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Original article

Deciphering the impacts of 'green' energy transition on socio-environmental lithium conflicts: Evidence from Argentina and Chile

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ABSTRACT

The surging demand for lithium-powered electric vehicles and energy storage systems, driven by the low-carbon energy transition, is explored in this study regarding its impact on socio-environmental lithium conflicts up to 2019. We show the limitations of applying resource curse models for this enquiry due to unique characteristics of lithium cases and discrepancies between economic (demand, price and production) and conflict data. Combining quantitative political ecology methods with the explanatory power of ethnographic insights from critical resource geography, this paper builds and investigates a dataset encompassing 13 lithium and 41 non-transition-related resource ('NTR') conflicts in Argentina and Chile, mainly using data from Environmental Justice Atlas. Findings reveal distinct patterns between the two conflict types, with lithium conflicts experiencing increased initiation and intensification during 2010–2019 when all of the core conflict events, i.e., human, indigenous and environmental rights violations & reported health hazards, legal actions, mass mobilisations and violent events took place. Forms of mass mobilisations, such as protests and roadblocks, were commonly observed in both lithium (15 events) and NTR (19 events) cases with higher intensity per case in the former whereas rights violations (1 vs 13 events) and legal actions (5 vs 34) were less common in lithium conflicts.

We then discuss the impacts of the demand pressure on governments, companies and indigenous residents, with their responses to these influences. We demonstrate that, while State actors became more active in the economic sphere of lithium mining, they abandoned their role as the guarantor of indigenous citizens' rights until 2019. Economic opportunities, uncertainties and the 'green discourse' fuelled by the transition demand led the State and private actors to neglect indigenous concerns, rights and lifestyles. In the absence of state support, indigenous communities asserted their agency through mainly protests and roadblocks navigating the socio-environmental impact landscape amidst evolving state-company-community dynamics.

1. Introduction

Over the past decade, electric vehicles, powered by lithium-ion batteries and energy storage systems used in low-carbon energy systems ('EVENSS')[1] saw an unprecedented rise of the demand. The World Bank estimate that '[a] low-carbon future will be very mineral intensive because clean energy technologies need [on average] more materials than fossil-fuel-based electricity generation technologies. (…) [A]ny lower-carbon pathway will increase the overall demand of minerals.' (Hund et al., 2020, pp. 11–14).[2] This signifies that the ongoing transition towards less carbon intensive energy systems is a highly material and non-linear process, relying '(…)on the social construction of natural resources as commodities' (Forget and Bos, 2022, p. 4). A scrutinised aspect of the transition is socio-environmental conflicts occurring in source countries which are suggested to be caused by the mineral demand (Section 4). That said, most of the raw materials required for the system transformation are used across many industries which are not directly related to the transition (Section 3). As a result, identifying the link between the green transition and the injustices related to its production becomes trivial. For example, to what extent can we attribute

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[1] Includes commercial electric (e-)vehicles, e-buses, e-bikes and energy storage systems used in these vehicles and other low carbon energy systems such as solar and wind power.

[2] This suggestion is supported by the evidence presented in the literature for different types of low-carbon energy technologies, including but not limited to EVENSS (Hertwich et al., 2015; Kleijn et al., 2011; The World Bank, 2017; Buchholz & Brandenburg, 2018; Fabre et al., 2020; Sonter et al., 2020).

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the emergence of socio-environmental conflicts[3] in lithium mining regions to the energy transition, if we can at all, given that lithium batteries are also part of many consumer electronics and other products?

Our paper presents new evidence and builds an analysis on our existing stock of knowledge on the topic. We scope into one of key materials required for the transition, namely lithium, to understand the possible role of the energy transition in the emergence of social tensions in source countries. For our in-depth analysis, we use mining conflict cases having occurred in Chile and Argentina until 2019.[4]

We analyse 41 conflict cases involving resources with no relation to the transition (non-transition related resources or 'NTR's) and 13 cases involving lithium mining taking place in the two countries to observe (whether there are) particular impacts of the energy transition on the latter. Our main observations from 54 conflict cases, presented in Section 5, reveal a shift in conflict events related to lithium mining in Chile and Argentina after 2010, coinciding with –but cannot be explained by– the increased demand for EVENSS. We spot more conflict initiation and intensification in the 2010–2019 period for the lithium conflicts. Forms of mass mobilisations, such as protests and roadblocks, were commonly observed in both lithium and NTR cases whereas reports of human, indigenous and environmental rights violations and legal actions were less common in lithium conflicts. Mass mobilisations, combined with legal actions, seem to be the prominent form of resistance in achieving environmental justice ('EJ') particularly in lithium cases. The use of our framework to analyse lithium and NTR conflicts showcases its adaptability to studying diverse mineral conflicts, including those tied to both transition and non-transition scenarios.

In Section 5, we discuss the impacts of the demand pressure on governments, companies and indigenous residents as well as their responses to these influences. Our analysis shows that, while State actors became more active in the economic sphere of lithium mining, they abandoned their role as the guarantor of indigenous citizens' rights over time. Moreover, the opportunities and uncertainties created by the transition demand led the State and private actors to be more hardline in some extraction negotiations, which led to the violation of indigenous rights and lifestyles. On the other hand, indigenous communities asserted their agency through mainly protests and roadblocks in the absence of state support as response to the socio-environmental impacts of mining. Our medium-N study contributes to the scholarships on the political economy of the energy transition, political ecology and critical resource geography (see Section 4.2).

The paper begins by an overview of our case selection process. Following that, the paper delves into the role of lithium in the energy transition and the resulting demand pressure on its extraction. Subsequently, we note the limitations of the resource curse literature on commodity demand shock-conflict in explaining lithium conflicts and present the main literature our framework is built upon. In Section 4, we showcase our observations and Section 5 discusses the impacts of the transition on stakeholders and their responses. Finally, the paper concludes by summarising our contributions to the literature and offering further research pathways.

2. Selection of lithium and countries for case analysis

Lithium constitutes a good case for our research topic for four reasons. First, the share of demand for lithium commodities from the low carbon energy technology ('LCET') manufacturers (mainly EVENSS) within the total global demand has been very high and increasing over the last decade.[5] Secondly, lithium-ion battery powered EV technology is considered one of leading, if not the foremost, transport technologies under the energy transition. Neither the Li-ion batteries, nor the lithium content in them do not appear to be largely substitutable by about 2040 (Castilloux, 2019; Pillot, 2019). Third, lithium supply is highly dependent on extraction with little prospect for significant amount of recycled material supply until at least 2030 (see e.g., Gregoir and van Acker, 2022; Maisel et al., 2023).[6] Thus, the demand pivoted by the transition would largely be met via mining operations for decades to come (Simas et al., 2022). Finally, lithium demand is estimated to be multiplied according to latest projections by industrial and international authorities (Birol, 2022; Hund et al., 2020). In other words, if we are to observe implications of the energy transition on resource conflicts, lithium mining would showcase the most suitable cases.

The focus case countries[7] of the paper are Argentina and Chile. These countries, along with Australia and China, have been the top producers over the last decade (Fig. 1). Chile and Argentina present many conflict cases around lithium and non-transition resources with abundant data to make a comprehensive analysis. There is no indication of lithium conflicts in Australia, the world's top producer of battery-grade lithium minerals.[8] Similarly, no conflict data was found for China.[9]

Lithium metal is commonly extracted from hard-rock (mostly in Australia and China) or brine (mostly in Chile and Argentina) deposits. In the latter, the mineral-rich brine in underground salt flat reserves is first pumped to overground ponds and let evaporated under strong sun and dry winds of deserts. In terms of the regulation of lithium mining, it is worth noting that whereas the mineral is considered a 'strategic resource' under Chilean law,[10] it is not under the Argentine federal law. The provinces can however implement their own policies regarding the natural resources. Jujuy, for instance, classified lithium as strategic (Heredia et al., 2020).

Mineral types selected for cases are lithium minerals and non-transition resources ('NTR'). The latter include oil, gas, coal, gold and, in some instances, silver, which are not extracted for significant use in wind and solar power as well as EVENSS and other LCETs. Therefore, conflicts over mining operations where the pivotal objective is to extract

[3] We adopt a wide definition for 'socio-environmental conflicts' à la Reboratti et al. (2012), described in Table 1, and use relevant terms, such as 'disputes', interchangeably like in Bebbington (2011).

[4] This end year is selected as the end of observations in order to eliminate the interference of Covid-19 restrictions on conflicts and global mineral supply and demand.

[5] See Fig. 7 for the share of transition demand in the total demand of lithium.

[6] Recent estimates show that alternative demand-side circularity approaches such as technological advancements, material efficiency and the introduction of new battery technologies would have minor effect on reducing lithium demand by 2050 (Simas et al., 2022; Energy Transitions Commission, 2023).

[7] A case of 'mining conflict' covered by this paper do not necessarily imply that a large part of the population is against the mining projects of the case in hand. However, it does show that there is a degree of opposition and a dispute arising because of the given project.

[8] Dolega et al. (2020) is the only report mentioning lithium conflicts in Australia. Although there are reports of environmental risks affecting areas near the Wodgina and Greenbushes mines, the report does not indicate any documented harm to the local populations or opposition to mining due to these risks. Albeck-Ripka (2020) cited by Dolega et al. pertains to an iron ore project in Pilbara, not specifically to lithium-spodumene mining.

[9] Unlike the Australian case, it is difficult to draw further conclusions on whether or not conflicts do exist in China based on existing data and literature.

[10] During the Cold War era, the possibility of utilising lithium in nuclear fusion prompted the Chilean government to designate it as a national interest, following advice from the United States (Decree-Law No. 2886). Although it no longer preserves this status, lithium exploitation is still strictly regulated resource. That said, private companies are permitted to participate in the exploitation of the Atacama salt flat. They operate and extract lithium through lease agreements granted by the state agency CORFO, the owner of the mining concessions for lithium within the salt flat. Lithium exploitation is not undertaken by the Chilean state (Bustos-Gallardo et al., 2021; Dorn & Gundermann, 2022; Forget & Bos, 2022).

