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LATIN AMERICA, CHINA AND A JUST ENERGY TRANSITION:
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Role of Chinese Public Development Financial Institutions in Fostering Renewable Energy Transformation in Latin America

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Role of Chinese public development financial institutions in fostering renewable energy transformation in Latin America

Jiajun XU[1] , Hanyue DENG, and Yang ZOU

Abstract

This paper aims at exploring the role of Chinese Public Development Financial Institutions (PDFIs) in fostering renewable energy transformation in Latin American countries. To describe the development status and current transition trends of the Latin American countries' energy industry, we conducted a comprehensive review of their energy supply and consumption patterns, along with an analysis of their national energy transition policies and regulations. Furthermore, drawing on the transaction-level data of China's overseas energy financing, the paper draws in detail the stylized facts on Chinese PDFIs' energy investment in Latin America. Finally, the paper aims to identify the key constraints and barriers faced by Latin American countries' renewable energy projects, further examine the role played by Chinese PDFIs in supporting the regional transition goals, and provide policy recommendations to advance a just and inclusive renewable energy transformation in Latin America.

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Introduction

As one of the most resource-rich regions in the world, Latin America is well-known for and heavily reliant on its mineral resources. In mining activities, ore and metal exports from Chile and Peru account for nearly half of their total exports. Both countries have similar mineral structures, with the top export being copper ore, valued at US$13.5 billion (Peru) and US$22.8 billion (Chile) in 2022[1]. Another large and resource-rich country targeting overseas markets is Colombia, where fuel exports accounted for 54.8% of its total merchandise exports in 2022[2].

Turning to the energy sector, fossil fuels are the leading energy source in most Latin American countries. According to the data corresponding to 2022 from the International Energy Agency (IEA), coal, oil, and natural gas account for more than 75% of the total energy supply in Peru and Colombia. Argentina also relies heavily on fossil fuels, with natural gas and oil accounting for more than 80% of its total primary energy mix. However, one special case worth noting is Chile, where fossil fuels account for around 60% of the country's total energy supply, yet renewable energy sources – such as wind, solar, hydro and biofuels – make up 90% of its domestic electricity production.

While Latin American countries consistently acquire wealth from the trade of mineral and energy resources, they face difficulties filling a huge gap between energy demand and supply at the domestic level. The energy supply in Latin American countries focuses on supporting daily living activities and the operation of essential economic sectors, such as household appliances, heating and lighting, as well as the extraction and transportation of mineral resources. In terms of energy consumption, fossil fuels and their related products dominate about 67% of the region's total[3]. During 2018–2022, Argentina imported an average of US$3.2 billion in refined petroleum annually, making it the country's top import product (US$6.81 billion)[4]. Chile and Peru import more energy than they export and, in the particular case of Chile, energy imports accounted for more than 60% of its total energy supply in 2023, indicating a remarkable shortfall across the nation[5].

Abundant natural resources do not always guarantee sustainable economic growth; in fact, without a full-fledged operation and management system, they may negatively impact the long-term development of a country (Ploeg, 2010). An unbalanced economic structure that overwhelmingly relies on resource trading, coupled with inadequate domestic energy supply to support essential daily and economic activities, can severely hinder the development of Latin American countries. According to OECD et al. (2023), the potential GDP per capita growth of Latin American countries has been below 1% since 1980, far behind the growth rate in advanced economies. In recent years, tighter-than-usual global conditions, caused in part by the COVID-19 pandemic and the war between Ukraine and Russia, have slowed economic activities in Latin American countries, prompting the World Bank to lower its growth forecast for the region from 2.2% in 2023 to 1.8% in 2024 (Marioli, 2024).

In addition to development demands, the global trend of combating climate change should also encourage Latin American countries to adopt more efficient and environmentally-friendly methods to ensure sustainable development in the region. The Paris Agreement, one of the most important legally binding international treaties on climate change, has been adopted by 196 Parties worldwide with the goals to "hold the increase in the global average temperature to well below 2°C" and to "pursue efforts to limit the temperature increase to 1.5°C" (United Nations, 2015; UNFCCC). To achieve these goals, countries and regions have recognized the importance of the energy transition, particularly emphasizing the development and utilization of renewable energy. According to IRENA (2020), 90% of the involved parties mentioned renewables in their Nationally Determined Contributions (NDCs) submitted under the framework of the Paris Agreement. In the region of Latin America and the Caribbean, 72% of countries included quantified renewable energy targets in their NDCs.

Furthermore, all four selected sample Latin American countries in the JET project, namely Peru, Chile, Colombia, and Argentina, have committed to achieving net-zero emissions by 2050, through legislation or policy directives. They are also setting national energy plans that use renewable energy as a complementary tool, looking forward to gradually replacing the use of fossil fuels. Most of the recent energy transition plans focus on diversifying the national energy mix, as well as improving the utilization rate of renewable energy in key industries. Specifically, Argentina made the decision for renewable energy to account for 20% of its power mix, and Peru set a target of 60% of renewables in its electricity mix by 2025 (González Jáuregui, 2025; IRENA, 2014). The Chilean government has set a goal to ensure that the mining sector is powered at 90% by renewable energy sources by 2030, and at 100% by 2050[6]. To reduce emissions, Colombia enacted in 2019 Law 1972, which requires that at least 20% of the total new fleet in all integrated transportation systems comply with zero-emissions technology by 2030.

China, as one of the most populous countries, is facing the same challenge of balancing the rapidly growing demand for energy with the need to achieve green and sustainable development in the long run. The most recent government policies demonstrate China's commitment to promoting clean energy transformation not only within the nation but also across the world.

The five-year plans published by the Chinese central government serve as the primary tool to guide national social and economic development. In its latest (14th) Five-Year Plan, China set a target of increasing the share of non-fossil fuel in the country's total primary energy consumption to more than 20% by 2025, and to 25% by 2030. In September 2020, President Xi Jinping announced at the general debate of the 75th session of the UN

