

WHO IS IN THE DRIVER'S SEAT?

South-South Green Technology Transfer,
Bargaining Power, and Lessons from
Chinese EV Investments in Brazil

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ABSTRACT

The green industrialisation race is unfolding within a transformed geopolitical landscape, marked by intensifying great-power competition, the fragmentation of multilateral trade governance, and China's emergence as the world's leading producer of electric vehicles (EVs), batteries, and other clean technologies. As Chinese firms increasingly globalise the production of these technologies through overseas manufacturing investment, new opportunities are emerging for developing countries to access advanced low-carbon technologies and pursue industrial upgrading. Yet we know relatively little about how China's rise as a leading green technology power reshapes these opportunities. While the technology transfer literature has traditionally explained variation in outcomes through domestic absorptive capacity, industrial policy, and foreign investor motivations, it was largely developed in the context of a relatively unipolar international order. As a result, it pays limited attention to how changing geopolitical conditions shape host-country bargaining power and, ultimately, the terms under which technology is transferred.

This paper develops an integrated framework that brings together the domestic determinants of technology transfer with the geopolitics of great-power competition, arguing that outcomes are jointly shaped by host-country bargaining power, set by a country's position within an increasingly multipolar world, and domestic capacity to convert negotiated commitments into technological upgrading. We first map Chinese low-carbon foreign direct investment (FDI) across Latin America, then examine the framework through an in-depth case study of BYD's electric vehicle manufacturing operations in Camaçari, Brazil. We find that geopolitical fragmentation expanded Brazil's bargaining space, enabling it to negotiate rising local-content commitments and the joint engineering of a flex-fuel powertrain adapted to Brazilian conditions. Yet these gains remained partial: BYD retained control over its core battery and software technologies, limiting greater technological transfers. The paper concludes that multipolarity expands the range of outcomes developing countries can negotiate with Chinese investors, but it is domestic industrial policy and enforcement capabilities that determines how much of that opportunity is ultimately realised.

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Introduction

Today's push for green industrialisation is playing out against an intensely geopolitical backdrop. Rivalry between the United States (US), China, and the European Union (EU) has sharpened, multilateral trade governance has splintered, and industrial policy has returned to the centre of economic strategy, together redrawing where and how global manufacturing takes place. Clean energy technologies are no longer simply instruments of climate mitigation; they have become strategic assets around which states compete for technological leadership and geopolitical influence. The US' Inflation Reduction Act (IRA), the European Union's Green Deal Industrial Plan and Net-Zero Industry Act (NZIA), alongside China's continued expansion as the world's leading producer and exporter of electric vehicles (EVs), batteries, solar photovoltaics, and other clean technologies, signal a profound reorganisation of the global political economy of green manufacturing. At the same time, Chinese firms have announced more than USD 227 billion in overseas clean-tech manufacturing investments across 461 projects in 54 countries (Xue & Larsen, 2025).

As Chinese firms extend their manufacturing footprint abroad, developing countries are gaining a foothold in advanced low-carbon industries that was largely closed to them a decade ago. What this shift means for technology transfers and green industrial upgrading, however, is far less settled. While foreign direct investment (FDI) has long been regarded as a potential channel for technology transfer (Globerman, 1979; Markusen & Venables, 1999; Amsden, 2001; Saggi, 2002; Luo & Wang, 2023), its developmental consequences have proven highly uneven across countries and sectors (Blalock & Gertler, 2008; Fu, Pietrobelli, & Soete, 2011). Some economies have succeeded in embedding foreign firms within domestic innovation systems and supplier networks, using them as a springboard for capability building (Lall, 1992; Amsden, 2001, Javorcik, 2004), while others have remained locked into low-value assembly enclaves characterised by weak backward linkages and limited technological learning (Haddad & Harrison, 1993; Kopinski, Carmody & Taylor, 2023).

For much of the post-Cold War period, the technology transfer literature explained variation in FDI-driven learning primarily through domestic factors such as absorptive capacity, industrial policy, and state effectiveness, largely reflecting a relatively stable,

unipolar international order anchored by the US and its Western allies. China's emergence as a leading technological power challenges this framing. As the US-led order has given way to an increasingly fragmented one (Schindler, DiCarlo, & Paudel, 2021), and as the US and China compete for centrality in the production, infrastructure, and financial networks underpinning the green transition (Schindler et al., 2024), the strategic environment in which technology transfer takes place has fundamentally changed. Yet these two dimensions remain largely disconnected in existing scholarship: the technology transfer literature focuses on domestic absorptive capacity and institutions, while international political economy examines the geopolitical dynamics of great-power competition. Neither, on its own, explains how shifting geopolitical conditions reshape host-country bargaining power, or how that bargaining power interacts with domestic capabilities to define the depth and quality of green technology transfer.

This paper addresses this gap by developing an integrated analytical framework in which green technology transfer is shaped by two interacting sets of conditions. The first is domestic absorptive capacity, the institutions, industrial policies, and productive capabilities that enable foreign knowledge to be assimilated and diffused. The second is host-country bargaining power, which is shaped by countries' strategic positioning within a multipolar international order. We argue that geopolitical competition determines what governments can negotiate from foreign investors, while domestic capabilities influence how much of those negotiated opportunities translate into technological upgrading. Through this lens, green technology transfer is understood as the outcome of bargaining between foreign firms and host states under changing geopolitical conditions.

Following a regional analysis of Chinese low-carbon investment flows in Latin America, we select Brazil as our case study and apply this analytical framework to examine BYD's electric vehicle and bus manufacturing operations. We find that geopolitical fragmentation expanded Brazil's bargaining space, enabling it to negotiate stronger localisation commitments, the joint engineering of a flex-fuel powertrain adapted to Brazilian conditions and investments in research and development (R&D) initiatives in the country. These gains, however, remained partial. BYD retained control over core battery and software technologies, limiting the depth of technology transfer. We conclude that while multipolarity expands the scope for developing countries to negotiate more

favourable terms with foreign investors, domestic industrial policy, absorptive capacity, and state enforcement ultimately determine how much of that opportunity is translated into technological upgrading.

The paper makes three contributions to the literature. First, it advances technology transfer theory by integrating geopolitical bargaining power into established accounts centred on domestic conditions, thereby linking international political economy with the economics of technology transfers. Second, it contributes to emerging debates on Chinese global green manufacturing investment by combining a regional analysis of Chinese low-carbon FDI in Latin America with a firm-level examination of technology transfer through the case of BYD in Brazil. This empirical strategy situates firm-level dynamics within broader regional patterns of Chinese green industrial expansion. Finally, it contributes to debates on South–South cooperation and green industrial policy by demonstrating that the developmental benefits of Chinese green investment depend less on the nationality of capital than on the capacity of host states to negotiate, absorb, and strategically govern foreign investment. As developing countries navigate a fragmented global economy, the capacity to negotiate, enforce, and leverage technology transfer may prove as important as attracting investment itself.

The paper proceeds as follows. Section 2 develops the analytical framework, linking the literature on technology transfer with insights from international political economy to explain how geopolitical bargaining power and domestic capabilities jointly shape technology transfer. Section 3 outlines the mixed-methods research design and explains the selection of Brazil and BYD as the case study. Section 4 maps the scale and distribution of Chinese low-carbon FDI across Latin America, situating Brazil within the region's broader green industrial landscape. Section 5 presents the empirical analysis of BYD's investment in Brazil, examining the interaction between geopolitical bargaining, industrial policy, and technology transfer. Section 6 concludes by discussing the implications for South–South cooperation and green industrial policy in a multipolar world.

2. Hedging for Upgrading: An Integrated Framework for Technology Transfer in a Multipolar Order

The literatures on technology transfer through foreign direct investment (FDI) and the geopolitics of technology have largely evolved in isolation. While the former has focused on the domestic determinants of technological diffusion and learning, the latter has examined how strategic competition among major powers shapes the international context in which technology transfer occurs. This section reviews these two bodies of literature before integrating them into a single analytical framework that explains how technology transfer is shaped by the interaction between domestic and geopolitical forces.

2.1 The domestic conditions for tech transfer

Technology transfer, the dissemination of technical knowledge and know-how embodied in products, processes, and management (Wahab et al., 2011), through FDI has long been regarded as a major engine of technological upgrading (Globerman, 1979; Markusen and Venables, 1999; Amsden, 2001; Saggi, 2002; Blalock and Gertler, 2008; Fu et al., 2011). The basic premise is that foreign-invested firms are technologically superior to local ones, so their interaction with local economies generates spillovers that help domestic industries catch up with the technology frontier (Lall, 1996; Ning & Wang, 2018), through formal training, supplier contracts, or the informal “leakage” of tacit know-how that, once circulating, becomes a public good (Kopinski, Carmody & Taylor, 2023).