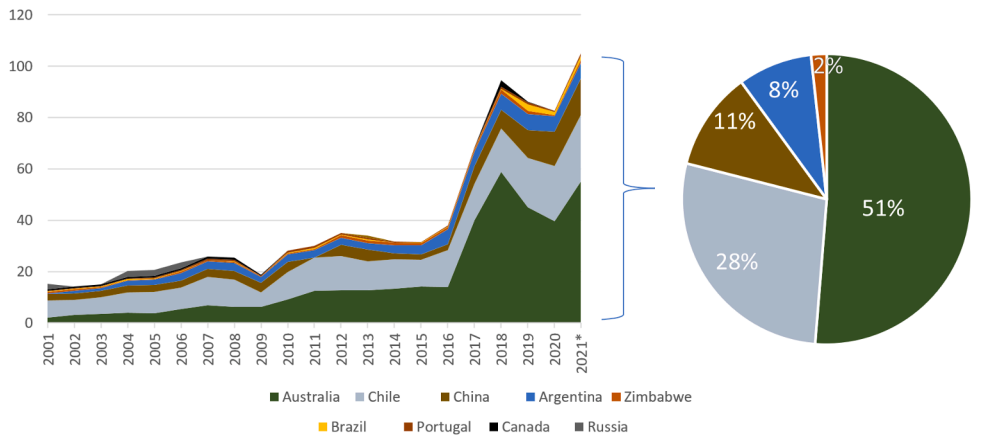

Fig. 1. Historic lithium minerals production (in thousand tonnes) by countries on the left and top five producers of the period 2011–2021 in the pie chart on the right (USGS, 2001–2022).

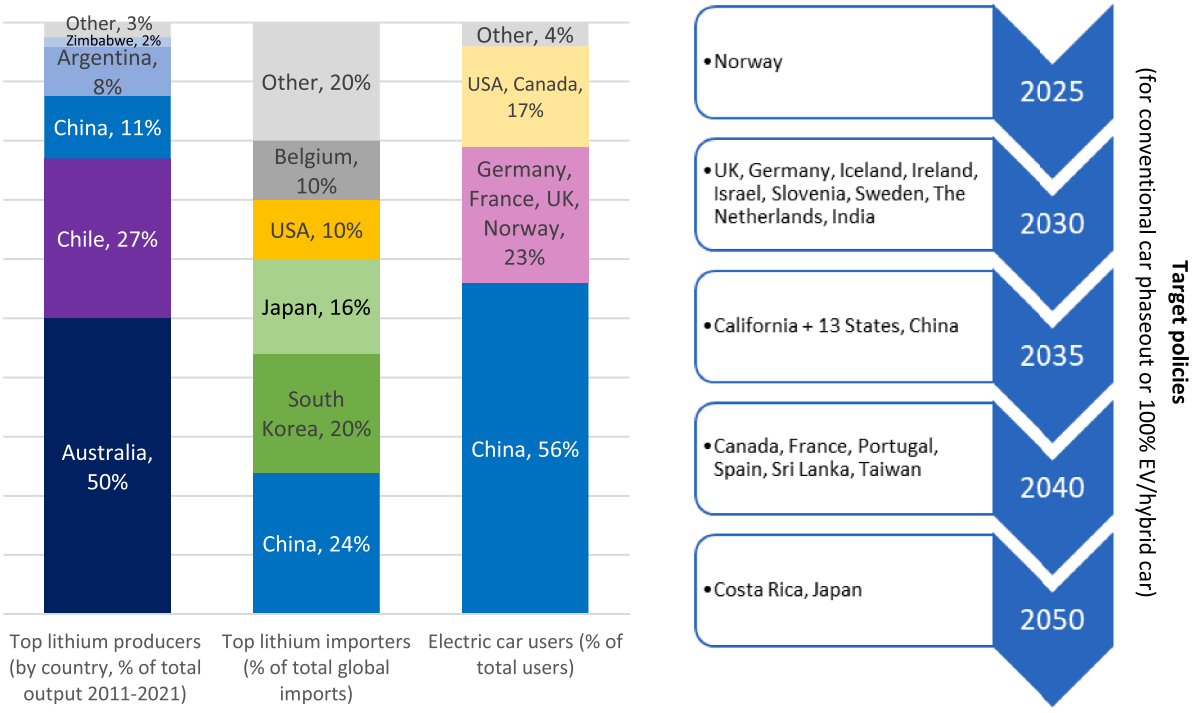

Fig. 2. Top lithium producers, consumers and announced decarbonisation pathways (Data from: Lee, 2020; Jerez et al., 2021; USGS, 2013-2022).

ores containing other transition-related minerals are not included.[11]

3. Growing share of EVENSS demand in lithium production

The expansion of EVENSS is part of the global transition towards a more sustainable resource use and efforts to meet soaring energy demand of industrial countries (Global Commission, 2019; Masson-Delmotte et al., 2021). The need for greener energy has been highlighted in various key international, regional and national policies such as UN Sustainable Development Goals, Paris Agreement (signed in 2016), EU's Green Deal and China's announcement of net-zero emissions by 2060 (Financial Times, 2020). As of 2021, 21 of the largest economies have declared their targets for EV deployment and ban on fossil fuel using vehicles between 2025 and 2050 (Fig. 2). The producers expanded the production significantly in response to the global calls to replace the conventional vehicle stock with e-powered fleets in the 2010s (IEA, 2023). These developments also mark the first three links in the causal chain which this paper aims to explore (Fig. 3).

Whereas the share of EVENSS in the global lithium corresponded to slightly over 1 % in 2011, the share of the industry rose to 44.4 % by the end of 2019. The EVENSS began to dominate the global li-ion battery market vis-à-vis consumer electronics starting from 2015, reaching to more than two-thirds (68.3 %) in 2019. Currently, EVENSS are the largest industry using lithium commodities, such as lithium hydroxide and carbonate, as input for final products (see Fig. 4).

From 2000 to 2019, contract prices for lithium commodities continually soared (Romei, 2016) and, despite volatilities in the 2010s, spot prices have similarly risen above the levels of previous decades.[12]

[11] For example, porphyry deposits in Chile often contain high copper concentrations. Although they also contain valuable metals such as silver, they are mainly extracted for copper.

[12] See USGS Mineral Commodity Summaries 2012-2021.

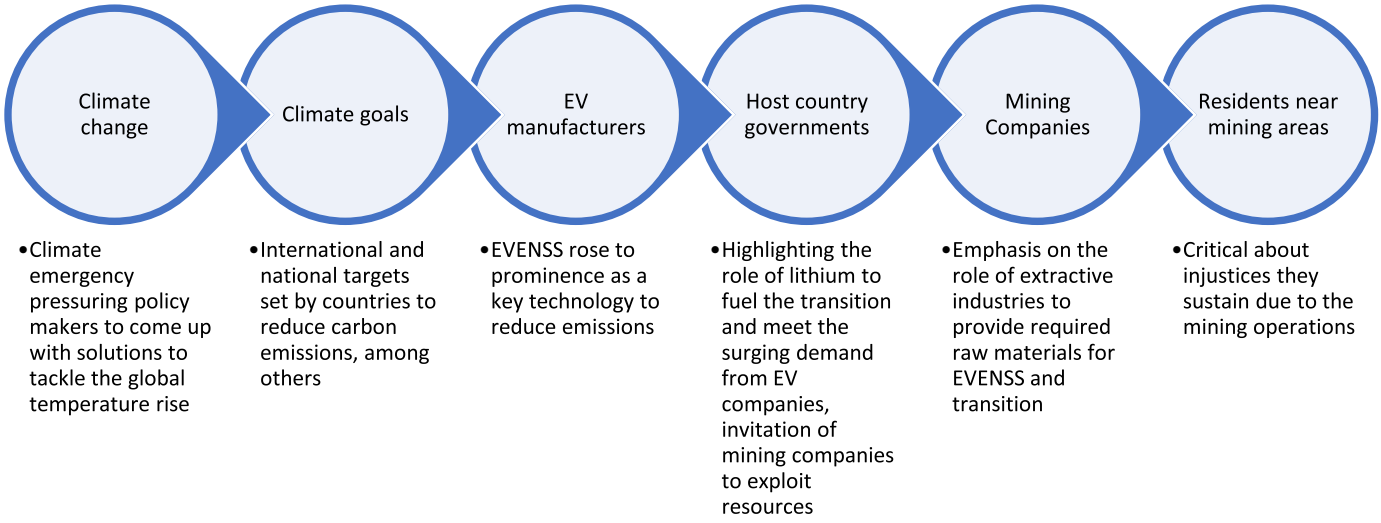

Fig. 3. The chain of relations leading to lithium conflicts.

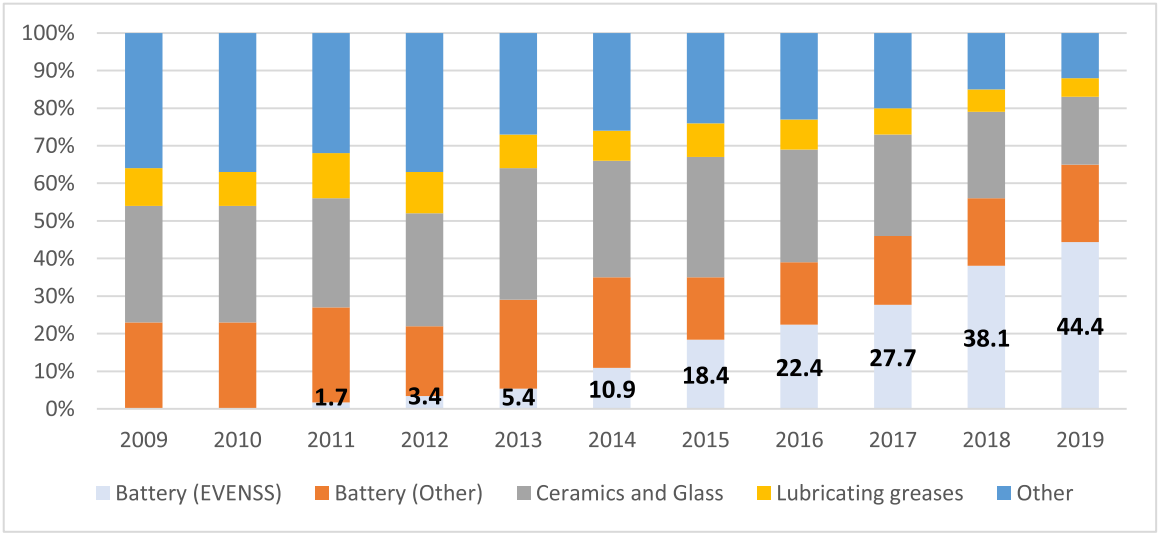

Fig. 4. Global demand for lithium by industries (Source: Based on 1.2 EVENSS lithium demand in Supplementary Document Tab-2).