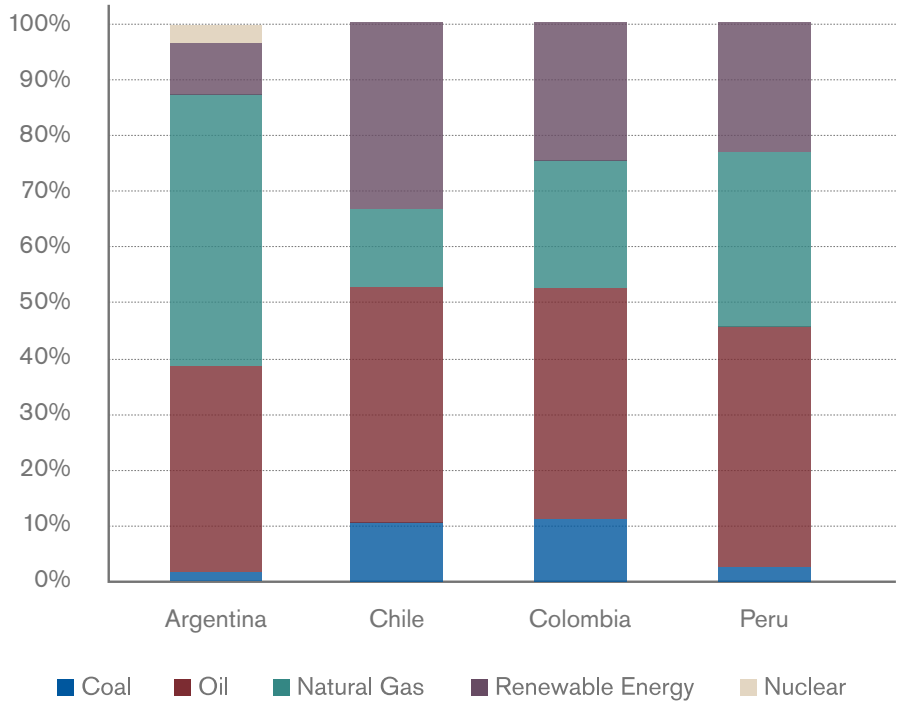
1 Data Source: OEC. "Chile Country Profile." OEC - The Observatory of Economic Complexity. Available at: https://oec.world/en/profile/country/chl, Accessed June 14, 2024.
2 Data Source: Word Bank. "Fuel exports (% of merchandise exports) – Colombia." Word Development Indicator. Available at: https://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN, Accessed July 10, 2024.
3 Data source: IEA. (2023) "Latin America Energy Outlook." IEA - International Energy Agency. Available at: https://www.iea.org/, accessed July 10, 2024.
4 Data source: OEC. "Argentina Country Profile." OEC – The Observatory of Economic Complexity. Available at: https://oec.world/en/profile/country/arg, Accessed June 20, 2024.
5 Data source: IEA. "Chile – Energy Mix". IEA - International Energy Agency. Available at: https://www.iea.org/countries/chile/energy-mix, Accessed July 15, 2024.
6 Source: Gobierno de Chile. (2021). "Green Hydrogen: An Opportunity for the Decarbonization of the Mining Industry." Available at: https://www.energy.gov/sites/default/files/2021-12/922-3-mission-innovation-chile.pdf. Accessed July 2, 2024.

General Assembly that China aims to achieve "peak carbon" emissions by 2030 and become "carbon neutral" by 2060.

Internationally, President Xi officially declared at the UN in 2021 that China would no longer invest in overseas coal power plants. More recently, in 2025, marking the 10th anniversary of the Paris Agreement, Xi delivered remarks at the Leaders Meeting on Climate and the Just Transition, stating that "countries must accelerate the just transition by adopting a people-centered approach to advance the well-being of people and climate governance". He emphasized that China, as "a steadfast actor and major contributor in promoting global green development, will vigorously deepen South-South cooperation and continue to provide help for fellow developing countries to the best of its capability."[7] The government also launched the Belt and Road Initiative (BRI), which emphasizes cooperation on projects related to green infrastructure, renewable energy, eco-friendly transport, and sustainable finance. Furthermore, the establishment of the BRI International Green Development Coalition (BRIGC) underscores the Chinese government's determination to integrate national and international resources to realize green development globally.

To meet the increasing demand for investments in renewable energy projects spurred by the BRI and related cooperation policies, national public development banks in China –China Development Bank (CDB) and the Export-Import Bank of China (China Eximbank) – have the primary responsibility for supporting the country-level overseas development financing in this field (Cheng & Wang, 2023; Ray et al., 2021). According to the global database of Public Development Banks and Development Financing Institutions (PDFIs)[9] , CDB holds the largest total assets among all the PDFIs with a flexible mandate, and China Eximbank leads in total assets among all the PDFIs associated with promoting exports, foreign trade and other overseas activities (Xu et al., 2021). While the China Export & Credit Insurance Corporation (Sinosure) does not have total assets on such a large scale, it also plays a crucial role in providing insurance and guarantees to support China's overseas renewable energy projects. Therefore, this research will include China's national development banks, as well as the state-owned insurance company, to conduct a comprehensive analysis of the role of Chinese PDFIs in fostering renewable energy transformation in Latin America.

Figure 1: Total Energy Supply in Sample Latin American Countries, Year 2022[8].



7 Source: Ministry of Foreign Affairs of the People's Republic of China (2025). "Xi Jinping Delivers Remarks at the Leaders Meeting on Climate and the Just Transition." Available at: https://www.fmprc.gov.cn/mfa_eng/xw/zyxw/202504/t20250425_11604454.html, Accessed May 24, 2025.

8 Xu, Jiajun, Régis Marodon, Xinshun Ru, Xiaomeng Ren, and Xinyue Wu. 2021. "What are Public Development Banks and Development Financing Institutions?——Qualification Criteria, Stylized Facts and Development Trends." China Economic Quarterly International, volume 1, issue 4: 271-294. DOI: https://doi.org/10.1016/j.ceqi.2021.10.001 Database DOI: https://doi.org/10.18170/DVN/VLG6SN. http://www.dfidatabase.pku.edu.cn/.

9 Data Source: IEA. "Country Energy Mix – Energy Supply." IEA – International Energy Agency. Available at: https://www.iea.org/, Accessed April 8, 2025.

1. Literature Review

1.1. Obstacles and challenges of clean energy transformation

To have a thorough bibliographic review on the research topic of renewable energy transformation, we first examined studies on the obstacles and challenges for energy transition in Latin American countries.

i. Insufficient domestic finance for renewable energy projects

Barrera et al. (2022) and Alarcón (2023) believe that Latin American countries lack adequate domestic finance for renewable energy projects because they face macroeconomic constraints and high borrowing costs in the global financial markets. Additionally, renewable energy projects are often run by small and medium-sized enterprises, which generates high transaction and implementation costs, making it difficult for them to attract sufficient capital from financial lenders (Anbumozhi et al., 2020).

ii. Underdeveloped infrastructure

From the perspective of renewable energy infrastructure, Cochran et al. (2014) identify specific constraints confronted by green infrastructure projects such as unattractive risk-return rates, unfavorable political and regulatory rules, and lack of investment experience and capacity.

iii. Unreliable technologies

Campodónico & Carrera (2022) observe severe technical criticism in Peru of renewable energy power generators because they lack the capacity to support reliable electricity supply, especially for unconventional renewable sources.

iv. Ineffective renewable energy subsidies

They also notice that while renewable energy subsidies are designed to encourage investments in low-carbon electricity projects, they will drive up electricity prices and affect low-income consumers when renewable energy resources become increasingly competitive (Campodónico & Carrera, 2022).

v. Prevailing reliance on fossil fuels

Coady et al. (2015) highlight a large portion of pre-tax subsidies on fossil fuels that reinforce the dependence of Latin American countries on traditional energy sources. IEA's 2022 statistics also stress the dominant position of fossil fuel products in the energy supply and demand in Latin American countries.

vi. Social-environmental risks

González Jáuregui (2025) and Defelipe Villa (2025) highlight the social conflicts and environmental concerns surrounding renewable energy and lithium extraction projects in Argentina and Colombia, respectively, emphasizing multiple tensions such as damage to ecosystems, poor working conditions, and labor rights violations. Debate continues on the appropriate strength of environmental and social safeguards. On the one hand, Rehner et al. (2025) argue that Chile's strict environmental and social governance standards pose potential constraints to the growth of Chinese investments. On the other hand, Merino (2025) points out that the mechanisms for monitoring and addressing social and environmental conflicts remain inadequate, which exacerbates tensions between Chinese firms and local communities.

vii. Lack of long-term integrated policy planning

Barrera (2022) argues that macroeconomic instability is usually a barrier to the continuity of public policies designed by Latin American countries for the long run. Guerrero (2021) agrees that for geopolitical reasons, Latin American countries show signs of stagnation in achieving energy integration. This is an obstacle for them to plan for a regional sustainable energy transition, which is usually supported by common energy policies and agreements signed between different countries in a region.

