

How to Stop a Boom from Busting

A Policy-Oriented Research Agenda for Capitalizing on China's Demand for Transition Materials in Latin America

BY THE WORKING GROUP ON DEVELOPMENT AND ENVIRONMENT IN THE AMERICAS

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Copper Mine, Chile.
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EXECUTIVE SUMMARY

Avoiding catastrophic climate change requires the dramatic acceleration of renewable energy deployment. This expansion is already occurring, with China playing the largest role in the expansion of solar and wind energy supply chains. Several of these supply chains begin in Latin America, which leads the world in deposits of lithium, copper and other critical transition minerals. Thus, the Latin America-China economic relationship will likely be key to the global expansion of renewable energy to mitigate climate change.

Many important knowledge gaps remain about the form that these new supply chains are likely to take and the applicability of policy lessons learned during previous commodity booms, to support the development of financially, socially and environmentally sustainable supply chains. In August 2022, the Boston University Global Development Policy Center, the Universidad del Pacífico's Centro de Estudios sobre China y Asia-Pacífico and Peking University's Institute for New Structural Economics convened a workshop for the Working Group on Development and Environment in the Americas, consisting of 24 experts with the goal of developing a policy-oriented research agenda to equip leaders, civil society members and investors as they navigate new supply chains that bring novel opportunities along with revived and nascent policy challenges. The Working Group reviewed key evidence and the state of current knowledge, to identify existing knowledge gaps and to propose a research agenda to fill those gaps. This report synthesizes the results.

The Working Group identified three broad categories of research gaps:

1. A better understanding of **structural factors and market conditions** that are poised to shape a likely commodity boom to support future energy transitions;
2. The application of lessons on **governance for development and risk mitigation** from past commodity booms; and
3. Mapping and developing the **role of outside stakeholders**, such as multilateral and Chinese development finance institutions, in supporting institutions and building integrated supply chains.

The Working Group's analysis of existing research in these critical areas finds a deep literature on lessons of past commodity booms and an emerging literature projecting possible paths for an upcoming renewable energy commodity boom. However, these two areas of research are not well connected, leading to significant gaps regarding how governance lessons from past booms may be applied under different possible scenarios of an upcoming boom in energy transition metals to ensure that benefits are broadly shared among Latin American communities, workers and economies as a whole, and that environmental, social and macroeconomic risks are mitigated. Furthermore, external stakeholders have proliferated as new multilateral and national development banks (MDBs and NDBs), as well as regional planning bodies, have been established with missions of mobilizing and coordinating capital to maximize benefits and minimize risks of investment markets.

Furthermore, existing research exists in isolation. Research on investment and governance in mining, manufacturing and generation stages of renewable energy are not integrated. Thus, the capacity of Latin America to benefit from all three of these types of investment is difficult to foresee or encourage. Moreover, research on macroeconomic, environmental and social aspects of governance are not integrated, complicating the region's ability to develop

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comprehensive policy approaches. Finally, research on the creation and growth of new MDBs, NDBs and other stakeholders exists in isolation from all aspects mentioned, making it difficult to chart a constructive role for these newly robust institutions. Therefore, the Working Group recommends an interdisciplinary and integrated approach to filling these research gaps, in order to develop policy recommendations that are relevant to the interconnected challenges and opportunities facing Latin America.

Specifically, the Working Group recommends incorporating the following elements into an interdisciplinary, policy-relevant research agenda:

Regarding Structural Factors and Market Conditions:

- Mapping anticipated transition material demand across Latin American and the Caribbean (LAC) countries and commodities. This effort should consider anticipated changes in the growth of the renewable energy manufacturing and deployment sectors in China, the speed of its energy transition and the composition of its new energy generation capacity.
- Analyzing the interaction of structural factors. LAC economies vary in their readiness for investment expansion and their capacity to absorb and deploy new technologies for extraction, refining, manufacturing, electric mobility and energy generation and transmission. Integrating these regional complexities with the varied possible trajectories of China's renewable energy and electric mobility sector will be crucial for the development of realistic policy recommendations.
- Outlining obstacles and bottlenecks for LAC economies to leverage market power. These obstacles may include institutional development, physical integration and policy coordination.

Regarding Governance for Development and Risk Mitigation:

- Evaluating the extent and circumstances in which policy lessons from past resources booms can be applied to a 21st century transition metals boom. This research will need to include changes in policy space due to international investment and trade agreements.
- Identifying specific policies and institutional capacities necessary to mitigate overlapping risks, including tradeoffs and complementarities among policy priorities. This approach should include evaluating current policy frameworks and institutional strengths for their readiness and compatibility with the region's stated sustainable development goals and strategies.
- Mapping local, national and regional stakeholders and their varied incentives, including analysis of inequalities among actors as they relate to national policy frameworks, local implementation and international coordination. This work should include comparing potential benefits of regional coordination and the pursuit of individual national strategies.

Regarding the Role of External Stakeholders:

- Mapping international stakeholders whose incentives and institutional strengths make them advantageous partners in developing and deploying policies for sustainable supply chains. This effort should track changes to these interests and capacities

over time, including the shift of Chinese economic engagement with Latin America from development lending toward equity investment.

- Evaluating the readiness of LAC states and regional bodies to coordinate responses to a competitive extra-regional environment in which the traditional regional partners of China, the United States and the European Union exhibit increasing competition.
- Assessing external stakeholders' willingness and capacity to support LAC's stated goals and strategies. This approach should consider Chinese actors' willingness to invest in value-added stages of production in LAC, establish upstream and downstream linkages with broader economies and allow for technology transfer.
- Exploring potential roles for LAC regional development finance and coordination institutions and their capacity to guide regional policy and investment coordination. This research should consider prior constraints in regional integration; regional gaps in infrastructure, finance and technology; and mechanisms to overcome these challenges.

Given the urgency of deploying supply chains to support renewable energy expansion, it is vital for researchers to lay the groundwork for practitioners, policymakers and civil society as they face the opportunities and challenges of leveraging LAC's location-specific assets in transition metals into sustainable and inclusive growth. Creation and dissemination of knowledge must be approached in an interdisciplinary and integrated fashion to be relevant to a policy and investment context with competing priorities and trade-offs. However, the complexity of the task facing researchers must not create delays. These knowledge gaps are as urgent as they are significant. The future of global energy and mobility depends on a solid foundation of public knowledge. It is vital for researchers across the natural and social sciences to unite and advance together in a commitment to creating a more sustainable and inclusive future for Latin America and beyond.

INTRODUCTION AND BACKGROUND

Limiting global warming to 1.5 degrees Celsius over pre-industrial levels will require the world's renewable energy capacity to triple 2022 levels by 2030, with 90 percent of annual new generation capacity coming from renewables (IEA 2023). This energy transition relies heavily on the continued and increased supply of several key transition materials, most of which are metals such as copper, lithium, nickel, cobalt, among others.¹ Latin American and Caribbean (LAC) countries are some of the world's largest suppliers of these materials; the region is home to over 65 percent of global lithium reserves, over 50 percent of copper, 23 percent of zinc, 17 percent of rare earth elements and approximately 10 percent of nickel, bauxite and manganese (Lebdioui 2022). These materials are unevenly distributed throughout the region, with Argentina, Bolivia, Brazil, Chile, Cuba, Jamaica, Mexico and Peru as the most common locations. China is one of the world's largest consumers of these materials and is a central actor in producing the refined products, as well as manufactured technology for renewable energy and electric mobility needed to achieve the energy transition. In 2020, China announced a goal to

¹ This report will focus primarily on lithium and copper for the sake of simplicity, as examples of legacy and new supply chains. These two metals have dominated and are likely to continue dominating the China-LAC relationship for transition materials in terms of physical quantities of resources and financial values of trade and investment. However, the incipient boom in transition minerals is not limited to these two commodities. Other materials such as nickel, cobalt, zinc, aluminum, manganese, graphite and balsa wood will be referenced as additional examples.

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achieve carbon neutrality by 2060, an objective that will require large scale transformation of the Chinese economy, which depends on fossil fuels for 85 percent of its energy needs and is the largest coal consumer in the world (IEA 2021c; 2022a). This combination of factors makes a new China-LAC commodity boom for transition materials increasingly likely in the coming years, a boom that has massive implications for not just the countries involved, but the world's overall prospects for reducing the impacts of climate change.