Although short term spikes in lithium prices (Fig. 6) can be attributed to speculative market factors, the economists agree that the overall increase can be attributed to the current and growing (anticipated) demand from EVENSS (Romei, 2016; Uribe et al., 2021). Beyond the economic factors and perhaps more importantly, the policy-driven character of the energy transition, which manifests itself in the green growth scenarios and discourses of major economies and international organisations, is another driver of the lithium extraction (Bustos-Gallardo et al., 2021).

Several points are noteworthy here. For one, the transition-led EVENSS demand has a growing influence on lithium supply chains particularly from the turn of last decade (Bos and Forget, 2021). Secondly, while remarkably increasing each year, the share of EVENSS in the total consumption remained small until 2014 and was not even an absolute majority by 2019. Finally, the lithium market dynamics are driven by not only actualised EVENSS demand but also anticipations about lithium's economic and political importance for the transition (also see Section 6).

4. Literature review

4.1. Existing literature on transition demand and lithium conflicts

The overarching focus of our research agenda is to explore the impacts of the energy transition on conflicts linked to mining of lithium. The literature generally agrees that while promoting a less carbon-intensive energy system in some parts of the world, the transition also creates socio-environmental injustices leading to conflicts between actors in regions where the key materials required for manufacturing the LCET are extracted. Whereas lithium extraction is concentrated in South America and Australia-Pacific regions; East Asia, North America and Europe are leading industrial importers of the metal (to be used as an input for EVENSS and electronics manufacturing) (see Bos and Forget, 2021, pp. 172–173). The latter have also the most EV users; however, none of the leading producers are amongst the countries with largest EV fleets, nor those announcing a decarbonisation policy for the transportation sector (Fig. 2). The academics and environmental justice organisations ('EJOs') call for a fairer distribution of the costs and benefits of the energy transition along the global production networks (Göbel, 2013; Jerez et al., 2021).

The political ecology literature on the social impacts of mining in

South America emerged hand-in-hand with key mining developments in the region. The global commodity demand boom from the late 1990s triggered a tremendous surge in extractive activities which, in turn, led to more interaction between companies and remote indigenous communities (Bebbington and Humphreys Bebbington, 2011). The vast majority of early works on firm-community social conflicts are grounded in ethnographic research (Bebbington, 2007; Bebbington et al., 2008, 2011, 2012; Babidge, 2013, 2016; Franks et al., 2014). The latter have predominantly utilised qualitative case studies covering one or few countries and process-tracing methodologies, which could be particularly apt for emerging topics (Eisenhardt, 1989) besides ongoing research topics. Researchers typically choose cases with pre-existing conflicts, often focussing on emblematic and extreme instances.[13] This approach has yielded valuable insights into conflict development, social movement strategies and the identification of potential causal variables (Haslam and Ary Tanimoune, 2016).

In the early 2010s, the key discussion topic about lithium boom was whether we had enough lithium reserves on the earth crust to meet the material demand for electronics and rising EVENSS but not its social impact (Mohr et al., 2010). Whereas the debates now shifted to the socio-environmental impact, the transition's role is a priori assumed endogenous and significant by the literature while discussing lithium conflicts (Dorn, 2021; Jerez et al., 2021; Escosteguy et al., 2022; Díaz Paz et al., 2023). In several papers, Church and Crawford cover the transition's role in local resource curses[14] and the creation of 'green conflict minerals', in the contexts of cobalt, nickel, rare earth elements (Church and Crawford, 2018, 2020), bauxite and lithium (Church and Crawford, 2018).[15] We advocate that the place of the energy transition within the complex demand spectrum for lithium (and other transition raw materials) and its reflection on conflict dynamics require further attention.

In the causal chain drawn above (Fig. 3), the implications of the transition are clear on EVENSS demand and motivations of lithium producers. But how can we observe the impacts of lithium demand on the occurrence or intensification of conflicts? Can we quantify the transition's impacts on conflicts? (How) does the transition shape the relationship between main conflict actors? An approach to answer these questions could be offered by the branch of the resource curse scholarship studying the conflict implications of commodity demand/price shocks on social conflicts in source countries. This scholarship conceptualises a demand-driven resource curse where positive commodity price shocks to capital-intensive industry (e.g., large scale mining 'LSM') or a negative price shock to labour-intensive industry (agriculture, artisanal scale mining 'ASM' etc.) increase the likelihood of an internal conflict. This would be the case particularly in a context where unemployed labour would steer for the labour-intensive sectors or an 'appropriation sector' because of the expansion of LSM. ASM is operated by illicit organisations that require manpower to be used in mining or seizing the extracted minerals (Dal Bó and Dal Bó, 2011; Dube and Vargas, 2013; Stoop et al., 2019; Sánchez de la Sierra, 2020; Stoop and Verpoorten, 2021). Using a similar model, Berman et al. (2017) suggest that skyrocketing commodity prices, driven by aggressive demand from emerging economies, were central to up to 24 % of all violent conflicts taking place in Africa from 1997 to 2010. Based on this literature, a multi-variate model could be built to analyse the relationship between the lithium demand of EVENSS (or price as its indirect proxy) and conflicts.

However, the particular dynamics of disputes over lithium sources cannot be explained with such a model. In the context of lithium extracting countries, there is no illicit organisation to host people who would work in the appropriation of the mineral. Lithium conflicts do not occur because of the price shock favouring LSM vis-à-vis other sectors.[16] The core problems circle around socio-environmental impacts on affected communities and the unequal share of tax revenues and investments brought by mining. While the demand-shock models often use indicators such as casualties in violent armed conflicts, lithium conflicts would involve mass mobilisations (see Section 5). Lastly, there are methodological limitations to applying the price or demand shock-conflict approaches above to lithium conflict cases. The quantified conflict data[17] on lithium cases is really scarce unlike the datasets used in the demand shock-conflict literature. Hence, it is challenging to get statistically meaningful results by replicating existing demand shock models in the context of lithium conflicts.

The nature of lithium conflicts calls for a departure from approaches used in previous papers. Beyond year-by-year consumption, the anticipated demand is another factor shaping actor motivations, making it challenging to establish a clear statistical relationship between prices/demand and conflicts.[18] The role of projections and uncertainties also highlights the limited applicability of existing models, such as those exploring insurgent social group dynamics with commodity price/demand on year-on-year basis. Moreover, the transition's policy- and norm-driven shock requires a specific analysis (Section 6.1.2) and differs from other commodity price shocks. Lithium extraction is predominantly carried out through LSM, requiring lengthy permit processes and lacking instant project initiation (Bustos-Gallardo et al., 2021). Unlike commodities like diamonds or gold, lithium is not lucrative in small quantities, hence appropriation of mines or taxation of ores over transport routes would not worth the cost of an armed initiative, let alone the absence of such insurgencies in lithium production areas. Thus, price shocks in the lithium market do not directly translate into violent armed confrontations.

4.2. Methodology and main literatures used in this paper

The study of lithium conflicts necessitates a novel approach to conflict data collection and analysis. Our paper builds on two scholarships which tended to grow apart so far: EJ literature, for data collection and analysis; and the recent critical resource geography scholarship on lithium mining, to understand changing actor dynamics.

We exploit the data inventory and quantitative approach developed by the EJ literature (e.g., Özkaynak et al., 2015; Haslam and Ary Tanimoune, 2016; Martinez-Alier et al., 2016; Avila, 2018) to observe the similarities, differences and trends amongst lithium and NTR conflicts in Argentina and Chile, which together make up 54 cases, adequate for medium-N research.[19] Our comparison combines the most-different system research design with Mill's methods of difference and agreement (Levi-Faur, 2006a). This approach allows for the strategic observation of differences and similarities and, by studying them sequentially,

[13] E.g., Dietz and Engels (2017) use cases from Colombia to demonstrate the conflict implications of the commodity demand boom between 2000 and 2012 in the context of South American mining projects.

[14] A typical definition of 'resource curse' is offered by Arellano-Yanguas (2011): The extraction of high-rent natural resources is prone to induce unexpectedly low economic growth rates and various negative governance consequences, particularly in nations with previously vulnerable political structures. These outcomes encompass authoritarian tendencies, increased militarisation, regional separatism, and disparities in socioeconomic conditions.

[15] Except for nickel in Guatemala, their case countries are outside South America.

[16] Also note that lithium mining is not conducted at artisanal scale in any part of the world.

[17] E.g., types of conflicts, the number of occurrences, their precise geo-location etc.

[18] For instance, the actual lithium consumption share of EVENSS' in a given year, say 38.1% in 2018 (Fig. 4), cannot be interpreted as its part in the occurrence of conflicts.

[19] According to Levi-Faur (2003), a 'medium-N' comparative study would typically contain between two and 100 cases.

the generation of more generalisable explanations (Levi-Faur, 2006b; Mollinga and Gondhalekar, 2014; Ragin, 2014). We attempt to understand how changes in a situational attribute (the demand shocks coming at different times; first the global commodity demand boom from Southeast Asia in early 2000s and then, the transition/EVENSS demand in the 2010s) impacts on the control variable (NTR conflicts) and the dependent variable (lithium conflicts) while other situational factors such as countries (Argentina and Chile), sector (mining) and observation periods are held constant across all the variables.