1.2. The Role of PDFIs in fostering renewable energy transformation

Second, we review the literature on the role of PDFIs in tackling challenges and obstacles, and facilitating renewable energy transformations.

i. Provide long-term finance

Cochran et. al. (2014) demonstrate that PDFIs have access to a great volume of stable national and international financial resources which gives them a strong capacity to provide long-term financing to renewable energy projects.

ii. Crowd in private investments

PDFIs can combine different financial instruments, from conventional financial instruments like equity and debt investment to risk-mitigating tools like guarantees, to effectively leverage and mobilize private capital into low-carbon projects (Cochran et. al., 2014).

iii. Incubate emerging market

Smallridge et al. (2013) and Bhattacharya et al. (2015) state that national development banks can take more project risks than private sector actors by aggregating small-scale projects to lower the transaction costs and the overall market risk. This is also demonstrated by state investment banks' leading financing activities toward high-risk renewable energy projects in OECD countries – these activities usually decrease once the market matures (Waidelich & Steffen, 2024).

iv. Fill in the gap of infrastructure construction

The research conducted by Bhattacharya et al. (2015) also reveals the leading potential of multilateral development banks to bridge the infrastructure gap in sustainable development projects, by mitigating overall project risks, leveraging large investment capital, and enhancing the efficiency of project development.

v. Facilitate the development of new technologies

Steffen & Schmidt (2017) find that, in recent years, multilateral development banks (MDBs) lean toward investing more in innovative renewable energy endeavors than in projects with conventional technologies like hydropower. In contrast, public financial institutions effectively cultivate new technical capacity among project developers or partners by either providing the resources directly or utilizing technical assistance to foster the development of new technologies and expertise (Cochran et. al., 2014).

vi. Positively influence the public policy

Zhang (2021) and Smallridge et al. (2013) discovered that national development banks can act as policy coordinators integrating information from the market and experts to influence decisions of policymakers since they not only operate directly on the financial market but also have strong ties with different government agencies.

Given the relevant advantages acknowledged by the literature to PDFIs in addressing challenges and advancing opportunities for renewable energy transformations, our study inquires how or to what extent they have played this role in Latin America to date.

2. Research Methods

The research employs a mixed-methods approach to identify and analyze the challenges of renewable energy transformation in Latin America, as well as the actual and potential roles of PDFIs in overcoming barriers and fostering the process of renewable energy transformation in the region.

For quantitative analysis, we collected and analyzed data on the financing provided by Chinese PDFIs for renewable energy projects in Latin America, including the amount of investment, types of renewable energy sources and sub-sectors, project distribution in various Latin American countries, etc. The data sources we relied on include third-party collections, for example, China's Global Energy Finance (CGEF) and Chinese Loans to Latin America and the Caribbean (CLLAC) database from Boston University (BU), and the Global Chinese Development Finance (GCDF) dataset from Aid Data. In addition, we also collected some of the missing data that is critical to our analysis, aiming to draw a comprehensive picture of Chinese PDFIs' energy investments in the region of Latin America.

For qualitative analysis, we conducted case studies to analyze in detail renewable energy projects financed by Chinese PDFIs in Latin American countries. We selected emblematic renewable energy projects financed by Chinese PDFIs in Latin America and conducted case studies. This includes document analysis of project reports, financing agreements, policy documents, and impact assessments. Through these methods, we sought to provide a comprehensive understanding of the distinctive financing mechanisms employed by Chinese PDFIs in Latin America, offering valuable insights into their strengths, challenges, and potential for fostering renewable energy transformation in the region.

3. Stylized Facts on Chinese PDFIs' Energy Investment in Latin America

To draw a comprehensive picture of clean energy investments from Chinese PDFIs to Latin American countries, we thoroughly reviewed all relevant worldwide databases compiled by various institutions. These databases include China's Global Energy Finance (CGEF) and Chinese Loans to Latin America and the Caribbean (CLLAC) database from Boston University (BU); the Global Power Plant database from the World Resources Institute; the Chinese Companies' Investment in Peru databases from Universidad del Pacífico, and the Global Chinese Development Finance (GCDF) dataset from Aid Data.

3.1. Data Selection

To select renewable energy projects from these databases, we first adhered to the UN's definition of renewable energy as "energy from natural sources that are replenished at a higher rate than they are consumed."[10] This includes solar power, wind power, hydropower, geothermal, and biomass energy, but excludes nuclear power. In addition, to ensure the comparability of projects' data across different databases, we restricted the type of finance provider to Chinese state-owned public development financial institutions; the funding sector to energy; and the recipient region to Latin America.

Based on the filtered results, we selected Aid Data's GCDF Dataset (version 3.0) for further research and analysis. We chose this dataset because it encompasses the largest number of Chinese energy investments in Latin American countries, and provides the most detailed project information, including financing type and amount, commitment and completion dates, current status, and certain contract descriptions.

Additionally, we noticed that the BU's databases, which specialize in Latin American countries' energy sector, classify each project's energy source and sub-sector into different categories. These additional details are critical to our analysis, prompting us to integrate this information with Aid Data's GCDF Dataset as well.

For Aid Data's GCDF Dataset, we set the recipient region to "the Americas", the funding agency to "State-Owned Policy Bank", and the sector to "Energy". Additionally, we set the field "Recommended for Aggregates" to "Yes", as suggested by Aid Data, to exclude all canceled or suspended projects and to avoid double accounting. After applying these filters, 75 projects remained in the dataset, covering 12 Latin American countries with commitment years ranging from 2005 to 2017.

For BU's CGEF and CLLAC databases, we first focused on data from the energy sector in Latin American countries and filtered it by lenders, which included China Eximbank and CDB. We then combined the datasets using STATA and conducted quality control by comparing project name, BU ID, country, commitment year, and other detailed information to avoid double counting. Ultimately, we included 41 projects in the combined BU dataset, covering 10 Latin American countries with commitment years ranging from 2007 to 2019. We did not find any new projects supported by Chinese PDFIs in the clean energy sector in Latin America after 2019, – the reasons for which are discussed in the conclusions.

Later, we examined the projects' information in detail and identified that 22 out of the 41 projects are the same as those in Aid Data's GCDF dataset. We extracted the projects' information on energy sources and energy sub-sectors from the combined BU dataset and inserted it into the GCDF dataset accordingly. For the remaining 53 projects in the GCDF dataset, we manually checked the projects' descriptions and accessed the provided data sources to identify and collect information on their related

10 Source: United Nations. "What is Renewable Energy?" Available at: https://www.un.org/en/climatechange/what-is-renewable-energy, Accessed November 22, 2024.

energy sources and sub-sectors.