However, diffusion of knowledge alone does not guarantee transformation. Whether local firms can internalise and build upon foreign technologies depends on their absorptive capacity, existing skills, and infrastructure (Glass & Saggi, 2002), a capacity that is especially critical in green technology given the complexity of EVs, batteries, and solar panels. Following Hirschman’s (1977) notion of linkages, these relationships stimulate both backward connections, such as local sourcing, and forward ones, where domestic industries put green technologies to downstream use.

The theoretical literature identifies two channels through which foreign firms facilitate technology transfer: horizontal and vertical spillovers. Horizontal spillovers involve the

transfer of skills between firms in the same industry through labour mobility or competitive pressure, as employees leave multinationals to establish or join domestic firms (Rojec & Knell, 2018; Liu, 2008; Iršová & Havránek, 2013). Vertical spillovers occur along the value chain, upstream to suppliers or downstream to customers, with the former considered more significant (Javorcik, 2004); when foreign firms provide suppliers with training and access to advanced technologies, this can foster substantial technological learning (Blomström & Kokko, 2001; Rojec & Knell, 2018).

Empirical evidence suggests such linkages are particularly strong in manufacturing and infrastructure-based industries (Lean, 2001; Javorcik, 2004; Blalock & Gertler, 2008). In low-carbon manufacturing they can embed new technical standards and maintenance skills across the local economy: building an EV assembly plant, for instance, can catalyse domestic suppliers in battery materials, electronics, and charging infrastructure. Ultimately, the diffusion of clean technologies depends not only on foreign investment, but on how effectively local actors, supported by the state, harness these linkages to move closer to the global green frontier.

Spillover effects have long intrigued policymakers, yet evidence that foreign firms generate positive developmental spillovers remains limited (Haddad & Harrison, 1993; Liu et al., 2009; Kopinski, Carmody & Taylor, 2023; El Kadi, 2024). A persistent challenge is endogeneity: rather than driving productivity growth, multinational corporations (MNCs) may simply invest where economies already perform better (Moran, 2011), and many foreign ventures have produced enclave economies with weak domestic linkages (Aitken & Harrison, 1999), what Hirschman (1958, p.110) described as investment “slipping out of a country without leaving much of a trace.”

Nonetheless, East Asia’s experience shows spillovers are not unicorns. Japan, South Korea, and Taiwan used strategic state intervention, tough negotiations, and local content requirements to extract technology and guide industrial upgrading, semiconductors being a prime example (Wade, 1990; Chang, 1993; Amsden, 2001); China similarly leveraged access to its market to compel technology transfer, laying the foundations for its own technological rise (Young & Lan, 1997; Fu & Gong, 2011). The literature generally identifies three key determinants of whether foreign investment generates meaningful technological spillovers or remains confined to enclave

production: host-country absorptive capacity, industrial policy frameworks, and foreign investor motivations.

Table 1. Key determinants of technology transfer

Determinant	Key Variables	Key References
Host country absorptive capacity	• Technological capabilities of domestic firms and gap between domestic and foreign firms • Educational systems, R&D infrastructure, and industrial capabilities • Prior experience in related industries	Cohen & Levinthal, 1990; Kokko et al., 1996; Fu et al., 2011
Industrial policy frameworks	• Local content requirements and joint venture mandates • Strategic design and implementation of technology transfer policies • Enforcement and monitoring mechanisms	Lall, 1992, Amsden, 2001; Pietrobelli and Rabelloti, 2011
Foreign Investor motivations	• Market-seeking vs. resource-seeking strategies • Long-term strategic positioning vs. short-term returns • Contractual arrangements	Dunning, 1993; Gallagher, 2016; Hanlin et al., 2019

Host country absorptive capacity

Absorptive capacity, the ability to recognise, assimilate, and apply external knowledge, is fundamental to technology transfers (Cohen & Levinthal, 1990). It depends on the technological capabilities of domestic firms relative to foreign firms, human capital, and institutional frameworks (Kokko et al., 1996; Crespo & Fontoura, 2007). This capacity takes on particular significance in low-carbon industries, where the technologies being transferred are complex and systemic (Lema, Iizuka, & Walz, 2015). Producing a

competitive EV, for instance, requires not just assembly know-how but the integration of battery chemistry, power electronics, software-defined vehicle architecture, and increasingly stringent safety and emissions standards, competencies that span multiple engineering disciplines and cut across firm boundaries. Latin American countries vary widely here: some have established sophisticated automotive sectors, while smaller economies may lack the workforce to absorb advanced tech. This heterogeneity affects both the depth of spillovers and how much a government can extract from MNCs.

Industrial policy frameworks

Even where bargaining power is limited, well-designed industrial policy frameworks can still enhance spillovers (Lall, 1992; Amsden, 2001; Pietrobelli & Rabelloti, 2011). In low-carbon manufacturing, industrial policy typically operates through a specific toolkit: local content rules that require a rising share of inputs to be sourced domestically, joint venture mandates that require foreign firms to partner with local capital, procurement practices that channel public demand toward domestically-produced clean technologies, and technology-sharing clauses attached to investment incentives. Used well, these instruments can foster genuine learning by compelling foreign firms to build the very supplier relationships and training pipelines that generate spillovers (Saggi, 2002; Lema et al., 2018). Industrial policy also shapes the legal terrain on which learning occurs, since intellectual property regimes and licensing rules determine whether domestic firms can legally build on and adapt foreign innovations once exposed to them (Maskus, 2004). Crucially, the effectiveness of these frameworks depends as much on implementation as on design.

Foreign investor motivations

Foreign investor motivations also shape technology transfer outcomes, since the type of investment a firm makes is rarely accidental — it reflects a strategic calculation about why the firm is there in the first place (Dunning, 1993). Market-seeking investments, aimed at capturing a share of the host country's domestic market, tend to involve deeper local integration, since firms have a lasting commercial incentive to build supplier relationships, adapt products to local conditions, and maintain a durable local presence (UNCTAD, 2005). Resource-seeking investments, by contrast, are oriented toward securing access to raw materials, land, or energy inputs, and tend to generate far more limited spillovers: the underlying rationale for the investment has little to do with building

local industrial capability, so few incentives exist to transfer knowledge beyond what extraction requires (Gallagher, 2016). Efficiency-seeking investments occupy a middle ground, locating labour-intensive stages of production in the host country to exploit cost advantages while retaining higher-value activities, particularly R&D and proprietary technology, at home (Zhao, 2006). These are not fixed categories: a single firm's investment can combine elements of more than one motivation, and motivations can shift over time as a firm's strategic priorities evolve.

Taken together, these three dimensions, absorptive capacity, industrial policy, and investor motivation, explain why the same foreign corporation might generate genuine learning in one economy and shallow assembly in another. What they cannot explain is why the terms on offer differ in the first place. This account treats the menu of possible deals as fixed, as if host countries simply negotiate more or less skilfully within a given set of options. In reality, that menu is increasingly shaped by geopolitical competition for supply chain access, competition that is also sorting countries into rival, not easily combined, production ecosystems.

2.2 The external conditions for green industrialisation: Geopolitical shifts and the logic of hedging

The conceptual frameworks for understanding technology transfer described above were largely constructed in a world of relative unipolarity, where the question of where to seek technology was answered by default: the advanced industrial economies of the Global North. That analytical scaffolding remains essential, but it sidelines the effect of great power competition on these processes.

A parallel literature on the geopolitics of the energy transition has emerged to fill this gap, though it remains fragmented and under-theorised. Reviewing several decades of scholarship, Vakulchuk, Overland and Scholten (2020) find that most work in this field addresses either the decline of incumbent fossil-fuel exporters or the emergence of new resource dependencies around critical minerals, but rarely offers a systematic account of how these dynamics interact with industrial upgrading in the Global South. Kalantzakos (2018; 2020) develops one influential strand of this literature, arguing that the geographic concentration of rare earths, lithium, and cobalt reproduces, for the green economy, the strategic anxieties long associated with oil, while creating new terrain for

economic statecraft as traditional industrial powers and China compete for upstream control of these inputs. This scholarship explains why the “menu” of possible technology-transfer deals is itself geopolitically constructed, a question that absorptive-capacity or investor-motivation frameworks do not address.