In our analysis of transition impacts and actor responses, we primarily tap into the explanatory foundations laid out by the recent scholarship on lithium conflicts which mostly relies on the primary evidence from the region. The literature presents rich insights into the reconfiguration of government-company-community relationships (Bos and Forget, 2021; González and Snyder, 2023; O'Faircheallaigh and Babidge, 2023) as well as the use of 'green discourse' by pro-extraction actors (Bustos-Gallardo et al., 2021; Forget and Bos, 2022; Mejia-Muñoz and Babidge, 2023). Our medium-N study contributes to the generalisability of the strong theoretical background developed so far by the ethnographic single and small-N case studies[20] (King et al., 1994).

5. Observing the impacts of the demand pressure in lithium conflicts

The purpose of the observations collected for this study is to give a comparative view about the occurrence of lithium and non-transition resource conflict events to help us understand if there is a difference between their frequency and intensity due to the booming demand for raw materials.

The data required to make the observations was retrieved using Environmental Justice Atlas ('EJAtlas'), with complementary literature review and exploratory expert meetings with sector representatives and local/international environmental justice organisations ('EJOs') taking part or supporting the resistance movements. The EJAtlas database compiles both qualitative and quantitative data for each conflict, encompassing case descriptions, project characteristics that ignite conflicts, impacted communities, mobilised stakeholders, whether the environmental justice ('EJ') has been achieved in the process and information sources (see Table 1 for definitions).[21] Conflict case studies are submitted by contributors, comprised of involved actors or academic/EJO experts working on the case. An internal review board scrutinises content and sources before publication of the cases.[22] Conceptually, the EJAtlas serves as a practical instrument to comprehend how shifts in material and energy circulation in the economy and the underlying institutions and power arrangements reshape the allocation of environmental advantages and disadvantages, both socially and spatially (Avila, 2018; Špirić, 2018; Scheidel et al., 2018; Pérez-Rincón et al., 2018). Given its usefulness, EJAtlas has been used by lecturers for teaching and by researchers across different countries to extract and analyse resource conflict data (Walter et al., 2020). Exemplary uses of the inventory include large-N statistical interpretation of mining conflicts (Özkaynak et al., 2015), of the socio-environmental conflicts involving indigenous communities (Scheidel et al., 2020, 2023) and land defenders (Le Billon and Lujala, 2020); presentation of data to demonstrate overarching tendencies in conflicts (Martinez-Alier et al., 2016; Conde and Le Billon, 2017), provision of supporting evidence (Walter et al., 2021) and, similar to our paper, mixed (quantitative and qualitative) analysis of collective action forms in medium-N cases (Avila, 2018).

The cases submitted to the database are supported by the reports, interviews, social media posts and videos released by conflict actors involved, news sources as well as the accounts of local experts, academics and partner databases such as South American Observatory for Mineral Conflicts ('OCMAL'). Except for the cases of Wealth Mineral and Perickuta mining projects, all of the conflict cases and most conflict events covered by the literature are already recorded in the database.

Using local civil society-based data has benefits despite potential biases. Newspaper coverage is prone to selection and description biases, similar to civil society sources. However, for research focussing on isolated rural areas across countries, crowdsourced platforms offer more information than national newspapers, which often miss reporting local protests. In these platforms, over-inclusion is a more likely risk than under-inclusion and they are often the only viable option for studying global social-environmental phenomena where total populations of cases are unknown (Le Billon and Lujala, 2020; Scheidel et al., 2023). Nonetheless, an in-depth analysis of case descriptions and cross-checking with other sources helps reduce the aforementioned biases. Moreover, other major databases on mining conflicts including mass mobilisation events[23] lack sufficient key data to create an observation pool. Hence, web-based civil society information platforms, such as EJAtlas, remain best sources for approximating the universe of known mine-community conflicts (Haslam and Ary Tanimoune, 2016), given the limited data availability, the activism and EJ-oriented nature of lithium conflicts.

Using MS PowerBI, we scraped data for all mining conflict cases covering lithium and NTR in Chile and Argentina by 18 April 2023. Next, we filtered ineligible cases, i.e. those involving copper and other transition-related materials, using the 'Specific commodities' column and based on their descriptions.[24] When needed, complementary research[25] to gather more information on the conflict actors and events.

For 54 eligible lithium ($n_L = 13$) and NTR ($n_{NTR} = 41$) cases, we made the yearly distribution of seven particular type of conflict events which are presented and described in Table 1. Conflict start and end years are categories provided by the database whereas the time data for other five types of events were collected by us through analysing the case descriptions, 'Form of mobilisation' info column supplied by EJAtlas and further literature review. The project start years are noted to provide further background on a project's timeline and only provided the cases where we found relevant details; the conflict start year can be referred to as the earliest known project-related activity when a project start year is not provided. We grouped most of the events, which were also noted by other sources making a conflict analysis (cited in the table), under four core conflict event types, namely reports of rights violations & health concerns, legal actions, mass mobilisations and violent events. These typologies are selected based on the most frequent

[20] In addition to the above, the small-N literature we reviewed includes the papers using qualitative case studies (Rüttinger et al., 2018; Heredia et al., 2020; Escosteguy et al., 2022) that are supported by interviews (Marchegiani et al., 2019, 2020; Jerez et al., 2021) and literature reviews (Díaz Paz et al., 2023).

[21] Although the main objective may vary or change as the resistance progresses, the search for EJ is in the core of most collective actions (Özkaynak et al., 2015). Regardless of its level, it is not uncommon that a counter-mining resistance movement is supported by national or transnational EJ NGOs and networks (Bebbington, 2007).

[22] Additional details of EJAtlas data collection process is available in Temper et al. (2015).

[23] The databases reviewed for this research include Armed Conflict Location & Event Data Project (Raleigh et al., 2010), Mass Mobilization Protest Data (Clark & Regan, 2021), Mass Mobilization in Autocracies Database (Weidmann & Espen Geelmuyden Rod, 2019), El Instituto Nacional de Derechos Humanos (INDH) (https://www.indh.cl/, accessed on 1 May 2022).

[24] Each conflict case has been analysed anonymously to minimise any bias for events. For example, the case title, minerals and resources involved were hidden while making the description analysis. See Supplementary Document Tab-1 for the description and other columns referred to throughout the text.

[25] For a similar approach to the use of extra research and categorisation in addition to EJAtlas data, see Avila (2018).

Table 1
Definitions of key concepts of this study.

Concept	Description	Source
Mining conflict	A dispute arising between two or more (groups of) actors because of the extractive operations in a territory. The extractive operations can be at any stage, i.e., pre-extraction (e.g., the announcement of a project or visit to a prospective site by company or state officials), ongoing extraction or post-extraction (e.g., post-closure environmental or social problems).	Authors' own definitions based on Reboratti (2012)
Conflict case	A mining project involving a conflict of interest between relevant actors, which often include companies, national or local administration and nearby residents but also environmental justice organisations, scientists, mining workers and project financiers in some instances. For this paper, we covered 14 (6 lithium, 8 NTR) conflict cases from Chile, 40 (7 lithium, 33 NTR) from Argentina and 11 (only lithium) from other countries.	Authors' own
Environmental justice and EJ success	'Environmental justice' (EJ) refers to the fair and equitable distribution of environmental benefits, burdens and risks among different social groups with respect to the development, implementation and enforcement of laws, regulations, policies as well as natural resource projects which bear implications on the people and their environment. 'Environmental justice success' refers to the categorisation of an outcome within the EJatlas database, where contributors assess and label the conflict outcome as either achieving or failing the EJ objectives. This classification is supported by an additional text field, allowing contributors to provide a detailed explanation that justifies their assessment of whether the particular case aligns with the principles of EJ.	Authors' own definitions using US EPA (2015) EJ Success data is scraped from EJAtlas
Conflict events		
Project start year	Marks the start year of the earliest mining-related activity which preceded the beginning of a conflict case, including exploratory works, an Environmental and Social Impact Assessment or announcement of a project etc. Where available, we often present this event type for information on a conflict's background and exclude it in our analyses of conflict events because, although it indicates the start year of a project which created a dispute, it is not a conflict event *per se*. Project start years of cases often overlap with conflict start years, although some projects may not involve any recorded conflicts for a long time after a project start.	Own categorisation
Conflict start	Marks the year where a conflict of interest between parties is first observed.	Data scraped from EJAtlas
Reports of (human, indigenous or environmental) rights violations and health concerns	Events where a health concern and/or human, indigenous or environmental right violation was reported by a conflict party following the first implications of an extractive activity. The violations could be reported on conventional media as well as social and alternative (publications, websites, blogs etc.) media of the opposing communities or a cooperating EJ organisation. They can also be asserted by the creation of alternative impact assessments and reports by opposing parties. Although rights violations may exist without turning into a violent action, they may precede legal actions and level mass mobilisations.	Own categorisation, core event. Defined using Ahmad & Lahiri-Dutt (2006), Aylwin et al. (2021), Conde & Le Billion (2017) and Özkaynak & Rodriguez-Labajos (2017)
Legal actions	Events where an affected population or a related EJOs took a legal or administrative action (including referenda, lawsuits, petitions or complaint letters delivered to a government or judicial body) to stop (harms done by) a mining project or to receive a compensation for the damages. Legal action events may, although observed rarely (e.g. in NTR Case 18), include those initiated by a mining company or government bodies against residents. This type of events does not include procedures which are not linked to a conflict of interest, such as request of information by citizens in the beginning of a project.	Own categorisation, core event. Defined using Martinez-Alier et al. (2016)
Mass mobilisations	Events where affected residents physically mobilised against a mining project. These events include protests, walks/marches, hunger strikes, roadblocks (to deny entry of company staff and equipment to mining sites), land (also public space, building or mining site) occupation, sabotages, boycotts of companies, products and infrastructure etc. related to the mining operation.	Own categorisation, core event. Defined using Martinez-Alier et al. (2016), Valenzuela et al. (2016), Jerez et al. (2021), Díaz Paz et al. (2023), González & Snyder (2023)
Violent events	Violent events include injuries, casualties, imminent violent threats by any party, interventions and detentions by law enforcement officers which occur linked to a mining conflict. These events include property damage as well as presence of heavily armed (riot) police and security guards in the settings such as community-company meetings and protests which showcase an imminent threat of the use of violence. Violent events can be observed during mass mobilisations (Lithium Case 5; 8), there can be individual events, e.g., where anti-mining community members being violently detained from their homes by police (Lithium Case 10). We do not include worker injuries occurring during mining operations in such events.	Own categorisation, core event. Defined using Martinez-Alier et al. (2016), Macintyre & Foale (2004) and Anguelovski (2011)
End year of the conflict	Year in which a conflict is resolved. The analysis of conflict descriptions indicate that these events tend to be a court or public body decision terminating a mining activity or reconciliation between a company and communities. Notably, moratorium decisions do not necessarily benefit communities or compensate the costs and damages already incurred.	Data scraped from EJAtlas

patterns observed in each conflict case and serve to simplify the conflict analysis we make in this paper. Although our data may be missing certain events and cases due to the limitations of available data, to the best of our knowledge, it includes one of most comprehensive sets of resource conflict event data in the literature for Chile and Argentina. The results of this analysis are presented in Fig. 5.