This is not the first time that China and LAC countries have been involved in a commodity boom; between 2002-2013, China's rapid growth fueled massive demand for LAC commodities such as oil, copper, soy and beef. Commodities accounted for 86 percent of LAC exports to China during this period, compared to 56 percent to the rest of the world (Gallagher 2016). One study estimates that LAC countries' export earnings for 15 key commodities increased by between \$41 billion and \$73 billion between 2002-2007 due to the "China Effect" (Jenkins 2011). While this boom brought significant income and gross domestic profit (GDP) growth to the region, it also led to the re-primarization of LAC's export basket (Rodrik 2015; K. P. Gallagher 2016; Ray 2017; ECLAC 2017). Additionally, these revenues were not necessarily saved or reinvested in longer-term growth, social development or technological upgrading (K. P. Gallagher 2016). While Chinese firms and Chinese-funded projects do not perform worse than their Western counterparts on environmental and social matters, the scale of the boom may run the risk of exacerbating environmental degradation, including deforestation, water pollution and scarcity and carbon emissions, as well as social conflicts with Indigenous peoples and other communities associated with these impacts (Ray et al. 2017; Gallagher 2016; Ray et al. 2022). LAC governments initially strengthened their social and environmental regulations in response to these challenges, but as commodity prices declined as the boom receded, many countries relaxed these regulations in an attempt to attract more investment (Ray et al. 2022). With this history in mind, this report considers the extent to which lessons from this previous boom can be applied to the impending boom for transition materials.

The present policy landscape in the region differs significantly from two decades ago. Today, global and regional commitments to environmental protection, clean energy and emissions reduction have changed the policy priorities for LAC governments. The United Nations 2030 Sustainable Development Goals (SDGs) and LAC countries' Nationally Determined Contributions (NDCs) under the Paris Agreement link economic growth and development to combating climate change. While the LAC region contributes comparatively little to global emissions, countries are already confronting the impacts of climate change in stronger hurricanes, severe droughts and increasing wildfires (WMO 2022). LAC's first regional environmental treaty, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, known as the Escazú Agreement, was signed in 2018. It links community rights and environmental protections, establishing the rights to information about the environment, to protections for environmental defenders and to participation in decisions that will affect the environment for present and future generations. While the ratification process has been slow (IISD 2021), this new global and regional context commits LAC countries to higher standards of environmental and social protections, providing a framework for limiting some of the potential negative impacts of a new commodity boom.

The Boston University Global Development Policy Center, together with Peking University's Institute of New Structural Economics and the Universidad del Pacífico's Centro de Estudios sobre China y Asia-Pacífico, hosted a workshop titled "Capitalizing on China's New Climate Economy in the Americas" in August 2022. The goals of this workshop were to survey existing

research on and identify knowledge gaps regarding the role of the China-LAC relationship in global energy transitions away from fossil fuels. This report synthesizes the results of the discussion among 24 experts from academia, government, international governmental organizations and non-governmental organizations. It is organized around three major knowledge gaps identified in the workshop:

1. *Structural factors affecting market conditions for transition materials*, such as the speed and scale of demand increases, the relationships between LAC as producing countries and China as a consuming country, macroeconomic and geopolitical instability and intra-regional variation in LAC countries' technical, financial and policy capacities.
2. *Governance challenges for mitigating risks and pursuing development* associated with the emergence of new supply chains and extractive patterns, necessitating updated or new protections and moving up the value-chains.
3. *The role of diversified external stakeholders*, including the Chinese government, Chinese commercial actors, Western-led and Southern-led MDBs, NDBs and Western private investors.

These three broad categories overlap, and this report will draw connections between them throughout. Underlying each is a need for research that crosses disciplinary, geographical and institutional boundaries. The research questions identified are driven by immediate policy needs and priorities, requiring collaboration between many different areas of expertise. The report proceeds in three sections organized around the knowledge gaps identified; each section first reviews existing literature that motivates the questions introduced in the latter part of the section. It will conclude with a more detailed research agenda to fill these gaps and leverage the impending transition materials commodity boom for positive economic, environmental and social outcomes.

STRUCTURAL FACTORS AND MARKET CONDITIONS

Prior to discussing the governance and actors involved in a potential new commodities boom, this section reviews existing evidence of the market conditions characterizing this boom. Markets for commodities are characterized by highly volatile prices driven by sudden positive and negative demand shocks, creating major challenges for commodity-exporting countries to calibrate production to demand. Transition materials face additional structural uncertainty from policy choices in commodity importing countries, technical and financial barriers to scaling up supply in exporting countries and geopolitical instability related to US-China tensions and Russia's war in Ukraine. China is centrally positioned as an importer of key transition metals, and LAC countries are the foundations for many of these global supply chains as raw materials exporters. This section describes what is known about the market for key transition materials, both in terms of supply from LAC and demand from China and the world. It then highlights the gaps in understanding of the volatility in these supply chains from a global and regional standpoint.

Existing Knowledge

There is a consensus that the global energy transition will require significant increases in key raw materials to produce batteries, build renewable energy production facilities and connect

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them via distribution infrastructure to each other and power grids more widely (Bazilian 2018; J. Lee et al. 2020). Studies suggest that deployment of large-scale renewable energy generation technologies, such as solar and wind power, battery-powered electric vehicles and connectivity infrastructure, are the primary sources of increased demand for transition materials. Valero et al. (2018) predict a 30 percent increase in demand for the relevant raw materials, while Gregoir and van Acker (2022) estimate metal consumption will double by 2050. There is little debate about whether the market for these transition materials – chiefly copper, lithium, nickel and cobalt, but including other metals – will grow in the coming years. However, significant uncertainty remains in terms of the speed and scale of this growth and the energy transition more broadly, which will affect global and Chinese demand for these raw materials. This uncertainty stems from unknown uptake speeds for the major technologies, choices among different types of renewable energy technologies, the availability and cost of substitutes and changes in recycling capacity (IEA 2021b; Hund et al. 2020; World Bank 2017; J. Lee et al. 2020; Dominish, Teske and Florin 2019). The case of balsa wood’s recent boom and bust illustrates how changing technology choices and newly available substitutes can quickly reverse demand growth. Ecuador’s balsa exports doubled between 2019-2020, with 75 percent destined for China (Alarcón 2021; *The Economist* 2021). By the end of 2020, however, conflicts between illegal logging operations and Indigenous communities had stalled supply, and Chinese wind turbine manufacturers shifted to cheaper and more consistently supplied synthetic foam (*The Economist* 2021).

Several studies have projected global demand for transition materials with a wide range of variation in their models. Broadly, there are two categories of transition metals: the first includes legacy metals such as copper, which are already mined in significant quantities and are likely to see incremental increases in demand, and the second are newly developed metals, such as lithium, which are currently extracted in lower quantities. While demand for the latter category is predicted to grow exponentially in the coming years, it is unlikely to meet the absolute levels of legacy metals production due to the fact that renewable energy technologies rely on smaller quantities of lithium than copper, for example. Copper has a wide range of applications across renewable energy technologies, including in electric vehicles, solar photovoltaics, wind energy, cabling and transmission wires. It is projected to account for half of demand by volume and one-third of demand by value for two of the most important energy transition applications: battery technologies and electricity network expansion (Schandl et al. 2016). Between 2015-2030, studies predict an annual growth rate of six percent for copper demand, reaching three and a half times of 2010’s production levels by 2050 (Buchholz and Brandenburg 2018). Similar growth rates are estimated for aluminum and iron (Valero et al. 2018). Projections for lithium demand growth by 2050 range from four and a half times (Hund et al. 2020) to 40 times (IEA 2021b) of 2018 production. The World Bank (2017) estimates that in a two degrees Celsius warming scenario, driven by battery technologies, lithium demand will grow tenfold. Goldman Sachs research predicts a 13-time increase (Bhandari et al. 2022). Increased demand for both lithium and copper can only be met by expanded mining operations (Agusdinata, Eakin, and Liu 2022), implying greater extraction burdens on countries with significant deposits. In addition to the uncertainty about demand, prices for these commodities are highly volatile: the price of one ton of lithium carbonate doubled between January-November 2022 before falling to 60 percent of its January 2022 value by April 2023 (Trading Economics n.d.).

