# China and the global expansion of green energy technologies: EVs, batteries and lithium investments in Latin America.

## China y la expansión global de las tecnologías de energía verde: vehículos eléctricos, baterías e inversiones en litio en América Latina

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POWER
CONNECT
CHARGING
FAULT
59%

## Resumen

China se ha convertido en un líder mundial en baterías de litio y ha utilizado estas capacidades para desarrollar un importante ecosistema de innovación en vehículos eléctricos, cuyas empresas se están expandiendo al mundo. El factor clave para la promoción exitosa de los vehículos eléctricos en China ha sido la política industrial. Las tecnologías verdes pueden verse como la nueva frontera para la expansión global de las empresas chinas debido a sus capacidades tecnológicas y de innovación y América Latina es uno de los principales destinos de la inversión extranjera directa (IED) en vehículos eléctricos, litio y baterías. El presente artículo examina el panorama y las tendencias de la IED realizada por empresas chinas en la región, con el objetivo de analizar la posibilidad de que los países latinoamericanos integren la cadena de valor liderada por China en energía verde como parte de sus procesos de desarrollo y políticas industriales. Los resultados son preliminares, pero inferimos que hay una nueva fase de participación China en América Latina post-Covid, con un cambio en el perfil de la IED: 1) las inversiones relevantes ahora se realizan no solo a través de empresas estatales, sino cada vez más realizadas por empresas privadas; 2) los sectores de destino están cambiando lentamente del petróleo, el gas y la agricultura hacia fuentes de energía renovables, vehículos eléctricos y minería de minerales estratégicos; 3) los flujos de inversiones son menores en la cantidad total, pero hay un mayor número de proyectos en la región en general; 4) los proyectos de IED se dirigen cada vez más a sectores intensivos en conocimiento/tecnología, en lugar de sectores intensivos en capital, con un aumento gradual de la IED totalmente nueva como modo de entrada.




**PALABRAS CLAVE:** China; vehículos eléctricos; upgrading; inversiones extranjeras directas; América Latina.


## Abstract

*China has become a global leader in ion-lithium batteries and has used these capabilities to develop an important innovation ecosystem in electric vehicles, which are now expanding to the world. The key driver to China's successful promotion of electric vehicles has been industrial policy. Green technologies can be seen as the new frontier for the global expansion of Chinese firms due to their innovation and technological capabilities and Latin America is one of the main destinations for foreign direct investments (FDI). The present article examines the landscape and trends of FDI conducted by Chinese firms in the region, analyzing the possibility for Latin-American countries to integrate Chinese-led value chain in green energy as part of their developmental processes and industrial policies. The key findings are preliminary,: 1) relevant investments are now conducted not only through state owned enterprises, but increasingly made by private firms,; 2) sectors of destination are slowly changing from oil, gas and agriculture towards renewable energy sources, electric vehicles and mining of strategic minerals; 3) the flows of investments are smaller in the total quantity, but there is a higher number of projects in the region overall; 4) the FDI projects are increasingly directed in knowledge/technologically intensive sectors, instead of capital intensive ones with a gradual increase in greenfield FDI as the mode of entry.*


**KEYWORDS:** China; electric vehicles; upgrading; foreign direct investment; Latin America.

# 1. INTRODUCTION

China has become a global leader in ion-lithium batteries and has used these capabilities to develop an important innovation ecosystem in electric vehicles, which are now expanding globally. CATL is the most well-known successful case in battery production, followed by BYD, which produces both batteries and cars, in a business model of vertical integration. Another important Chinese player in EVs market is Great Wall Motors. Taken together these firms have invested significant funding in foreign direct investment projects for manufacturing and assembly, mainly in Argentina, Brazil and Chile. Other important Chinese actors in this landscape include mining firms such as Tianqi Lithium, Jixing Mining and Ganfeng Jixin (Sanderson, 2022; AEI, 2024).



Green technologies and efforts towards decarbonization can be seen as a new frontier for the global expansion of Chinese firms due to their innovation and technological capabilities in these areas, and Latin America has been a region of growing interest in this regard. Considering these points, the present article examines the landscape and trends of FDI conducted by Chinese firms in the region, aiming to analyze the possibility for Latin-American countries to integrate Chinese FDI in green energy as part of their developmental path and industrial policies.

Ford's popularization of combustion vehicles led the way for the creation of immense wealth for oil companies in the XX century. The popularization of electric cars could create wealth for the mining companies that access the minerals needed for producing the batteries for these vehicles, something that will bear a cost for the environment. The lithium-ion battery is a game changer due to its capacity for powering digital devices, the fact of being small-sized, safe, and offering a long time of use (autonomy) before needing to be recharged. These batteries have made possible the extensive production and use of electric vehicles. Investments in R&D capacity for ion-lithium batteries and governmental subsidies for the purchase of electric vehicles are the main policy drivers leading the development of these sectors. In 2021 China sold half of the world's EVs. However, this development has not been without costs. From 2009-2019, the total cost for the government stood at just under 100 billion USD. Almost half of the total corresponded to EV purchase subsidies (Dezan & Shira associates, 2020).

As the industry's capabilities grew, subsidies have been lowered and R&D investments have risen. Between 2018-2020, each year's R&D spending was almost six times the spending on R&D for the 2009-2017 period, showing a growing concern with innovation and upgrading, which fuel the global expansion of its firms. The research will include a theoretical framing regarding the importance of technology and upgrading and has a focus on qualitative analysis using the case study method mentioning the main investments in the countries in the region, semi-structured interviews were conducted with specialists in related fields in order to ascertain the nature and trends of China's FDI in Latin America.