3.2. Stylized Facts

First, the total adjusted amount of funds from policy banks involved in energy investments was US$30,406 million, accounting for 73% of all the energy projects financing from China to Latin American countries. Of this total, 36.5% was directed toward power generation and distribution, while the remaining investments primarily financed oil trading initiatives. The average loan maturity for PDFIs involved in energy projects is 10 years, 2 years more than the average repayment time of the other Chinese energy investments. The average interest rate of PDFIs-supported energy investments is 3.49%, which is 3.82% lower than the average interest rate for non-PDFIs involved in Chinese energy projects in Latin American countries.

Additionally, and in line with their government-supported identities and policy goals, Chinese PDFIs are more likely to lend funds to the public sector than the private sector. According to the statistics, 89.33% of the PDFIs' loan recipients are government agencies, state-owned banks, or state-owned companies. Only 5.33% of the Chinese PDFIs' direct recipients are from the private sector. In contrast, 57.28% of the direct receiving agencies of non-PDFIs' Chinese energy investments are from the public sector, and 33.01% are from the private sector.

As discussed earlier, specifically for Chinese PDFIs' energy projects in Latin American countries, we followed the categories setting in the BU databases to classify their energy sources into eight types, including gas, coal, oil, hydropower, wind, biomass, solar, and unspecified. The energy sub-sectors are divided into six categories, including transmission and distribution, exploration and extraction, power generation, energy efficiency, technical study, and mixed.

Figure 2: Distribution of Chinese PDFIs Energy Investment to Latin American countries, by Energy Source

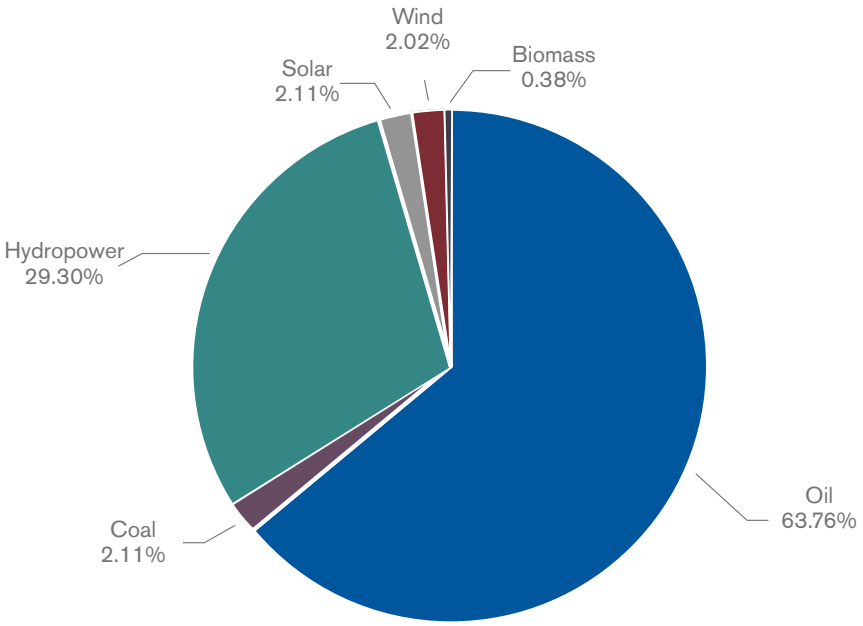
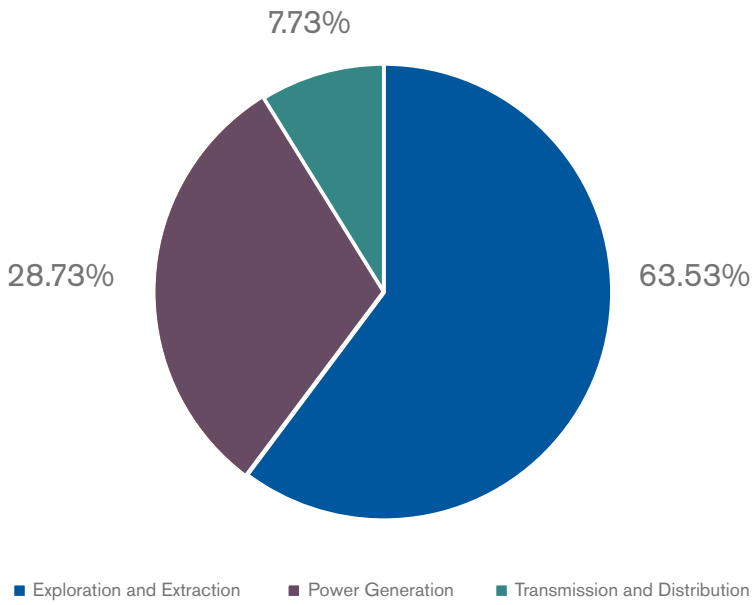


Figure 3: Distribution of Chinese PDFIs Energy Investment to Latin American countries, by Energy Sub-sector



First, it is noteworthy that the exploration and extraction activities account for more than 60% of Chinese PDFIs' energy investments in Latin American countries. Upon examining the detailed project descriptions, we realized that the exploration and extraction activities are related only to the energy source of oil.

Chinese PDFIs provide loans to local oil companies to help them address their maturing debt obligations. In return, these companies sign oil-supply contracts as collateral, allowing Chinese companies to lock in future oil purchases at a fixed market price. This kind of contract is similar to international trading of crude oil futures and options. Therefore, it is inappropriate to compare these oil-related financial trading with other energy investments that focus on power generation and transmission, as well as the development and upgrade of the national energy system. For this reason, we decided to exclude the oil exploration and extraction projects from our subsequent analysis of Chinese PDFIs' clean energy investments in Latin American countries.

After excluding investments in oil exploration and extraction, the total energy investments by Chinese PDFIs in Latin American countries amount to US$11,090 million. Within the recipient region, nine out of 12 Latin American countries have signed a memorandum of understanding with the Chinese government under the framework of the BRI. The adjusted loan amount extended to LAC members in the BRI was US$8,575 million, representing 77% of the total energy investments from Chinese PDFIs.

In terms of energy resources, Chinese PDFIs initially concentrated their investments in Latin American countries in gas-, coal-, and oil-fired power plants. Between 2009 and 2019, however, investments in fossil fuels steadily declined and were gradually replaced by renewable energy projects. Today, 93% of the overall energy projects financed by Chinese PDFIs in the region utilize renewable energy as the primary power source, while only 7% rely on fossil fuels. It's also worth noting, however, that among all renewable energy investments, hydropower accounts for 87%, while other renewable energy sources make up 13% of the projects.

Historically, Chinese PDFIs showed a strong preference for financing conventional renewable sources like hydroelectricity. From 2009 to 2015, hydro plants predominantly accounted for more than 90% of their total renewable energy projects in Latin American countries. Between 2015 and 2019, however, there was a noticeable increase in support for non-conventional renewables, with wind, solar, and biomass energy making up around 60% of the total renewable energy investments from Chinese PDFIs to Latin American countries. This overall trend was driven in part by the declining costs of solar and wind power due to a large domestic investments by China toward non-conventional renewable energy and their new technologies, aligning with global goals to combat climate change and the BRI's emphasis on green energy investments.