China represents significant portions, and in some cases, majorities of manufacturing and assembly market shares for renewable energy products, particularly solar and wind energy. In the solar supply chain, China represents at least 75 percent of every manufacturing and assembly stage (IEA 2022b). This is despite only representing 36 percent of final demand,

indicating its central position in the intermediate stages of the supply chain. Likewise, Chinese firms control 52 percent of the global wind turbine market, more than double the next closest player, Europe (Zhao, Lee, and Lathigara 2021). Deliberate industrial policies have successfully positioned it as a dominant player in refining low-concentration materials and in developing raw material supplies internationally for export to China (“Safeguarding the Global Market for Critical Minerals” 2022). China depends heavily on imports of ore and refined copper, as well as secondary copper scrap (Dong et al. 2020; J. Wang et al. 2020). Della Vigna et al. (2021) predict that China’s demand for copper will increase 15 percent by 2060, with slightly less growth predicted for lithium, aluminum and nickel. Again, solar and wind energy applications are the main drivers for this increasing demand (Elshkaki 2019). China’s domestic lithium reserves lack sufficient quality for battery applications (Benchmark Mineral Intelligence 2022), making it likely to remain the world’s largest lithium importer (Institute of the Americas 2020). China’s imports of these and other metals are variable based on domestic consumption and exports of clean energy, policy incentives and implementation and technological and recycling improvements (Khanna, Zhou and Price 2021; P. Wang et al. 2019).

As much as China is central to the renewable energy supply chain as both an importer of raw materials and consumer and exporter of value-added products, LAC countries are the foundation of many of these supply chains as raw material exporters. As Figure 1 shows, LAC’s exports to China in both legacy (copper) and new (lithium) supply chains are already significant on a global scale. The Lithium Triangle countries of Argentina (21 percent), Bolivia (22 percent) and Chile (11 percent) account for approximately half of the world’s lithium resources, including non-commercially available deposits (US Geological Survey 2023). Chile and Peru are also major exporters of copper and molybdenum; Brazil and Peru of cobalt, iron, manganese and titanium; Brazil and Jamaica of bauxite and alumina; Chile, Peru and Bolivia of silver; Guatemala of nickel; Peru and Bolivia of zinc; and Peru of cadmium and lead (World Bank 2017). LAC countries are the origins for 64 percent of world trade in copper ores and concentrates, and 90 percent of world trade in lithium. These extensive resources present few constraints on long-term production of transition materials (Valero et al. 2018). Countries in the region

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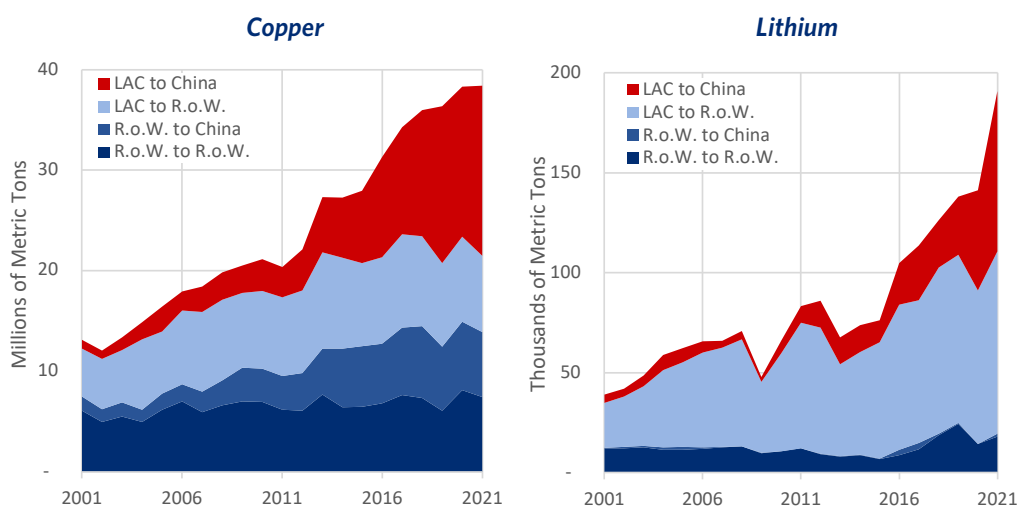
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Figure 1: Global Trade in Copper and Lithium



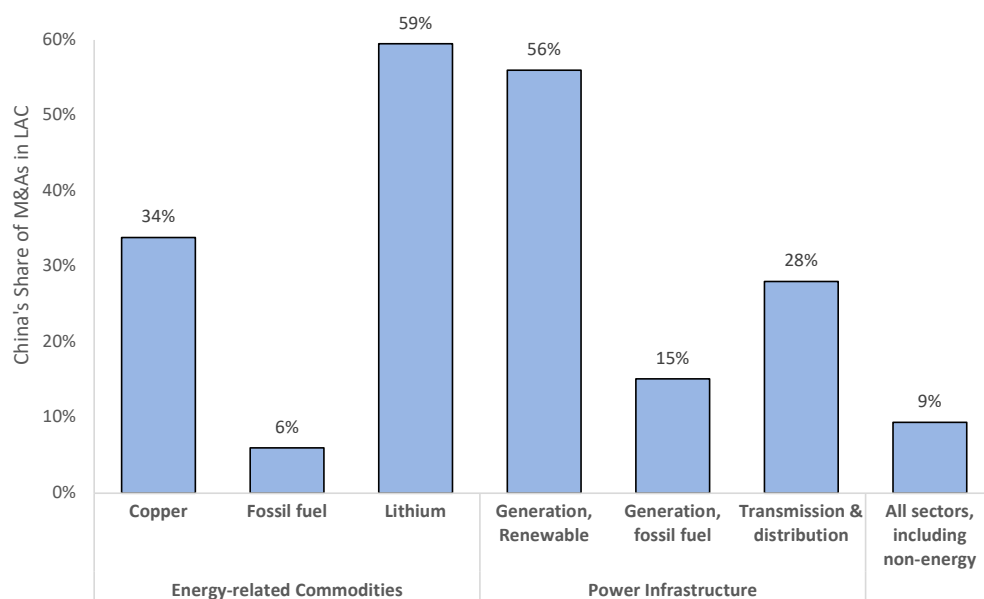
Source: Author calculations from UN COMTRADE data.

Note: R.o.W. refers to 'Rest of World.'

are already active in refining copper, aluminum and molybdenum, but remain primarily in the extractive phase of the supply chain for other metals (US Geological Survey 2023). The risk of Dutch disease, in which a commodity boom leads to stagnation in non-extractive sectors, may restrict LAC countries' ability to move up the value chain into refining and manufacturing (Corden and Neary 1982; Brahmhatt, Canuto, and Vostroknutova 2010).

Studies suggest that technical and financial capacities in many LAC countries are insufficient to meet short- and medium-term demand, with current and planned projects only expected to meet 80 percent of global copper demand and 50 percent of demand for lithium, nickel and other metals (Benchmark Mineral Intelligence 2022; Bhandari et al. 2022; Copley 2021; Dominish, Teske, and Florin 2019; IEA 2021b; Janes, Stringer, and Leung 2021; Lee, Bazilian, and Hastings-Simon 2021; "Safeguarding the Global Market for Critical Minerals" 2022). Expanding existing mines and developing new mines have significant lead times of six to eight years for expansion and averaging 16 years from discovery to production for new mines. New lithium mines take between four and seven years to begin production. LAC countries will also need extensive capital to finance these projects but face barriers accessing the necessary funds due to a lack of investment by multinational mining companies, concerns over political and regulatory risk and a lack of transparency in lithium trading (Copley 2021; "Safeguarding the Global Market for Critical Minerals" 2022; Lee, Bazilian, and Hastings-Simon 2021; Quinteros-Condoretti et al. 2020). As Figure 2 shows, between 2013-2022, China accounted for nearly 60 percent of mergers and acquisitions (M&As) in LAC's lithium and 34 percent of its copper, as well as 56 percent of its overall renewable energy power infrastructure (DeaLogic). China has also financed several major power projects in the region with official finance, such as Ecuador's Coca-Codo Sinclair hydroelectric project (\$509 million), Argentina's Cauchari solar park (\$331 million) and Cuba's La Herradura wind farm (\$160 million) (Ray and Myers 2023). Its investment in LAC's renewable energy, transmission and lithium mining have been increasing in recent years (Institute of the Americas 2020) through a combination of direct acquisitions, loans and long-term contracts.

Figure 2: China's Share of LAC M&As, by Sector 2013-2022



Source: Author calculations from DeaLogic data.

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In summary, market conditions indicate that a major new commodities boom centered around several key metals necessary for global energy transitions is already underway, and significant growth in demand for these materials is likely in the next years and decades. Both China and LAC countries lie at the heart of this boom. However, there are several structural factors in the global economy and geopolitical landscape that raise as-yet unanswered questions about the course this boom will take and its implications for both China and LAC countries, as well as relationships between the two. The next part of this section highlights those uncertainties and identifies related research gaps.