Today, clean energy technologies have become a theatre of great-power rivalry. The US Inflation Reduction Act, the EU’s Net Zero Industry Act, export controls targeting semiconductors, battery materials, and EV supply chains, and China’s industrial strategy from *Made in China 2025* onwards all reflect a strategic competition for leadership in low-carbon industries (Meckling & Nahm, 2018). Recent scholarship contends that this rivalry constitutes a Second Cold War, characterised by competition between China and the US to secure central nodes in infrastructure, production, digital, and financial networks, rather than territorial control alone (Schindler, DiCarlo & Paudel, 2021; Schindler et al., 2024). This resonates with Farrell and Newman’s (2019) theory of “weaponised interdependence,” which shows how states occupying central nodes in global economic networks, whether in finance, data, or increasingly clean-technology supply chains, can convert that structural position into coercive leverage over dependent states and firms. Applied to green industrialisation, this suggests that competition is not only about who invests where, but about who controls the chokepoints, refining capacity, cell chemistries, charging protocols, through which green technology flows.

Competing technical standards have become a central instrument of this rivalry. Divergent battery chemistries, charging architectures, and vehicle-to-grid protocols increasingly demarcate rival production ecosystems, since a supplier that has upgraded to serve one standards regime may face costly reconversion to serve another. China’s 2021 *China Standards 2035* initiative made this dimension of competition explicit, seeking to embed Chinese specifications, particularly in EVs, batteries, and connected-vehicle systems, into international standard-setting bodies as a complement to its domestic industrial policy (Zúñiga, Datta Burton, Blancato & Carr, 2024). The US and European Union have responded with their own standard-setting initiatives, reinforcing the emergence of parallel technological ecosystems rather than a single global frontier. For countries such as Brazil, this raises a question that classical technology-transfer theory does not anticipate: alongside how much a country can absorb, which standards regime it becomes embedded in materially shapes future market access and bargaining

position, since switching costs rise the longer a supplier base is locked into one ecosystem's specifications.

This is not, however, a story of competition alone. Nahm (2021) shows that the rapid cost declines achieved in wind and solar manufacturing were themselves the product of collaborative, cross-national divisions of labour between Chinese, German, and American firms, each specialising in distinct stages of the value chain. His account is a useful corrective: production ecosystems are simultaneously arenas of rivalry between states and networks of collaboration between firms, and the two logics coexist uneasily rather than one simply displacing the other.

As rival production ecosystems emerge around competing technological standards, supply chains, and industrial policies, countries face growing pressure not only over where they trade and invest, but also over which value chains and technological ecosystems they become embedded in. For developing countries in Latin America, Africa, and Southeast Asia, this rivalry creates both opportunities and constraints. Competition between the US, EU, and China for supply-chain access and political alignment expands host-country bargaining power by creating alternative investment partners. The challenge is negotiating partnerships that maximise long-term technological upgrading while avoiding new forms of technological dependency, or entrapment within a standards ecosystem that later proves commercially or geopolitically costly to exit.

Green industrial development should therefore be understood as shaped as much by international partnerships and the distribution of rents across global value chains as by domestic policy alone. In *Survival of the Greenest*, Lebdioui (2024) argues that countries seeking to enter green value chains face a fundamental dilemma: the technologies they most need are precisely those incumbent powers have the strongest incentives to retain. Green technologies are strategic assets protected through intellectual property, trade secrets, and industrial policy rather than freely available commodities. Bargaining power therefore becomes a key determinant of technology transfer. This shifts the analytical question from simply how countries build domestic capacity to absorb foreign technology to how they position themselves within a multipolar, standards-fragmented green economy to maximise bargaining leverage and technological upgrading.

Is there room for hedging in a multipolar green order?

The concept of hedging, long used in international relations to describe how middle powers avoid lock-in to a single great-power alliance (Goh, 2005; Kuik, 2008), has acquired new relevance for green industrialisation. Originally a security concept, hedging has since broadened into a multidimensional one spanning economic, diplomatic, and security behaviour (Ciorciari & Haacke, 2019), which is precisely the terrain developing-country governments navigate when weighing competing green investment offers. Kuik's (2008, 2016) typology is useful here: governments can simultaneously pursue "risk-contingency" behaviours, diversifying across investment partners and avoiding overdependence on any single supplier, and "return-maximising" behaviours, extracting favourable terms from whichever investor is most eager to enter and locking these in through binding agreements. Applied to green industrialisation, this means a government can court Chinese and US manufacturers at once, decline exclusive supply arrangements, and still negotiate generous localisation commitments with whichever partner offers them.

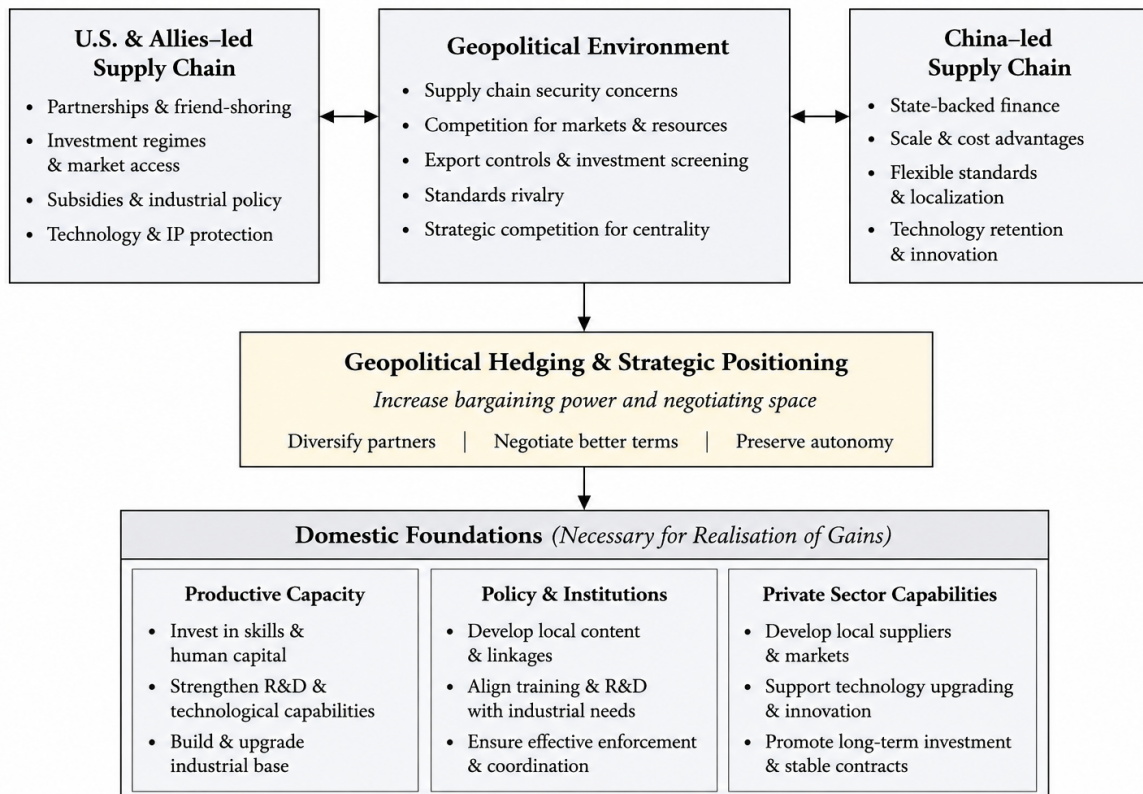
In this context, hedging enables governments to exploit competition among major powers to negotiate stronger localisation, supplier-development, research, and technology-transfer commitments than would be possible under a unipolar order. As the US and its allies seek to reduce dependence on Chinese battery supply chains, while China seeks manufacturing partnerships in mineral-rich and strategically important economies, governments from Chile to the Democratic Republic of Congo (DRC) acquire bargaining opportunities that previously did not exist. Effective hedging, however, requires more than playing powers off against one another: it requires the institutional capacity to convert competitive leverage into technology transfers and capability building.

2.3 Bringing the two traditions together

Understanding technology transfer in an era of intensifying geopolitical rivalry requires an analytical framework that integrates both the domestic determinants of technology transfer and the broader geopolitical environment in which technology flows occur. While domestic factors, such as absorptive capacity, industrial policies, investor motivations, determine a country's ability to acquire, adapt, and diffuse foreign

technologies, these processes are increasingly conditioned by strategic competition between major powers. Geopolitical dynamics influence not only the availability of technologies but also the partners involved, the types of supply chains integrated, the standards diffused and the political constraints governing cross-border innovation and investment.

Figure 1. Analytical Framework for Technology Transfer under Great-Power Competition



Source: Authors' elaboration

Figure 1 summarises this integrated framework, illustrating how domestic capabilities and geopolitical bargaining interact to shape technology transfer outcomes. This framework presents three key analytical advantages. First, the framework recognises that technology transfer is not a politically neutral process. The diffusion of green technologies increasingly takes place within a world of competing technological powers and production networks. Decisions about which foreign firms invest, which technologies are transferred, and which standards, suppliers, and innovation systems host countries become embedded in have long-term implications for industrial development.