The article will be structured as follows: the first section will analyze the importance of technology for economic growth while reviewing concepts such as upgrading. It is an important topic as technological capabilities are the reason that explain why China is able to invest abroad and compete with established developed countries in key strategic sectors. The second section will analyze the development of ion-lithium batteries in China; the third section oversees the upgrading in the EVs sector. And the fourth section verses on the general trends of Chinese investments in Latin America's energy sector, with a focus on specific projects, located mainly in Argentina, Brazil and Chile. The conclusions analyze all these facts and present the preliminary results of the research summarized in four key points.

# 2. ANALYTICAL FRAMEWORK: THE IMPORTANCE OF TECHNOLOGY AND UPGRADING

Technology is a fundamental input of economic growth, as it engenders productivity gains across different sectors. In this sense, technological upgrading provides stimulus and supports the process of economic development. From the perspective of late industrializers or emerging countries, it is a necessary input in order to promote catching up with global markets. Domination of the leading technologies of each historical period allows nations to capture the higher value-added activities and the resulting rents in order to foster economic growth.

Solow (1994) was perhaps one of the first to point out the importance of technical advances for sustained economic growth, by separating this factor from the inputs of capital and labor which were prominently featured in classical economic models. Romer (1990) follows on this thread, but presents an endogenous model of economic growth, highlighting the importance of human capital for technological change. However, in a sense, this tradition dates back to Joseph Schumpeter's "Capitalism, Socialism, and Democracy" (1942), which analyzes economic change and the role of innovation and technology in increasing productivity. One main subject that remains across these studies is the prevalence of state-led policies or market institutions as propellers of technological change.

Market-led growth often focuses on the role of firms as actors in the process of technological development, while also recognizing the importance of institutions. Institutions are the rules of the game which help to organize the economy and the market (North, 1990). Examples include securing property rights, an adequate system of intellectual property, opportunity for high quality education, among others (Acemoglu and Robinson, 2012). The State-led growth perspective relies on public policy and the agency of the state, through industrial policy and other mechanisms, to foster growth and innovation. The concept of the developmental state was coined by Chalmers Johnson (1984) to explain the development of Japan in the post-War period and later has been applied to other cases in Southeast Asia, such as South Korea, Taiwan, Singapore, Hong Kong, among others (Haggard, 2018).

Technology policy is a tool by which the State acts to foster the development of specific economic sectors that are deemed strategic for a country. It can be seen differently from the perspective of a developed country and another who is still trying to catch up to the international technological frontier. However, the perception that technology is central for economic growth is one key aspect. Technology policy aims to bridge the gap between investments in basic science and research on one hand; and the activities of firms and industry on the other (Lundvall and Borras, 2005).



These policies are based on the notion that market failures need some form of intervention in order to be solved and that markets may not be the most efficient allocators of resources for invention and innovation. Arrow (1962) affirms that markets tend to underinvest in new technologies due to the unpredictability of the resources and the time that needs to be invested in order to produce profitable results from R&D. The author reaffirms the importance of the public sector in this process, in order to maximize spillover effects as well as promoting invention and innovation as public goods.

Even if investments in innovation do not generate immediate gains through commercially viable products, they can spillover to other activities over time. Mazzucatto (2014), for example, shows the importance of the investment in military research in the United States (conducted mainly by the government agency DARPA) that ended up creating many technologies, such as infrared waves, the GPS, the internet, touch screen technology and even computers. These technologies were then scaled to civilian and commercial use, engendering new whole industries and high profitability in subsequent decades.

Furthermore, in recent years technology is not only linked with actual products but is intertwined with the ability to produce knowledge. Knowledge and information can be seen as commodities or be characterized as intangible assets, such as patents, trademarks, industrial designs, marketing; in addition to other forms of knowledge, such as business strategies, organizational capacity, management tools, among others is an important fact that contributes to prosperity and development (Stiglitz, Greenwald, 2018).

The national systems of innovation approach, on the other hand, looks at the interaction between the state, national firms and research institutions aiming at a broader paradigm for analyzing innovation. Knowledge is assumed to be the central element for the economy, consequently, learning and innovation are the central processes through which knowledge is reproduced and applied into the generation of value through goods and services. Learning occurs in a socially embedded context and in a dynamic process that cannot be dissociated from the modern state (Lundvall, 2010).



In this sense, the systems of innovation approach present and encompassing view on the subject, by affirming that countries that would be best positioned to stimulate innovation would foster a combination of three elements working together: 1) the national economy and public policy; 2) institutions such as universities and research centers, and 3) private firms. The mutual interaction between these different actors with their respective goals and perspectives would be the best scenario conducive to innovation (Lundvall and Borras, 2005). None of the three elements of an Innovation System is more important than the other. Depending on the historical period and the technology in question, one of these three elements might have a greater role in generating either radical or incremental innovations in a given sector.

According to a Schumpeterian view, there are breaking points of technological change which bring about new economic paradigms. These radical innovations alter the structure of different national economies which later expand these to a set of incremental innovations across many industries (Perez and Soete, 1988; Perez, 2001). In each of these stages, different possibilities arise for late-industrializers and their firms, depending on the responses, catch-up strategies, and the global geopolitical context. These moments of rupture and change in technical paradigms would be the best window of opportunity for latecomers to try to leapfrog into new products and sectors that surpass the international technological frontier (Lee, 2019).