Knowledge Gaps

The Working Group identified several structural factors that may affect market conditions for transition materials: the speed of the energy transition, variation in financial and technical capacity in exporting countries, lingering economic effects of the COVID-19 pandemic, geopolitical competition between the US and China and Russia's war in Ukraine. To explore the interactions between these factors and their effects on LAC and China's positions in the markets for transition materials, collaborative research across disciplines, geographies and academic-policy spheres will be crucial.

There is a clear gap in the literature to link the mostly separate research on LAC's position as a producer of key transition materials and China's position as major importer of raw materials and exporter of manufactured products. As discussed, the pace of the global energy transition and rollouts of new technology depend on consumer preferences, like for electric vehicles versus traditional gas-powered vehicles; industry practices, such as relying on coal power or transitioning to renewables; and policy choices of governments across the supply chain, particularly policy incentives to either encourage or stall energy transitions. The literature widely agrees that each of these factors will impact the amount of demand, and the studies reviewed represent examples of different modelling assumptions. Research has emphasized demand-side perspectives, and projections for China's demand tend to treat it as being met by two broad categories: domestic and international. Future research could disaggregate this international category and explore factors affecting the geographical distribution of China's imports. Both the capacity of exporting countries and geopolitical conditions are likely to affect this distribution. Supply-side research on LAC countries as exporters tends to be isolated from demand-side work; cross-regional expertise is needed to bring these two workstreams together to better map global supply chains.

Technical, policy and financial capacity of LAC countries are highly variable within the region, and there is an opportunity for research linking supply and demand considerations to examine the interaction of China's pursuit of energy security with LAC's pursuit of profitable and sustainable energy-related exports. National governments have different readiness levels to develop new supply chains, labor in sufficient scales and skills, commodity endowments and infrastructure suitability. For example, while Chile has approximately half the lithium resource deposits of Argentina or Bolivia, its production is six times that of Argentina, and Bolivia's production is minimal (US Geological Survey 2023). The following section discusses in more detail the policy challenges for governing a new commodity boom on the domestic front, but clear and well-designed policies will also be necessary to successfully leverage LAC countries' latent market power over transition materials, particularly lithium and copper. The ability of LAC countries individually or as a region to bring this power to bear remains an outstanding

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question, and there is an opportunity for future research to explore the internal and external obstacles.

Related to exporting countries' capacities are the potential shifts in their broader macroeconomic conditions, including growth rates, inflation and industrial structures. While growth rebounded to just over 6 percent in 2021 after a 7 percent contraction in 2020, it slowed to under 4 percent in 2022 and is projected to fall further to 1.8 percent in 2023 (Albright, Ray and Liu 2022; 2023; IMF 2023). Persistent inflation has also constrained policy space for many countries in LAC to spur growth; regional year-over-year inflation peaked at just under 15 percent in 2022 but is projected to remain close to 10 percent for 2023 and 7 percent for 2024 (Adler, Chalk and Ivanova 2023). A commodity boom, coupled with rising commodity prices, raises the risk of Dutch disease, in which resource-exporting countries' non-commodity sectors, especially manufacturing, shrink in response to artificially high or volatile domestic currency values (Corden and Neary 1982; Brahmabhatt, Canuto and Vostroknutova 2010). The previous China-driven commodity boom in the region contributed to re-primarization of LAC economies (ECLAC 2017). These macroeconomic variables present potential obstacles to the region exploiting its market power in transition materials and moving up their value chains. More research is needed to understand the obstacles to attracting downstream investments in industrial development in past booms and the extent to which they apply to transition materials. This will require collaboration across economics and political science disciplines, as well as between academics and policymakers familiar with local contexts and political constraints.

Finally, geopolitical competition between the US and China and Russia's war in Ukraine have the potential to destabilize the global economy for the long-term. This section has largely focused on economic structures affecting market conditions, but geopolitical structures also have major implications for global supply chains. For example, as a result of the US-China trade dispute, China's solar manufacturing firms relocated significant production to Malaysia to avoid tariffs (Ratan 2023). The US Inflation Reduction Act aims to reduce China's share in the global solar supply chain and distribute it among other regions; the extent to which this is successful will affect the destinations of LAC exports and the potential partnerships foreign governments offer in return for securing raw materials. Given that US firms represent no more than 6 percent of each stage of the solar supply chain, and 15 percent of the wind turbine market share, China would remain a major player even if US firms doubled their current shares. More interdisciplinary research bridging political science and economics is necessary to map the pathways between global geopolitical developments and their more localized economic impacts. For example, the extent to which US-China tensions may spill over into lithium competition, and whether this improves technology transfer or financing offers from eager foreign investors, has important policy implications for LAC countries trying to build capacity. Future studies could explore how these global factors interact with each other and supply side considerations, and the conditions under which they reinforce or counteract each other.

GOVERNANCE FOR DEVELOPMENT AND RISK MITIGATION

The anticipated commodity boom for transition materials is far from the first commodity boom that has affected LAC and is indeed the second time that Chinese demand for key commodities stands to significantly impact LAC exports of those commodities. The introduction to this report briefly reviewed the course and lessons of the previous Chinese-driven commodity boom in the region from the mid-2000s to the mid-2010s. This section will discuss several strands of literature on the governance of commodity booms – resource curse, structuralism,

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dependency theory and just transitions – that offer useful frameworks for analyzing the current boom. These frameworks suggest policy mechanisms that LAC states can employ to leverage this moment for sustainable and inclusive development and mitigate risks of a new extractive boom. It then highlights knowledge gaps of the extent to which old lessons can and should be applied in this new global context.

Existing Knowledge

Studies have shown that countries with extensive natural resources have tended to experience lower economic growth rates than countries without them, leading to what is known as the resource curse (Auty 1995; Papyrakis and Gerlagh 2004; Ross 2015). Beyond sluggish growth, these countries disproportionately face problems of rent seeking behavior, constrained civic space and higher likelihood of authoritarian government (Beblawi 1987; Coronil 1997; Karl 1997; Ades and Di Tella 1999; Ross 2001; Collier and Hoeffler 2004). Policy responses to these challenges have largely relied on an institutionalist framework, in which sound economic and financial institutions, robust legal frameworks, transparency and government accountability are the solutions (Karl 1997; Humphreys, Sachs and Stiglitz 2007; Bebbington et al. 2018). The World Bank’s good governance agenda champions this framework (Stevens, Lahn and Kooroshy 2015; Vieyra et al. 2019). A distinct strand of literature in the social movements space has examined localized effects of resource endowments through conflicts between communities affected by extractive projects and the companies or other entities executing these projects (Serje 2003; Paredes 2008; León and Muñoz 2019; Mena et al. 2020). Policy recommendations from these studies have also suggested institutional solutions, including strong environmental regulations, legal frameworks for prior consent, participatory policymaking, a larger role for state-owned enterprises and corporate accountability (Rabi et al. 2020; Stefanović and Saavedra Alvaayay 2016; Pérez, De la Puente Burlando and Ugarte 2019).

Latin American economists confronting the declining terms of trade and commodity price volatility that come with natural resource-based export economies have conceptualized two major frameworks for turning these resources into engines for development: structuralism and dependency theory. While the former argues for leveraging trade and managing foreign investment to move up the value chain, the latter emphasizes industrialization and a much stronger state role in resource extraction, including national companies to allocate concessions, direct exploration and produce oil and minerals (Sonntag 2001; Fajardo 2022). More recent work also underscores the importance of independent economic policy space to enact industrial policies governing commodity extraction. These policies include maintaining a flexible taxation regime to take advantage of high revenues during booms and maintain investment levels when commodity prices decline (Natural Resource Governance Institute 2014), upstream and downstream linkages with commodity extraction, diversification beyond resource exploitation (Vieyra et al. 2019), local content regulations, limitations on investor-state-dispute settlement mechanisms and incentives for technology transfer. These policies have been inconsistently implemented in previous booms, and countries will need to rapidly deploy frameworks to take advantage of new booms while supply chains are still being built. These frameworks – the resource curse, structuralism and dependency theory – are primarily linked to questions of economic governance, but social and environmental governance will also be key to successfully navigating the current boom.

