Energy Research & Social Science 130 (2025) 104428

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Perspective

# Chile's lithium exceptionalism: Strategic legacies and the contested future of the Salar de Maricunga

Vlado Vivoda [a,*], Natalie Ralph [b], Asmaa Khadim [c], Nigel Wight [d], Morgan D. Bazilian [e]

[a] The University of Queensland, Brisbane, QLD, Australia
[b] Warwick University, Coventry, United Kingdom
[c] Leiden University, Leiden, the Netherlands
[d] SMI-ICE-Chile, The University of Queensland, Santiago, Chile
[e] Payne Institute for Public Policy, Colorado School of Mines, Golden, CO, United States

ARTICLE INFO

*Keywords:*
Chile
Critical minerals
Lithium
Geopolitics
Governance
Sustainability

ABSTRACT

Lithium has become foundational for the global energy transition, yet its extraction raises unresolved dilemmas of governance, geopolitics, and justice. In Chile—the world's second-largest producer—lithium is governed under an exceptional legal regime, created during the Cold War to safeguard potential nuclear applications, which sets it apart from other minerals, most notably copper. This paper argues that Chile's approach represents a case of *lithium exceptionalism*: a uniquely Chilean configuration shaped by historical legal restrictions, renewed state ambition, and intensifying global competition. We examine the Salar de Maricunga, a high-altitude basin with world-class lithium concentrations but limited development, as a lens into these dynamics. Unlike the heavily industrialised Salar de Atacama, Maricunga remains a frontier of potential where state recategorisation, Indigenous consultation, and environmental safeguards are being tested in real time. The case shows how Chile's lithium governance sits at the intersection of competing pressures: sovereignty versus investor certainty, global demand versus ecological fragility, and procedural consultation versus substantive Indigenous rights. By situating Maricunga within wider debates on resource nationalism, justice, and the geopolitics of critical minerals, the paper extends scholarly and policy discussions of energy transition governance. It offers a test case for whether exceptionalist regimes can reconcile sovereignty, sustainability, and justice in the contested era of energy transition.

## 1. Introduction

Once a niche commodity, lithium is now central to global energy and transport systems. Its role in electric vehicle (EV) batteries and energy storage has elevated it to a strategic asset, triggering a geopolitical scramble for secure supply and downstream value capture. Since 2020, global lithium demand has tripled, with forecasts suggesting a further tripling by 2035 [1]. Framed as a "strategic mineral," lithium has become the focus of securitised supply chains and debates around governance, justice, and sustainability. At the same time, expansion poses complex challenges for producers—from environmental degradation and Indigenous rights to contested visions of sovereignty and development.

Chile, which holds the world's largest lithium reserves and is the second-largest producer [2], offers a particularly revealing case. Unlike copper, where concessions and private capital dominate, lithium has long been subject to an exceptional legal regime dating back to Cold War anxieties about nuclear uses. We term this *Chile's lithium exceptionalism*: a hybrid governance model in which legal restrictions, geopolitical alignments, and renewed state-led ambition combine to create a resource regime that is neither fully statist nor neoliberal. This exceptional status is unique to Chile; in other major producers such as Australia and Argentina, lithium is governed under ordinary mining concession regimes without special legal restrictions. The concept contributes to broader scholarly and policy debates on resource nationalism, critical mineral governance, and the geopolitics of the energy transition.

We examine the Salar de Maricunga, a geologically rich but

* Corresponding author.
*E-mail addresses:* v.vivoda@uq.edu.au (V. Vivoda), Natalie.Ralph@wbs.ac.uk (N. Ralph), a.n.khadim@law.leidenuniv.nl (A. Khadim), n.wight@smiicechile.cl (N. Wight), mbazilian@mines.edu (M.D. Bazilian).

https://doi.org/10.1016/j.erss.2025.104428
Received 25 May 2025; Received in revised form 29 August 2025; Accepted 28 October 2025

understudied site where state ambition, private capital, and local contestation intersect. With some of the highest lithium concentrations globally, Maricunga lies within the ancestral territory of the Colla people. Unlike the heavily industrialised Salar de Atacama, it remains a frontier of potential—not yet subject to multiple overlapping projects—making it a test of whether Chile can avoid replicating Atacama's socio-environmental harms.

Chile's evolving approach is shaped by a broader reassertion of state control, beginning with the 2016 *National Lithium Policy* and culminating in the 2023 *National Lithium Strategy* [3,4]. Articulated by the Boric administration, the strategy envisions greater state ownership (via Corporación Nacional del Cobre de Chile, CODELCO, and Empresa Nacional de Minería, ENAMI), stronger Indigenous consultation, downstream value capture through R&D and battery production, and designation of environmentally protected salares. It also aims to attract private capital and maintain macroeconomic stability, walking a fine line between nationalisation and liberalisation [5]. Maricunga, one of two "strategic salares" designated for majority state control, sits at the centre of this recalibration.

Our analysis situates the Salar de Maricunga case within broader debates in energy research and social science. First, we engage with literatures on resource governance and "neoextractivism" in Latin America, examining how states assert greater control over natural resources while remaining enmeshed in global capital flows [6,7]. Second, we consider the geopolitical dimensions of critical minerals, especially the positioning of Latin American-based lithium producers amid intensifying U.S.–China competition [8]. Finally, we explore how the energy transition reshapes, but does not resolve, longstanding tensions over land, water, and rights in Indigenous territories [9,10].

By bringing these threads together, this paper contributes to a growing body of work that critiques techno-optimistic visions of decarbonisation and emphasises the socio-political conditions that shape mineral supply chains [11]. We argue that Chile's lithium policy represents a case of *lithium exceptionalism*: a uniquely Chilean configuration in which legal, historical, and geopolitical factors combine to produce a hybrid model of resource governance that is neither fully statist nor neoliberal. The unfolding governance of Maricunga offers a provocative lens through which to assess whether such exceptionalist regimes can reconcile sovereignty, sustainability, and justice in the global energy transition. This Perspective challenges techno-optimistic views of the energy transition by showing that Chile's lithium governance is shaped as much by historical legacies, contested politics, and social struggle as by markets and technology.

The paper is structured as follows. Section 2 examines Chile's legal and institutional foundations for lithium governance, detailing how Cold War-era legislation established lithium as a non-concessionable resource and shaped a legacy of state exceptionalism that still influences policy today. Section 3 explores geopolitical realignments and Chile's emerging lithium diplomacy in the context of shifting geopolitics, the U.S.–China competition, Chile's courting by the European Union (EU) and other countries, and Latin American regional dynamics. Section 4 assesses Chile's socio-environmental governance challenges, including water risks, free, prior and informed consent (FPIC) implementation, and constitutional reform, situating these within broader questions of justice and legitimacy. Section 5 concludes by reflecting on the broader implications of Chile's evolving model for other critical mineral producers navigating the tensions between sovereignty, sustainability, shifting global energy transition imperatives.