According to Lee (2019) catching-up means trying to close the gap between lower and higher-income countries and although the process involves a certain aspect of emulating the technologies from the leading nations, this is not enough. Catching up involves taking different paths, adapting technologies into new usages or new scales and it can also involve leapfrogging. By leapfrogging one understands a process in which a less advanced nations manages to produce a technology that transcends the international frontier, going even beyond that which is being produced in the leading nations.

Upgrading can occur within economic sectors, in the case that a country becomes more sophisticated, more efficient and/or adds more value to a product that is already being made. Upgrading can also occur between economic sectors, in the case that a country or firm ceases to produce lower value-added goods and moves into other economic sectors. Henry Yeung (2016) cites the example of Samsung, which started as a trading company focused on food and textiles and eventually upgraded into high value-added activities such as the production of smartphones and computers, for example.

Overall, these perspectives emphasize different aspects regarding the importance of technology for economic growth and prosperity. There are different ways to promote innovation and upgrading if these matters are analyzed through a predominantly market-led or state-led lenses. Some perspectives emphasize the importance of institutional factors such as property rights while others see the importance of technology policy in order to address market failures. Pundits studying

cases of late-development point that industrial policy might be one of the most valuable tools in order to foster catching-up processes. Among other factors, (neo) Schumpeterian perspectives point to the importance of specific windows of opportunity, during which latecomers can approach the international technological frontier. Finally, the national systems of innovation approach aim to bring a holistic perspective for studying innovation, growth and technology, presenting a framework that considers the importance of firms, universities and national institutions.

## 3. THE STRATEGIC IMPORTANCE OF ION-LITHIUM BATTERIES: THE CASE OF CATL

The ion-lithium battery has been a game changer due to its capacity for powering digital devices, the fact of being small-sized, safe, and offering a long time of use (autonomy) before needing to be recharged. These batteries have made possible the extensive production and use of electric vehicles. Although first invented in the 1970's in the context of growing environmental concerns about climate change and the high dependence of oil in economic systems, it wasn't until the mid-1980's that these batterie became effective to be used in vehicles. ExxonMobil and BP, two of the biggest energy companies in the world, were among the first entities to fund research in the search for alternative energies, predicting that combustion vehicles would soon become obsolete.

However, in the 1980's the tide turned with falling oil prices fueling yet another round of global expansion of combustion vehicles. According to Sanderson (2022), companies investing in ion-lithium batteries at the time realized that it would take too long to see returns remotely similar to those that could be rapidly achieved by investing in oil and betting on internal combustion vehicles, due to the fact that at that point, the investment in ion-lithium batteries was basically still working in the basic science stage of innovation. It wasn't until 1985, with the innovations made by Oxford-based chemist John Goodenough that ion-lithium batteries would become suitable to be used in vehicles.

His invention would pave the way for Japan-based scientists to conduct secondary innovations enhancing the batteries capacity, operational system, and weight, which would ultimately lead to the rise of electronic consumer products in the 1990's and beyond, initially led by companies such as Sony, Toshiba, among others. The basic science in lithium-ion batteries, which is a crucial step for any innovation, was developed by researchers in the United States and the United Kingdom. But Japanese researchers and firms did the second crucial step: upgrading the technology for mass production with cost-efficiency. This is the key step that allows for the expansion of firms, new business models and innovative products. If Sony was the mass producer for the batteries that would be used in consumer goods, China would occupy this place in regard to ion-lithium batteries used in electric vehicles (Sanderson, 2022).

According to He et. Al. the Tenth Five Year plan (2001-2005) marks the beginning of an official policy for the development of electrical vehicles in China through growing R&D investments, denominated the "Three Verticals and Three Horizontals". The Three Horizontals refer to developing technologies for engines, batteries, and vehicle controllers, corresponding to the parts and components used to build the Three Verticals, which corresponds to the finished goods such as battery electric vehicle, hybrid electric vehicle and fuel cell electric vehicle (FCEV) (He et. Al., 2022).

In 2009 Beijing expanded its previous industrial policy for the EV industry. Wan Gang, Minister of Science and Technology and automotive expert, was a central figure in this process. China also launched a program to subsidize electric buses in 2009 covering ten cities, which later expanded to include financing for private electric car covering six cities as the first efforts to try to stimulate that segment. Between 2009 and 2017 subsidies reached a staggering US$ 60 billion. Government procurement was a strong policy tool with local governments purchasing vehicles from local companies (Sanderson, 2022).

China accounted for more than 60% of global sales of electric vehicles in 2022, showing the success of these policies over time. The country has focused especially on battery-powered vehicles due to its strong capabilities in battery production. This has resulted in the growing importance of the minerals used to fuel these industries. In fact, lithium, cobalt, nickel, and copper, as well as aluminum and steel are some of the most important minerals in the value chain. The battery is one of the most expensive parts of an electric vehicle and this is especially important considering that more than 60% of EVs in China and Europe are SUVs and larger cars, which require batteries that can be two to three times larger than those used in smaller models (IEA, 2023).



The extraction of the minerals needed to build electric vehicles are subject to geopolitics and distribution conflicts between countries, not to mention the fact that they have an environmental impact. The structure of ion-lithium batteries supply chain has shown China's greater dominance, with China-based CATL (Contemporary Amperex Technology), founded in 2011, reaching more than 37% of the global market share by 2022. Furthermore, the company has managed to strike a deal in 2019 to produce ion-lithium batteries in Germany, supplying companies such as Audi, BMW and Mercedes-Benz in their attempt to advance in the EVs market. It also supplies goods to Daimler's electric buses (Kim, 2023).