Research on previous commodity booms has illustrated the unique social and environmental problems resulting from resource extraction, including incentives for corruption, the potential

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for capital flight, illegal extraction (especially in forestry), exploitative labor conditions and weakening state capacity (Heinrich 2011; Le Billon and Good 2016; Dargent, Feldmann and Luna 2017). During the prior China-driven commodity boom in LAC, environmental and social regulations strengthened and weakened in response to changing prices; Figure 3 illustrates these shifting regulations which strengthened (shown in blue) as commodity prices rose in the last boom, but weakened (shown in red) as prices cooled again (Ray et al. 2022). It is important to underscore that Chinese labor and extractive practices are not significantly different from those of Western and other investors, but China’s approach of relying on LAC countries’ regulations for social and environmental protections makes strong LAC policies even more crucial (Ray et al. 2017). The more recent case of balsa wood demonstrates the additional challenges for states to design and deploy robust policies in the face of sudden and exponential growth in demand for these new transition materials. When demand surged, illegal logging also skyrocketed, leading to massive unregulated deforestation and conflicts with Indigenous communities that sometimes turned violent (Illanes et al. 2022; Bravo 2021; Rodriguez Zunino, Norman and Fenton 2022). Research shows that a lack of regulatory frameworks and inability to quickly develop and enforce them contributed to these outcomes, leaving local communities to bear the brunt of negative impacts (Rodriguez Zunino, Norman and Fenton 2022).

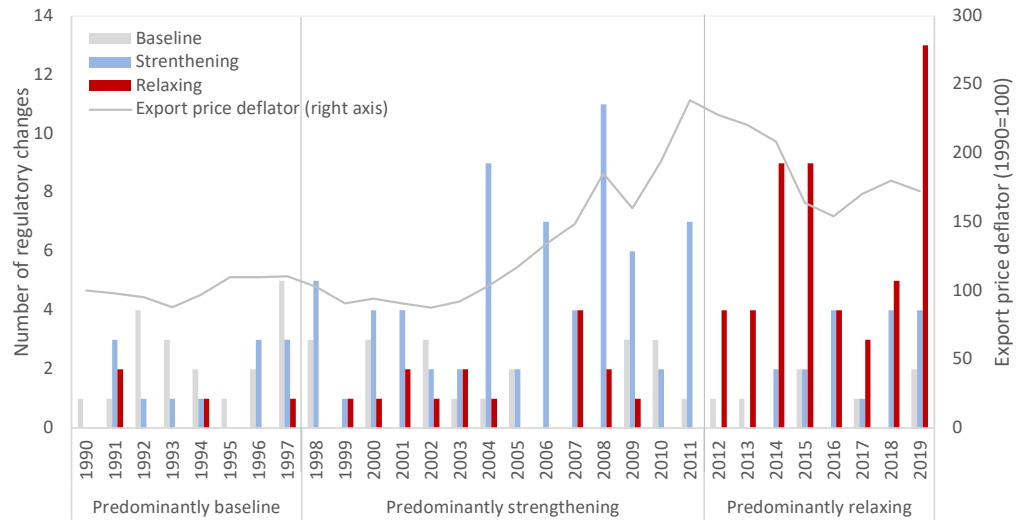


Figure 3: Regulatory Changes in Amazon Basin Countries, 1990-2019

Source: Ray et al 2022.

Another crucial policy framework, climate justice, considers dimensions of transition materials extraction, such as the impacts of phasing out fossil fuels on income and employment, the role of local communities in decision-making for new extractive projects and how to incorporate renewable energy production into local grids in addition to exports. Meeting global and national goals for emissions reduction will not only require a massive scale-up of renewable energy, discussed in the previous section, but also necessarily implies a significant decline in fossil fuel extraction and consumption (IEA 2021a; Coffin and Grant 2021). Projections indicate that this shifting energy matrix is likely to precipitate a \$13 trillion shortfall in global fiscal revenues, stemming primarily from stranded assets in oil and coal dependent countries facing lower demand and prices for these commodities (Coffin and Grant 2021; Manley, Cust and Cecchinato 2017; López and Patzy 2021; Peszko et al. 2020; Manley, Heller and Davis 2022). The concept of a just

transition recognizes the major social and political implications of these changes and aims to center the needs of those most vulnerable to quickly changing policies. Based in workers' rights and community participation frameworks, just transitions have expanded to consider retraining and support for workers who lose jobs in fossil fuel industries, distributing the burdens of climate change, ensuring energy access in a post-transition world and involving citizens in design and implementation of environmental policies (Lager et al. 2021; Atteridge and Strambo 2020). Furthermore, a poverty-alleviation lens highlights how transitions to renewable energy could help LAC countries reach the 34 million people lacking access to electricity (Flavin et al. 2014). China has already shown a willingness to partner with LAC countries on renewable energy production for local markets to meet this need; compared to other regions, Chinese-financed energy capacity in LAC is overwhelmingly in renewables, as Figure 4 shows below.

Facing these twin challenges of promoting economic development and ensuring sound environmental and social protections will require regional-level governance solutions in a region where historical efforts at integration have often failed to materialize. This is not due to a lack of effort or incentive; Pan-American and sub-regional organizations have proliferated since the early 20th century. Research has suggested several reasons for this phenomenon: the lack of a common external enemy, asymmetrical power relationships within the region, geographic barriers, limited funding to overcome those barriers and competing domestic political and economic interests (Gómez-Mera 2017; Long 2020; Armijo 2023). Riggirozzi and Tussie (2012) characterize three main types of regional integration in the 21st century: commercial integration with limited socio-political aims (e.g. Comunidad Andina), trade projects that have expanded to include broader political goals (e.g. Unión de Naciones Suramericanas) and explicitly socio-political projects (e.g. Alianza Bolivariana). The Unión de Naciones Suramericanas (UNASUR) and the Comunidad de Estados Latinoamericanos y Caribeños (CELAC) are two of the most recent initiatives for political integration. UNASUR's Consejo Suramericano de Infraestructura y Planeamiento (COSIPLAN), formerly known as the Iniciativa para la Integración de la Infraestructura Regional Suramericana (IIRSA), is the latest effort to integrate physical infrastructure across the regional to overcome its geographical barriers.

The foregoing discussion demonstrates that under certain conditions, there is a major opportunity for LAC countries to leverage their centrality in the transition materials supply chains for positive growth and development outcomes. The resource curse literature emphasizes the role of robust institutions in mitigating potential negative economic and political outcomes of commodity booms. Dependency theory offers specific recommendations for industrial policies to moderate the volatility of commodity booms and their effects on exporting countries. Climate justice perspectives incorporate the new governance challenges of managing booms for some commodities with simultaneous busts for other commodities. Regional integration offers a potential pathway for collective action to navigate these challenges and share best practices for overcoming them. The following part of this section considers the extent to which the emerging commodity boom for transition materials parallels previous booms in the types of risks and opportunities it presents, highlighting the knowledge gaps related to best governance practices.

Knowledge Gaps

In the Working Group's estimation, characteristics of this upcoming boom indicate that it will share several of the social, environmental and economic governance challenges of previous booms, but the nature of the extractive processes and supply chains for transition materials also present novel questions on how to mitigate risks. Table 1 summarizes these challenges

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Table 1: Governing Risks Along the Supply Chains for Transition Materials

	← UPSTREAM Extraction	MIDSTREAM Manufacturing	DOWNSTREAM → Ren. energy, elect. mobility
Environmental	<- Sunsetting fossil fuel industries? ->		
	<- Prod. conditions: pollution, waste, competition with communities for natural resources->		
Social	<- Employment: unions, national employment quotas, sub-contracting, fossil fuel workers->		
	FPIC rights		FPIC rights
			Access/subsidies for R.E. / E.V.s
Economic	<- Macropprudential policy to avoid "Dutch disease" and capital account volatility ->		
	Taxes/royalties	Linkages with national, regional economies	
	Nationalization	Integration of upstream/downstream supply chains across LAC	
Governance	← Transparency → ← Policy space for all of the above →		

Source: Author compilation.

across upstream, midstream and downstream stages of renewable energy supply chains, across environmental, social, economic and governance themes. Research that couples concerns from each of these dimensions will be necessary to design multidimensional policies that consider political and territorial effects, as well as macroeconomic factors.

The risks to social, environmental and economic outcomes from this new boom are likely to manifest across the supply chain, from extraction to manufacturing to electric vehicle and renewable energy deployment. Governance efforts have historically targeted each of these phases independently. Table 1 illustrates the overlapping nature of these concerns on two axes: the stages of the supply chain and the governance dimensions. Existing literature tends to treat these dimensions separately, and there is an opportunity for new research that takes a holistic approach to risk mitigation, particularly within the framework of a transition that is just for affected communities, employees in these industries and final consumers. For example, issues of production conditions such as resource competition or pollution management have (1) environmental impacts on local ecosystems and water sources, (2) social impacts on the ability of affected communities to support themselves and maintain societal traditions, (3) economic impacts on the costs of production and potential revenue and (4) governance impacts on the relationships between the state and civil society. There is a clear need for research that links the locally-focused, territory-based environmental and social impacts of these projects with the national macroeconomic policies and outcomes for commodity extraction. Filling these gaps will require collaboration between the strands of macroeconomic research and social movement studies discussed in the first part of this section. There is also room for deeper understanding on where different types of risks overlap and how to design policies that target multiple categories of risk.