Figure 4: Chinese PDFIs' Energy Investment in Latin American countries (oil exploration and extraction excluded)

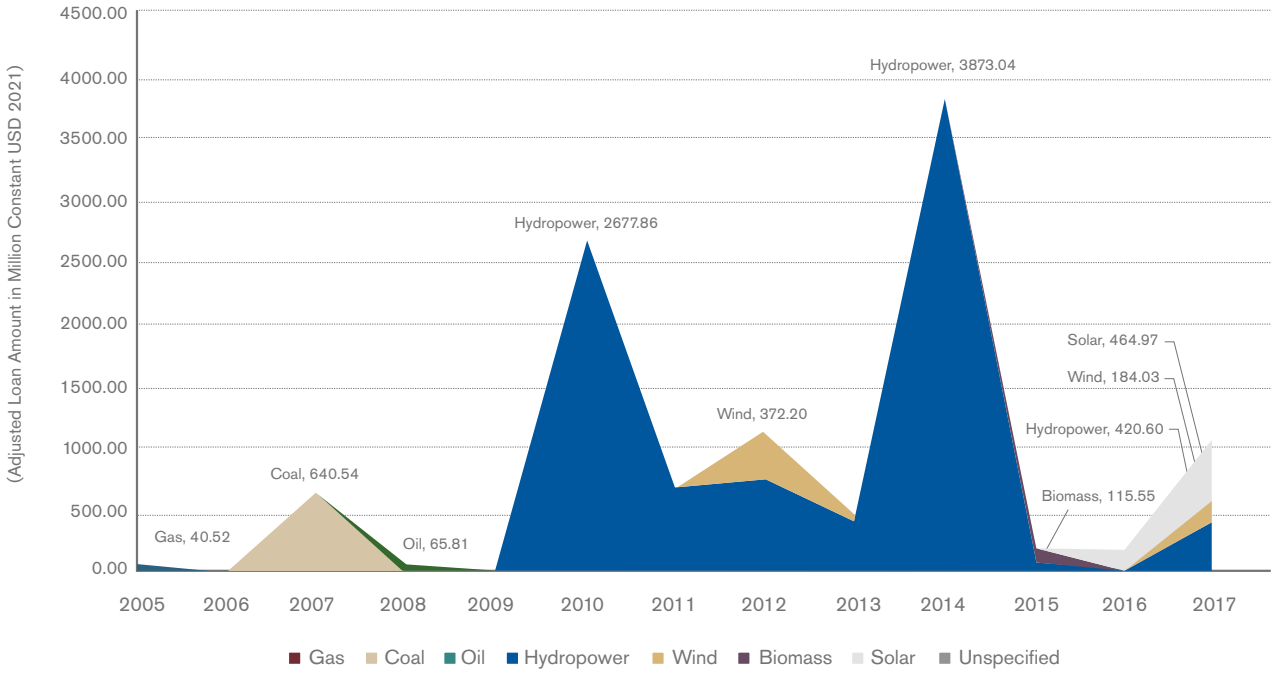
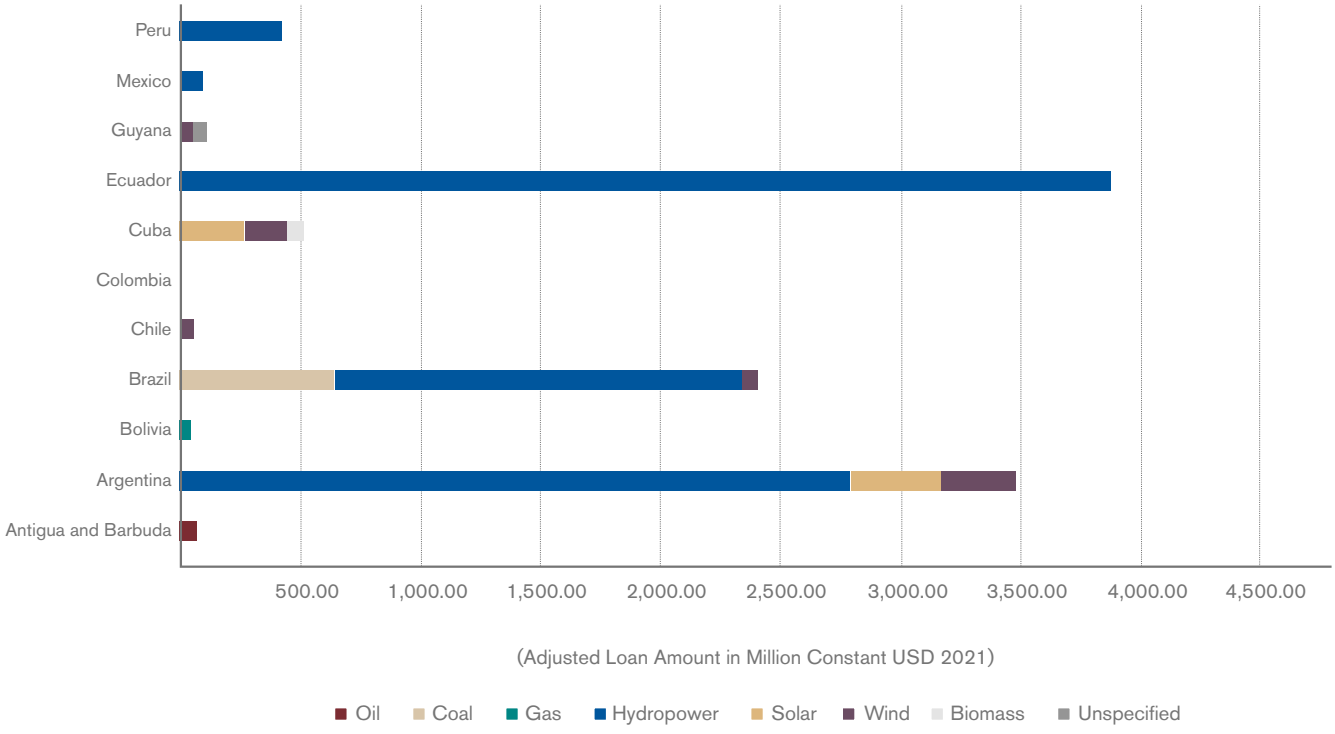


Figure 5: Country Distribution of Chinese PDFIs' Energy Investments



4. Challenges of Renewable Energy Transformation in Latin America

In this section, we have applied the analytical framework proposed by Xu and Gallagher (2022) to identify the system-level constraints and barriers in the renewable energy transformation process in Latin America.

4.1. Unmet Energy Demand

In terms of energy supply and demand, renewables are typically used to generate electricity for households and industrial activities. According to statistics provided by IEA for 2022, fossil fuels remain the predominant source of energy generation and consumption in Peru, Chile, Colombia, and Argentina. Among them, both Peru and Chile have greater energy imports than exports, indicating a huge unmet energy demand (IEA, 2023). However, in Latin America, renewable energies do not have significant comparative advantages over traditional fossil fuels in power generation and are insufficient to serve as a reliable complement to addressing the energy gap.