ATL was originally founded in Hong Kong in 1999 as a company manufacturing batteries for mobile phones. In the 2000's with the boom of mobile phones and later MP3 players, ATL bought a patent from Bell labs in the US to produce polymer batteries. ATL managed to produce batteries at a much lower cost than their Korean and Japanese counterparts and became a supplier to major telecommunications and electronics companies. This period coincided with China's entry into the WTO and foreign direct investment was abundant. ATL received funding from the US-based Carlyle Group and integrated Apple's GVC, supplying batteries for the Ipod in 2004. The company was on a path of modernization and in 2005 it was bought by the Japanese company TDK (Sanderson, 2022).

CATL separated from ATL in 2011 in the context of the boom of the governmental policies fostering the expansion of electric vehicles in China. The company hired foreign talent who had worked on the joint ventures between Chinese firms and multinational companies in the automotive sector in order to structure its research and development sector. CATL built a battery that lasts for 16 years, meaning it could be reutilized, outlasting the original car. It also continued to work on reducing the size and weight of the batteries as well as improving durability and safety. The reduction of costs is a fundamental step in popularizing EVs for mass consumption.

In 2013 CATL was contracted by BMW Brilliance, a joint venture with a Chinese firm. The rigorous supervision and standards of BMW helped CATL to upgrade its processes and product quality. According to Sanderson:

> "Between 2014 and 2017 CATL's sales increased at a compound annual growth rate of 263 percent. (...) In 2017 CATL filed for an initial public offering (IPO) on the Shenzhen Stock Exchange, with the help of Goldman Sachs. The company raised $853 million and became the world's largest producer of electric car batteries with a fifty percent share of the Chinese market. It would maintain that position consistently for the next four years." (Sanderson, 2022, p. 44).

Furthermore, the use of robotics rapidly enhanced China's electric batteries scale, reducing its costs and raising its competitive capabilities (Wang, 2023). The fact that the Chinese Government determined that Chinese electric vehicles had to use locally produced batteries was a powerful incentive to the industry's expansion. In 2020 Tesla created a factory in Shanghai using CATL as their supplier (Kane, 2020).

## 3. THE STRATEGIC IMPORTANCE OF ION-LITHIUM BATTERIES: THE CASE OF CATL

The key driver to China's successful promotion of electric vehicles has been subsidies for purchasing EVs (given to the automakers for each car sold), which were first introduced in 2009. Although they were supposed to be phased out several times including this year, there is renewed discussion about extending them.[1] Over time, the subsidies have been adjusted in large part due to widespread scale fraud by automakers who sold cars to themselves and passed government certification tests with larger batteries than were used in the cars sold on the market in order to qualify for larger subsidies (subsidies were based on battery size). Tax rebates for EVs have also played a role and will loom larger as China eventually phases out subsidies. The government also introduced a credit system in 2018. Automakers received credits for each EV sold with the aim to force automakers to sell more and more EVs as a percentage of total cars sold (Yang et. al. 2021; Dezan Shira and Associates 2022).

The cost of building this industry has been substantial for the government. From 2009-2019, the total cost was just under 100 billion USD. Almost half the total were the EV purchase subsidies. As subsidies have been ratcheted down, the state has increased R&D spending. For both 2018 and 2019, each year's R&D spending was almost six times the spending on R&D for the 2009-2017 period (Dezan Shira and Associates 2022). While many have hailed the government's investment in the infrastructure of EVs, it has not been costly relative to the other types of expenditure. Four of the top ten recipients of subsidies in China are automotive manufacturers and most of those subsidies are for EVs: SAIC, BYD, Great Wall and JAC. Contemporary Amperex Technology Co. Limited (CATL) was the eleventh largest recipient, and two other automakers were in the top twenty (Kawase 2022).

The goal established by the Central Government for 2020 was for new energy and electric vehicles to account for 70 percent of the domestic market. Moreover, China aimed to produce two firms ranking in the top 10 players worldwide. Electric batteries, motors, and other components should have reached an international level of quality and represent 80 percent of China's market. By 2025, Chinese EVs firms should represent 80 percent of the domestic market, and two homegrown companies should be in the ranks of the 10 leading firms with 10 percent of their total sales (State Strategic Advisory Committee 2015). The electric vehicle industry presents an interesting example of China's growing proficiency in the production of electric batteries (ion-lithium batteries), with CATL being the most well-known success case. Founded in 2011, the company has advanced



1.- Provincial governments have stepped in to make up for the shortfall in central government subsidies (https://www.bloomberg.com/news/articles/2023-03-07/china-s-provinces-offer-ev-sweeteners-as-national-subsidies-fade#xj4y7vzkg).

quickly in global markets and in 2021 it accounted for more than 32% of the global market share of ion-lithium batteries, making it the biggest producer in the world (Sanderson 2022).

China's domination of lithium batteries for EVs has also been a direct product of government policy. The government operated a "whitelist" of approved domestic battery manufacturers which were the only producers that EV manufacturers could use if they wished to receive the government subsidies for EVs. This policy led directly to the rise of CATL and helped BYD transition from phone batteries to auto batteries. With Guoxuan, these three are the second, fifth and ninth largest EV battery makers in the world. From 2014-2017, CATL's sales increased at a compound annual growth rate of 263 percent (Sanderson 2022).