Previous commodity booms, such as the first China-driven boom in the 2000s, largely confronted established supply chains and extraction patterns. The supply chains and extraction patterns for some of these transition materials, lithium in particular, are relatively new, compared to others like copper, and consequently lack governance frameworks for their environmental and social impacts. Most lithium in South America is located in salt flats and extracted

through a water-intensive process in which freshwater pumps brine to surface-level evaporation pools, where the freshwater is evaporated to leave behind a highly concentrated brine of lithium salts (Vásquez 2020). This process has already been linked with soil and water contamination, and is likely to exacerbate the water scarcity already facing local communities and exporting countries (Dominish, Teske and Florin 2019; Lee, Bazilian and Hastings-Simon 2021; Copley 2021). There is an important opportunity for research exploring the extent to which existing social and environmental risk mitigation policies in LAC countries, established during previous booms for different commodities, are sufficient to meet new protection challenges of this boom. Questions remain about whether constraints on adequate protection during previous booms will apply today, and how much policy innovation will be required. These are especially important questions for LAC countries seeking to move up the value chain beyond their position in previous booms, which can bring new benefits and risks.

In addition to the new supply chains and extraction patterns, LAC states are party to new global and regional agreements that govern key aspects of social and environmental protections. At the global level, the SDGs dispute the prevailing notion that the relationship between environmental protection and economic growth is characterized solely by tradeoffs. The Escazú Agreement established a rights-based framework for environmental protection, emphasizing transparency, inclusivity and justice in matters of environmental governance (IISD 2021). At the time of writing, there are 24 signatories and 15 parties to the agreement. These overlapping and interlocking levels of governance – local, national, regional and global – have combined to elevate standards for environmental and social protection, but have also created an increasingly complex system for monitoring and enforcement. There is a need for research on the extent to which LAC’s policies are ready to meet the higher standards in these agreements, particularly in the face of volatile commodity prices that may incentivize fluctuations in protection frameworks. There are also outstanding questions about gaps in implementation of these policies as they are written, and the effects of changing macroeconomic conditions on future implementation.

Finally, each of the frameworks discussed – resource curse, structuralism and dependency theories and climate justice – implies shared regional challenges in moving up the value chain, navigating insertion in the global economy and managing the environmental and social impacts of this boom. Much like lessons for environmental and social governance, there remain questions about the extent to which lessons from previous efforts at regional integration can be applied to the present context. While not directly competing, Argentina and Chile have thus far pursued separate and distinct lithium governance policies, with the former encouraging private sector – including foreign – investment and the latter seeking a larger state role (Vásquez 2020; 2023). There is an opportunity for research to explore whether this new boom for lithium and other transition materials can provide a sufficient impetus for integration, and under what conditions such an initiative might be successful. In South America, efforts for physical integration are underway by IIRSA/COSIPLAN, operating under the more politically and strategically oriented framework of UNASUR. The Asociación Latinoamericana de Instituciones Financieras para el Desarrollo (ALIDE) brings together NDBs in the region to discuss shared development challenges and coordinate policy solutions. These and other regional governance initiatives are likely to be pivotal in mitigating the effects of commodity price volatility, ensuring common standards for environmental and social protection and leveraging LAC’s potential market power with external stakeholders. However, these and similar efforts have struggled at coordinated action and institutional longevity in the past, necessitating analysis of the political processes involved, resulting impediments and potential solutions (see for example Bértola

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and Ocampo 2012; Cárdenas, Ocampo and Thorp 2000; Franko 2018). To preview the following section, there is an opportunity for more research on lessons learned from the histories of regional fora, such as CELAC-China and IIRSA/COSIPLAN, in coordinating external stakeholders and deepening intra-regional integration.

THE ROLE OF EXTERNAL STAKEHOLDERS

As the previous two sections have indicated, extra-regional actors have a central role in precipitating this new commodity boom for transition materials and in affecting its course and outcomes. This section assesses the role of Chinese and other external stakeholders as partners to LAC countries in these processes, including MDBs, other development finance institutions (DFIs) (Xu et al. 2021) and private sector actors. While these external actors are important, this report does not suggest that they are the sole, or even primary, drivers of outcomes for this boom. LAC countries have meaningful agency to exercise in shaping their relationships with China, private investors and DFIs. This section will review the interests and expertise of various external stakeholders as part of the matrix of opportunities for LAC countries to leverage this boom for their own sustainable development goals, as well as the potential obstacles these actors create for LAC countries. It then considers knowledge gaps regarding LAC countries' abilities and desires to coordinate among diverse actors to achieve the policy goals outlined in the previous section.

Existing Knowledge

While the previous sections have mentioned the role of Chinese and other external actors in LAC's new commodity boom, this section aims to systematically review the major groups of actors, their interests vis-à-vis transition materials and their relevant experiences with financing that LAC countries may seek. It is first important to disaggregate China into state actors, including both its DFIs and major state-owned enterprises (SOEs), and Chinese commercial actors, including private enterprises and commercial banks; these two groups have overlapping but not identical interests. Western-led MDBs, such as the World Bank and Inter-American Development Bank (IDB) are major actors in the region, along with borrower-led banks, such as the Latin American Development Bank (CAF). Finally, Western private companies are key players in LAC's greenfield foreign direct investment (GFDI) and M&As but behave quite differently than both Western MDBs and Chinese private enterprises. Research has shown that when confronting a wide variety of DFIs, countries in LAC and other regions strategically balance between the types of financing and expertise of these different institutions according to their own policy goals (Humphrey and Michaelowa 2013; Bunte 2019; Gallagher 2021; Hwang 2021). With deliberate policy choices, LAC countries may also strategically regulate the role of private investors to achieve desired development outcomes.

The China Development Bank (CDB), Export-Import Bank of China (CHEXIM) and major Chinese SOEs (e.g., China MinMetals, SinoHydro), are all part of the landscape of Chinese state actors involved in LAC. In line with China's domestic priorities, these actors seek long-term energy security to meet development goals, and easy access to key transition materials is central to that objective (Wise 2020; Ye 2020; Hepburn et al. 2021; Moses and Zhu 2022). Research has shown that to achieve their policy goals, China's DFIs and SOEs are willing to be patient through changes in regulations of recipient or host countries (Kaplan 2021; Ray et al. 2022). This stands in significant contrast to Western investors focused on short-term profits.

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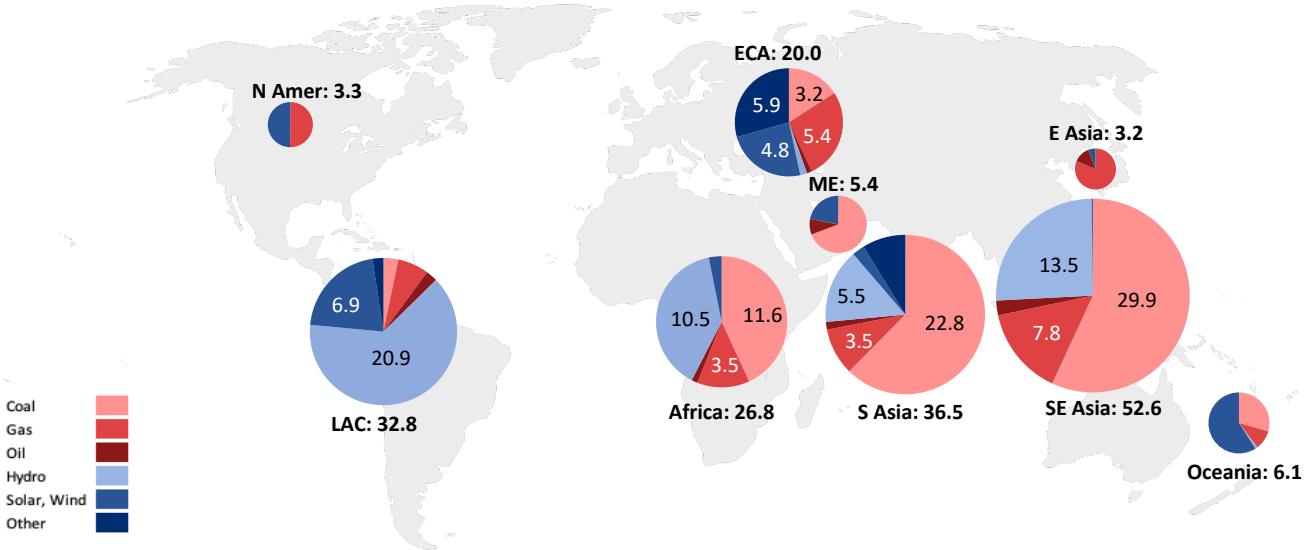
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Chinese SOEs play a key role in these relationships as contractors for CDB and CHEXIM's loan-financed projects in LAC. Together, Chinese DFIs and SOEs create a coordinated credit space wherein multiple Chinese actors cooperate to finance, execute and sometimes operate, large development projects, chiefly in infrastructure sectors (Chin and Gallagher 2019). Several LAC countries have taken advantage of this new source of finance for major energy and transportation projects; since 2005, LAC countries have borrowed \$136 billion from Chinese banks (Ray and Myers 2023). As Figure 4 shows, LAC has been the center of China's overseas lending and investment in renewable energy; 85 percent of Chinese-funded installed energy capacity in the region is hydro, wind or solar power (Boston University Global Development Policy Center 2022). The region's Chinese borrowing peaked in 2015 and has been declining since then, a trend accelerated by the COVID-19 pandemic (Albright, Ray and Liu 2023; Ray 2023). As large-scale projects have become less common, private Chinese companies have continued investing in the region and its renewable energy sector.