Technology transfer is therefore not simply a mechanism for acquiring knowledge, but also a process through which countries become integrated into competing technological ecosystems.

Second, the framework helps explain why industrial policy has re-emerged as a central determinant of technology transfer. As major powers increasingly deploy industrial policy to secure technological leadership and reorganise global production, governments have greater legitimacy and policy space to shape the terms of foreign investment. Technology transfer is therefore influenced not only by the absorptive capacity of domestic firms, but also by the state's ability to negotiate, implement, and enforce policies that foster localisation, supplier development, collaborative innovation, and capability formation.

Finally, the framework reconceptualises hedging as a development strategy rather than solely a foreign policy posture. Rather than viewing geopolitical rivalry only as a source of external constraint, it highlights the opportunities it creates for host countries to strengthen their bargaining position. By maintaining relationships with multiple technological partners and leveraging competition among them, governments may be able to negotiate deeper technology transfer commitments and more favourable conditions for industrial upgrading, third countries can gain greater scope to negotiate localisation, supplier development, collaborative research, training, and other technology-transfer commitments. The following section outlines the mixed-methods research design used to analyse these processes.

3. Methodology

This paper adopts a mixed-methods design combining descriptive quantitative analysis with an in-depth qualitative case study, structured around the two analytical dimensions developed above: the geopolitical conditions shaping the terms of technology transfer, and the domestic conditions determining whether these translate into genuine capability formation. While aggregate investment data reveal the scale and distribution of Chinese green manufacturing investment in Latin America, they cannot explain how technology transfer unfolds, or fails to unfold, in practice. The analysis thus triangulates three sources

of evidence: a descriptive mapping of Chinese green investment across the region, a firm-level case study, and semi-structured interviews.

The descriptive quantitative component draws on the Xue and Larsen (2025) Net Zero Policy Lab database, which provides project-level information on Chinese low-carbon FDI worldwide, including investment value, technology type, host country, and project status. The dataset is used to map the sectoral and geographical distribution of Chinese green manufacturing investment across Latin America. As shown below, Brazil emerges as by far the region's largest recipient of Chinese low-carbon investment, making it the most appropriate case through which to examine the conditions under which technology transfer occurs.

Brazil approximates more closely than any other Latin American country the conditions identified in Section 2 as conducive to technology transfer. It possesses the region's strongest absorptive capacity in EV manufacturing, reflecting its long-established automotive industry, extensive supplier base, and engineering capabilities (Sturgeon, Van Biesebroeck, & Gereffi, 2008). It also has a dedicated industrial policy framework, the *Rota 2030* programme, through which technology transfer and local content requirements are encouraged, although its institutional effectiveness remains debated (Pelegriana, Stoeber, & Fouto, 2023). Geopolitically, Brazil occupies a distinctive position. As China's largest trading partner in Latin America, it has deep economic ties with Beijing, while also being actively courted by the US and the European Union as part of efforts to diversify clean technology and critical mineral supply chains (Allan, Gordon, & Wang, 2023). This gives Brazil greater potential bargaining power than most countries in the region.

The empirical analysis focuses on BYD, the world's largest producer of new energy vehicles and one of the few firms controlling the entire EV value chain, from battery production to vehicle assembly. This vertically integrated model underpinned BYD's rapid technological catch-up and makes it one of the most strategically significant Chinese investors in global green manufacturing (Whitfield & Wuttke, 2025). Its substantial investments in Brazil, including its bus manufacturing operations in Manaus and the EV complex in Camaçari, provide sufficient operational history to assess actual technology transfer practices.

The case study combines documentary analysis (Bowen, 2009) with 14 semi-structured interviews. Documentary sources include Brazilian federal and state policy documents, particularly those relating to *Rota 2030*, corporate communications from BYD, and independent media reporting. These sources are systematically triangulated: corporate claims of technology transfer are treated as evidence of firms' strategic narratives rather than proof of transfer itself, and are assessed against government records and independent accounts. Semi-structured interviews were conducted with three groups of respondents: Brazilian policymakers involved in industrial policy and investment negotiations, researchers specialising in China–Latin America relations and green industrialisation, and BYD employees in Brazil. Participants were selected purposively, with additional interviewees identified through snowball sampling. Interview questions were organised around the framework developed in Section 2, focusing on absorptive capacity, industrial policy implementation, BYD's investment strategy, and the extent to which Brazil could leverage geopolitical competition in negotiations. Respondents were anonymised and are identified by role rather than by name in the paper.

4. China's low-carbon FDI in Latin America

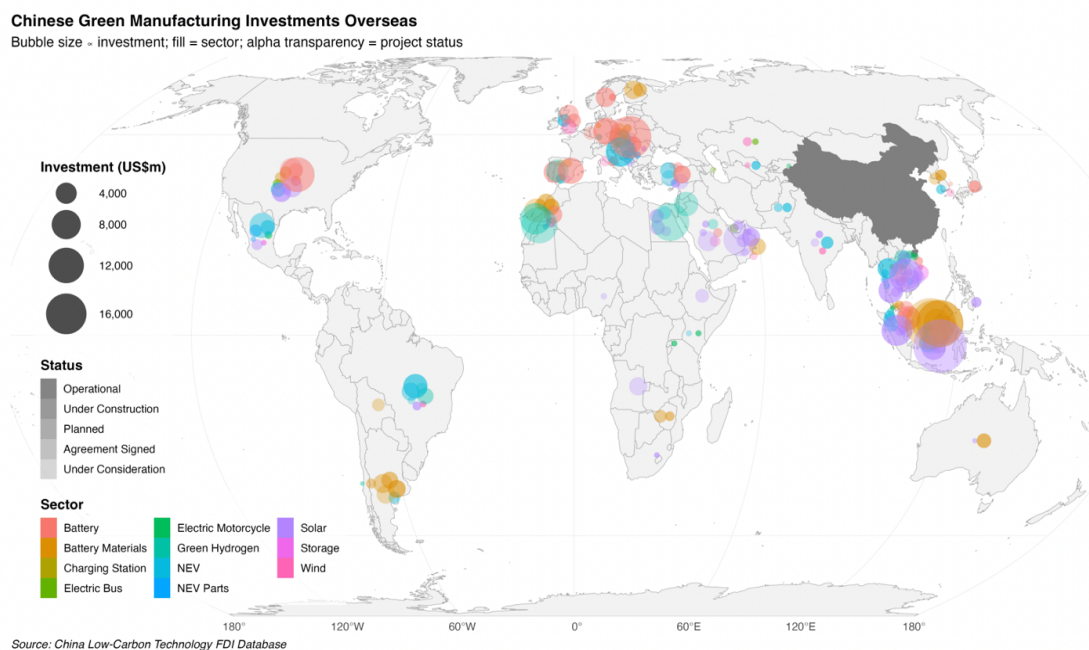
Latin America occupies a growing place in China's global green industrial expansion. The region has attracted investment in EVs, batteries, renewable energy, and critical minerals, making it a key arena in the evolving geography of green industrialisation. Against this backdrop, this section situates the Brazilian case within the broader landscape of Chinese green manufacturing investment in Latin America. Drawing on project-level data on Chinese low-carbon FDI, it maps the scale, sectoral composition, and geographical distribution of investment across the region, highlighting Brazil's distinctive position as the principal destination for diversified Chinese green manufacturing investment.

Scale and Flow of Chinese Low-Carbon Investment

Over the past decade, Chinese FDI in Latin America has shifted from traditional large infrastructure projects toward "new sectors", with innovation-related industries accounting for 58 percent of total Chinese FDI in the region by 2022 (Myers et al., 2024). According to the Net Zero Policy lab database on Chinese low-carbon FDI, Latin America

has experienced, similarly to other regions, dramatic growth since 2022, emerging as a strategic hub for battery materials, solar manufacturing, and EV production.