## 2. Strategic legacies and the emergence of lithium exceptionalism in Chile

Chile's prominence as a lithium producer stems not only from geological endowment but also from a distinctive legal and institutional framework that still shapes its resource governance. Central to this is the concept of Chile's lithium exceptionalism: a strategic designation dating to the Pinochet dictatorship that subjected lithium to different legal treatment than other minerals. In 1979, lithium was declared non-concessionable, preventing private claims under normal mining regimes [12,13]. Extraction could only proceed through state-led ventures or special contracts—Contratos Especiales de Operación de Litio (CEOLs)—approved by the Ministry of Mining under presidential authority [14].

Cold War nuclear anxieties drove this classification. Lithium's potential role in thermonuclear applications led to its designation as a strategic resource reserved for state control. *Decree Law No. 2886*, alongside the 1982 *Organic Law on Mining Concessions* and the 1983 *Mining Code*, cemented this status, placing lithium outside the market-based rights that governed Chile's booming copper sector [15,16]. This legal anomaly, rooted in lithium's potential role in nuclear weapons development—particularly lithium-6 enrichment for thermonuclear fuel cycles—was unique to Chile. This exceptional status endures, making Chile less a transferable model than a historically contingent anomaly whose legacies continue to shape policy.

Over time, this exceptional status produced paradoxical outcomes. It enabled the state, via development agency Corporación de Fomento de la Producción (CORFO), to retain control over strategic leases in the Salar de Atacama, but also limited competition and blocked new entrants. Lithium production became concentrated in SQM and Albemarle, operating under grandfathered pre-1979 leases. As lithium demand surged in the 2010s and 2020s, the rigidity of this model became a liability, with critics warning that Chile was missing opportunities to scale production and generate downstream value [17].

Within this context, the Salar de Maricunga has re-emerged as a key expansion site. Located approximately 160 km (93.206 mi) northeast of Copiapó, near the Argentine border, and at an altitude of 3760 m (12,336 ft) above sea level, Maricunga is the southernmost salt flat in Chile. It spans about 80 $km^2$ (30.888 sq. mi) and has some of the highest lithium concentrations globally, averaging over 1000 mg/l, second only to the Salar de Atacama [18]. Situated within the ancestral territory of the Colla people, it has historically been a site of gold mining—led by Kinross, Barrick, and Goldcorp—before attracting sustained lithium interest in the past decade. Its more complex geology, including higher sulphate concentrations and distinct hydrology, raises both technical and environmental challenges, including risks to lagoons, wetlands, and fragile Andean ecosystems [19].

Despite these challenges, Maricunga has become a central focus of the Boric administration's National Lithium Strategy, with CODELCO tasked with advancing the state's role [20]. In 2017, CODELCO secured approval from Chile's Nuclear Energy Commission (CChen) to extract lithium in Maricunga and was granted a CEOL by the Ministry of Mining in 2018 [12,21]. In 2023, both Atacama and Maricunga were declared "strategic," requiring majority state ownership in any new lithium projects [22]. CODELCO was mandated to negotiate joint ventures and consolidate operational rights. By 2024, it acquired Lithium Power International, whose local subsidiary held environmental permits for the Salar Blanco project [23]. As a result, CODELCO now controls about 18 % of the salar's surface area, with further acquisitions under review [24].

To operationalise its mandate, CODELCO established three subsidiaries focused on lithium, including Salar de Maricunga SpA, dedicated to extraction activities in the salar. These entities reflect an institutional deepening of the state's role but also expose major capacity constraints. Despite its global copper reputation and benefit from high commodity prices, CODELCO has recently struggled with rising debt, project delays, and governance issues [25]. Perhaps in recognition of these limits, in May 2025, CODELCO's board approved a joint venture with Rio Tinto, giving the latter a 49.99 % stake in Salar de Maricunga SpA, while CODELCO retains 50.01 %, in line with the National Lithium Strategy [26,27]. This partnership may strengthen technical and financial capabilities, but its success will depend on the ability to navigate environmental regulations, ensure inclusive community engagement, and align with Chile's aspirations for a just and sustainable lithium

model [28].

Maricunga has also been shaped by recent legal and social contestation. In 2022, the Supreme Court upheld a protection appeal filed by the Colla Pai Ote and Colla Tata Inti communities against a project promoted by SIMCO/Grupo Errázuriz, citing non-compliance with International Labour Organization (ILO) Convention 169 and ordering consultation before proceeding [29]. In 2023, the Colla Pai Ote Community challenged the Blanco project in the Environmental Tribunal, alleging its observations had been disregarded in the environmental assessment. In early 2025, the Ministry of Mining concluded a formal Indigenous Prior Consultation on the modification of CODELCO's CEOL, reaching 11 agreements with six Colla communities on land use, monitoring, and employment [30]. While procedurally compliant, questions remain about whether these processes meet the standard of FPIC in a substantive sense [31].

Maricunga encapsulates the contradictions of Chile's attempt to modernise its lithium regime. It is where legal exceptionalism collides with market pressures, ecological limits, and justice claims. The state's dual role as both regulator and producer invites scrutiny, particularly when the same institution issues permits and promotes extraction. Multiple stakeholders, including foreign firms, Indigenous communities, regional authorities, and environmental groups, make consensus fragile and governance complex.

In sum, Chile's lithium exceptionalism is not merely a legacy but an evolving institutional condition, shaped by global market shifts and domestic political dynamics. Maricunga remains a frontier of potential: a real-time test case for whether a state-led model can deliver both economic development and socio-environmental integrity, or whether it will replicate the socio-environmental harm already evident in Atacama. How Chile navigates this challenge offers lessons not only for other Latin American lithium producers, but for the broader task of governing critical minerals amid accelerating demands for a just and sustainable energy transition.

Lithium's exceptional legal status contrasts sharply with Chile's approach to copper, where private concessions dominate and CODELCO operates under a distinct state mandate [32]. Unlike the copper sector's relative liberalisation, lithium's legal rigidity has constrained early-stage exploration and dampened investor interest—yet it has also allowed the state to reassert strategic control and shape extraction terms around social and environmental priorities. In response, the *National Lithium Strategy* introduced a differentiated model: strategic salares (Atacama and Maricunga) require majority state ownership; others are open to private-led development; and some are designated for environmental protection [5]. These distinctions aim to balance investment with commitments to sovereignty, stewardship, and legitimacy. Still, tensions remain, especially in Maricunga, where central questions persist: can the state lead without stifling innovation, and can such models ensure procedural legitimacy and environmental integrity amid historical mistrust and present-day volatility?

## 3. Geopolitical realignments and Chile's emerging lithium diplomacy

Chile's lithium sector operates within a shifting global landscape, where critical minerals are increasingly seen as levers of geopolitical power, national security, and climate strategy [33]. Amid intensifying U.S.–China competition and calls for "friend-shoring," countries endowed with critical minerals, including Chile, are navigating a new form of resource diplomacy, shaped not only by economic interests, but also by strategic alliances, ESG standards, and technological dependencies.

Chile accounts for 20.4 % of global lithium supply, second only to Australia, and holds 31 % of known reserves [2]. Alongside Bolivia and Argentina, it forms the so-called Lithium Triangle, home to over half the world's lithium [2,34]. While Bolivia pursues full state control and Argentina leans on provincial liberalisation, Chile adopts a hybrid model [32], asserting greater state authority while inviting foreign investment through joint ventures and ESG commitments.

