify what hopes, fears and expectations different stakeholders are bringing to debates about lithium. My approach builds on the idea of resource imaginaries, particularly the concept of sociotechnical imaginaries that highlights the importance of science and technology to projections of desirable futures. I analyze the tensions, visions and metaphors used by different stakeholders, including activists, the media, and state and industry officials, to imagine and thus legitimate lithium extraction. This study finds three co-existing positions in these debates: lithium as a commodity, as a strategic resource or as the subject of a sociotechnical imaginary. Chile, Argentina and Bolivia are converging on the last of these, best described as a reimagining of the relationship between mining and development in which lithium, through innovation and industry, will redefine the relationship between Latin American economies and global markets. This imaginary projects a binary between raw and industrial materials and deterministically assumes that science and technology will transform the former into the latter. Disagreements and challenges notwithstanding, the article argues that this imaginary is evidence of a crisis of confidence in development that is creating space for a more dynamic debate about the social value of mining and the proper role of the state in development. This convergence will have also implications for how sustainable, equitable and reliable lithium production will be.

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## 1. Introduction

In 2014 Tesla CEO Elon Musk announced that his company would build a lithium-ion battery “gigafactory” outside Reno, Nevada. Soon after, Tesla unveiled its Model 3 priced at US \$35,000. Although no prototype or test vehicle existed for consumers to try, in just one week 325,000 people paid US\$1000 a piece to pre-order it. Tesla hailed it the biggest one-week launch of any product ever. This episode speaks to the global excitement around lithium and the low-carbon technologies it enables. Lithium-ion batteries are expected to make electric vehicles and renewable sources of energy, like solar and wind power, feasible and (eventually) affordable (Tran, Banister, Bishop, & McCulloch, 2012). Indeed, Tesla is one of several companies behind a boom in lithium demand that has led investors to South America in search of staking their claim to the region's lithium deposits.

Investors encountered a complex and dynamic political terrain in Chile, Argentina and Bolivia, the three countries where the world's largest deposits of brine-based lithium are found. Various

South American stakeholders have been engaged in heated public debates about how to best manage the region's lithium deposits. Whereas some have argued for deregulating lithium, others demand greater state control, and yet others are concerned about the impacts on frontline communities. The three countries have different histories with lithium and natural resource politics. In Chile and Argentina, most natural resources are privately owned, but not lithium. Whereas Chile and Argentina have been exporting lithium for decades, Bolivia has yet to start large-scale commercialization. Bolivia's government, led by President Evo Morales, has re-asserted state ownership of all natural resources, but particularly of lithium. The unknown future of lithium inspires hope and optimism among stakeholders who hail lithium as the “new oil” or “white gold,” or as the potential catalyst for new forms of development. Yet others are skeptical, seeing lithium as a simple source of income or something far worse—the source of a new resource curse.

These wide-ranging debates resonate with recent scholarship on resource extraction in Latin America that highlights that struggles over natural resources are about more than dollars and cents; rather, debates about resources are also about competing visions of how the nation should grow, what levels of ecological harm and human risks society will tolerate, and what activities and groups

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should benefit from extractive activities (Hinojosa et al., 2015; Perreault & Valdivia, 2010; Watts, 2001). This article introduces to this scholarship the concept of *sociotechnical imaginaries*, which emphasize the role of science and technology in collective projects of nation-making. Using imaginaries as an analytical framework, the article captures the nuances, contradictions and complexities in lithium debates while identifying three salient (though partially overlapping) positions: (1) lithium as a banal, market commodity; (2) lithium as a strategic resource; and (3) lithium as the subject of a sociotechnical imaginary that reimagines how mining can serve development goals. Surprisingly, this article finds that despite the multiplicity of histories and co-existing discourses whirling around lithium, Chile, Argentina and Bolivia have been converging around the third position, with implications for how sustainable, equitable and reliable lithium production will be.

Debates about lithium are particularly dynamic because lithium's future is unknown and contested. Stakeholders can therefore gesture to possible futures without answering for the contradictions inherent in extractivism. For instance, while the *New Yorker* projected a hopeful future for Bolivia, asking “can Bolivia become the Saudi Arabia of the electric-car era?,” a local think tank dismissed lithium as providing a “present without a future” (Calla Ortega, Montenegro Bravo, Montenegro Pinto, & Poveda Ávila, 2014). When Tesla announced its battery gigafactory, NPR's Marketplace criticized that “Tesla bets on the present while the future races on,” suggesting that investments in lithium-ion batteries are nonstarters. Contradictions and practical challenges notwithstanding, lithium has an evocative power grounded in its uses in low-carbon technologies and its apparent novelty (Bruckman, 2015; Revette, 2016). At a time when scrutiny of the negative impacts of resource extraction is high, with some Latin American regions introducing mining bans (Broad & Fischer-Mackey, 2016), lithium provides an apparent “clean slate” in that its extraction history is unknown among a broad, global public. Cultural theorist Karen Pinkus (2017, p. 417) notes that fuels that “have not yet been inserted into a system that will consume them, use them up, [may]=hope”; though not technically a fuel, lithium fits this vision. These factors conspire to enable lithium to inspire among South American stakeholders a multiplicity of hopes and fears, analyzed in this article in the context of broader discussions about mining and development.