4.2. Incumbent Entrenchment of Fossil Fuels

Government subsidies for fossil fuels have erected entry barriers for renewable energies. Worldwide fossil fuel subsidies increased up to 6.5% of global GDP in 2015, and pre-tax fossil fuel subsidies in Latin American countries are estimated to account for about 5% of the global total (Coady et al., 2015). Furthermore, local residents and businesses in Latin American countries rely heavily on cheap fossil fuels to support their daily lives and economic activities. For instance, Colombia has long been a producer of coal and oil, so that a shift to other energy sources would imply some negative impacts on their industries due to employment displacement and loss of public revenues. As a result, they naturally resist the elimination of fossil fuel subsidies and the shift to renewable energies, which would lead to an increase in electricity prices (Alarcón, 2023; Hwang & Díez, 2024).

4.3. Weak Production Capacity

Moreover, despite possessing abundant natural resources, Latin American countries lack the necessary production capacity to convert renewable energy into electricity. Taking the solar photovoltaic industry as an example, solar statistics from Ember Climate (2023) indicate that Asia, Europe, and North America dominate the global solar generation capacity. China, in particular, leads the solar industry, generating 584.15 terawatt-hours of solar power and reaching a total installed capacity of 1419 gigawatts by the end of 2023. In contrast, countries such as Chile, Argentina, Colombia, and Peru have relatively limited generation capacities, with a total solar generation of 16.65, 3.27, 1.04, and 0.95 terawatt-hours, and installed capacities of 8.47, 1.41, 0.68, and 0.33 gigawatts, respectively, by the end of 2023.

4.4. Lack of Supporting Infrastructure

While renewable energy technologies have become more mature, the amount of electricity produced by renewables is easily influenced by weather conditions and the time of day, making the power supply highly unpredictable. Therefore, infrastructure is also a crucial factor in determining the success of a renewable energy project. In Latin American countries, supporting infrastructure is required for the storage, transmission, and distribution of renewable energy. Ploeg (2010), however, maintains that natural resource windfalls cause de-industrialization. In his explanation, companies operating in resource-rich developing countries generally do not reinvest profits in their generation assets. Because Latin American countries are endowed with rich natural resources, their economy relies largely on mineral exports, thus producing an insufficient focus on the construction of infrastructure. In this regard, Latin American countries are currently facing difficulties in three dimensions. First, existing power grids need to be upgraded to integrate renewable energy sources into the traditional fuel-based system. Second, building additional renewable energy infrastructure requires higher initial capital expenses than building traditional energy infrastructure (Ding & Somani, 2010). However, local governments often lack public financial resources, while the private sector does not have sufficient incentives or organizational capacity to invest in and manage such large-scale renewable infrastructure projects. Third, the energy markets in Latin American countries are highly fragmented (Edwards & Roberts, 2015). This prevents the integration of infrastructures and impedes sharing energy surpluses between countries, thereby reducing the overall efficiency of the renewable energy system.

5. The Role of Chinese PDFIs in Latin American countries' Renewable Energy Transformation

This section delves into the role of Chinese PDFIs in Latin America's energy transformation projects. Through case studies, we aim to understand and categorize the strategies used by Chinese PDFIs to overcome the barriers and constraints identified in Section 5.

5.1. Mission-driven Vision and Policy Planning

The capacity of Chinese PDFIs to design, implement, and influence policies at both institutional and national levels lays the foundation for advancing renewable energy investment in Latin America. According to Xu et al. (2021), possessing a proactive development-oriented official mandate is a key criterion to identify an institution as a PDFI. A review of the mission and vision statements of the CDB and China Eximbank, shows that they have a special focus on energy transition. CDB identifies energy conservation and environmental protection as strategic financing areas, while China Eximbank highlights its responsibility to promote green finance and the construction of a low-carbon society. In fact, these mandates align closely with broader commitments made by the Chinese government. In response to President Xi's announcement in 2021 to cease investing in overseas coal power plants, in recent years Chinese PDFIs have progressively reduced to zero their fossil fuel financing activities. Building on the Initiative for Belt and Road Partnership on Green Development launched by the Chinese government, China Eximbank, together with CDB, Sinosure, and other financial institutions, issued the Initiative for Supporting Belt and Road Energy Transition with Green Finance.[11] The initiative calls on facilitating transregional collaboration between China and the other BRI member countries to continuously increase financial support for green and low-carbon energy projects, which demonstrates further the policy-led actions of Chinese PDFIs in promoting global shifts towards sustainable energy practices.

In addition to implementing government policies, Chinese PDFIs also communicate with government ministries on a regular basis to advocate for policy reforms. For instance, Sinosure's recent recommendations on medium- and long-term export financing policy have significantly favored overseas renewable energy investments.[12] The updated guidelines extend the insurance period from 15 years to 20 years and offer more favorable insurance terms, such as waiving guarantor requirements under certain circumstances for renewable energy projects. These adjustments are expected to boost investor confidence and incentivize Chinese investments in overseas renewable energy markets. This also underscores the role of Chinese PDFIs, not only in supporting but also actively shaping policy frameworks that reinforce China's commitment to facilitating the global trend of energy transformation.

5.2. Scaling up Renewable Energy Investment

With their leading position in the financial sector, Chinese PDFIs have largely expanded the scale of renewable energy investment in Latin America. Internationally, they issue quasi-sovereign climate bonds and leverage the Bond Connect program to attract foreign investment to support clean energy projects. Domestically, as the renewable energy market has matured and saturated, **Chinese PDFIs have gradually stepped aside to allow private capital to enhance market competitiveness in resource allocation and adjusted their focus to support companies to explore overseas renewable markets.** In Latin America, Chinese PDFIs have contributed to financing two multilateral funds, including the US$10 billion China-Latin America and Caribbean Cooperation Fund (CLAC Fund) administered by China Eximbank, and the US$30 billion China-Latin America and Caribbean Industrial Cooperation Investment Fund (CLAI Fund) managed by CDB (Ding et al., 2021). Besides these funds, the Chinese government also established a US$20 billion Special Loan Program for China-Latin America Infrastructure Projects, organized and implemented by CDB (Myers & Ray, 2021). All three programs prioritize the energy sector and have boosted clean energy investment from China to Latin America. The São Simão Hydropower Station, and Jupiá and Ilha Solteira Hydropower Plants in Brazil, for instance, are some of the successful projects supported by the CLAI Fund and CLAC Fund.

In addition to establishing funds and loan programs, Chinese PDFIs actively collaborate with other financial institutions. CDB and China Eximbank often partner with China's big four state-owned commercial banks to co-finance renewable energy projects. Beyond collaborating with domestic banks, Chinese PDFIs have also built strong relationships with institutions in Latin America. In 2019, CDB proposed and led the creation of the first multilateral financial cooperation mechanism between China and several Latin American countries, initially involving seven PDFIs (Myers & Ray, 2022). This mechanism expanded further in 2023 to include additional institutions from Latin America, now encompassing Argentina, Ecuador, Mexico, Peru, Panama, Colombia, Chile, and Costa Rica. This kind of regional cooperation among PDFIs is instrumental in mobilizing large-scale financial resources while reducing financial risks, thereby providing a robust financial environment for renewable energy investment across the region.