This shift toward a hybrid governance and investment strategy has coincided with volatile lithium markets. Prices surged in 2022, collapsed in 2023, and modestly recovered in 2024. Major producers, SQM and Albemarle, warned that 2024 prices were too low to sustain new greenfield projects outside China. Chile's low-cost production, supported by its established infrastructure and long-term contracts, has helped it weather short-term shocks and retain a central role in supply chains [35]. However, it would be misleading to describe production as ESG-friendly without qualification, given persistent concerns about water use, biodiversity loss, and Indigenous rights violations in the Atacama and emerging projects such as Maricunga [36].

At the centre of these dynamics is a recalibration between Chile and its key partners. China views Chile as critical to its lithium strategy [37]. Tianqi holds 22 % of SQM, while in 2023 EV giant BYD signed an agreement with CORFO to build a lithium cathode plant in Antofagasta, leveraging CORFO's quota of discounted Atacama lithium [38]. Yet China's position faces growing constraints. The Boric government's strategy mandates majority state ownership in strategic salares, complicating Tianqi's influence. Although SQM's Atacama lease runs until 2030, CODELCO was tasked with negotiating a new joint venture. A preliminary SQM–CODELCO deal reached in late 2023 would restructure SQM's lithium assets under a new entity [22]. Tianqi has challenged this in court, citing lack of consultation and risks to its influence and dividends. These disputes have strained relations with Chinese stakeholders and may signal a shift toward more diversified, state-aligned actors [39,40]. For Maricunga, where CODELCO is leading negotiations, such tensions are decisive: they determine which partners are acceptable under majority state control and shape the future of one of Chile's last high-grade lithium frontiers.

The United States intensified its critical minerals diplomacy in Latin America during the Biden administration. The *Inflation Reduction Act* (IRA), passed in 2022, linked EV tax credits to critical minerals sourced from Free Trade Agreement (FTA) countries, including Chile, creating strong incentives for U.S. automakers to invest in Chilean lithium and bypass non-FTA competitors [41]. In March 2024, U.S. Treasury Secretary Janet Yellen visited Santiago to reinforce these ties, coinciding with the implementation of a new U.S.–Chile tax treaty and bilateral talks on lithium refining and battery tech [42]. Washington's rhetoric at the time echoed a broader Western push to "de-risk" from China by embedding lithium producers such as Chile within ESG-compliant frameworks.

Under the Trump administration, this strategic focus has persisted but taken a different tone. In April 2025, critical minerals, including lithium, were exempted from new tariffs on Chinese imports [43]. While tariffs returned on EVs, solar panels, and other green tech, critical minerals were treated as essential inputs requiring competitive sourcing. This shift reflects a pragmatic recalibration: maintaining economic pressure on China while securing vital inputs for U.S. manufacturing and defence. For Chile, this preserved its strategic relevance, though questions remain about policy consistency and the durability of ESG priorities under changing U.S. leadership.

The EU has also sought to deepen ties with Chile, albeit more cautiously. In June 2023, following Chile's *National Lithium Strategy* announcement, the EU signed a memorandum of understanding to promote sustainable raw materials value chains. This led to the Chile–EU Strategic Partnership on Sustainable Raw Materials, covering cooperation on environmental standards, traceability, research, and responsible financing [44]. Over €200 million in EU funding is to be channelled through CORFO, focusing on clean hydrogen and battery materials [45]. Yet despite this alignment, the EU's role remains limited, constrained by risk-aversion, fragmented coordination, and slower mobilisation.

Chile's challenge, then, is not simply to choose between partners, but to navigate multi-alignment while retaining policy space. Although 21

Latin American countries have joined China's Belt and Road Initiative (BRI), most, including Chile, view foreign partnerships through a pragmatic, transactional lens [46,47]. This reflects a broader trend in which diplomacy is increasingly shaped by strategic flexibility and practical economic considerations rather than ideological alignment [48]. Chile's lithium diplomacy exemplifies this posture: welcoming diversified investment while embedding sovereignty clauses and ESG benchmarks into contractual frameworks.

The strategic calculus also involves regional dynamics. Argentina, for example, has embraced a liberal investment climate with over 30 lithium projects at various stages, many involving Chinese firms such as Ganfeng. Bolivia, by contrast, has pursued full state ownership via Yacimientos de Litio Bolivianos (YLB), relying heavily on Chinese and Russian partners for infrastructure and technology transfer [49–52]. Mexico, after nationalising its lithium in 2022, has struggled to operationalise its plans due to institutional constraints and unclear investment rules [53,54]. Compared to its neighbours, Chile occupies a middle path: statist but open, protectionist in rhetoric but flexible in design.

Calls have emerged to integrate Chile more fully into multilateral frameworks such as the Minerals Security Partnership (MSP), led by the United States and its allies [55,56]. The extent to which the MSP will remain a central pillar of U.S. minerals diplomacy under Trump is less clear, as recent policy has emphasised domestic extraction and bilateral deals framed around 'America First' mineral security. Proposals to extend IRA subsidies to Chilean lithium cathode products [57] have likewise stalled as climate provisions face rollback. Instead, Washington now values Chile as a "trusted supplier" in bilateral arrangements, even as multilateral initiatives lose traction. These shifts create space for BRICS-led efforts to coordinate critical mineral policy in the Global South [58]. For Maricunga, this means CODELCO's partnerships are increasingly likely to be struck through bilateral deals rather than safeguarded by multilateral standards—placing greater pressure on Chilean regulators to uphold sovereignty and justice commitments domestically.

Chile's participation in this contested landscape will ultimately hinge on its ability to maintain domestic legitimacy. As debates intensify over state control, investor risk, and community consent, lithium governance risks becoming a site of fragmentation rather than cohesion. The Maricunga case illustrates these tensions vividly: state-owned CODELCO is at the helm, but its success depends on effective consultation with Colla communities, credible environmental safeguards, and international partnerships that move beyond extractive logics—that is, partnerships oriented not only toward resource extraction but toward shared governance, long-term ecological stewardship, and genuine social consent.

Tensions between national policy and foreign interests are not unique to Chile. In Bolivia, partnerships with Chinese firms have advanced despite concerns about transparency and limited community involvement [59]. In 2023, the Bolivian government signed agreements with CATL and other Chinese firms for direct lithium extraction (DLE) projects [8]. Similarly, Argentina's openness to foreign investment has led to rapid project approvals, with Ganfeng and other Chinese companies heavily involved especially in provinces such as Jujuy and Salta (that have seen ensuing community unrest and alleged state oppression) [60,61]. These cases highlight divergent governance pathways across the Lithium Triangle and underscore how geopolitical rivalry plays out through bilateral investment deals, diplomatic partnerships, and trade agreements.