The case of BYD Auto is important and needs to be mentioned, considering it overtook Tesla's position as the biggest market share in electric vehicles, producing cars, trucks, buses, electric bikes, among other products. BYD has been founded in 1995, the company expanded upon the acquisition of Qinchuan Automobile Company in 2002 and after that it has raised HKD$ 1.6 billion in the Hong Kong Stock Market. The firm's electric batteries division, called Fin Dreams, currently holds third place among the biggest battery makers in the world, with a 13% market share.



The firm grew very rapidly in the last two decades, supported by the expansion of China's consumer market, while also being aided by the intensive industrial policies conducted by the Chinese state, currently holding more than 30 industrial parks across six continents. Although most of its sales are focused on Mainland China, the firm has been expanding into global markets, with special focus on Europe. According to the firm's official website it had sold more than 2.68 million vehicles (BYD, 2023) by September 2022.

By 2019, local firms, including JVs, already dominated China's EV market with 85 percent market share.[2] As of now SAIC, Geely and BYD have had a certain degree of success in their internationalization strategy, especially exporting to European markets. Other firms such as BAIC and Chery continue to be suppliers mainly to the domestic market. There are also smaller brands such as Nio Inc. and Xpeng which are trying to expand internationally. In fact, SAIC-GM-Wuling (a joint venture with General Motors) and BYD ranked third and fourth in the largest sales of EVs in 2021, with market shares of 10.5% and 9.1% respectively (Kane 2022), which means China has reached the goal of producing two major international players in the sector.

In 2021, China accounted for more than half of the world's global sales of EVs. However, the structure of the EV market in China is still fragmented with more than 200 firms producing parts, components and the other steps in the EV value chain. Trends suggest that there will be growing competition in the domestic market between the established firms, SAIC-GM-Wuling, BYD, Geely, and newcomers such as Nio and Xpeng (Daxue Consulting 2022). Sanderson (2022) points out that government funding and subsidies that have been directed to the industry since 2009 have directly contributed to the rise of new firms in the sector.

While the building of large-scale battery makers has been successful, subsidies have encouraged both lots of firm entry into the EV market and allowed too many of them to continue to survive. There were 119 producers of EVs in 2020. With a market of approximately 1.5 million EVs, each producer on average produced 12,600 vehicles, far below the necessary scale economies (Kennedy 2020). The other issue is that quality of Chinese EVs still lags behind. They tend to export only to developing countries. While BYD sells more units than Tesla, Chinese EV firms generally sell to the low and middle tiers of auto buyers. The Chinese makers comprise 80 percent of the domestic market, which at 3.3 million cars sold in 2021 comprised 53 percent of global sales in units. In the same year China accounted for 35% of exported electric cars, compared with 25% in 2021. Europe

2.- McKinsey "Winning the Chinese BEV Market," May 4, 2021.

remains China's largest trade partner for both EVs and batteries. In 2022, the share of EVs made in China and sold in the European market increased to 16%, up from about 11% in 2021 (IEA 2022; IEA, 2023).

## 4. AN OVERVIEW ABOUT CHINESE INVESTMENTS IN LATIN AMERICA

Between 2005 and 2012 is estimated that China's total FDI toward South America plus Mexico totaled around $63 billion, while between 2005-2023 the total FDI of Chinese firms in the same countries reached $212 billion. Brazil represented just over one-third of the total, with $73.3 billion worth of Chinese investment in 264 projects (AEI, 2024). Chinese FDI in Latin America continued to grow until it was interrupted by the social and economic challenges of the pandemic, aggravated by China's strict lockdown and zero COVID policies. In 2020 and 2021, Latin America saw a downfall of the total amount invested by China in the region.

However, the investment flows grew in 2022 and 2023 – only this time, the funds were directed toward new sectors such as solar, wind, and hydropower as well as electric vehicles (EVs). Mining in strategic materials such as lithium and rare earth minerals, which are crucial as supplies for the value chain of many advanced technologies involved in decarbonization is also a priority. Prominent Chinese firms acting in these new subsectors are privately owned and/or mixed capital companies, such as BYD and Great Wall Motors, for example (Rhodium Group, 2024).

In Latin America in 2022-2023 the general trend of Chinese investment has been of a higher number of smaller projects. This means a shift from the previous trend of big infrastructure projects under the Belt and Road Initiative (BRI), such as State Grid's and China Three Gorges' multi-billion investments in Brazil and Argentina, for example, toward more nimble, numerous, and technologically intensive projects (Kotz and Haro-Sly, 2023). Albeit smaller in size, these new projects are directed toward strategic areas.

Analysts have noted that the term "New Infrastructure," which has appeared in Chinese media and policy documents, as the lexicon designating the sectors China wants to develop at home while also becoming a competitive global player (Myers, Melguizo and Wang, 2024). Information technologies linked to data centers, semiconductors, and artificial intelligence are important focuses of policymakers in Beijing, but so are renewable energy generation and electric vehicles. Technology is a key aspect in China's efforts to revive its domestic economy and competing with the United States.



The shift in foreign investment policy reflects the changing priorities and characteristics of the Chinese economy. Concepts such as new "quality productive forces," "small but beautiful," "indigenous innovation," and self-reliance have emerged as priorities for the Chinese state. The government is trying to reignite economic growth amid the difficulties and slowdown caused by an aging population, high youth unemployment, the property crisis in the real estate sector, and a recovery in consumption post-COVID that was not as exuberant as Beijing had expected. All of these reflect in Chinese firms investing abroad, which are trying to find new markets and trade partners, focusing on technology and innovation, while also exporting overcapacity in industries where domestic demand is falling, as the case of EVs (Myers, Melguizo and Wang, 2024).