Figure 4: Chinese-Financed Energy Capacity, by Region and Source (Gigawatts)



Source: Author calculations from Boston University Global Development Policy Center 2022.

In the past decade, Chinese commercial entities have invested \$122 billion in LAC through both GFDI (\$59 billion) and M&As (\$63 billion). While the vast majority of these investments have historically been in the extraction and infrastructure sectors, an emerging trend shows a shift towards renewable energy, electric vehicles and lithium (Albright, Ray and Liu 2022). Chinese companies have been responsible for 56 percent of all renewable energy M&As in LAC between 2013-2022 (“Dealogic” 2023). There is a clear interest on behalf of Chinese commercial entities in the green transition, and LAC states are well poised to take advantage of their investments. However, recent events suggest that LAC countries may face a new obstacle from Chinese companies acting more like their Western counterparts: investor-state dispute settlement (ISDS) claims. While Chinese SOEs are willing to wait for their investments to pay off, private Chinese companies have been increasingly more disposed to make ISDS claims when recipient countries' environmental and social regulations threaten profits (UNCTAD n.d.). Of the 15 recorded instances of a Chinese company suing a state, only one claim has been brought by an SOE, highlighting a key distinction in how SOEs and private companies behave (Pathirana

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2017). LAC states seeking to enforce existing or design new environmental and social governance policies will need to contend with this new phenomenon, especially as rising Chinese FDI in transition materials confronts uncharted territory in governing new extraction patterns.

Another set of external actors may be an important for this objective: Western-led MDBs tend to favor policy and technical support projects and have significant expertise in their implementation. The World Bank and the IDB, the two main Western-led MDBs operating in LAC, have focused much of their lending on building up technical capacity, improving social and environmental governance, fostering institutional development and other soft infrastructure projects. These loans tend to be smaller and concentrated in the health, education and environment sectors (Chin and Gallagher 2019). Over the past five years, and looking forward to projects in the pipeline, the IDB's largest sector is state reform and modernization (IDB n.d.). However, both the World Bank and the IDB have stepped up hard infrastructure (in transportation, energy and communications) financing in recent years, opening opportunities for LAC's NDBs to cooperate with larger MDBs. For example, the IDB has partnered with the Brazilian Development Bank (BNDES), the National Bank of Works and Public Services of Mexico (Banobras) and ALIDE to attract greater investment in multinational and regional infrastructure projects (IDB 2022). In 2014, the World Bank launched a new Global Infrastructure Facility with the Group of 20 (G20) to mobilize private, public and multilateral finance for infrastructure projects, with an emphasis on climate resiliency (World Bank 2014).

Finally, Western private actors are driven almost exclusively by shorter-term profit motives and are highly sensitive to both macroeconomic and political instability. Private Western loans have an average maturity of five years, compared to 17 years for Chinese loans (Kaplan 2021). LAC has faced several waves of capital outflows in response to and exacerbating economic crises in the past several decades: the 1980s debt crisis, the Asian financial crisis in the late 1990s, the 2008 global financial crisis and more recently the COVID-19 pandemic (Batini, Borensztein and Ocampo 2020; Cavallo et al. 2022). The effects of the latter two have been moderated by the influx of capital from the first Chinese-led commodity boom, as well as countercyclical lending from multilateral institutions and access to international capital markets, respectively. In these times of uncertainty, Chinese investors have taken advantage of Western capital flight from LAC countries to buy their former assets. For example, Chinese investment in Brazil grew as Western investment simultaneously declined in the wake of the 2008 global financial crisis, Brazil's 2014 economic crisis and the 2015 *Lava Jato* corruption scandal (Kaplan 2021). Since 2017, Chinese investors have been buying assets in the electricity infrastructure sector as Western investors sell them; these M&As accounted for over 70 percent of Chinese M&As in LAC between 2017-2021 (Albright, Ray and Liu 2022). Extraction and manufacturing led M&As from the rest of the world over the same time period, at 30 percent and 26 percent, respectively. These trends in private sector investment again demonstrate the potential for LAC countries to leverage complementary rather than competing interests of Chinese and Western stakeholders. The next section highlights knowledge gaps in terms of how these potential complementarities might shift in the context of the new commodity boom for transition materials, suggesting avenues for future investigation.

Knowledge Gaps

The proliferation of external stakeholders presents LAC countries with more choice in how they finance and govern this new commodity boom, but it also represents a significant coordination challenge. These actors may share broad goals of achieving a green transition and combatting

climate change, but particular investors or institutions may operate in a more competitive framework based on immediate interests in accessing key resources. Research has shown that Chinese financing and Western financing have important complementarities in the sectors they finance, the amounts of finance they offer and the countries to which they lend (Chin and Gallagher 2019; Moses and Zhu 2022). The same research has also noted competitive behavior of these same actors; the Group of Seven's (G7) Partnership for Global Infrastructure Investment (PGII) was deployed largely as a competitor to China's Belt and Road Initiative (BRI). There is a gap in research exploring more specific complementarities in this new context of transition materials, especially in light of scaled down Chinese official lending and potential competition between private Chinese and private Western investors over key resources. Research that facilitates cross-regional collaboration and incorporates diverse perspectives from external actors and LAC countries is needed to identify shared goals and roles for various stakeholders.

Another outstanding challenge for LAC countries will be incentivizing external stakeholders to support development goals, from moving up the supply chain of transition materials to enforcing environmental and social protections. There are open research and policy questions about the conditions under which these external actors will be willing to meet LAC's goals in exchange for access to resources. As Chinese financing shifts away from large state-led projects towards smaller projects and private investment, and as private Chinese investors resort more frequently to ISDS claims, the governance considerations for LAC countries necessarily change. There is a need for research into the drivers of these trends and the new obstacles and opportunities they present for LAC countries. Collaboration between firm-level management frameworks, national-level economic frameworks and cross-regional political science frameworks will be key to answering questions about shifting interests of external actors and their effects on LAC's policy space.

While Western-led MDBs have been and will remain key sources of external financing and expertise, the rise of Southern-led development banks and new partnerships between Southern NDBs have the potential to reshape this landscape. LAC's regional borrower-led MDBs such as CAF, extra-regional Southern-led MDBs including the Asian Infrastructure and Investment Bank (AIIB) and the New Development Bank (NDB) and NDBs such as Brazil's BNDES can serve as coordinators for financing and knowledge transfer from external actors to local institutions and banks. These banks have experienced a resurgence in the wake of the COVID-19 pandemic, building on their experience in infrastructure projects, clear public mandates and access to multiple information flows to provide rapid counter-cyclical lending (Barrowclough and Marois 2022). However, the success of these efforts varied across the Global South due to different levels of pre-crisis capitalization, autonomy and technical capacity (Griffith-Jones, Barrowclough and Mishra 2023). Beyond crisis recovery, these banks also face challenges in scaling up beyond transferring resources and towards durable structural transformation (Barrowclough, Gallagher and Kozul-Wright 2021). More research is needed into the capacities of Southern MDBs and NDBs to fill the gaps in financing, infrastructure and technology that will be necessary for LAC to move up the value chains of transition materials. There is also an important knowledge gap of how successful coordination between NDBs has been through organizations such as ALIDE, and the conditions under which this coordination is likely to succeed moving forward. Preliminary research shows that some of the more successful COVID-19 recovery programs involved North-South partnerships between development banks (Griffith-Jones, Barrowclough and Mishra 2023), but more work is needed to identify partnerships that will be fruitful over the long-term for scaling up finance and technical support to LAC countries.