Fig. 5 displays that all of the 'core conflict events' related to lithium mining in Chile and Argentina took place after 2010. Rights violations, legal actions, mass mobilisations and violent events became more common in the last decade, particularly after 2017, in both the mining projects activating after 2010 and those ongoing since the 1980–1990s.[26]

The radar charts in Fig. 6 illustrate the temporal distribution of events in NTR and lithium conflicts. The chart on the left revealing a concentrated surge of NTR conflict starts and events during the 2000–2009 period, followed by a gradual decline in the subsequent decade. This pattern indicates an initial period of heightened conflict initiation and subsequent moderation in NTR conflicts. In contrast, the radar chart representing lithium conflicts showcases a different trajectory. Here, the 2010–2019 period stands out as a prominent phase of conflict starts and core events, displaying a noteworthy increase compared to earlier decades.

With regards to the core conflict events, mass mobilisations were commonly observed in both lithium and NTR cases whereas reports of rights violations and legal actions were relatively less common in lithium conflicts. Both types of resource conflicts experienced considerable legal actions targeting projects in their nascent stages, yet NTR conflicts displayed a higher frequency of such actions. This distinction could be attributed to the longer time span over which NTR conflicts have developed, leading to more opportunities for often long-lasting legal battles to manifest. Furthermore, NTR conflicts displayed a higher frequency of legal actions as opposed to mass mobilisations whereas the opposite is observed in lithium cases. Despite containing less than a third of the number of NTR cases ($n_{NTR} = 41$), lithium conflicts ($n_L = 13$) observed nearly equivalent instances of mass mobilisations (15 events in lithium vs 19 in NTR) and violent events (3 lithium vs 4 NTR) during the 2010–2019 period. Both established (e.g., San Pedro de Atacama) and new lithium projects witnessed occurrences of mass mobilisations and violent events during this period.

Another noticeable tendency is the rising violence which is more frequently witnessed in the last decade both in NTR and lithium conflicts, with higher violent event per case ratio observed in the latter (3/13 vs 4/41). Irrespective of political orientation, all South American administrations developed a rising intolerance to social resistance to mining operations (Conde, 2017), which could explain the growing violence in lithium cases.

EJAtlas conflict data also includes an evaluation of whether the EJ was eventually served over the course of a conflict. Based on the accounts of local experts and community representatives, EJ was reportedly achieved in only 3 lithium and 18 NTR cases out of total 54 cases analysed.[27] Legal actions played a pivotal role in this dynamic, occurring in 81 % (17/21) of all the cases where justice was served and they single-handedly helped achieve EJ in nearly half (10/21) of the conflicts. The reporting of human, indigenous and environmental rights violations by communities alone seems to have limited impact on achieving EJ. However, the attainment of EJ was rare without legal actions, which were frequently accompanied by mass mobilisations. 33 % (7/21) of cases saw both legal actions and mass mobilisations as combined strategies and mobilisations alone led to achieving environmental justice in 19 % (4/21) of cases. In three lithium cases where the EJ was achieved, one saw only mass mobilisations, one only legal action and one did both.

6. Impacts of the transition on stakeholders and their responses

In Fig. 6, we observe that the numbers of violent and mass mobilisations and all conflict events linked to lithium mines in Argentina and Chile accumulated particularly towards the end of the decade. The disputes linked to non-transition resource extraction were observed less commonly during this time compared to the period up to 2010 under the global commodity demand boom, which confirms the findings of works on mining conflicts in Africa (Berman et al., 2017) and South America (Arsel et al., 2016; Haslam and Ary Tanimoune, 2016).

Fig. 7 illustrates lithium conflicts with additional demand and production indicators. The share of EVENSS within the global consumption was above 1 % from 2011 on. From this year onwards, EVENSS became a significant player of the global lithium market (Bos and Forget, 2021). Lithium conflict events began to significantly proliferate from 2017, in parallel with soaring overall lithium output from the region and rising Li-carbonate prices (Fig. 7). The spike in 2017 came after the period of 2013–2015 when no conflict events were reported and the period of 2007–2012 when some conflicts began with only one core conflict event being recorded. Interestingly, the global output (except for Argentine production) and lithium prices dropped over this period, potentially due to the burst of price bubble caused by (transition) demand speculations about demand (Uribe et al., 2021). Reduced investment inflows to lithium sector might have meant less pressure on the producing countries and mining companies, hence resulting in less conflicts (both in terms of start and events) during 2013–2015. In contrast, NTR conflict events saw a big leap from 2006 to 2007 and saw a decreasing trend thereafter, showing a completely different pattern than lithium cases for the same period.

Another point worth noting is that the demand, price and production do not entirely match with the conflict data in Fig. 7, despite what the price shock-conflict literature would predict.[28] Other than possible imperfections in the available data, the anticipated demand is another potential contributor to this mismatch. EVENSS were considered a potential demand powerhouse since the late 2000s by international organisations, such as IEA (2009). After mid-2010s, the gigantic amount of virgin raw materials, particularly lithium, required for the transition in the future was unanimously acknowledged by public (see e.g., Blagoeva et al., 2016, for EU; IEA, 2016; The World Bank, 2017) and private reports (see e.g., Goldman Sachs, 2016).

The numerical findings above demonstrate different patterns followed by NTR and lithium conflicts. In this section, we suggest that this difference mainly stems from the impacts of the EVENSS demand. We exhibit the perspectives of major pro-mining (governments and companies) and resisting (indigenous communities) parties of the lithium disputes examined in Chile and Argentina. For both types of actors, we show in the first subsections how the energy transition impacted them and contributed to the emergence of conflicts. Then, we closely examine how the actors responded to these impacts and how their actions reflected on the conflicts.

[26] Note that, besides the possibility of low conflict intensity and the imperfections of national archives and EJAtlas platform, the lack of any conflict data for 1980s in Chile and Argentina might be due to the repression of resistance movements or the concealment of relevant accounts by the military dictatorships.

[27] We have also looked at stopping of a project as another possible indicator of 'resistance success'. The projects stopped as a result of a resistance movement overlap to a large extent with those where EJ was served, therefore no separate analysis was made for these cases.

[28] We do not make any statistical conclusions here; a statistically meaningful analysis cannot be made here because of the low number of data points.