In this context, Chile's posture of strategic multi-alignment may be its most valuable diplomatic asset. Rather than aligning exclusively with any one geopolitical bloc, Chile is positioning itself as a stable, rules-based partner capable of delivering ESG-aligned critical mineral supply. This approach allows Chile to engage both Western and non-Western actors while maintaining a degree of autonomy over its lithium strategy. Yet such positioning is not without risks. It depends on consistent regulatory performance, credible institutional governance, and active diplomacy. Diplomatic missteps or episodes of domestic instability, such as those witnessed during the constitutional reform process, could undermine Chile's strategic credibility. Still, Chile's evolving approach offers a contested but instructive model of how middle powers leverage resource endowments to shape global norms [62]. The question is no longer whether Chile will remain central to the lithium supply chain, but whether it can become a standard-setter for ethical, sustainable, and geopolitically adept resource governance.

## 4. Lithium, law and legitimacy: governance, rights and resistance in Chile's lithium sector

As Chile repositions its lithium sector at the core of a green industrial strategy, questions of governance and justice have moved to the foreground. The legitimacy of new extractive models rests not only on economic rationale or geopolitical alignment, but on the ability of institutions to address historical inequities, prevent environmental harm, and engage meaningfully with affected communities. The case of the Salar de Maricunga—still largely at the stage of *potential* development—offers a compelling test of whether Chile can move beyond extractive logics or whether it will reproduce the socio-environmental harms already evident in the Salar de Atacama.

Lithium mining in Chile is governed by a layered legal and institutional framework. Under Article 19(24) of the Constitution, the state retains absolute ownership of all mineral resources, including lithium [63]. While most minerals can be subject to concessions, lithium is legally "non-concessionable" and may only be extracted under special contracts authorised by the state [64]. The 1983 *Mining Code* operationalises this model, enabling the state to grant rights to explore or exploit resources under specific terms, often through CEOLs [16]. However, these contracts exist within a wider governance ecosystem involving environmental tribunals, water authorities, Indigenous law, and constitutional rights frameworks.

In practice, Chile's environmental governance ecosystem is fragmented. The SEIA (Environmental Impact Assessment System) requires project proponents to demonstrate compliance with sustainability and mitigation measures [65,66]. While formally participatory, SEIA often fails to account for cumulative and long-term impacts of lithium brine extraction, especially in fragile desert ecosystems [29]. Legal recourse through environmental courts or constitutional actions tends to be slow and biased toward powerful actors. For Indigenous and local communities, access to justice remains limited by technical, linguistic, and financial barriers [67]. These dynamics echo broader patterns of sociocultural risks associated with resource extraction for the energy transition across the Global South [68]. A few legal victories exist, such as the First Environmental Tribunal's ruling in favour of the Peine Indigenous Community in the Salar de Atacama, which ordered reparation by BHP Escondida, Zaldivar, and Albemarle for aquifer damage [36]. Yet the case entailed a resource-intensive legal battle, underscoring the uneven terrain on which environmental justice is pursued.

Nowhere are these challenges more acute than in the realm of Indigenous rights [69]. The Atacama Desert and surrounding salares are ancestral territories of Indigenous peoples, including the Atacameño and Colla communities [70]. Although Chile ratified ILO Convention 169 in 2008, mandating FPIC for projects affecting Indigenous territories, implementation has been inconsistent. Lithium projects in the Salar de Atacama have proceeded with limited or procedurally ambiguous consultation. Albemarle's agreement with 18 Indigenous communities, for instance, emerged outside formal FPIC processes and was initiated by the communities themselves [71]. More recently, CODELCO's alliance with SQM in late 2023 was announced without prior consultation, sparking backlash including rare blockades in the Salar. A formal consultation was later initiated in 2024, but only after the agreement was confirmed, raising concerns about the timing and legitimacy of the process. SQM's early operations also predated FPIC obligations and lacked meaningful community engagement [72]. These fragmented, often retrospective approaches have deepened mistrust toward both

state and private actors in the lithium sector.

The Maricunga project provides a sharper test of these dynamics. As noted in Section 2, in early 2025 the Chilean government concluded a formal consultation with six Colla communities, resulting in 11 agreements covering land access, monitoring, benefit-sharing, and employment. As the first state-led lithium consultation, it marked a procedural advance. Yet its narrow scope—focused on modifying a single CEOL—illustrates how FPIC has been reduced to narrow, project-level consent, rather than broader deliberation over the Colla people's long-term visions for development in their territories. As recent research shows, such deeper questions around autonomy, justice, and acceptable development have been largely absent from official decision-making in the past decade [73]. This narrowing of FPIC to project-level negotiations risks reproducing tokenistic consultation, raising questions about whether Chile's lithium governance can deliver substantive Indigenous co-governance.

Beyond consultation, water scarcity remains a central concern for local stakeholders—Indigenous and non-Indigenous alike—alongside fears of cultural heritage loss and enclosure of communal lands [74,75]. Brine-based lithium extraction is highly water-intensive: estimates suggest that producing one tonne of lithium carbonate equivalent requires more than two million litres of water, much of it drawn from fragile aquifers [76]. In the Salar de Atacama, extensive research links extraction to groundwater decline, reduced wetland flows, and habitat loss in ecologically sensitive areas, including flamingo breeding grounds [77–79]. In Chile, lithium extraction has already contributed to salt flat transformation and groundwater depletion, exacerbating water scarcity and threatening converged ecosystems across the Atacama [80]. While Maricunga's hydrology differs due to elevation and basin composition, early environmental assessments indicate similar risks to local lagoons and aquifers [81]. Scientific consensus remains contested, but there is broad agreement on the need for independent, continuous monitoring to assess and mitigate long-term ecological impacts.

These environmental concerns intersect with Chile's broader political moment. The constitutional reform process, initially energised by the 2019 social uprising, brought environmental rights and Indigenous recognition to the forefront [82]. The first draft constitution, rejected in 2022, proposed sweeping changes including plurinational recognition, rights of nature, and stronger consultation mandates. A second, more conservative draft was also rejected in 2023, leaving Chile's constitutional future uncertain [83,84]. Nonetheless, these debates reshaped discourse, raising expectations of environmental and Indigenous justice in resource governance.

The Boric administration's *National Lithium Strategy* frames sustainability, justice, and transparency as guiding principles. It proposes a public R&D institute, support for lower-impact technologies, and adherence to international initiatives such as the Extractive Industries Transparency Initiative (EITI). Yet implementation is uneven. Critics argue official sustainability commitments often remain aspirational, while under-resourced regulators limit the state's ability to enforce legitimacy in practice [30,85]. CODELCO's role in Maricunga highlights this enduring tension: as both operator and state actor, it embodies the conflict-of-interest risks built into Chile's exceptionalist regime.

Chile's experience suggests that procedural improvements—FPIC processes or environmental audits—are necessary but insufficient. A more holistic governance model is needed, one that aligns scientific and Indigenous knowledge, redistributes value more equitably, and embeds environmental rights into the core of lithium governance. Whether Maricunga can evolve into such a model remains open, but its outcome will carry implications far beyond the Andean plateau.