Figure 2 – Global Distribution of Chinese Green Manufacturing Projects by Technology and Project Status



Source: Xue and Larsen (2025), accessible at : <https://www.netzeropolicylab.com/china-green-leap>

The database records large commitments in key markets including Brazil, Mexico, Argentina, and Chile where Chinese firms have announced megaprojects exceeding USD 1 billion across multiple clean-tech sectors. Battery materials manufacturing represents substantial commitments, particularly in Argentina’s lithium sector, where firms like Ganfeng Lithium, Tianqi Lithium, and Zijin Mining have established operations to secure access to critical minerals. Solar manufacturing has attracted significant Chinese capital, with megaprojects distributed across Argentina, Brazil, and Chile, whilst hydropower continues to dominate renewable energy generation investments, despite mounting environmental controversies. The EV and battery sector has emerged prominently, with BYD aiming to produce over 150,000 electric and hybrid vehicles annually and already manufacturing lithium battery-powered buses in Manaus, in the Brazilian Amazon. Recent major investments include Ningbo Xusheng Group’s USD 350 million electric vehicle plant in Mexico, BYD’s USD 290 million lithium cathode factory in

Chile, and Zijin Mining Group's USD 600 million investment in Argentina's Tres Quebradas lithium project.

Table 2 – Major recipients of Chinese Low-Carbon Technology FDI

Country	Total Projects	Total Investment (USD millions)	Primary Technologies	Investment Pattern
Brazil	15	\$5,612	Green Hydrogen (largest share), NEV, Solar, Wind, Electric Motorcycle	Most diversified portfolio; balanced across multiple clean-tech sectors
Mexico	11	\$4,572	NEV (dominant), Green Hydrogen, Wind, Battery Materials	Heavily concentrated in NEV production and parts for North American market access
Argentina	9	\$5,627	Battery Materials (dominant)	Highest investment concentration in single sector (lithium extraction/processing)

Source: Xue and Larsen (2025), accessible at: <https://www.netzeropolicylab.com/china-green-leap>

The three Latin American countries display distinct investment profiles that reflect their comparative advantages and strategic positioning within Chinese low-carbon supply chains. Argentina attracts the highest total investment despite having the fewest projects (9), reflecting the capital-intensive nature of battery materials and critical minerals processing, particularly lithium extraction in the country's northern provinces. Brazil leads in project count with 15, showcasing the most diversified technology mix spanning green hydrogen, solar, and wind, positioning itself as a comprehensive clean-tech manufacturing hub serving both domestic and regional markets. Mexico counts about \$4.6 billion in investments strategically focused on NEV assembly, leveraging its

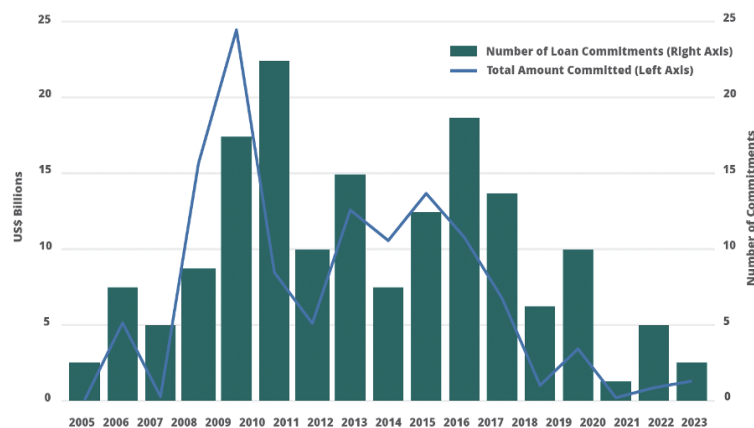
proximity to US markets and integration into North American supply chains. Combined, these three countries represent approximately \$15.8 billion in pledged Chinese low carbon manufacturing investment, underscoring Latin America's emerging role as a key node in China's global green manufacturing expansion.

Financing Mechanisms: From Policy Banks to Construction Arrangements

The financing architecture underpinning Chinese low-carbon investments in Latin America has undergone significant transformation. A decade ago, Chinese finance to Latin America surpassed that of the World Bank and Inter-American Development Bank (IADB) combined; now, lending from these multilateral institutions has surpassed Chinese development finance institutions in the region (Ray et al., 2024). This shift reflects a broader recalibration in China's overseas engagement strategy.

Historically, China's two policy banks, the China Development Bank (CDB) and the Export-Import Bank of China (CHEXIM), played a pivotal role in financing energy and manufacturing projects overseas. Together, they financed more than USD 44 billion in hydropower projects globally, including major commitments in Latin America such as Argentina's Cóndor Cliff and Barrancosa dams, Bolivia's Rosita hydropower project, and the Cauchari Solar Park in Argentina's Jujuy province (Inter-American Dialogue & Boston University Global Development Policy Centre, 2024). Chinese commercial banks such as the Industrial and Commercial Bank of China, Bank of China, and China Construction Bank have also financed several regional projects, including the Punta Sierra wind farm in Chile (ibid).

Figure 3 - China Development Bank and Ex-Im Bank Finance to LAC, 2005-2023
(US\$ Billions)



Source: Chinese Loans to Latin America and the Caribbean Database, Inter-American Dialogue and Boston University Global Development Policy Centre, 2024.

The contemporary landscape, however, shows Chinese firms are progressively pursuing direct equity investments rather than relying on policy bank loans. This shift is largely attributed to Chinese companies having gradually learned about regulatory and labour issues through years of infrastructure lending, allowing them to jump directly into investments without relying on bank backing as they previously had. This being said, according to Boston University's China's Global Energy Finance database, China's development finance institutions have financed nearly USD 10 billion in energy generation and distribution projects in Latin America and the Caribbean since 2000, with Chinese companies and commercial banks supporting additional deal-making (Castano, 2024). Major construction firms including China Three Gorges, PowerChina, and Sinohydro have established prominent regional footprints, particularly in hydropower development across Bolivia, Ecuador, Peru, and Brazil.

Beyond direct investment, Chinese firms maintain a substantial presence through EPC contracts. Companies like PowerChina have contracted multiple photovoltaic projects across the region, including nine PV projects with over 570 megawatts of total installed capacity in Colombia alone, spanning projects like the 238 MW Tikuna PV Project Cluster and the 109.2 MW Las Marias PV project (Jauregui, 2024). BRI projects are often executed through EPC contracts, an approach that ensures Chinese state-owned

enterprises maintain operational control whilst providing financing through development banks. This engagement, combining direct manufacturing investments, development finance, equipment supply, and EPC contracts, positions Chinese firms as important actors in Latin America's low-carbon transition, though questions about technology transfer and local value capture remain contested.

5. Technology Transfer in Practice: The Case of BYD in Brazil

Having established the regional contours of Chinese low-carbon projects in Latin America, this section turns to the paper's empirical core. It examines the conditions under which Chinese green investment generates meaningful technology transfer. Through the case of BYD's electric vehicle manufacturing operations, the analysis traces the mechanisms, limits, and governance of technology transfer, assessing whether Chinese investment is fostering genuine industrial upgrading or primarily reproducing assembly-based production within global value chains.

5.1 China-Brazil technological cooperation

China–Brazil technological cooperation long predates the recent wave of Chinese green manufacturing investment. Since the establishment of diplomatic relations in 1974 and the deepening of scientific cooperation during the 1980s, the two countries have progressively built one of the most extensive technology partnerships among major developing economies. What began as a small number of state-led scientific collaborations has evolved into a much broader relationship encompassing research, infrastructure, digital technologies, energy, agriculture, telecommunications, and advanced manufacturing.

The landmark example remains the China–Brazil Earth Resources Satellite (CBERS) programme, established in 1988 through a partnership between Brazil's National Institute for Space Research (INPE) and the China Academy of Space Technology (CAST) (Delgado-López, 2012; De Stange, 2023). Unlike conventional forms of foreign investment, CBERS was based on joint financing, shared engineering responsibilities, and the co-development of successive generations of Earth observation satellites. Beyond producing satellite technology, the programme strengthened scientific capabilities in both countries through sustained collaboration between engineers,

research institutes, and public agencies. It also generated important downstream benefits by supporting applications in agriculture, environmental monitoring, deforestation control, and natural resource management. CBERS remains one of the clearest examples of successful South–South technological cooperation built around capability creation rather than simple technology acquisition.

Over the past two decades, bilateral cooperation has broadened considerably as China's commercial presence in Brazil has expanded. Chinese firms have become important actors in various sectors including high-tech ones, often complementing investment with technical training, engineering support, and partnerships with Brazilian firms and research institutions (Rubio & Jáuregui, 2022). At the same time, cooperation has become increasingly decentralised, involving not only national governments but also state governments, universities, development banks, and private firms. The relationship has therefore shifted from predominantly state-to-state scientific collaboration towards a more complex ecosystem in which technology transfer increasingly occurs through commercial investment and production networks.