The following cases of FDI in different countries illustrate the broader trends mentioned in the previous paragraphs. For example, in 2022, there were two FDI acquisitions in the lithium sector in Argentina, made by Ganfeng Lithium and Zijin Mining Group, with a total value of $1.7 billion.

Greenfield investments in battery factories and mining by Chinese automobile manufacturer Chery and a lithium carbonate factory from Liex, a subsidiary of Zijin Mining Group, were both announced in Argentina in 2023 (AEI, 2024).

In Chile, the Chinese EV manufacturer BYD announced a $290 million investment to exploit lithium. In addition to that, automobile manufacturer Geely acquired seven plants globally, including one in Cordoba, Argentina, by forming a joint venture with Renault. The plants make aluminum parts for gearboxes that will be used in its subsidiary Horse, which produces gearboxes at other plants in Chile and Brazil and supplies companies like Renault, Dacia, Nissan, and Mitsubishi (China Daily, 2024). Chile produces circa 32% of the world's lithium and represented 89% of China's imports of lithium carbonate in 2022, reinforcing the country's strategic position vis-à-vis the Asian partner. Moreover, much of the lithium that is produced in Argentina goes through Chile to be exported to China, reinforcing its competitive profile due to logistics.



Chile has developed a national strategy to try to move up the lithium value chain, adding value to the sector instead of just extracting and exporting the mineral. Although in its initial stages, Boric's industrial policy will focus on public-private partnerships to try to maintain stages of the adding value inside the country's territory. It will also establish the creation of a public company focused on research and development and technology projects linked to mineral sectors. Moreover, Chile also detains expressive reserves of copper, which is also used in technologies linked to decarbonization and just general-purpose electronics (Chile National Lithium Strategy, 2024). As of this moment in the North American firm Albermale and Chilean private firm SQM are the main firms acting in Chile's lithium sector. The firm Tianqi Mining acquired a 22% stake at SQM and if BYD's project does go through, it would promote a greater presence of Chinese firms in Chile.

In Brazil, there was continued investment by Great Wall Motors, which in 2021 bought a Mercedes-Benz factory in São Paulo state aiming to produce electric vehicles and batteries. The company continues building production capacity with an investment plan of 4 billion Brazilian real ($776 million) between 2022-2025. The automaker will manufacture electric cars and hybrids, in addition to developing research and development projects. Volvo, a Swedish automaker whose main shareholder position has been acquired by the Chinese firm Geely, made an investment of 881 million real in its factory in Paraná state, Brazil. These funds will be used for the development of products and services focusing on electromobility and decarbonization and are part of a greater investment cycle that is projected to reach 1.5 billion yuan between 2022-2025 (Reuters, 2024).

BYD is investing 1.1 billion reals in the Brazilian state of Bahia to produce chassis for electric buses and trucks, manufacture electric and hybrid passenger vehicles (with an initial projected capacity of 150,000 units annually), as well as processing lithium and iron phosphate in Brazil, that will later be exported to global markets. In July 2023, the project was confirmed. BYD will take over three factories formerly owned by U.S.-based Ford Motors in the Bahia state, which left the country in 2021 after more than 50 years of operations in Brazil. BYD expects to start production in Brazil in the second half of 2024 and has already partnered with local energy firm Raizen to build charging network stations in eight large metropolises in the country (Reuters, 2024).

The only Chinese battery manufacturing plant in South America is owned by BYD and it's located in the Northen region of Brazil called Manaus. The production started in 2020 and there are still many improvements that could be made possible by industrial policies and local suppliers' upgrading, seeing that the Manaus plant acts mostly in the assembly of batteries, a lower value-added activity if compared to the actual manufacturing of key parts and components. As BYD's plants in Bahia start their production in 2025, there will possibly be a greater demand for batteries and possibly greater investments in that sector within Brazil. However, since the country's consumer market is very expressive, with a population exceeding 215 million people, and sales of automobiles reaching 2.3 million in 2023 (CSIS, 2024), it is still uncertain whether or not BYD's battery factories will serve

simply to supply for the local market and/or if they will also be used for exports to other countries, potentially the MERCOSUR partners with whom Brazil has a preferential agreement on common tariffs based on the amount of local added value in the end-product, for example.

In Peru, Zijin Mining has just announced a US$ 250 million investment project for metal extraction, which is still at the planning stage. Regarding the case of Bolivia, the country lost possible funding opportunities due to political and institutional instability. Only very recently, in June and July of 2023 Chinese companies began to invest there again, with two projects focused on the extraction of lithium. The first amounting to US$ 1.38 billion, to exploit the salt flats of Uyuni and Copasa in partnership with local firm Yacimientos de Litio Boliviano (YLB), and led by China's CATL, the battery firm previously mentioned. CATL has 66% of the shares in this project. The second one was conducted by China International Trust and Investment (CITIC) amounting to US$ 400 million, which is still underway (Benchmark Minerals, 2024; CSIS, 2024).

Regarding its position in Latin America, in summary, China's state-owned enterprises were the firstcomers to the region in the 2000's, building the basis in oil and gas and agriculture investments, aiming to access natural resources needed for maintaining the growth of China's economy, through mergers and acquisitions. After 2012, came a different phase of FDI, in which state-owned firms such as State Grid and China Three Gorges made multibillion dollar investments in generation, transmission and distribution of electricity, which were then considered as being part of China's foreign policy of economic integration known as the Belt and Road Initiative. In this period there was greater presence of China's banks in this process, such as the China Export Import Bank (EXIMBANK) and the China Development Bank, trends that have been going down since 2019 and, since then, firms have taken the lead through greenfield and brownfield FDI. These processes allowed for Chinese firms to learn about the local realities as well as the institutional, regulatory and labor standards in different countries.