Globally, best practices are emerging to improve resource governance in Indigenous territories. Frameworks including the Initiative for Responsible Mining Assurance (IRMA), the Consolidated Mining Standards Initiative (CMSI), and the EU's battery passport regulations promote transparency, independent audits, and robust stakeholder engagement. In the Salar de Atacama, SQM and Albemarle have voluntarily submitted to IRMA assessments—SQM attaining IRMA 75 and Albemarle IRMA 50—signalling a growing, if uneven, uptake [86,87]. Chile has yet to mandate such frameworks across all lithium projects, though the *National Lithium Strategy* suggests alignment with EITI and broader ESG norms. To bolster procedural legitimacy and public trust, Chile could institutionalise third-party monitoring and ensure consultation processes are more participatory, iterative, and transparent, especially where confidence in state governance remains low.

## 5. Conclusion and policy implications: navigating lithium's contested futures

As Chile positions itself at the forefront of global lithium supply chains, it faces interlocking strategic, environmental, and political challenges that demand more than technocratic solutions. This paper has examined how these tensions converge in the Salar de Maricunga, an emblematic site where Chile's evolving lithium governance model is being tested in real time.

What emerges is a story of Chile's "lithium exceptionalism": a uniquely Chilean configuration in which legacy legal frameworks, national development ambitions, and rising global demand interact in ways that defy simple classification. Unlike Bolivia's model of full state control or Argentina's liberalised provincial regimes, Chile's hybrid approach blends public ownership with private participation under a centralised state framework. This reflects both historical continuities and new political imperatives, as the country attempts to move beyond extractive orthodoxy while remaining competitive in a fast-moving market.

Yet ambition alone does not guarantee legitimacy or success. The rollout of the *National Lithium Strategy* and CODELCO's leadership in Maricunga signal a new phase in Chilean resource governance. However, persistent vulnerabilities remain: fragmented institutions, limited enforcement capacity, and fragile trust between the state, Indigenous communities, and civil society. CODELCO's dual role as operator and regulator, and its recent joint venture with Rio Tinto [26–28] illustrates both opportunities for capacity-building and risks of conflict-of-interest and social legitimacy gaps.

Internationally, Chile's lithium diplomacy has grown more strategic. The country is increasingly courted by both China and the United States, each seeking long-term access to lithium for their requirements. Thus far, Chile has pursued deliberate multi-alignment, seeking to maintain strategic autonomy by engaging multiple partners without aligning exclusively with any single bloc. This offers a potential model for other resource-rich states. But sustaining this posture will require more than rhetoric: it depends on Chile's ability to deliver regulatory clarity, maintain transparency, and uphold social and environmental standards, especially as disputes such as the Tianqi–SQM case highlight risks of opacity and contested investor treatment.

Although calls for Chile's integration into multilateral frameworks such as the MSP were prominent under the Biden administration, its future under Trump remains uncertain. Current U.S. critical minerals policy emphasises domestic extraction and bilateral deals over collective arrangements. For Chile, opportunities remain to expand bilateral cooperation with actors including the United States, EU, Australia, and Canada, but such moves must be carefully managed to avoid unsettling its diplomatic balance with China. In this context, strategic collaboration and pragmatic diplomacy are as essential as governance reform in shaping Chile's role in a contested global minerals landscape.

Perhaps the most critical frontier is social acceptance. The Maricunga case highlights the limits of procedural compliance without substantive consent: agreements signed under narrow terms may erode legitimacy and provoke backlash. The success of Chile's lithium model will hinge on relational politics, institutional trust-building, and meaningful co-governance with Indigenous communities.

What, then, are the broader implications for Chile and other

resource-rich countries?

First, lithium's exceptional legal status can be a strategic advantage if harnessed thoughtfully. Chile shows how unique governance arrangements, backed by strong institutions, can embed ESG safeguards and public ownership from the outset.

Second, a new demand paradigm cannot be built on extractive business-as-usual. Moving from rhetoric to reality requires water stewardship, biodiversity protection, Indigenous co-management, and circular economy principles as core design criteria.

Third, governance of critical minerals must be adaptive. Chile's case demonstrates that rigidity can stifle both legitimacy and innovation; instead, governance should remain iterative and reflexive.

Finally, Maricunga disrupts any illusion that global climate goals can be pursued independently of local struggles over territory, justice, and sovereignty. The geopolitics of critical minerals cannot be separated from the politics of place.

Looking ahead, two scenarios appear plausible. In an optimistic trajectory, Chile balances state control with private capital, strengthens FPIC, and institutionalises ESG norms, with Maricunga emerging as a flagship project influencing global standards. In a pessimistic scenario, litigation, delays, and ecological degradation erode trust, polarise stakeholders, and undermine Chile's reputation. Either way, the lessons from Chile will resonate far beyond its borders. As other nations govern strategic minerals in the energy transition, Chile's evolving model will serve as both reference and warning.

The realisation of the optimistic scenario will also depend on the social performance of the companies at Maricunga. CODELCO faces technical constraints [88] but stands out as the only state mining company in Latin America consistently aligned with global sustainability standards [89]. Rio Tinto, meanwhile, continues to grapple with the reputational damage of Juukan Gorge [90], though its commitments in Serbia's Jadar lithium-borate project suggest efforts to move beyond legal compliance and rebuild trust with communities, stakeholders, and regulators [91]. Delivering a just and legitimate model will therefore require both firms to adopt leading practice standards in Indigenous engagement, transparency, and accountability, rather than relying on formal compliance alone.

Future research should assess whether Maricunga becomes a model or a warning. As a model, it could show how exceptionalist regimes enable alternative governance—through long-term ecological monitoring, Indigenous co-management, and adaptive legal frameworks. As a warning, it could reveal the limits of procedural consultation, the persistence of ecological degradation, and the fragility of social consent under geopolitical pressure. This dual horizon makes Maricunga both a policy experiment and an intellectual frontier for critical mineral research.

## CRediT authorship contribution statement

**Vlado Vivoda:** Validation, Project administration, Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **Natalie Ralph:** Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **Asmaa Khadim:** Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **Nigel Wight:** Validation, Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **Morgan D. Bazilian:** Validation, Supervision, Conceptualization, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

No data was used for the research described in the article.