Brazil's own industrial capabilities have been central to this evolution. Unlike many developing economies, Brazil possesses a diversified manufacturing base, an extensive engineering workforce, and longstanding capabilities in sectors such as aerospace, agriculture, energy equipment, and automotive manufacturing. Decades of industrialisation have also produced dense supplier networks, specialised technical institutions, and engineering expertise capable of supporting adaptation, learning, and incremental innovation (Sturgeon, Van Biesebroeck, & Gereffi, 2008). These capabilities do not guarantee successful technology transfer, but they provide many of the absorptive conditions identified in Section 2 as necessary for translating foreign investment into technological upgrading.

At the same time, the character of China–Brazil technological cooperation has changed as China's position within the global innovation system has evolved. Earlier collaborations such as CBERS were established at a time when the technological gap between the two countries was relatively limited and cooperation centred on jointly developing capabilities. Today, China has become a global technological leader across a growing number of strategic industries, giving Chinese firms stronger incentives to retain control over proprietary technologies, intellectual property, and higher value-

added activities. This transformation has altered the balance of technological capabilities within the bilateral relationship. Rather than co-development between relatively equal Southern partners, technology transfer increasingly takes place through commercial investment by globally competitive Chinese firms, raising new questions about the depth of knowledge diffusion, local value creation, and host-country bargaining power (Gallagher, 2016; Alves & Lee, 2022; Stallings, 2020). Against this backdrop, the following section examines how these broader dynamics unfold in practice through the case of BYD's EV manufacturing in Brazil.

5.2 Negotiating Green Technology Transfer: BYD in Brazil

BYD's engagement in Brazil represents the most substantive case of Chinese low-carbon technology transfer in Latin America. Combining market-seeking and efficiency-seeking motivations, the firm has pursued an investment trajectory that goes well beyond simple export-oriented assembly. It amounts instead to a deepening industrial presence, calibrated to Brazil's distinctive institutional and technological context. This expansion also reflects the broader reorganisation of the global EV industry under conditions of intensifying geopolitical competition. As access to North American and European markets has grown more contested through tariffs, and investment restrictions, Brazil has emerged as one of the principal destinations of China's global EV expansion and one of its most important overseas markets. This shifting international context has simultaneously increased China's incentives to localise production abroad and strengthened Brazil's leverage in negotiating the terms of investment.

Camaçari's emergence as a site for green manufacturing cannot be understood without reference to its distinctive place in Brazil's automotive geography, or to the industrial legacy left by the US' Ford. Unlike the country's traditional automotive clusters, concentrated in São Paulo, Minas Gerais, and Rio de Janeiro, Camaçari sits in the northeastern state of Bahia. Its development as an industrial hub has long been framed within Brazilian industrial policy debates as a case of decentralisation, reflecting decades of efforts to extend industrialisation beyond the country's Southeastern parts through targeted fiscal incentives for the North and Northeast (Rodríguez-Pose & Arbix, 2001; Cavalcante & Uderman, 2005). Ford played a crucial role in this earlier phase. Its Complexo Industrial Ford Nordeste (CIFN), inaugurated in 2001, was the first large-scale automotive plant built in the Northeast and became a key reference point for regional

industrial policy (Cavalcante & Uderman, 2005), producing models including the Fiesta, EcoSport, and Ka over roughly two decades of operation. Ford's withdrawal from manufacturing in Brazil, announced in January 2021 as part of a broader global restructuring (Ford Motor Company, 2021), left the Camaçari complex idle for over two years. The Bahia state government repurchased the site from Ford in 2023, and BYD took it over later that year (BYD, 2023).

The transition from Ford to BYD reflects the changing geography of the global automotive industry: a manufacturing complex once operated by one of the US' most iconic carmakers is now home to the largest overseas production base of China's leading EV manufacturer (BYD, 2023). In this sense, Camaçari illustrates how shifts in the global balance of industrial and technological leadership are being translated into new manufacturing geographies, with Chinese firms progressively replacing Western incumbents in strategic industries (Schindler et al., 2024).

BYD entered Brazil in 2014 as a bus manufacturer, producing electric buses in Manaus, a free trade zone in the Brazilian Amazon, well before the current wave of green manufacturing investment made such ventures fashionable. This long prior presence matters analytically: it endowed the firm with contextual knowledge of Brazilian regulatory environments, labour markets, and energy systems that purely export-oriented Chinese investors typically lack. In July 2023, BYD announced a transformative expansion: a three-factory complex at the former Ford plant in Camaçari, Bahia, representing an initial investment of over R\$3 billion (BYD, 2023). Construction began in March 2024, and by July 2025 the first Dolphin Mini rolled off the Camaçari line, just fifteen months after groundbreaking, a pace that drew significant attention across the Brazilian automotive sector.¹

By October 2025, the official inauguration of the final assembly line was attended by President Lula da Silva, signalling the political importance Brazil's government attaches to the investment as a symbol of green reindustrialisation in the Northeast (South China Morning Post, 2025). Total committed investment has since risen to R\$5.5 billion, with plans to scale annual production from 150,000 to 300,000 vehicles, positioning Camaçari as BYD's largest facility outside Asia (BYD, 2025). The timing of this expansion is also

¹ Interview with policymaker at Brazil's ministry of finance, 19/03/2026

significant. As geopolitical fragmentation has accelerated and advanced economies have sought to reduce their dependence on Chinese EV supply chains, overseas manufacturing has become more central to Chinese firms' internationalisation strategies. Brazil became valuable not only as a consumer market, but as a regional manufacturing platform from which BYD could consolidate its position across Latin America.

The question of vertical spillovers, whether BYD's investment generates knowledge transfer along the supply chain, hinges on the trajectory of localisation. As the conceptual framework in Section 2 underlines, such spillovers are not automatic; they depend critically on the firm's willingness to source locally and on domestic suppliers' capacity to meet the required technical standards. The Camaçari plant began operations under an SKD assembly model, importing pre-assembled component sets from China and benefiting from a temporary import tax exemption (Reuters, 2026). This arrangement, common in the first phase of automotive investments, limits spillovers to logistics, assembly, and quality control, rather than component manufacture (Lemoine and Ünal-Kesenci, 2004)

At the same time, the broader geopolitical context has expanded Brazil's policy space. With advanced economies embracing industrial policy, local-content requirements, and strategic subsidies, localisation has become a more legitimate policy instrument internationally. This shift has reduced the political cost of requiring local production, while increasing Chinese firms' willingness to localise manufacturing in exchange for stable market access (Wang, 2026).

Regulatory requirements imposed by the Brazilian government have nonetheless compelled BYD to commit publicly to raising local content to 50% by January 2027 (Reuters, 2026). This localisation strategy extends beyond final assembly to include in-house stamping, welding, and painting facilities, now nearing completion, alongside expanded procurement from Brazilian suppliers, including tyre manufacturers (Reuters, 2026). The former Ford facilities at Camaçari are also being repurposed to host local parts producers, creating geographical proximity between BYD and its emerging supplier base (Fundação Andrés Bello, 2024). If realised, this trajectory would activate the backward linkages that Hirschman (1977) identified as a central mechanism of industrial transformation, embedding domestic firms within a technologically sophisticated green value chain. BYD's plan to use Camaçari as an export hub for

Mercosur markets from 2026 further strengthens the commercial rationale for deepening local sourcing (Reuters, 2026).

More broadly, Brazil's ability to hedge among competing international investors appears to have strengthened its bargaining position.² Rather than competing solely through fiscal incentives, Brazil has been able to combine market size, industrial capability, and growing strategic importance within China's overseas EV expansion, allowing it to negotiate more ambitious localisation commitments than many other developing economies.

The most analytically significant dimension of the BYD Brazil case, from the standpoint of technology transfer, is the co-development of a flex-fuel plug-in hybrid powertrain adapted specifically to the Brazilian energy context. Over two years, more than 100 Chinese and Brazilian engineers jointly modified BYD's DM-i (Dual Mode Intelligent) 1.5-litre engine to run on any ratio of petrol and ethanol. This work culminated in the unveiling of vehicles such as the SONG PRO at the Camaçari inauguration in October 2025, described by BYD as the world's first dedicated biofuel plug-in hybrid (Just Auto, 2025). This represents a qualitatively different mode of engagement from simple assembly: it involves co-design, adaptation to local resource conditions, and the mobilisation of Brazilian engineering expertise within BYD's global innovation process. In the terminology of Cohen and Levinthal (1990), it demonstrates that Brazilian absorptive capacity, grounded in the country's decades-long leadership in biofuels and flex-fuel automotive technology, is sufficient to participate not only in production, but in product development. As such, Brazil's flex-fuel capabilities functioned not only as absorptive capacity but also as a bargaining asset: because BYD required local engineering expertise to adapt its global platform to Brazilian energy conditions, capability formation and bargaining power reinforced one another.