The article is organized as follows. Section two introduces readers to South American lithium, including how it is extracted, its known and expected impacts, and the political terrain. Section three reviews the literature on resource imaginaries and argues for the usefulness of sociotechnical imaginaries in development studies. A methods subsection is included at the end of the theory discussion. Section four offers the article's empirical material, organized in the three positions identified above. Section five reflects on the overlaps and distinctions of the three positions, the strengths and weaknesses of the lithium-induced sociotechnical imaginary, and the consequences of lithium politics for development debates. This is followed by a short conclusion.

## 2. Background to South American lithium mining

South American lithium production began in the 1980s in Chile and Argentina, home to several salt flats with mineral-rich brines (Fig. 1). Across the border in Bolivia, the Uyuni salt flat holds the world's single largest known deposit. These salt flats are popular with tourists and home to indigenous communities; for instance, sections of Chile's Atacama and Bolivia's Uyuni are protected sites. From the perspective of mining, these South American deposits stand out because of the abundance of lithium and low cost of extraction. More costly deposits of lithium are found in rocks (spo-

dumene and petalite) in China, Australia and elsewhere, and experiments are underway to extract it from hectorite clay (Pistilli, 2016). Extracting lithium from brines does not produce piles of sterile rock or toxic tailings, nor does it require high fossil fuel use or explosives (Kesler et al., 2012). Neither is lithium itself toxic.

The environmental impacts of brine lithium stem mostly from the use of solar radiation to evaporate large amounts of water from the mineral-rich brine (Anlauf, 2015; Kesler et al., 2012). Brines are pumped from underneath the salt crust into large evaporation pools. Below the crust lies a sponge-like formation that is porous, layered and irregularly shaped. Lithium is not renewable; along with other valuable minerals found in the brines, lithium accumulated in salt flats through leaching that occurred over thousands of years. Once in the pools, which are constructed on the surface of the salt flat, the brines are left for the sun to evaporate the water away over many months (Kesler et al., 2012). Adding sodium carbonate to the resulting sludge produces lithium carbonate, which is then exported to chemical facilities worldwide that produce battery-grade and other lithium products.

Scientific studies of the ecological impacts of lithium extraction from brines are still rare. Life-cycle assessments of electric vehicles do not single lithium out as problematic for the environment; instead, factors like the metal oxide paired with lithium (Padashbarmchi et al., 2015) and the source of electricity matter more (Oliveira et al., 2015). The sustainability of electric vehicles, these studies claim, will depend on other issues like battery lifetimes, manufacturing and recycling. By contrast, communities living near salt flats worry about the impacts on water, as the evaporation process is removing water from the world's driest ecosystem (Anlauf, 2015). Little scientific information about this is available, and that which does exist has been produced by the companies that operate there, raising questions of trust and credibility.

Will lithium mining produce wealth and development in this region? Will it be sustainable? Scholars, activists, journalists and politicians have been offering myriad tentative answers to these forward-looking questions, prompting a broad-ranging and complex debate about how to manage lithium-occurring in a context where both the future of lithium is unknown and the past of mining in the region is contested. Mining in Latin America has long produced a cyclical pattern of growth, in which periods of rapid growth are followed by busts driven by the collapse of commodity prices, overcapacity and environmental exhaustion (Bebbington, Bornschlegl, & Johnson, 2013). As detailed in the empirical section below, some fear lithium will reproduce this pattern. However, proving whether or not resource-rich economies under-perform compared to those without natural resources has proved difficult. Looking at data for minerals with longer extraction histories, some scholars argue there is no proof for the so-called “resource curse” (Brunnschweiler, 2008; Lederman & Maloney, 2008), while others disagree (Atkinson & Hamilton, 2003; Bjorvatn, Farzanegan, & Schneider, 2012; Boschini, Pettersson, & Roine, 2013; Orihuela, 2013).

Moreover, Andean countries recently saw increased investment in mining that produced wealth for some but was met also with resistance from groups concerned about negative environmental and social impacts (Bury & Bebbington, 2013). In countries like Ecuador and Bolivia, for instance, progressive leaders that came to power in the 2000s tried to legitimate mining by increasing the state's control of natural resources and claim to royalties, using these to increase social spending (Bebbington, 2012; Bebbington & Bebbington, 2012). Despite national welfare gains, case-studies find that even in these conditions mining remains a contradictory and harmful activity that entrenches inequalities (Bury & Bebbington, 2013; Gudynas, 2010; McKay, 2017). In this context where mining's contribution to development is contested –possibly

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