11 The Export-Import Bank of China. 2023. "The Export-Import Bank of China participated in the 3rd Belt and Road Energy Partnership Forum and released the Initiative for Supporting Belt and Road Energy Transition with Green Finance." Available at: http://210.12.198.63/info/news/202305/t20230531_49488.html

12 China Export & Credit Insurance Corporation. "Medium and long term export credit insurance". Available at: https://www.sinosure.com.cn/ywjs/zcqckxybx/zcqckxybxjj/index.shtml.

5.3. Facilitate Technological Transfers Across Nations

PDFIs play a crucial role in overcoming technical obstacles and incubating nascent renewable technologies (Xu & Gallagher, 2022). Over the past ten years, Chinese industrial policies have largely emphasized the development of non-conventional renewable energy sectors, particularly in solar and wind power. In response to government policy, Chinese PDFIs serve as market pioneers, bearing substantial startup risks. In 2014, for instance, China Development Bank established CDB New Energy Technology Co., Ltd., as one of its subsidiaries to provide services for the construction and operation of solar- and wind-powered renewable energy projects. Chinese PDFIs also provided affordable loans to incubate the renewable energy market. Numerous enterprises with mature renewable energy technologies, such as Trina Solar, Suntech Power, and Gold Wind have flourished under such a supporting model implemented by Chinese PDFIs.

Today, China has become a major player in both markets, accounting for more than 80% of global solar panel manufacturing and over 60% of the global wind turbine production capacity (IEA; Reuters, 2024). The large investment from China not only incubated new technologies, but also drove down the price of electricity generated by non-conventional renewable energy sources. According to the UN, from 2010 to 2020, solar power costs have dropped by 85%, and wind energy costs fell by about 50%.[13] Besides, as the domestic market approaches saturation, a large number of manufacturers and suppliers of solar photovoltaic and wind power material in China are actively seeking overseas opportunities. Building on this, Chinese PDFIs should have motivation and the potential capability to help domestic solar and wind companies in expanding their projects into Latin American countries, thereby indirectly facilitating the transfer of advanced non-conventional renewable energy technologies to the region. Such support would contribute to increasing the electricity generation capacity and improving the technical expertise of Latin American countries, ultimately creating mutual benefits.

5.4. Support the Construction and Upgrading of Infrastructure

From the perspective of project construction and management, Chinese PDFIs are pivotal in supporting the development and improvement of large infrastructure projects and providing effective coordination services to ensure successful project implementation. As previously discussed, the development and upgrading of storage and transmission infrastructures for renewable energy and related products require significant financial investment which is hard to be fully financed within Latin American countries. To address this issue, Chinese PDFIs possess strong financing capabilities, attracting both private capital and public funds, thereby ensuring sufficient cash flow and the ability to support the execution of these critical infrastructure projects. For instance, the CLAC fund provided $600 million in project financing for the 30-year operation rights of the Jupiá and Ilha Solteira Hydropower Plants, which involves technical renovations and infrastructural upgrades on the existing infrastructure. In addition, CDB provided a US$365 million loan for the San Gabán III Hydroelectric Power Plant Project in Peru, including the construction of supporting facilities, such as a transmission line from the Paquillusi substation in Puno to the Onocora substation in Cusco, as well as several tunnels to ensure its daily operations.

Case Analysis 1 – Argentina: Jujuy Caucharí Photovoltaic Power Plant Project

During the first Belt and Road Forum for International Cooperation in 2017, China and Argentina signed cooperation agreements to finance the 312 MW Jujuy Caucharí Photovoltaic Power Plant Project (Ni, 2020). The project represents an overall investment of about US$390 million, with 85% of the financing coming from the Export-Import Bank of China and the remainder funded by the local government of Jujuy through green bonds issuance (Morais, 2019). The provincial energy company, Jujuy State Energy and Mining Society (JEMSE), managed the operation of the solar power complex – a move praised for increasing local ownership – while construction was jointly executed by Shanghai Electric Power Construction Co. Ltd and PowerChina Ltd. Another Chinese company, Zhongli Talesun Solar Co., Ltd., supplied the 1.18 million solar panels and Huawei Technologies Co., Ltd. provided the inverters (Tierney et al., 2011).

The project faced significant technical, financial, and social-economic hurdles that tested its resilience. Technically, the extreme high-altitude location (4,020–4,200 meters) posed major construction and operational difficulties, exacerbated by the remote, harsh environment. Financially, risks beyond the initial funding emerged, particularly concerning the green bond, which culminated in a 2021 restructuring. These pressures stemmed from Argentina's broader fiscal constraints, and the global economic downturn during the pandemic. Critically, the project faced social and governance challenges, including concerns over the quality and transparency of its environmental impact assessments.

The project employed targeted financial and socio-economic strategies to address the above challenges. Financially, China Eximbank provided a crucial concessional loan with favorable terms (3% interest, 15-year repayment), which was diversified through the green bond, with its 2021 restructuring ensuring ongoing sustainability. Socio-economically, the project generated over 1,500 construction jobs. With the full operation of Caucharí solar power project, the strain on the local electricity supply has been significantly eased, helping promote local economic development and improve people's livelihoods (Ni, 2020). [14]

The Jujuy Caucharí Photovoltaic Power Plant Project exemplifies the critical and complex role that development banks like China Eximbank play in facilitating energy transition projects. While the financial instruments successfully launched a major renewable energy facility, the experience shows that for future projects, the governance embedded within these financial arrangements needs to be further strengthened to better balance national development goals with local expectations and rights.

Case Analysis 2 - Brazil: Jupiá and Ilha Solteira Hydropower Plants

In December 2015, the CLAC Fund completed its first investment with China Three Gorges Corp., providing US$600 million in project financing for a 30-year concession operation for the

13 United Nations. "Renewable Energy – Powering a Safer Future." Available at: https://www.un.org/en/climatechange, Accessed May 28, 2025.
14 Morais, Lucas. (2019). "Argentina's 312-MW solar power complex casuchari completes construction." Renewables Now. Available at: https://renewablesnow.com/news/argentinas-312-mw-solar-power-complex-cauchari-completes-construction-679538/, Accessed May 6, 2025.

existing Ilha Solteira and Jupiá hydroelectric power plants in Brazil, with a 33% equity stake. The total investment for the Three Gorges Brazil Hydropower Ilha Solteira and Jupiá Hydropower Plants project was R$13.8 billion (approximately US$3.7 billion), around 30% of which was financed through debt [15] (Tierney et al., 2011).