## 5. CONCLUDING REMARKS

Regarding the development of technology and domestic manufacturing capabilities in China, industrial policy was essential for the growth of the EVs market since 2009, when the Government started acting more directly in the industry through two different measures: on the demand side, government procurement for taxis, buses and public transportation helped to boost up the market and subsidies for buyers were also offered. On the other hand, in the supply side, protectionism was used to ensure that national companies would be the main beneficiaries of government funds. Subsidies were given to companies that produced cars domestically, but even foreign firms were obliged to use components made by Chinese firms such as the batteries made by CATL and BYD if they wanted to sell to Chinese customers.

After Covid, private companies in the EVs and green energy sector have been investing abroad in sectors that allow for greater profits, and which are more intensive in technology. As was mentioned before, these changes in the profile of FDI are connected to the domestic challenges and the qualitative transformation of China's domestic economy, which is inextricably linked to the processes of upgrading, innovation and technological development. In this sense, as China's economy transitions towards different sectors such as A.I, biotechnology, pharmaceuticals, solar and wind power generation and equipment, electric vehicles, among others,

so changes the profile and strategy of Chinese firms abroad. The recent changes in the profile of FDI in Latin America is part of the new chapter of Chinese firms going global. It may yet be too soon to affirm, but evidence point to the articulation of a regional value chain in green technologies led by Chinese firms, with Chile and Argentina producing strategic minerals and batteries, for example, while manufacturing capacity for EVs and solar panels is located in Brazil, which could serve as a hub for exports to the region as a whole.

The key findings are preliminary, but we infer that there is a new phase of Chinese engagement in Latin America post-Covid, with a change in the profile of FDI: 1) relevant investments are now conducted not only through state owned enterprises, but increasingly made by private firms, especially when seeing outside of legacy sectors; 2) sectors of destination are slowly changing from oil, gas and agriculture towards renewable energy sources, electric vehicles and mining of strategic minerals such as lithium and rare earth minerals; 3) the flows of investments are smaller in the total quantity, but there is a higher number of projects in the region overall; 4) the FDI projects are increasingly directed in knowledge/technologically intensive sectors, instead of capital intensive ones, as was the case in traditional (legacy) sectors (such as electricity generation and oil) of the pre 2019 phase, which was the year of transition with the first EV projects being rolled out and the post-Covid period being the consolidation of this new phase, which is also seeing a gradual increase of greenfield investments as a mode of entry, vis-a-vis a predominance of mergers and acquisitions in the early to mid-2010's.

In conclusion, in a context of higher tariffs and protectionism being imposed on Chinese products in developed country markets such as Europe and the US, China will continue to focus on the international expansion of its companies in the Global South, and Latin America is gaining relevance. Faced with this situation, Latin American countries must develop their own plans, industrial policies and strategies for technological upgrading, innovation and production of higher value-added goods. Chinese capital can be seen as a positive factor for the region's development processes, as long as the respective countries take control of their own macroeconomic and institutional environments.

Trends indicate that there is a window of possibilities and opportunities open in this regard, especially in sectors linked to decarbonization, renewable energy, electromobility and green technologies. However, the countries in the region must focus on developing their industrial policies and innovation strategies, as well as maybe requiring technology transfer agreements linked to some of these FDI projects. In addition to that, investments in education and integration of local labor into these initiatives could potentialize spillover effects for upgrading. Conversely, the risk remains that Latin America could go down on a path of dependency and continuing to export natural resources and commodities, in exchange for industrial goods, a historical pattern that has deleterious effects on local societies in terms of sustainable development.

# 6. REFERENCES


American Enterprise Institute (2024). China Global Investment Tracker Database. Available at: https://www.aei.org/china-global-investment-tracker/.

Arrow, Kenneth (1962). "Economic Welfare and the Allocation of Resources for Invention." In The Rate and Direction of Inventive Activity: Economic and Social Factors, pp. 609-625. Princeton, NJ: Princeton University Press.

Benchmark Minerals (2024). Bolivia chooses Chinese consortium led by CATL for $1 billion lithium investment.

Bennett, Andrew. Case Study Methods: design, use and comparative advantages. In. Sprinz, Detlef, wolinsky, Yael. Cases, Numbers, Models: International Relations Research Methods. University of Michigan Press, 2004, Cap. 2, p. 19-55.

Center for Strategy, Intelligence and Strategic Studies (CSIS) (2024). Mazzocco, Ilaria. Driving Change: How EVs Are Reshaping China's Economic Relationship with Latin America. Availabnle at: Driving Change: How EVs Are Reshaping China's Economic Relationship with Latin America

China Daily (2023). Chinese EV makers set eyes on Latin America. Available at: https://global.chinadaily.com.cn/a/202308/31/WS64efbfdba31035260b81f161.html

Chile National Lithium Strategy (2024). Government of Chile. Available at: https://www.gob.cl/litioporchile/en/

Daxue Consulting Group. 2022. "China's EV market: a rising global leader in EV technology". August 10. https://daxueconsulting.com/electric-vehicle-market-in-china/

Department of Commerce of the United States. 2022. CHIPS and Science Act. https://www.commerce.senate.gov/services/files/1201E1CA-73CB-44BB-ADEB-E69634DA9BB9

Dezan Shira Associates. 2022. "China Considers Extending its EV Subsidies to 2023". China Briefing. September 29. https://www.china-briefing.com/news/china-considers-extending-its-ev-subsidies-to-2023/

Haggard (2018) Developmental States. New York: Cambridge University Press.