## References


[1] International Energy Agency (IEA), Global Critical Minerals Outlook 2025, Paris. https://www.iea.org/reports/global-critical-minerals-outlook-2025, May 2025.
[2] United States Geological Survey (USGS), Mineral Commodity Summaries 2025, USGS, Reston, VA, 2025. https://pubs.usgs.gov/publication/mcs2025.
[3] Comisión Nacional del Litio, Informe Final de la Comisión Nacional del Litio, Gobierno de Chile, Santiago, 2015 https://ciperchile.cl/pdfs/2015/06/sqm/INFORME_COMISION_LITIO_FINAL.pdf.
[4] Government of Chile, Chile advances with lithium: these are the main definitions of the National Strategy. https://www.gob.cl/en/news/chile-advances-with-lithium-these-are-the-main-definitions-of-the-national-strategy/, 26 March 2024.
[5] Government of Chile, National Lithium Strategy: For Chile and Its People. https://s3.amazonaws.com/gobcl-prod/public_files/Campa%C3%B1as/Litio-por-Chile/Estrategia-Nacional-del-litio-EN.pdf, 14 June 2023.
[6] H. Warnecke-Berger, H.-J. Burchardt, K. Dietz, The failure of (neo-) extractivism in Latin America–explanations and future challenges, Third World Q. 44 (8) (2023) 1825–1843, https://doi.org/10.1080/01436597.2023.2215301.
[7] M. Svampa, Neo-Extractivism in Latin America: Socio-Environmental Conflicts, the Territorial Turn, and New Political Narratives, Cambridge University Press, 2019.
[8] M.D. Sanchez-Lopez, Geopolitics of the li-ion battery value chain and the Lithium triangle in South America, Lat. Am. Policy 14 (1) (2023) 22–45, https://doi.org/10.1111/lamp.12227.
[9] I. Rodríguez, M.L. Inturias, Conflict transformation in indigenous peoples' territories: doing environmental justice with a 'decolonial turn', Dev. Stud. Res. 5 (1) (2018) 90–105, https://doi.org/10.1080/21665095.2018.1486221.
[10] J.R. Owen, D. Kemp, A.M. Lechner, J. Harris, R. Zhang, É. Lèbre, Energy transition minerals and their intersection with land-connected peoples, Nat. Sustain. 6 (2) (2023) 203–211, https://doi.org/10.1038/s41893-022-01070-w.
[11] C. Dowling, G. Otero, Mirages or miracles? Lithium extraction and the just energy transition, Energy Res. Soc. Sci. 119 (2025) 103862, https://doi.org/10.1016/j.erss.2024.103862.
[12] G. Gutiérrez, D. Ruiz-León, Lithium in Chile: present status and future outlook, Mater. Adv. 5 (20) (2024) 7850–7861, https://doi.org/10.1039/D4MA00176A.
[13] H.G. Burnett, National resource control in Latin America: shifting dynamics of lithium and mineral reserves amidst rising commodity prices, Glob. Energy Law Sustain. 4 (1–2) (2023) 159–176, https://doi.org/10.3366/gels.2023.0085.
[14] Government of Chile, Decree Law No. 2 (1979) 886.
[15] Government of Chile, Organic Constitutional Law on Mining Concessions, 1982.
[16] Government of Chile, Mining Code (Law No. 18,248). Santiago: Official Gazette of the Republic of Chile, 1983.
[17] F. Irarrazaval, S. Carrasco, One step forward, two steps back? Shifting accumulation strategies in the lithium production network in Chile, Extr. Ind. Soc. 15 (2023) 101327, https://doi.org/10.1016/j.exis.2023.101327.
[18] J. Cabello, Lithium brine production, reserves, resources and exploration in Chile: an updated review, Ore Geol. Rev. 128 (2021) 103883, https://doi.org/10.1016/j.oregeorev.2020.103883.
[19] D. Roa, S. Navrud, K.E. Rosendahl, Accounting for unintended ecological effects of our electric future: optimizing lithium mining and biodiversity preservation in the Chilean high-Andean wetlands, Resour. Energy Econ. 75 (2023) 101389, https://doi.org/10.1016/j.reseneeco.2023.101389.
[20] CODELCO, Salar De Maricunga: Proyecto Codelco, 13. https://www.camara.cl/verDoc.aspx?prmID=289188&prmTipo=DOCUMENTO_COMISION, September 2023.
[21] Fernández C. Flores, R. Alba, Water or mineral resource? Legal interpretations and hydrosocial configurations of lithium mining in Chile, Front. Water 5 (2023) 1075139, https://doi.org/10.3389/frwa.2023.1075139.
[22] S. Carrasco, The role of business in Chile's lithium policy, in: From (De)Regulation to Industrialization? Chilean Lithium Policy in Comparative Perspective, Springer Nature, Switzerland, Cham, 2025, pp. 123–151.
[23] Lithium Power International, Activity report for the quarter ended March 2020. https://lithiumpowerinternational.com/wp-content/uploads/2021/08/LPI-Quarterly-22Apr20.pdf, 22 April 2020.
[24] A. Villegas, Chile's copper giant Codelco buys Australia's LPI, its first lithium acquisition, Reuters (28 October 2023). https://www.reuters.com/article/world/asia-pacific/chiles-copper-giant-codelco-buys-australias-lpi-its-first-lithium-acquisition-idUSL1N3BN3TN/.
[25] A. González, F. Sánchez, E. Castillo, The nationalization of the large-scale copper mines in Chile: successful investment or financial failure? Miner. Econ. 37 (4) (2024) 787–807, https://doi.org/10.1007/s13563-023-00335-5.
[26] CODELCO, Codelco elige a Rio Tinto como socio para el desarrollo de proyecto de litio, 19. https://www.codelco.com/prensa/2025/codelco-elige-a-rio-tinto-como-socio-para-el-desarrollo-de-proyecto-de, May 2025.
[27] Rio Tinto, Rio Tinto Partners with Codelco to Develop lithium Project in Chile's Salar de Maricunga, 19. https://www.riotinto.com/en/news/releases/2025/rio-tinto-partners-with-codelco-to-develop-lithium-project-in-chiles-salar-de-maricunga, May 2025.
[28] D.B. Solomon, F. Cambero, Chile lithium deal deepens Rio Tinto's push into 'white gold' EV metal, Reuters. https://www.reuters.com/markets/commodities/chiles-codelco-taps-rio-tinto-major-new-lithium-tie-up-2025-05-19/, 19 May 2025.