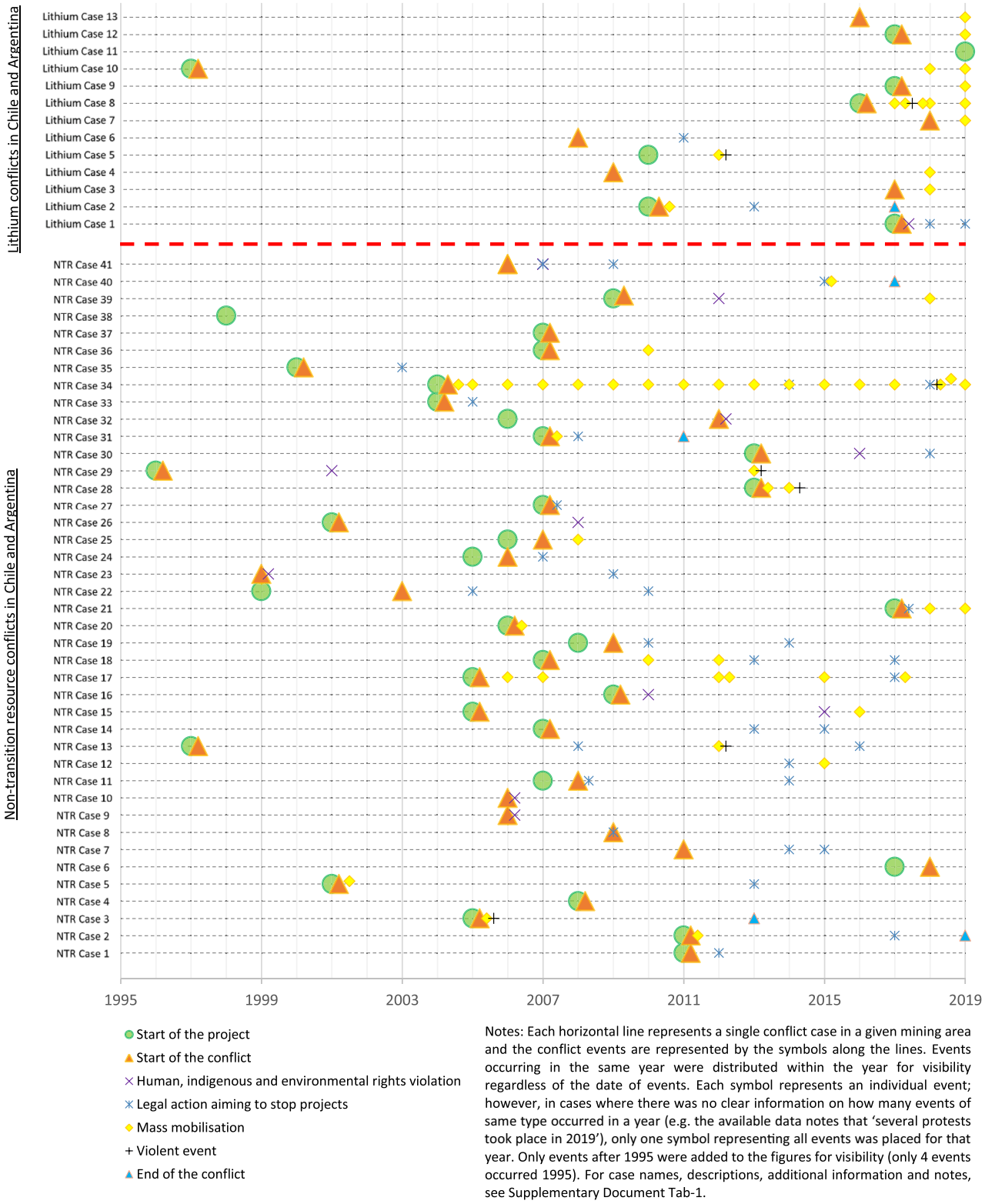

Fig. 5. Scattered plot showing the beginning and peak year of mining conflicts.
Notes: Each horizontal line represents a single conflict case in a given mining area and the conflict events are represented by the symbols along the lines. Events occurring in the same year were distributed within the year for visibility regardless of the date of events. Each symbol represents an individual event; however, in cases where there was no clear information on how many events of same type occurred in a year (e.g. the available data notes that 'several protests took place in 2019'), only one symbol representing all events was placed for that year. Only events after 1995 were added to the figures for visibility (only 4 events occurred 1995). For case names, descriptions, additional information and notes, see Supplementary Document Tab-1.

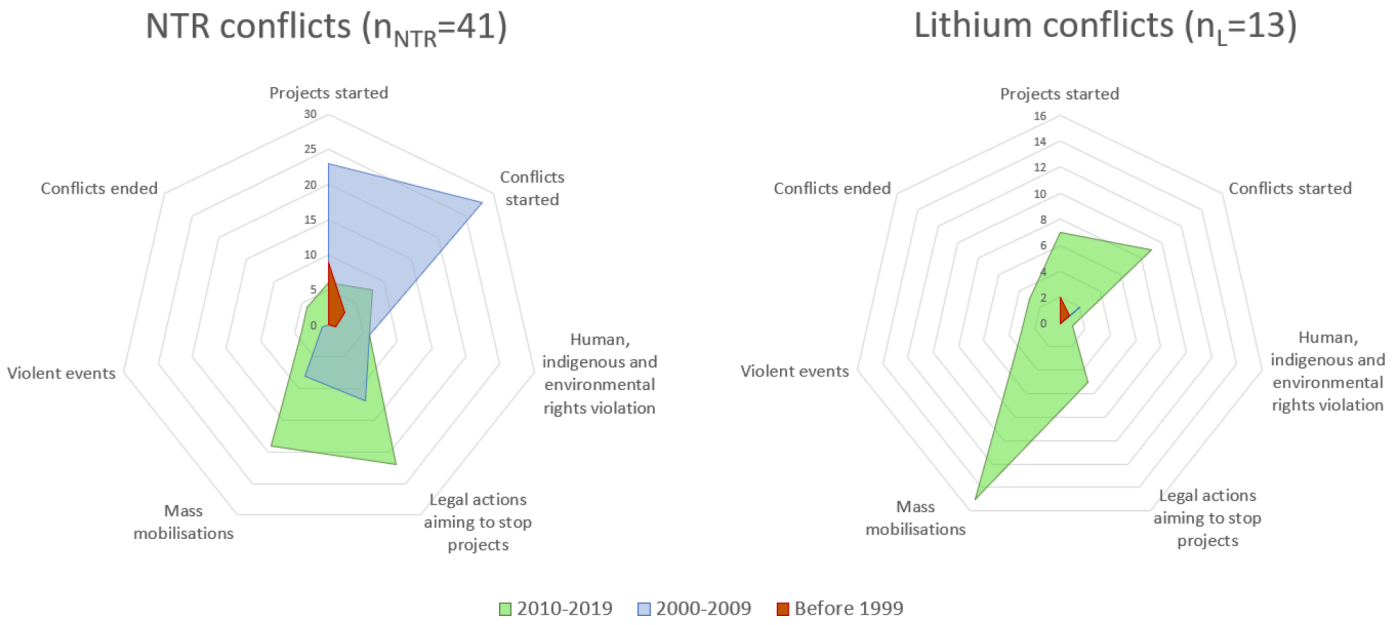

Fig. 6. Distribution of non-transition resource and lithium conflicts in Chile and Argentina over 3 periods.[36]

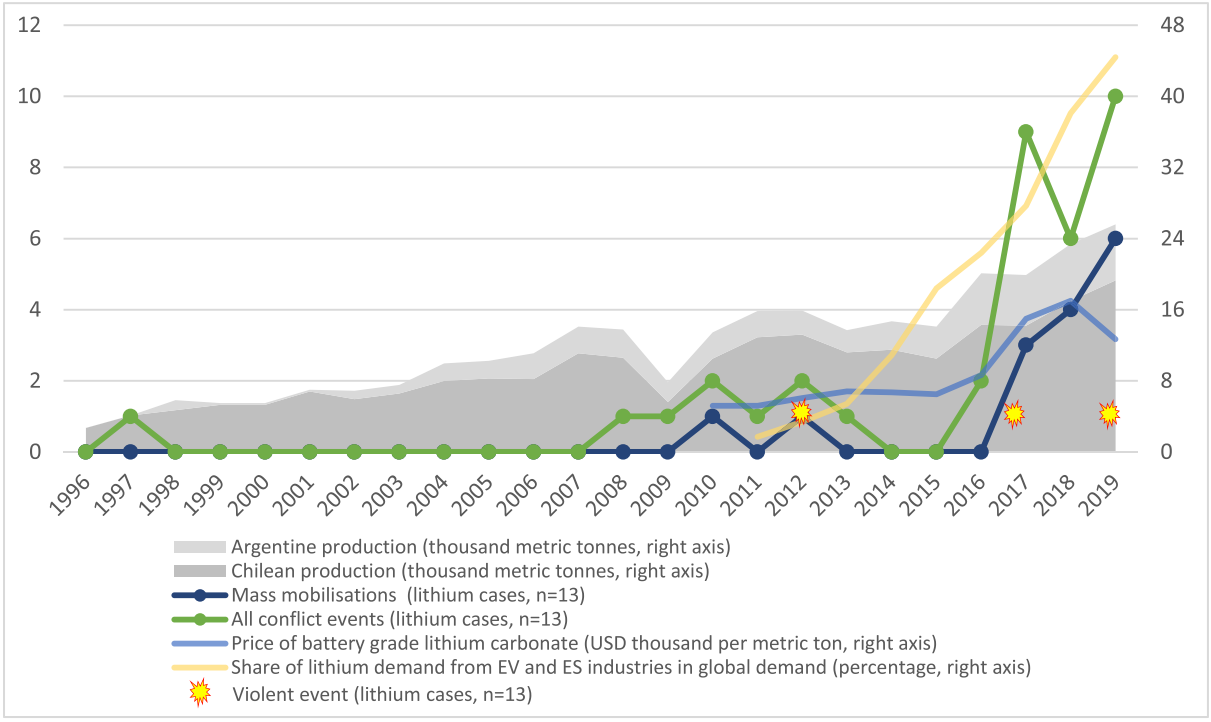

Fig. 7. Stacked bar chart of early distribution of mass mobilisations, violent and all conflict events for lithium and non-transition resource extraction cases, with line charts of global lithium output and share of EVENSS in lithium demand.[37]

6.1. *Governments and companies*

6.1.1. *The economic 'opportunities' created by lithium demand for governments and mining companies*

An explanation for the connections as well as divergence between the lithium economics and conflicts could be the dual pressure created by the EVENSS demand on the extractive motivation and behaviour of actors in the lithium supply chain. On one hand, the governing bodies of host territories and mining companies want to make use of the 'window of opportunity' created by the ongoing demand boom from EVENSS to maximise revenues from mining to be used in development projects (Göbel, 2014; Raftopoulos, 2017; Mejia-Muñoz and Babidge, 2023). This first pressure is reinforced by extremely ambitious target years to decarbonise the transportation sector in large economies (Fig. 2) and related high demand projections for upcoming decades set out by international organisations and companies. On the other hand, there are

uncertainties about how long the 'window' will stay open. Because of heightening importance of lithium for them,[29] major economies such as the US and EU seek to either reduce or substitute the lithium content in EV batteries or replace the EV technology by another (e.g., hydrogen fuel cells via initiatives such as Clean Hydrogen Partnership) (CNBC, 2023). Thus, while a strong lithium demand is highly likely for the next 15 years or so given the forward supply contracts with car manufacturers, there may be uncertainties in the longer term (Bustos-Gallardo et al., 2021). Considering that even an unopposed, new brine-based lithium mine can take on average 7 years to begin production in South America (IEA, 2021), many governments and mining companies would want to get the projects going as soon as possible to make use of the current price and demand conjuncture.

Fig. 8 summarises some key policies and actions implemented by Chilean and Argentine governments to boost lithium mining from 1980s which gained an impetus with the open market agendas adopted in the 1990s (Bebbington, 2012). In the 2000s, Chile was the top producer of lithium but policy-wise, Argentina was relatively more active to expand lithium mining projects. While first extraction projects in Chile began in the 1980s and in Argentina late 1990s, a surge of new projects and explorations was particularly observed in the 2010s in both countries – although commercial production remained restricted to two countries in Chile. Over these decades, Chilean, Argentine and provincial Argentine governments either passed or attempted to deliver legislations, policies and incentives to attract mining investors into their countries in the age of EVENSS demand boom.