BYD has additionally committed to establishing a dedicated R&D centre and test facility at Camaçari, both aimed at adapting vehicles to Brazilian market conditions (Advanced BioFuels USA, 2025). These commitments mark forward movement toward the kind of embedded, higher-value engagement that distinguishes genuine technology transfers and upgrading from shallow assembly. Whether Brazilian engineers will gain access to

² Interview with Brazilian researcher, 13/03/2026

core battery chemistry and drivetrain design, which BYD controls vertically across its global supply chain, remains an open and critical question that future fieldwork should probe.

The horizontal spillover dimension, centred on labour mobility and demonstration effects, remains difficult to assess in the BYD case at this early stage. The plant had employed approximately 5,000 workers by early 2026, including around 2,300 direct BYD employees alongside construction and service subcontractors, with a target of 20,000 direct and indirect jobs once at full capacity (Reuters, 2026). The symbolic resonance of the site is notable: Adson Santana, a BYD assembly manager, described becoming emotional on returning to the Camaçari site, where he had previously worked for Ford before the American firm's exit in 2021³. In several respects, the prior presence of Ford contributed to the accumulation of domestic capabilities, fostering a pool of specialised human capital, skilled technicians, engineers, and managers familiar with large-scale automotive manufacturing. This legacy may lower the absorptive barriers for BYD's operations and, over time, facilitate the adaptation and diffusion of EV-related knowledge within the local labour market.

Workers and engineers who acquire EV-specific capabilities, such as battery management systems, electric drivetrain diagnostics, and charging infrastructure, could in principle transfer these skills to Brazilian-owned firms, startups, or supplier networks, thereby activating a labour mobility spillover. Such dynamics, however, remain prospective. Given how recently the plant was established, more time is needed to observe whether and how labour transitions materialise. Empirical assessment is contingent on future evidence regarding the depth and structure of training programmes, and on the extent to which technical knowledge diffuses across sectoral and national boundaries.

The role of Brazil's industrial policy framework in shaping these outcomes cannot be separated from the analysis. Rota 2030, Brazil's automotive industrial policy adopted in 2018, incentivises local R&D investment, fuel efficiency improvements, and rising domestic content, structuring the conditions under which BYD must operate if it wants to access the Brazilian market on competitive terms. The import tax exemption on SKD

³ Interview with Brazilian researcher, 12/03/2026

units, a concession that supported BYD's ramp-up phase, was itself a deliberate policy instrument, calibrated to enable rapid deployment while the firm built local production capacity (Reuters, 2026; LatamFDI, 2025). This reflects the kind of sequenced, instrument-specific industrial policy that the literature associates with successful technology transfer outcomes in East Asia (Amsden, 2001; Wade, 1990): rather than imposing immediately prohibitive local content requirements, Brazilian authorities offered a temporary concession to attract the initial investment, then allowed market pressures and regulatory frameworks to push toward deeper localisation. This sequencing unfolded, importantly, in a global environment where industrial policy had become normalised. The resurgence of localisation policies in the US, Europe, and China itself expanded the policy space available to countries such as Brazil to pursue domestic value creation alongside foreign investment (Boston University Global Development Policy Center, 2026).

Nonetheless, the limits of Brazil's policy leverage are also visible. BYD retains proprietary control over its battery chemistry, its blade battery technology, and its core software systems, none of which appear subject to explicit transfer requirements⁴. The joint engineering on the flex-fuel engine is thus an example of localised adaptation rather than fundamental technology transfer: it remains within parameters set by BYD, rather than driven by Brazilian regulatory demands. Brazil's ability to signal, even implicitly, that Western and other Asian EV manufacturers, themselves responding to reshoring pressures, could substitute for BYD may have strengthened the credibility of its bargaining position.

The BYD case is not without controversy, and it underscores that technology transfer outcomes cannot be meaningfully assessed in isolation from their social and governance dimensions. In December 2024, Brazilian labour authorities rescued 163 Chinese workers from the Camaçari construction site after an investigation found conditions described as "degrading" and analogous to forced labour, including confiscated passports, withheld wages, and unsafe housing (Bloomberg, 2024). Brazilian prosecutors subsequently filed suit against BYD, the Jinjiang Group subcontractor, and a second contractor, seeking over USD 45 million in damages (GoodElectronics, 2025). In April 2026, Brazil's Ministry of Labour added BYD to its "dirty list" (Lista Suja) of employers who have subjected

⁴ Interview with Brazilian Engineer working for BYD, 12/03/2026

workers to “slavery-like” conditions, restricting the firm's access to certain state and private bank financing for two years (CNBC, 2026; South China Morning Post, 2026). BYD attributed responsibility to its subcontractor, but Brazilian officials held the firm ultimately accountable for supervision of its supply chain.⁵

These events, which provoked international controversy and delayed construction by several months, matter beyond their immediate human rights implications. They suggest that the governance of technology transfer cannot be separated from the governance of socio-environmental and labour relations: the same regulatory capacity Brazil needs to enforce substantive local content requirements and R&D obligations must also be capable of monitoring working conditions across contractor chains.⁶ In this respect, the scandal is not an aberration but a stress test of the institutional framework that will ultimately determine whether BYD’s presence constitutes a genuine developmental contribution to Bahia’s industrial ecosystem, or a more limited form of market-seeking enclave production.

In sum, BYD’s Brazilian investment presents an empirically complex picture that resists simple characterisation as either a textbook spillover success or an extractive enclave. The flex-fuel engine co-development, the announced R&D centre, the repurposing of Ford’s former supply base, and the ambition to reach 50 percent local content by 2027 all point toward meaningful vertical integration and technological engagement with the Brazilian economy. Brazil’s absorptive capacity, rooted in its longstanding automotive industry, its world-leading flex-fuel expertise, and its pool of engineering talent, provides precisely the conditions the existing research associates with the realisation of technology spillovers from FDI (Cohen & Levinthal, 1990; Kokko et al., 1996). At the same time, BYD retains control over its most sensitive technologies, the SKD transitional phase limited early learning, and the labour scandal exposed governance gaps that could constrain the depth of long-run integration. Ultimately, the difference between investment that leaves a transformative trace in a host economy and investment that simply “slips out” without one is shaped less by the investor’s intentions than by the state's capacity to enforce the conditions under which linkages are built.

⁵ Interview with policymaker at Brazil’s ministry of finance, 19/03/2026

⁶ Interview with Brazilian researcher, 06/02/2026

The BYD case suggests that Brazil's position within a multipolar international economy expanded the scope of what it could negotiate with a leading EV manufacturer. Geopolitical fragmentation increased China's incentives to internationalise production, while simultaneously expanding the policy space available to Brazil to pursue localisation and industrial upgrading. The replacement of Ford by BYD is emblematic of this broader shift, illustrating how emerging economies are becoming strategic sites in the reorganisation of global EV production. Whether these opportunities translated into meaningful technology transfer and capability building, however, depended on domestic conditions.

6. Conclusion and implications for rethinking South-South development cooperation in the context of green industrialisation

This paper has argued that green technology transfer in the contemporary era cannot be explained by domestic absorptive capacity alone. It develops an integrated framework in which two conditions jointly determine outcomes: the external geopolitical environment, which sets the ceiling on what governments can negotiate from foreign investors, and domestic institutional capacity, which determines how much of that negotiated space is converted into genuine technological learning.

The case of BYD in Brazil illustrates both the promise and the limits of green industrial cooperation under multipolarity. The replacement of Ford by BYD at Camaçari symbolises a broader reorganisation of global manufacturing, in which Chinese firms are increasingly becoming anchor investors in strategic industries. Brazil's market size, industrial capabilities, and room to manoeuvre amid US-China rivalry allowed it to negotiate localisation commitments, collaborative engineering on a flex-fuel platform, supplier development, and research partnerships. Yet these gains remained partial: BYD retained control of core battery and software technologies, assembly initially relied on semi-knocked-down kits, and the 2024 labour scandal at Camaçari exposed the fragility of state enforcement. Developmental outcomes depend on the interaction between geopolitical leverage, industrial policy, absorptive capacity, and state enforcement, with

fragmentation expanding the range of outcomes governments can negotiate, while domestic capabilities determine how much of that opportunity is actually captured. That being said, assessing technology transfers requires more time: the plant remains in its early years of operation, and future research will be needed to capture spillover effects, supplier upgrading, and local innovation capacity more meaningfully as the case matures.

Our analytical framework and the case of China-Brazil technological cooperation centred on BYD bear important implications for rethinking South-South cooperation in green industrialisation and development. Rather than offering definitive prescriptions, what follows identifies where existing scholarship converges, where it leaves important questions open.