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Existing research has shown that Western private investors tend to react quickly and negatively to economic or political uncertainty in LAC countries, but transition materials and the impending boom may provide sufficient incentives for them to overcome some hesitancy. Argentina's market-led strategy for lithium development has already shown some success, attracting over \$4 billion in investments since 2020 (Vásquez 2023). These include deals with both Chinese commercial entities and Western investors. It remains to be seen whether these deals, which often include favorable tax and royalty rates, foreign exchange provisions and extended concession timelines, will produce the anticipated results from their accompanying technology transfer objectives (Vásquez 2023). There are also gaps in knowledge of how changing interests and commitments to environmental and social risk management (ESRM) among Western investors themselves will affect these processes. One of the largest global ratings agencies, S&P Global Ratings, introduced an environmental, social and governance (ESG) creditor indicator in 2021 but withdrew it in 2023 after political backlash in the US (S&P Global Ratings 2023; Segal 2023). European Union regulators have also proposed new supervisory measures for ESG ratings (Segal 2023). As LAC countries attempt to establish and enforce environmental and social protections, the extent to which the investors they target for transition materials projects prioritize these measures in their portfolios will necessarily affect the amount and types of investments they are able to secure. There is an important opportunity to combine policy-focused research with risk analysis and studies of firm behavior to understand the relationships between ESRM policies in investors' home countries, ESRM policies of the countries they are investing in and their own strategic goals vis-à-vis ESRM.

In summary, there are several interrelated gaps in knowledge about the future of relationships between LAC states and other regional actors and external stakeholders, including Chinese state and commercial entities, Western-led MDBs, Southern-led MDBs and Western private actors. The long-standing interests of each of these groups have shown signs of shifting in recent months and years, with the implications for LAC's transition materials uncertain. Chinese DFIs are moving towards smaller and higher impact financing after several years of large loans. Southern-led MDBs and NDBs may be able to take advantage of new interest from Western-led MDBs in infrastructure financing to support regional integration of value chains. Chinese commercial entities may be acquiring some behaviors of their Western counterparts with waning patience for shifting ESRM regulations. Western private actors in turn have inconsistently prioritized ESRM in their portfolios, but may be willing to invest in countries they previously would have avoided if it means accessing transition materials.

A POLICY-ORIENTED RESEARCH AGENDA

This report has highlighted three broad categories of research knowledge gaps about the future of a commodity boom for transition materials between China and LAC countries. By outlining these gaps, we aim to build on existing bodies of literature from previous commodity booms and the China-LAC relationship more broadly to understand the likely processes and outcomes facing this partnership. This final section summarizes those gaps and proposes a specific research agenda.

Structural Factors and Market Conditions

The first section identified four main knowledge gaps related to different types of structural factors that are likely to affect global market conditions for transition materials: (1) the

connections between LAC as a producer of transition materials and China as a major actor in intermediate refining and exporting of manufactured products, (2) the capacity of LAC countries to leverage their individual and collective market power, (3) volatility in macroeconomic conditions such as inflation, growth rates and industrial structures and (4) geopolitical and economic tensions between the US and China, as well as Russia's war in Ukraine. Specifically, we recommend that researchers:

- Thoroughly map anticipated impacts of transition material demand by country and by commodity. Location-based supply chain mapping will be key to national and regional policy planning. This includes modelling changes in China's growth and its ripple effects in LAC countries, as well as more transparent identification of all actors involved. Quantitative modeling, such as through computable general equilibrium (CGE) models, can fill a crucial role in setting reasonable bounds for expectations.
- Analyze the interaction of these structural factors. By bringing together expertise across disciplines, researchers will be better able to understand the relationships between factors such as US-China economic disputes and commodity prices, improved recycling abilities and reliable substitutes and LAC market power and concentrated demand from China versus dispersed global demand.
- Outline the obstacles for LAC countries to leverage their market power and potential solutions. This includes barriers to quickly and sustainably scaling up production of transition materials that have not yet been mined in large capacities, such as lithium. LAC countries will need to consider the viability of substitutes for these materials as an obstacle; the case of balsa wood demonstrates how rapidly a boom can bust. The extent to which LAC countries can coordinate with each other is likely to have a heavy impact, and variation in country capacities could either exacerbate barriers to coordination or enable complementary capacity-sharing.

Governance for Development and Risk Mitigation

Ensuring sound environmental and social protections is not at odds with improving economic development outcomes for LAC countries. Key gaps in existing literature on governance questions include (1) whole of supply chain approaches to risk mitigation that link local territorial impacts with national macroeconomic outcomes, (2) the ability of pre-existing policies for environmental and social governance to ensure adequate protections in the face of new extraction patterns and supply chains, (3) the role of new global and regional commitments to sustainable development in supporting policy design, implementation and enforcement and (4) the extent to which new governance challenges provide a sufficient impetus for deeper and more effective regional integration. To fill these gaps, we recommend that researchers:

- Evaluate the extent to which existing lessons from prior commodity booms apply in the context of new supply chains and the current global economic environment. This will involve first identifying the prior constraints on downstream integration and positive development outcomes. Research will need to consider the limits that new trade and investment treaties may place on policy space to achieve these goals, and what industrial policies will be necessary and possible for LAC countries to attract investment.
- Identify policies and capacities necessary to confront overlapping risks, whether these risks present tradeoffs or complementarities for policymakers. This includes

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the readiness of existing macroeconomic, social and environmental policies to govern new extractive processes. Studies should evaluate whether LAC countries have the technical capacity to implement a whole of supply chain governance framework.

- Map local and national stakeholders in this commodity boom and their respective interests. These studies should consider the relationship between national governance frameworks and localized implementation, as well as the uneven influence that various stakeholders have on policy processes.
- Compare the potential for cooperation among LAC states with incentives for pursuing independent approaches. There are learning opportunities where LAC states have implemented different policies both to govern prior booms and in anticipation of this commodity boom. There are also concerns about how the end of previous commodity booms have led to weakening of regulations in attempts to attract investment.

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While many of the external stakeholders in this commodity boom have been active in LAC for decades, their shifting interests in relation to each other and these new materials have created knowledge gaps of their roles moving forward. The third section identified four areas: (1) coordination challenges for LAC countries seeking to leverage complementary expertise in a potentially competitive environment, (2) the extent to which these stakeholders' will be willing to support LAC countries' own development goals, (3) the emergence of Southern-led MDBs and NDBs as additional sources of funding beyond the traditional Western-led MDBs and (4) shifting interests of Western private investors in higher-risk economies and environmentally-sound investments. Specifically, we recommend that researchers:

- Map international stakeholders and their respective abilities and willingness to fill financial and technical gaps in LAC countries. This research should identify the relevant expertise of Chinese and other stakeholders for transition materials specifically.
- Compare how various stakeholders and their interests are changing over time. This will involve identifying how the actors themselves are changing, as well as their stated interests and actual behavior, such as Chinese loans becoming smaller and the rise of Chinese commercial actors in the region.
- Evaluate the readiness and capacities of LAC states to coordinate among competitive external actors. These studies should examine the extent of policy space for autonomous maneuvering and the effects on LAC of the US, EU and China placing increasing importance on energy security.
- Assess external stakeholders' willingness to support LAC goals, such as Chinese actors' appetite for locating value-added steps in LAC, as opposed to domestically. The power relationships within multilateral institutions are a crucial factor in LAC's ability to assert its preferences with Western-led and Southern-led multilateral lenders.
- Explore how to unleash the role of DFIs, including MDBs, NDBs, public equity funds and guarantee funds, in accelerating the green transition in China and LAC and examine the conditions under which their full potentials can be realized.

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- Explore potential roles for regional fora and their potential strength and coordinating capacity. This research should take into consideration the prior constraints in developing regional supply chains; the regional-level gaps in infrastructure, finance and technology; and mechanisms to prevent competitive regulatory regimes.

Given the global stakes of the impending China-LAC commodity boom for transition materials, including but not limited to lithium and copper, research answering these questions is both urgent and important. This report has identified three broad categories of knowledge gaps: market uncertainties, governance challenges and diverse stakeholders. Through the process of conducting studies to address these gaps, we anticipate that further research questions and gaps will emerge. This report and the related workshop suggest that this research agenda and its evolution will be best served by convening experts across academic disciplines, areas of geographical expertise and institutions both within and beyond academia and government.

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Salar de Uyuni, Bolivia. Photo by Ksenia Ragozina via Shutterstock

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