The expansion of extractive boundaries occurs without genuine institutional or infrastructural integration while fuelling a drive for maximal financial gains by individual states, leading to territorial competition and the erosion of social and environmental safeguards (Forget and Bos, 2022). Despite the growing resistance of indigenous communities from the 2000s (see Section 6.2), there was a continual push from the governments and companies to either expand existing lithium projects or start new ones. The consultation processes were often rushed and could not address the concerns of the communities (e.g., see Lithium Case 2). Specifically, the socio-environmental impacts of the new projects[30] are not presented timely, thoroughly and clearly (Rüttinger et al., 2018; Marchegiani et al., 2019, 2020; Heredia et al., 2020; OCMAL, 2020; Escosteguy et al., 2022; Díaz Paz et al., 2023).

González and Snyder's (2023) paper can help us understand why Free, Prior and Informed Consent ('FPIC') irregularities occur under 'asymmetrical' negotiations and some operations end up being opposed, or even 'aborted', instead of being negotiated in a symmetrical setting. The authors argue that each stakeholder, i.e., the government, the companies and the communities (and the fractions within them), has a preferred mode of extraction ahead of the start of a mining activity. The outcome of the project would depend on the influence of each actor in the interactions. The compromise of at least one player's priorities is inevitable and for a negotiated extraction, these are often government and company priorities. However, the demand pressure on them makes their initial positions firmer and their compromise unlikely. Such seems to be the case in all the FPIC or Environmental and Social Impact Assessment ('ESIA') violations observed in lithium conflicts. When combined with the growing intolerance to the indigenous resistance to mining,[31] the uncompromising position of companies and governments could lead to more violent confrontations. For example, in the Lithium Case 1, the local police were stationed in the exploration area to ensure safe continuation of the operations despite ongoing community claims for improper consultations. In Lithium Case 10, the police even violently intervened to the resisting members of a Catamarcan community. The use of violence is particularly exploited by States and private security forces of the companies supplying critical raw materials such as lithium, possibly based on a misconceived legitimacy granted by the urgency of providing these materials for the global energy transition.

6.1.2. *The response by policymakers and companies: 'Green discourse' as a legitimisation mechanism for more mining*

The 'green (mining) discourse' has become a crucial tool for legitimising the extraction of resources vital for the energy transition and the implementation of low carbon energy projects, often without adequate community consent and consultation (Forget and Bos, 2022). Indeed, the green discourse around lithium mining should not be considered as a standalone phenomenon. It is part of a much broader 'green mining' agenda in South America, which serves to justify the mining of transition-related metals (Walter et al., 2021), such as copper (O'Faircheallaigh and Babidge, 2023) and other material-intensive projects such as solar power plants. In the brine-based lithium mining, sun-drying is used as an important input as part of the arid, windy climate of the region, which is also very convenient for solar energy generation. Thus, the sun is often presented as the main labourer who naturally delivers solar power and lithium. The only task that humans has to do is to merely 'harvest' it, as if the whole process is a sort of local farming which does not involve any ecological or social cost to nearby communities in a low population zone (Bustos-Gallardo et al., 2021; Forget and Bos, 2022). Nonetheless, this viewpoint is now being rejected by many communities who point out the role of transition in the opening of new mines or expansion of existing projects (Lithium Cases 4; 6; 13).

The significance of lithium extraction for transition-related industries has been emphasised at different levels extending from upper echelons of Chilean government to Argentine provincial decision-makers and from multinational mining companies to North American EVENSS manufacturers. Our analysis shows that at least one (type) of the actors involved in 100 % of the lithium mining cases are motivated by the rising demand of the manufacturers of EVEN and/or the energy transition. In some conflict instances, car manufacturers (or their relevant battery subsidiaries/providers) involved as shareholders in mining projects, such as Toyota and Mitsubishi's investment in Lithium Case 5. More often, mining companies sign supply agreements with EV manufacturers (or their relevant battery subsidiaries/providers), e.g., Tesla's agreements with Albemarle (operating in Salar de Atacama and other mining regions).[32] Moreover, public participation in the private lithium extraction has been increasing, as observed in the acquisition of 8.5 % of Sales de Jujuy company by Jujuy provincial government (Bos and Forget, 2021, Lithium Case 5), indicating that South American policymakers are progressively involved in the lithium supply.

6.2. *Community perspective*

This part looks at the implications of the mineral demand on indigenous communities and how they address to the impacts on their

[29] The 'criticality' status of lithium, which indicates the economic importance and its supply risks, was non-critical for the US in 2015 (Graedel et al., 2015) and near-critical for the EU in 2017 (European Commission, 2017). But the material's status was raised to 'critical' for both of them at the turn of the new decade (European Commission, 2020, 2023; Nassar & Fortier, 2021). See Fig. 2 for the pathways announced by the US and EU.

[30] Whereas operational problems or visible damages were central to the ongoing/first major lithium mining regions until the late 2000s, FPIC issues in ESIA and other stages were observed in the expansion projects.

[31] Scheidel et al. (2020) evidence that protesters face higher rates of criminalisation, physical violence and killings when indigenous peoples are involved. The authors suggest that this may be linked to the racism and colonial history experienced by indigenous communities.

[32] These observations hold for all lithium conflict cases, including mining regions in other countries (see Lithium Cases 14 onwards in Supplementary Document Tab-1)

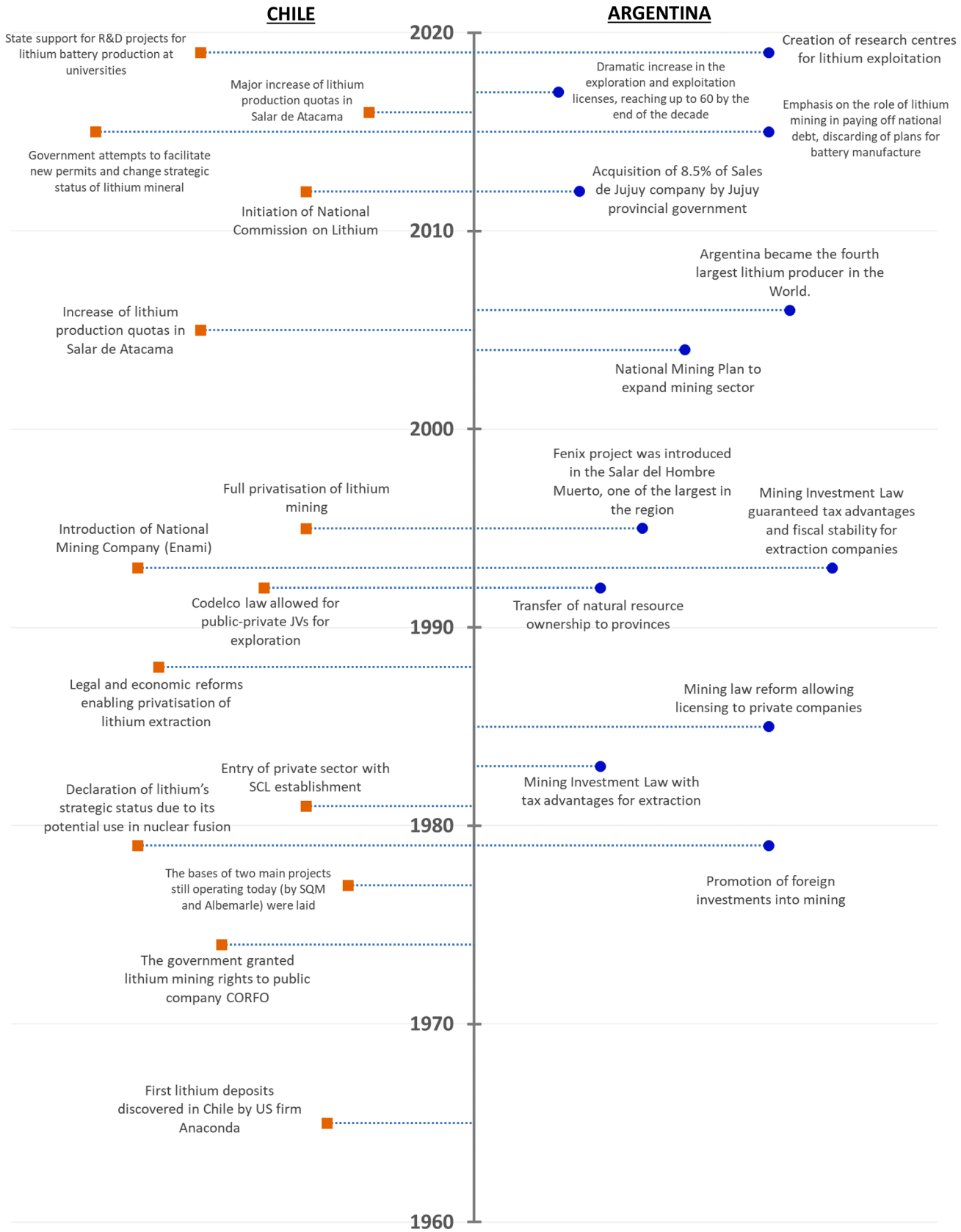

Fig. 8. Timeline of some key policies and actions by public actors in Chile (on the left) and Argentina (on the right). Authors' own (using Aylwin et al., 2021; Bustos-Gallardo et al., 2021; Dorn and Gundermann, 2022; O'Faircheallaigh and Babidge, 2023).

environment, lands and lifestyle. The transition towards low carbon energy and lithium-intensive technologies has reshaped stakeholder relations, often placing local communities at the centre of negotiations due to their proximity to valuable resources and territories (Forget and Bos, 2022). While the States' economic involvement saw an increase towards the end of the decade, they gradually withdrew from their role as mediator or guarantor of indigenous rights in the community-company negotiations. This led indigenous residents to develop their own approach to (re-)negotiate (existing and) new agreements and employ civil resistance strategies based on what the situation called for.