The Shifting Architecture of Development Cooperation and Technology Transfer Beyond Discursive Dimensions

Development cooperation has been in flux since the early 2000s, driven by policy reforms in industrialised economies and the gradual repositioning of Southern countries from policy and technology 'importers' to 'exporters' (Gulrajani, 2017; Mawdsley, 2017; Porto de Oliveira and Romano, 2022). This transformation has accelerated over the past decade, moving from what scholars initially described as a diffuse 'Southern powers or BRICS Effect' (Lauria and Fumagalli, 2019) toward a more distinctly China-centred dynamic in scale, financing, and standard-setting.

The South-South cooperation literature has long emphasised the discursive significance of 'horizontal relations', 'mutual benefit', and 'doing development differently', or 'better' (Waisbich, 2025; Six, 2009). These framings carry real political weight, but discursive shifts do not automatically translate into substantive changes in the distribution of benefits, bargaining power, or technological capacity. The central analytical challenge is to move beyond official narratives and examine the conditions under which genuine mutual benefit occurs, and when it does not. Green industrial cooperation and technology transfer offers a concrete site in which to test these ubiquitous claims of 'win-win' cooperation in today's multipolar world.

Asymmetric Relations and the Role of Agency in China-Global South Cooperation

Contemporary debates on China's relations with the Global South have moved beyond the binary of China as 'good' or 'bad' partner, and now centre on the conditions under which 'mutually beneficial' relations actually take shape (Mohan and Lampert, 2013; Stallings, 2020; Bernal-Meza and Xing, 2020). 'Asymmetric interdependence' is a productive framework here, neither outright dependency nor symmetrical partnership, but a structured unevenness in which China's superior capital, technological, and diplomatic resources shape the terms of engagement. This asymmetry is not fixed: its degree is itself endogenous to whether a host government can credibly diversify its partnerships. Where hedging leverage is weak or unexercised, asymmetric interdependence tends toward the more dependency-like outcomes documented below; where credibly mobilised, as Brazil's case suggests, the same structural asymmetry can be partially offset.

For Latin America, this asymmetry has manifested in deindustrialisation and reprimarisation, diminishing intra-regional trade, problematic debt trajectories (notably in Ecuador and parts of the Caribbean), and enclave-style extractive development patterns (Mazwi et al., 2024; Hönke et al., 2024; Mohan, 2014). Chinese-backed extractive industries have also generated conflicts in ecologically sensitive zones and on the lands of indigenous and marginalised communities (Amar et al., 2022; Sanchez-Lopez, 2023; Bringel and Svampa, 2023). China is neither the sole actor responsible for 'neo-extractivism' in the region nor an entirely uniform one across contexts, but its growing role as financier and contractor in resource sectors makes it a central participant in these dynamics (Gardini, 2021).

China-Africa relations present a broadly comparable but analytically distinct picture, with older, more developed scholarship on BRI infrastructure financing and technology transfer in agriculture and renewable energy (Chiyemura, 2019). It is primarily in this literature that 'agency' has been theorised most rigorously, reintegrating national institutions, state capacity, and domestic politics, including 'politics from below', into accounts that had previously treated African actors as largely passive (Mohan and Lampert, 2013; Soulé, 2025; El Kadi, 2025; Lisinge, 2020). The concept allows for integrating the role of national and regional institutions in 'negotiating' or even 'locking

in' China around previously agreed priorities, including more favourable technology transfer.

China-Ethiopia wind energy cooperation is instructive: Ethiopia's relatively coherent developmental state and strategic orientation toward China enabled it to shape the terms of wind farm development, a form of structured, if constrained, agency (Chiyemura, 2019). Yet the same body of work shows the limits of that agency: employment remained skewed toward Chinese workers during construction, technology transfer was circumscribed to operational rather than design or manufacturing capability, and local communities experienced dispossession and inadequate compensation (Chen, 2018; Alves and Lee, 2022; Chiyemura, 2019).

Together, BYD in Brazil and the China-Africa technology cooperation literature illustrate a key argument of this paper: agency matters, but its scope and depth vary considerably with institutional, political, and sectoral context. A strong developmental state or preexisting industrial capacity are necessary but not sufficient for equitable technology transfer. As Soulé (2025) argues, agency itself requires typologisation, a differentiated set of capacities and practices operating across different scales and actors, not a single variable. Ethiopia's centralised developmental state and Brazil's industrial capacity, biofuels policy legacy, and relative autonomy vis-à-vis China each enabled forms of bargaining that weaker or more fragmented countries might not replicate, a reminder that hedging capacity itself is unevenly distributed, as work on 'active non-alignment' in Latin America suggests (Heine et al., 2023).

Bringing the Global Green Transition into the Picture

The green transition opens a new chapter in these dynamics, simultaneously an opportunity and a risk. China's commanding position in renewable energy manufacturing means Southern countries decarbonising their economies will, in many cases, do so through and with Chinese technology, financing, and firms, creating structural dependence even in sectors ostensibly oriented toward national sustainability and industrial upgrading.

The lithium value chain in South America is emblematic: despite holding a large share of global reserves, Argentina, Bolivia, and Chile remain largely confined to raw mineral

extraction, with battery manufacturing and electric transport value-add dominated by Chinese and other East Asian firms (Sanchez-López, 2023). BYD in Brazil illustrates a more optimistic scenario, where industrial capacity, domestic policy frameworks, and market size created conditions for deeper localisation and collaborative green innovation. But this case is likely exceptional rather than representative, reflecting a specific combination of market size, industrial history, and geopolitical positioning that is not easily replicable elsewhere in the Global South.

A future research agenda should advance our understanding of when Chinese green investment displaces domestic industrial development, when it complements it with limited spillovers, and when conditions exist for genuine co-development. It should also situate these questions within US-China rivalry and the adoption of de-coupling/de-risking strategies by Western powers alongside 'active non-alignment' and hedging strategies by Southern countries — including whether and how critical mineral-rich countries leverage their supplies amid greater rivalry between China, the United States, and other Western powers.

Conditions and Constraints Towards More Equitable Green Industrial Cooperation

What can existing research tell us about the conditions for Southern countries to act as agenda-setters rather than passive recipients, forging more equitable partnerships with China and other green tech powers? Three sets of lessons stand out.

First, national conditions: the China-Africa literature's emphasis on institutional capacity and domestic regulatory frameworks (Chiyemura, 2019; Lisinge, 2020) converges with China-Latin America literature on state capacity and policy coherence (Stallings, 2020; Gallagher, 2016), but also domestic politics, as the BYD case shows, in shaping localisation outcomes.

Second, regional conditions: individual Southern states may lack the leverage to negotiate equitable terms unilaterally, pointing to a need for regional coordination — whether through MERCOSUR, the African Union, or other platforms — as a complement to bilateral hedging (Lisinge, 2020; Nantulya and Lazarus, 2024). This is the hedging logic scaled beyond the bilateral level: a bloc negotiating collectively can credibly threaten to redirect more demand toward alternative partners than any single member state acting

alone, which is precisely what gives hedging its bargaining power. Third, Chinese domestic politics and industrial policy: China's own green transition imperatives, alongside competitive pressure from other Eastern and Western countries, create incentives for Chinese firms to deepen localisation and form genuine green industrial partnerships, as BYD arguably illustrates. This is not simply an effect of host-country bargaining power; it reflects changing conditions within China's own political economy and geoeconomics.

The green transition creates new conditions for renegotiating South-South cooperation, but whether these translate into meaningful gains depends critically on host countries' institutional capacity, policy coherence, and willingness to coordinate beyond the bilateral. Denouncing 'uneven' power and economic relations has been at the core of the Southern critique of North-South relations for decades. The rise of Southern powers, China in particular, has shifted the discursive register of development cooperation toward partnership and mutual benefit, and expanded the material options available to many developing countries. Yet these shifts have not dissolved underlying asymmetries in technological capability, financial leverage, or standard-setting power; in some cases, as the Latin American evidence here suggests, they have reconfigured rather than reduced dependency. Countries with greater industrial, policy, and diplomatic capacity are better positioned to negotiate equitable partnerships and demonstrate the value of joint green innovation. Replicating Brazil's experience is not straightforward, it reflects a specific combination of market size, industrial history, and state capacity most Southern countries do not share. What can be emulated is the underlying logic of treating green industrial cooperation not as a transfer relationship but as a site of strategic negotiation, backed by coherent domestic policy and, where possible, coordinated regional positioning. As geopolitical competition intensifies and the language of 'win-win' partnerships becomes ubiquitous, converting that language into tangible gains will depend less on rhetoric and more on the institutional and political foundations that make genuine bargaining possible.

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