[29] M. Figueroa, C. Flores, N. Silva, Energy transition and indigenous communities in Chile: Integrating meaningful stakeholder engagement and energy justice, in: The Routledge Handbook on Meaningful Stakeholder Engagement, Routledge, 2024, pp. 332–351.
[30] S. Meckievi, Villa L. Zenteno, Chile's lithium Boom: A Green Revolution or Environmental Ruin? Columbia Law School, Columbia University, Climate Law Blog, 6 May 2025. https://blogs.law.columbia.edu/climatechange/2025/05/06/chiles-lithium-boom-a-green-revolution-or-environmental-ruin.
[31] International Labour Organization (ILO), Indigenous and Tribal Peoples Convention, 1989 (No. 169). https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:55:0::NO::P55_TYPE%2CP55_LANG%2CP55_DOCUMENT%2CP55_NODE:REV%2Cen%2CC169%2C%2FDocument, 1989.
[32] J.C. Orihuela, S. Serrano, Rules, institutions and policy capacity: a comparative analysis of lithium-based development in Argentina, Bolivia and Chile, Energy Res. Soc. Sci. 118 (2024) 103761, https://doi.org/10.1016/j.erss.2024.103761.
[33] V. Vivoda, R. Matthews, J. Andresen, Securing defense critical minerals: challenges and US strategic responses in an evolving geopolitical landscape, Comp. Strateg. 44 (2) (2025) 281–315, https://doi.org/10.1080/01495933.2024.2309424.
[34] S. Ellerbeck, Latin America's Lithium Triangle: Opportunities and Risks, World Economic Forum, 2023.
[35] Benchmark Mineral Intelligence, Lithium Price Outlook and Supply Chain Forecast, 2024.
[36] M. Akchurin, Environmental justice at the environmental courts? Mining, socioenvironmental conflicts, and environmental litigation in northern Chile, Extr. Ind. Soc. 15 (2023) 101279, https://doi.org/10.1016/j.exis.2023.101279.
[37] P. Maxwell, M. Mora, Lithium and Chile: looking back and looking forward, Miner. Econ. 33 (1) (2020) 57–71, https://doi.org/10.1007/s13563-019-00179-2.
[38] Oxford Analytica, Concerns over Chile's China dependence will mount, Expert Briefings (5 June 2024), https://doi.org/10.1108/OXAN-DB287452.
[39] C.A. Johnson, A. Clavijo, M. Lorca, Andrade M. Olivera, Bringing the state back in the lithium triangle: an institutional analysis of resource nationalism in Chile, Argentina, and Bolivia, Extr. Ind. Soc. 20 (2024) 101534, https://doi.org/10.1016/j.exis.2023.101534.
[40] D.B. Solomon, S. Morland, China's Tianqi appeals Chile ruling on SQM-Codelco lithium deal, Reuters (28 July 2024). https://www.reuters.com/markets/commodities/chinas-tianqi-appeals-chile-ruling-sqm-codelco-lithium-deal-2024-07-27/.
[41] White House, Fact Sheet: Two Years in, the Inflation Reduction Act Is Lowering Costs for Millions of Americans, Tackling the Climate Crisis, and Creating Jobs, 16. https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2024/08/16/fact-sheet-two-years-in-the-inflation-reduction-act-is-lowering-costs-for-millions-of-americans-tackling-the-climate-crisis-and-creating-jobs/, August 2024.
[42] U.S. Department of the Treasury, Remarks by Secretary of the Treasury Janet L. Yellen at press conference following bilateral meeting Minister of Finance Mario Marcel of Chile. https://home.treasury.gov/news/press-releases/jy2145, 1 March 2024.
[43] A. Cook, S. Cefai, S. Shaw, X. Du, J. Raboca, Critical minerals sidestep US 'liberation day' reciprocal tariffs, Fastmarkets (4 April 2025). https://www.fastmarkets.com/insights/critical-minerals-tariff-exemptions-us-market-impact/.
[44] European Commission, EU–Chile Partnership on Sustainable Minerals, Press Release, 2023. https://www.iea.org/policies/18084-chile-eu-strategic-partnership-on-sustainable-raw-materials-value-chains.
[45] S. Scholvin, Green hydrogen and linkage-based development in Antofagasta, Chile, Local Econ. 38 (5) (2023) 506–517, https://doi.org/10.1177/02690942231189671.
[46] L. Wu, Role constellations and foreign policy: Brazil and Chile's approaches towards the belt and road initiative, Can. Foreign Policy J. 30 (2) (2024) 144–159, https://doi.org/10.1080/11926422.2023.2281226.
[47] M. Zamani, The strategic position of Chile in Latin America, Polit. Sci. Secur. Stud. J. 6 (1) (2025) 10–19.
[48] J. Prantl, E. Goh, Rethinking strategy and statecraft for the twenty-first century of complexity: a case for strategic diplomacy, Int. Aff. 98 (2) (2022) 443–469, https://doi.org/10.1093/ia/iiab212.
[49] F.M. Dorn, K. Dietz, Legitimising lithium mining: global energy transition and green developmentalism in Jujuy, Argentina, Eur. Rev. Lat. Am. Caribb. Stud. 118 (2024), https://doi.org/10.32992/erlacs.10903.
[50] D.V. Kingsbury, Lithium's buzz: extractivism between booms in Bolivia, Argentina, and Chile, Cult. Stud. 37 (4) (2023) 580–604, https://doi.org/10.1080/09502386.2023.2179530.
[51] M. Obaya, The evolution of resource nationalism: the case of Bolivian lithium, Extr. Ind. Soc. 8 (3) (2021) 100932, https://doi.org/10.1016/j.exis.2021.100932.
[52] Seefeldt J. Lunde, Lessons from the lithium triangle: considering policy explanations for the variation in lithium industry development in the "lithium triangle" countries of Chile, Argentina, and Bolivia, Politics Policy 48 (4) (2020) 727–765, https://doi.org/10.1111/polp.12357.
[53] V. Vivoda, M.D. Bazilian, A. Khadim, N. Ralph, G. Krame, Lithium nexus: energy, geopolitics, and socio-environmental impacts in Mexico's Sonora project, Energy Res. Soc. Sci. 108 (2024) 103393, https://doi.org/10.1016/j.erss.2023.103393.
[54] M. Singh, Who Controls lithium? The global supply chain race, Financial Times, 2024.
[55] V. Vivoda, Friend-shoring and critical minerals: exploring the role of the minerals security partnership, Energy Res. Soc. Sci. 100 (2023) 103085, https://doi.org/10.1016/j.erss.2023.103085.
[56] V. Vivoda, R. Matthews, "Friend-shoring" as a panacea to Western critical mineral supply chain vulnerabilities, Miner. Econ. 37 (3) (2024) 463–476, https://doi.org/10.1007/s13563-023-00323-9.
[57] Bloomberg, Economy chief says Chile's lithium products likely to get US subsidies. https://www.miningweekly.com/article/economy-chief-says-chiles-lithium-products-likely-to-get-us-subsidies-2024-03-18, 18 March 2024.
[58] V. Vivoda, R. Matthews, N. McGregor, A critical minerals perspective on the emergence of geopolitical trade blocs, Res. Policy 89 (2024) 104587, https://doi.org/10.1016/j.resourpol.2023.104587.
[59] L. Hancock, N. Ralph, S.H. Ali, Bolivia's lithium frontier: can public-private partnerships deliver a minerals boom for sustainable development? J. Clean. Prod. 178 (2018) 551–560, https://doi.org/10.1016/j.jclepro.2017.12.121.
[60] J.G. Jauregui, Chinese investments in Argentina's lithium sector: economic development implications amid global competition, Extr. Ind. Soc. 20 (2024) 101551, https://doi.org/10.1016/j.exis.2024.101551.
[61] L.I. González, R. Snyder, Modes of extraction in Latin America's lithium triangle: explaining negotiated, unnegotiated, and aborted mining projects, Lat. Am. Politics Soc. 65 (1) (2023) 47–73, https://doi.org/10.1017/lap.2022.28.
[62] E. Jordaan, The concept of a middle power in international relations: distinguishing between emerging and traditional middle powers, Politikon 30 (1) (2003) 165–181, https://doi.org/10.1080/0258934032000147287.
[63] A. Wedemier-Allan, Shouldering the burden of renewable energy: Lithium mining in Chile's indigenous communities, U. Miami Inter-Am. L. Rev. 55 (2023) 178, https://repository.law.miami.edu/umialr/vol55/iss1/11.
[64] Fernández C. Flores, R. Alba, Water or mineral resource? Legal interpretations and hydrosocial configurations of lithium mining in Chile, Front. Water 5 (2023) 1075139, https://doi.org/10.3389/frwa.2023.1075139.
[65] E. Silva, The politics of policy implementation and reform: Chile's environmental impact assessment system, Extr. Ind. Soc. 15 (2023) 101321, https://doi.org/10.1016/j.exis.2023.101321.
[66] K. Bergamini, C. Pérez, Environmental impact assessment follow-up institutional and regulatory frameworks: lights and shadows of the Chilean experience, Impact Assess. Proj. Apprais. 40 (5) (2022) 423–436, https://doi.org/10.1080/14615517.2022.2039928.
[67] Á.A. Sanabria-Rangel, Environmental justice and globalization: putting a focus on indigenous peoples and local community rights and perspectives, J. Envtl. L. Policy 3 (2023) 1.
[68] J. Matanzima, J. Loginova, Sociocultural risks of resource extraction for the low-carbon energy transition: evidence from the global south, Extr. Ind. Soc. 18 (2024) 101478, https://doi.org/10.1016/j.exis.2024.101478.
[69] C. O'Faircheallaigh, Indigenous Peoples and Mining: A Global Perspective, Oxford University Press, 2023.
[70] M. Lorca, Andrade M. Olivera, M. Escosteguy, J. Köppel, M. Scoville-Simonds, M. Hufty, Mining indigenous territories: consensus, tensions and ambivalences in the Salar de Atacama, Extr. Ind. Soc. 9 (2022) 101047, https://doi.org/10.1016/j.exis.2021.101047.
[71] C. O'Faircheallaigh, S. Babidge, Negotiated agreements, indigenous peoples and extractive industry in the Salar de Atacama, Chile: when is an agreement more than a contract? Dev. Chang. 54 (3) (2023) 641–670, https://doi.org/10.1111/dech.12729.
[72] M. Becerra, Chile: Indígenas exigen transparencia en acuerdo de Codelco y SQM sobre el Salar de Atacama, Business & Human Rights Resource Centre (20 June 2024). https://www.business-humanrights.org/en/latest-news/chile-ind%C3%ADgenas-exigen-transparencia-en-acuerdo-de-codelco-y-sqm-sobre-el-salar-de-atacama/.
[73] Fernández C. Flores, Beyond extractivist logic? Contested dynamics of lithium frontier expansion in Chile, Energy Res. Soc. Sci. 122 (2025) 104029, https://doi.org/10.1016/j.erss.2024.104029.
[74] R. Haboucha, D. Jofré, Safeguarding indigenous heritage in the Chilean Atacama Desert: negotiating identity claims and community perceptions of long-term climate change, Herit. Soc. 14 (2–3) (2021) 216–241, https://doi.org/10.1080/2159032X.2022.2096543.
[75] H. Romero-Toledo, K. Jenkins, Contested waters, extractivisms, and territories: Indigenous people in Chile and the neoliberal crisis, in: Current Directions in Water Scarcity Research vol. 4, Elsevier, 2022, pp. 189–208.
[76] S. Mousavinezhad, S. Nili, A. Fahimi, E. Vahidi, Environmental impact assessment of direct lithium extraction from brine resources: global warming potential, land use, water consumption, and charting sustainable scenarios, Resour. Conserv. Recycl. 205 (2024) 107583, https://doi.org/10.1016/j.resconrec.2024.107583.
[77] B. Bustos-Gallardo, G. Bridge, M. Prieto, Harvesting lithium: water, brine and the industrial dynamics of production in the Salar de Atacama, Geoforum 119 (2021) 177–189, https://doi.org/10.1016/j.geoforum.2020.12.018.
[78] E.S. Rentier, C. Hoorn, A.C. Seijmonsbergen, Lithium brine mining affects geodiversity and sustainable development goals, Renew. Sust. Energ. Rev. 202 (2024) 114642, https://doi.org/10.1016/j.rser.2024.114642.
[79] P. Marconi, F. Arengo, A. Clark, The arid Andean plateau waterscapes and the lithium triangle: flamingos as flagships for conservation of high-altitude wetlands under pressure from mining development, Wetl. Ecol. Manag. 30 (4) (2022) 827–852, https://doi.org/10.1007/s11273-022-09878-8.
[80] M.S.A. Chaudary, Lithium dreams, local struggles: navigating the geopolitics and socio-ecological costs of a low-carbon future, Energy Res. Soc. Sci. 121 (2025) 103952, https://doi.org/10.1016/j.erss.2025.103952.
[81] M.A. Alam, R. Sepúlveda, Environmental degradation through mining for energy resources: the case of the shrinking Laguna Santa Rosa wetland in the Atacama region of Chile, Energy Geosci. 3 (2) (2022) 182–190, https://doi.org/10.1016/j.engeos.2022.03.003.
[82] N.M. Somma, Social protests, neoliberalism and democratic institutions in Chile, Can. J. Lat. Am. Caribb. Stud. 47 (3) (2022) 436–457, https://doi.org/10.1080/08263663.2022.2131702.