6.2.1. *Socio-environmental impacts of mineral demand grows in the region*

Following the discovery of lithium in the Salar de Atacama, Chile in the 1960s, the period from 1987 to 1995 marked the second stage in the development of lithium extraction. During this phase, the Chilean State withdrew from Public–Private Partnerships ('PPPs') such as SQM, supervision and control, leading to the transfer of exploration and exploitation projects to the private sector. Importantly, the communities were not seen as party to negotiations about land and water use permits to be granted to lithium and copper mining companies in Atacama. In 2005, a new phase commenced with the emergence of new players in the Atacama mining sector and established companies, such as SQM, increased their lithium production capacity (Aylwin et al., 2021). In Argentina, on the other hand, the governments began promoting the private lithium projects since the 1990s which gained a significant momentum particularly in the 2010s, in response to the rising demand from the electric vehicle industry. In the meantime, the disengagement of the State from company-community engagements meant that communities would now directly negotiate damages but also any potential benefits of the lithium projects by sidelining the State (Forget and Bos, 2022).

The mounting visibility of socio-environmental impacts from earlier projects contributed to the communities' scepticism towards new expansions, exploration permits and project tenders in their regions (Conde and Le Billon, 2017). In early stages of the production (in Chile, 1980s; in Argentina, 1990s), socio-environmental concerns were not central to community-company-government interactions due to the initially inconspicuous nature of brine-based extraction processes, whose consequences could be hardly noticed at first (González and Snyder, 2023).[33] The projects were not severely opposed until the 2000s and even considered to yield economic and developmental benefits in the mining regions (Göbel, 2013; Revette, 2017; Gundermann and Göbel, 2018; Heredia et al., 2020). However, the opposition began to rise as the negative impacts of lithium boom became more and more visible in ongoing projects, in addition to the mounting irregularities in new ones. Particularly after the new millennium, high freshwater and underground water uses of the production facilities were scrutinised by the communities who reside close-by or share overlapping territories with resource frontiers (Prieto, 2016; Agusdinata et al., 2018; Liu et al., 2019). Indeed, the observed impacts of first major projects in Chile (Lithium Case 4) and Argentina (Lithium Cases 10) as well as the difficulties the communities had in renegotiating the first agreements where they were never involved, made them more wary about new exploration permits and project tenders in their lands.

6.2.2. *Protests and roadblocks: communities assert their own agency to tackle socio-environmental impacts of lithium mining without state support*

Our research emphasises that the communities wielded their own agency in the absence of state mediation and support in the negotiations over lithium mining projects in their region. Thus, this paper highlights that the absence of state involvement does not render communities powerless; instead, they adapt to this absence through diverse strategies (O'Faircheallaigh and Babidge, 2023). Moreover, it underscores that such adaptation does not signify passive acceptance of the status quo under which the state absence and mineral extraction for green transition are legitimised. On the contrary, communities resist this narrative by challenging the conditions through active engagement in company-community negotiations, as well as through various forms of mass mobilisation.

The end of dictatorships in the two countries by the 1990s and adoption of indigenous rights frameworks, such as the ILO Convention 169 (ratified in 2000 in Argentina and in 2008 in Chile), increased the legal avenues available to communities for resistance (Aylwin et al., 2021; Mejia-Muñoz and Babidge, 2023). This enabled them to challenge projects more assertively from early stages based on irregularities in FPIC or ESIA procedures,[34] although both frameworks came with considerable limitations (Marchegiani et al., 2019; Papillon et al., 2020).

The choice of resistance strategies among communities offers a revealing insight into their means of navigating the socio-environmental impacts as well as benefits of mining projects, especially in the absence of robust government support. Such strategies include tapping into the EJ networks (comprised of other indigenous groups, EJ organisations and scientists), lobbying and resistance strategies, such as mass mobilisation forms and legal actions (Conde, 2017; Mejia-Muñoz and Babidge, 2023; O'Faircheallaigh and Babidge, 2023). This phenomenon becomes clearer when examining the context and distribution of resistance strategies over time, reflecting the communities' adaptability to the evolving dynamics of mining activities.

As shown in Fig. 6, mass mobilisations are increasingly observed in the region and particularly in lithium conflict cases. We suggest that the prevalence of mass mobilisations as a prominent form of resistance in the 2010s emerged as part of the communities' innovative responses to the challenges posed by mining projects in the absence of effective State mediation (O'Faircheallaigh and Babidge, 2023). The communities and collaborating scientists often report their concerns about hazards and cite violation of rights by mining operations but this does not help achieving EJ. This indicates that the State does not proactively act as the guarantor of rights. Moreover, taking definitive legal actions against large-scale operations requires a lot of money, effort and time (Fulmer et al., 2008; North and Young, 2013). In contrast to NTR projects which saw many legal actions, many lithium projects began or expanded in the 2010s, often with such speed which left communities little time for a lawsuit. And despite all the costs involved, legal actions may not deliver EJ (Akchurin, 2023), nor stop/compensate for harms on non-monetizable assets such human rights, biodiversity and extended livelihoods[35] (Martinez-Alier, 2009). Furthermore, the indigenous

[33] Based on their analysis of EJAtlas data, Özkaynak et al. (2015) found that a visible resistance from communities begins as a result of an incident or when they feel a project's negative effects. Another large-N analysis by Haslam and Ary Tanimoune (2016) also confirm that the visibility of the physical impacts of mining plays a key role in the breakout of mining conflicts.

[34] See Supplementary Document (Tab-1 Raw Data, Columns AW:AX).

[35] These include pastoral and agricultural territories, water aquifers, sacred lands as well as touristic and natural reserve sites which might be of any importance to indigenous lifestyle (Bebbington et al., 2008; Bebbington, 2012; Babidge, 2016).

[36] There is an ongoing monthly march (counted towards mass mobilisations) for NTR Case 34 since 2004. To balance out the bias towards protests caused by the project, we count 1 protest for each decade from this project because all monthly protests represent a continuous resistance process. As noted earlier, we did not add project start year for cases where we could not retrieve an information going earlier than the conflict start. See Supplementary Document Tab-3 for data.

[37] The share of demand from low-carbon industries within the global lithium demand is calculated using the data from USGS 1998-2022; Pillot (2019); Stringer & Rathi (2020). 'Start of the project' and 'End of the conflict' events are not included. Also see Supplementary Document Tab-4.

access to justice remains inadequate as a mechanism for effectively protecting their rights violated due to lithium mining projects (Aylwin et al., 2021), as also observed in the low EJ success in lithium conflicts via legal actions so far (see above). All in all, it seems that the recognition and progression of indigenous rights have not addressed core issues of the State-company-community relations in recent South American mining projects. Against these backdrops, mass mobilisation emerges as a mode of asserting concerns and frustrations in resource frontiers where the state's presence is limited.

Mass mobilisation tactics such as protests (observed in 9 lithium cases) and roadblocks to prevent machinery and staff entry to facilities (observed in 3 lithium cases) are employed by communities for exerting pressure on stakeholders to yield in favour of the affected communities and enhancing the visibility of their resistance (Bebbington et al., 2010; De Echave et al., 2009; Mejia-Muñoz and Babidge, 2023). The objectives and strategies of the communities are particularly relevant at the time of the energy transition which put many remote mining regions and their communities under the spotlight of the national and international public opinions (Revette, 2017). For example, in 2019, the leaders of the Atacameño peoples protested the Chilian government at their pavilion during COP24 in Madrid, which helped raising awareness about their problems at a global scale (Mejia-Muñoz and Babidge, 2023).

The complex interplay of strategies, policies and shifting dynamics underscores the communities' resilience and adaptability in confronting mining projects' challenges. It also highlights the crucial role of local communities in shaping not only their own fates but also influencing broader policy trajectories in the mining sector. Through their diverse resistance forms, communities assert their agency, navigating the socio-environmental impact landscape amidst evolving state-industry-community dynamics. Whether or not desired outcomes are to be served in the end of the (re-)negotiation processes are yet to be observed, given the recency of the lithium projects and the resistance rising against them.

7. Conclusion: recommendations and outlook

Our paper describes a chain of relations extending from climate change to lithium conflicts, providing insights into the socio-environmental impacts of the transition in mining zones. The paper also discusses the effectiveness of different approaches in analysing lithium conflicts and introduces a new approach to mining conflict data collection and analysis. The conflict data collected and presented in this study can serve as a resource for new databases, resource conflict scientists and future research endeavours.

Our comparison demonstrates noticeable distinctions between lithium and other (NTR) conflicts. The lithium conflicts saw a surge in conflict initiation and in mass mobilisations between 2010 and 2019, coinciding with the heightening EVENSS demand, whereas NTR conflicts mostly began in the 2000s during the global commodity demand boom and were observed mostly in the forms of legal actions and, then, mass mobilisations. We suggested that the communities employ various forms of mass mobilisation and, to a smaller extent, legal actions to resist the negative impacts of mining boom in their territories amidst the lack of state support in their engagements with companies.

There is a growing reconfiguration observed in both business-to-business (mergers and acquisitions between downstream and upstream companies) and business-to-government (acquisition of shares by governments from private companies) levels along global production networks of lithium-based products (Bos and Forget, 2021). This trend indicates a convergence of interests of the supply-side actors championing the 'green ethos' (Howe and Boyer, 2016; Salazar Bravo, 2021) of the transition. However, the low carbon energy transition can neither be just nor 'green', unless the participation of the indigenous residents in source countries as well as end-users of EVENSS in China and Global North in the global distribution of its costs and benefits.

The analytical framework of this paper can be applied not only to lithium conflicts but also to other resource conflicts to create very focussed small-N studies or (empirical) medium to large-N analyses. The indicators such as violent events enable a more nuanced measurement of the intensity of resource conflicts over time. Finally, the eclectic structure of our analytical framework also allows for the addition of sub-types of conflict events, such as armed interference (Matthysen et al., 2019).

To expand on the current research, future studies could apply the data collection and analysis methodology to more cases, thus building a larger dataset that captures various conflict events similar to those examined in this paper. A larger dataset can be used to make more comprehensive case studies. Furthermore, more data points can help scholars build and apply new models for lithium and other transition as well as non-transition resource conflicts which were not the main focus of our paper. We also note that conduct of in-depth discourse analyses, as demonstrated by Diaz Paz et al. (2023), would enhance our understanding of the underlying discourses and power dynamics involved in these conflicts. These avenues for further research would contribute to a more comprehensive and nuanced understanding of resource conflicts in the context of the energy transition.

Declaration of Competing Interest

The authors have no competing interests to declare.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.exis.2023.101373.

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