He, Hongwen; Fengchun Sun, Zhenpo Wang, Cheng Lin, Chengning Zhang, Rui Xiong, Junjun Deng, Xiaoqing Zhu, Peng Xie, Shuo Zhang, Zhongbao Wei, Wanke Cao, Li Zhai. 2022. China's battery electric vehicles lead the world: achievements in technology system architecture and technological breakthroughs, Green Energy and Intelligent Transportation, Volume 1, Issue 1,. Disponível em: https://www.sciencedirect.com/science/article/pii/S2773153722000202.

Huang, Yasheng. 2008. Capitalism with Chinese Characteristics: Entrepreneurship and the State. Cambridge: Cambridge University Press

International Energy Association (IEA). 2022. Global EV Outlook 2022: securing supplies for an electric future. Paris: France. IEA Publications.

International Energy Association (IEA). 2023. Global EV Outlook 2023: catchinjg-up with climate ambitions. Paris: France. IEA Publications.

Johnson, Chalmers (1984). "The Developmental State: Odyssey of a Concept," in Meredith Woo-Cumings, ed., The Developmental State (Ithaca, Cornell University Press.

Kane, Mark. 2022. "Global sales of Electric Vehicles Q1-Q4 2021". Inside EVs. February 02. https://insideevs.com/news/564800/world-top-oem-sales-2021/

Kawase, Kenji. 2022. "Made in China 2025' thrives with subsidies for tech, EV makers". Nikkei Asia. July 22. https://asia.nikkei.com/Business/Business-Spotlight/Made-in-China-2025-thrives-with-subsidies-for-tech-EV-makers

Kennedy, Scott. 2020. "The Coming NEV War? Implications of China's Advances in Electric Vehicles". Center for Strategic and International Studies (CSIS) Brief. November 18. https://www.csis.org/analysis/coming-nev-war-implications-chinas-advances-electric-vehicles

Kotz, Ricardo; Haro-Sly, Maria (2023). China's economic diplomacy in the context of the far-right government's neoliberal nationalism: the case of Brazil's energy sector. In. New nationalisms and China's Belt and Road Initiative: exploring the transnational public domain. ed. / Julien Rajaoson; R. Mireille Manga Edimo. Palgrave Macmillan, 2022. p. 195-215.

Lee, Keun (2019). The Art of Economic Catch-up: Barriers, Detours and Leapfrogging in Innovation Systems. Cambridge, UK and New York, NY: Cambridge University Press.

Lee, Keun (2021). China´s Technological Leapfrogging and Economic Catch-up: A Schumpeterian Perspective, Oxford University Press.

Lundvall, Ben-Adtke; Borras, Susana. Science, Technology and Innovation policies. In. Fagerberg, Jan, Mowery, David C. and Nelson, Richard R. (2005) (eds): Innovation Handbook. (Oxford: Oxford University Press). Chapter 22. Pages 599-631.

Mazzucatto, Mariana (2014). The Entrepreneurial State: Debunking Public vs. Private Sector Myths. Anthem Press.

Myers, Margaret; Melguizo, Ángel; and Yifang Wang (2024). New Infrastructure: emerging Trends in Chinese Foreign Direct Investment in Latin America and the Caribbean. United States: The Dialogue edtior.

National Congress of the People's Republic of China. Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035. Translation available at: CSET Original Translation: China's 14th Five-Year Plan (georgetown.edu)

Naughton, Barry (2021). The Rise of China's Industrial Policy from 1978-2020. Mexico: Universidad Autónoma de Mexico, Centro de Estudios sobre China. Available at: https://dusselpeters.com/CECHIMEX/Naughton2021_Industrial_Policy_in_China_CECHIMEX.pdf.



North, Douglas (1991), Institutions, Institutional Change and Economic Performance (Cambridge: Cambridge University Press).

Perez, C., and Soete, L. (1988). Catching up in technology: entry barriers and windows of opportunity. In Technical Change and Economic Theory, pp. 458-479, London: Francis Pinter.

Reuters (2024). China automaker BYD to invest $620 million in Brazil industrial complex.

Rhodium Group (2024). Pole Position: Chinese EV Investments Boom Amid Growing Political Backlash. United States: Rhodium Group.

Romer, Paul (1990). Endogenous technological change. The Journal of Political Economy, Vol. 98, No. 5.

Sanderson, Henry. 2022. Volt Rush: Winners and losers in the race to go green. One World Publications.

Schumpeter, Joseph (2008). Capitalism, Socialism, and Democracy. Harper Perennial Modern Classics; unknown edition (November 4, 2008).

Solow, Robert (1994). Perspectives on growth theory. Journal of Economic Perspectives — Volume 8, Number 1 — Winter 1994 — Pages 45. Available at: https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.8.1.45

Stiglitz, Joseph; Greenwald, Bruce (2018). Creating a Learning Society. United States: Columbia University Press, First Edition.

Wang, Dan (2023). China's Hidden Tech Revolution: how Beijing Threatens U.S. Dominance. Foreign Affairs. Available at: China's Hidden Tech Revolution: How Beijing Threatens U.S. Dominance (foreignaffairs.com)

Yang Andrew Wu, Artie W. Ng, Zichao Yu, Jie Huang, Ke Meng, ZhangY. Dong. 2021. A review of evolutionary policy incentives for sustainable development of electric vehicles in China: Strategic implications, Energy Policy 148(B).