[83] M. Mazzeo, The process before the promise: ensuring indigenous recognition from the Chilean constitution, William & Mary Bill Rights J. 33 (1) (2024) 293.
[84] S. Issacharoff, S. Verdugo, The uncertain future of constitutional democracy in the era of populism: Chile and beyond, U. Miami Law Rev. 78 (2023) 1.
[85] F. Cortés, Chile's National Lithium Strategy: Key Governance Questions, Natural Resource Governance Institute, Blog Post, 7. https://development.resourcegovernance.org/articles/chiles-national-lithium-strategy-key-governance-questions, May 2023.
[86] Albemarle, Albemarle becomes first lithium producer to complete independent audit and publish IRMA report. https://www.albemarle.com/global/en/news/albemarle-becomes-first-lithium-producer-complete-independent-audit-and-publish-irma-report, 20 June 2023.
[87] Initiative for Responsible Mining Assurance (IRMA), Onsite Surveillance Audit at SQM Salar SpA this July. https://responsiblemining.net/2025/05/05/onsite-surveillance-audit-at-sqm-salar-spa-this-july, 5 May 2025.
[88] S. Carrasco, S. Madariaga, The middle-income trap, state capacity, and institutional business power: understanding the failed upgrading of the lithium industry in Chile, Bus. Polit. (2025) 1–25, https://doi.org/10.1017/bap.2025.10012.
[89] M.A. Zambrano-Monserrate, The role of governance in large-scale mining sector in Latin America, Environ. Sci. Pol. 168 (2025) 104071, https://doi.org/10.1016/j.envsci.2025.104071.
[90] D. Kemp, K. Kochan, J. Burton, Critical reflections on the Juukan gorge parliamentary inquiry and prospects for industry change, J. Energy Nat. Resour. Law 41 (4) (2023) 379–402, https://doi.org/10.1080/02646811.2022.2156202.
[91] V. Vivoda, J. Loginova, Lithium at the crossroads: geopolitical, economic, and socio-environmental complexities of the Jadar project in Serbia, Miner. Econ. (2025) 1–17, https://doi.org/10.1007/s13563-025-00517-7.