The Jupiá and Ilha Solteira Hydropower plants, which began operations in the 1970s with an installed capacity of about 5,000MW, serve as the backbone of the power grid in southeastern Brazil. After more than 50 years of operation, the infrastructure of the power plants had suffered from lack of maintenance and age, rendering technological upgrades an urgent need. After assuming operational control of the two hydropower stations in 2016, China Three Gorges Brazil (CTG Brazil) undertook extensive renovation work. By July 2023, the renovation of nine generating units across the two plants had been completed. After all the renovations were finished, the Jupiá Hydropower plant was able to generate an additional 160 million kWh of electricity per year. This modernization effort and technical transformation played a vital role in enhancing the reliability and efficiency of Brazil's national power system. The project also employed a localized management approach, combining local workforce hired by CTG Brazil with the involvement of Chinese technical engineers. This collaborative model strengthened technological and managerial expertise on both sides, creating a win-win situation (Ma, 2023). [16]

Case Analysis 3 – Chile: Negrete Cuel Wind Project

In February 2013, CDB provided a US$52 million senior project finance loan to an Irish renewable company –Mainstream Renewable Power Ltd.– for the development of the Negrete Cuel Wind Project in Chile. The loan did not include a Power Purchase Agreement (PPA). The wind farm was located 12 km west of the city of Los Angeles, in the Biobío region in southern Chile, with a 33MW power generation capacity. One of the leading Chinese wind turbine manufacturers, Goldwind, cooperated with Mainstream on this project by supplying its GW87 1.5MW turbines for the wind farm, demonstrating the advanced technology and cost-efficient products that improved the company´s capacity to operate as a leader in emerging renewable markets (Tierney et al., 2011; Mainstream Renewable Power, 2013).

The Negrete Cuel Wind Project encountered significant hurdles across financing, community engagement, and technical aspects during its initial development. A primary challenge was securing financing without a PPA, forcing the project to rely on selling energy into the volatile spot market. This risk likely deterred commercial lenders, requiring the involvement of development financing for the project to proceed. The project addressed these challenges through strategic interventions involving both the developer and the development bank. The critical hurdle of operating without a PPA was overcome by CDB's US$52 million loan. This structure specifically mitigated the heightening merchant risk, enabling Mainstream to proceed with construction despite commercial bank hesitancy within Chile's then-evolving renewable energy market.

In order to address community concerns about local development, including job creation, land use and environmental impacts, the developers launched a Community Fund in 2014. This fund was managed by a Projects Evaluation Committee, composed of community representatives, local officials, and project managers, selected local initiatives via an open annual call for proposals. During the construction phase of the wind farm, temporary employment was also generated, which had a short-term positive economic impact on the area.

Over time, nonetheless, concerns emerged from local communities regarding noise, machinery traffic, and impacts on groundwater (La Tribuna, 2021). Residents complained that mitigation measures were promised but not fulfilled, and local municipal authorities did not respond to their concerns, leading them to appeal to national environmental authorities. Although the Chinese PDFI was no longer involved in the operation, this points to the need for careful monitoring of such initiatives over time.

The financial structure of the case, involving an Irish company and the purchase of Chinese equipment, reflects the growing participation of Chinese technology in renewable energy projects in the region. Although there are no explicit policies promoting Chinese technology, it has gained ground due to its competitiveness and accessibility, even in projects financed by other multilateral banks (IPS, 2025; Global Renewable News, 2025).

The Negrete Fuel Wind Project shows how CDB worked to overcome financing and initial community engagement challenges. It also shows that community engagement over the lifecycle of a project is critical. While the value of wind energy for the energy transition is recognized across Latin America, its implementation requires ongoing engagement with communities to assure the distribution of benefits and mitigation of externalities.

Case Analysis 4 – Peru: San Gabán III Hydroelectric Power Plant Construction Project

During President Xi Jingping's visit to Peru in 2016, China Three Gorges Corporation, Energias de Portugal (EDP), CDB, and the Peruvian Ministry of Energy and Mines jointly signed a financing memorandum for the San Gabán III Hydropower Project (He, 2017). One year later, on November 29, 2017, the Hebei Branch of CDB officially reached a US$365 million loan agreement with Hydro Global Perú S.A.C. for the project, which was backed by an insurance policy from Sinosure and a corporate repayment guarantee from China Three Gorges Corporation (Li, 2017).

The San Gaban III Hydropower Project is located in the Puno Region in southeastern Peru and serves as the lowermost cascade hydropower station on the San Gaban River. The plant uses a low dam with a long diversion system for hydraulic head for power generation. It also involves the construction of important supporting infrastructures, including two 104.6MW impulse turbines, a 139km transmission line from the Paquillusi substation in Puno to the Onocora substation in Cusco, as well as a low-pressure tunnel, a vertical shaft, a high-pressure tunnel, a cavern power station, and a discharge tunnel to return turbine water to the river (Tierney et al., 2011).

The hydropower plant has a total installed capacity of 209 MW and an average annual power output of 1.25 billion kilowatt-hours. Once completed, the hydropower station is expected to reduce carbon dioxide emissions by 338,000 tons annually, along with significant reductions in other air pollutants and waste, delivering notable environmental benefits. It is also the first power investment by a Chinese company in Peru, contributing to deepen China-Peru

15 Aid Data, https://china.aiddata.org/projects/88000/.

16 Xue, Ma. (2023). "Chinese Technology Assists Brazil's Hydropower Station Renovation." Seetao. Available at: https://www.seetaoe.com/details/221827.html, Accessed April 7, 2025. Wang, Lu. (2024). "A Cross-Equator 'Two-Way Journey,'" China Three Gorges Corporation. Available at: https://www.ctg.com.cn/sxjt/xwzx55/zhxw23/1476306/index.html, Accessed April 7, 2025.

production capacity cooperation, alleviate electricity shortages in southeastern Peru, and promote regional economic development and overall social progress (Li, 2017). [17]

17 China Three Gorges. (2023). “Tunneling Work Completed on the San Gaban III Hydropower Project in Peru.” Available at: https://www.renewableenergyworld.com/hydro-power/dams-civil-structures/tunneling-work-completed-on-the-san-gaban-iii-hydropower-project-in-peru/, Accessed May 3, 2025. ProInversion. “San Gabán III Hydroelectric Power Plant”. Available at: https://www.gob.pe/proinversion, Accessed May 6, 2025.

Conclusions and Policy Recommendations

The present research report is part of the project entitled "Capitalizing on the New Climate Economy in the Americas," which offers recommendations for policymakers. By providing an analysis of the challenges and opportunites of PDFIs in renewable energy projects, this report is crucial for guiding future actions and strategies, to unleash the full potential of PDFIs for promoting renewable energy transformation in Latin American countries.

In this report, we first highlight the necessity and importance of fostering renewable energy transformation in Latin American countries, and then present stylized facts of Chinese renewable energy investments in Latin American countries. Based on our data analysis, Chinese PDFIs played a pivotal role in China's energy investments in Latin American countries. Approximately one third of these investments have been directed toward electricity generation and distribution. While most of the projects focus on renewable energy sources, and hydropower continues to account for the largest share of overall investments by Chinese PDFIs in the region, the energy mix has become increasingly diversified as solar and wind power is gaining more and more importance.

Why are there no significant Chinese PDFI projects in renewable energy in LAC after 2019? Evidence points to the prolonged impacts of the COVID-19 pandemic, which disrupted international project financing, and constrained outbound capital flows. Chinese commercial banks have also moved into this renewable energy sector, as the renewable technologies are becoming more and more mature and the price of renewable energies has become more and more competitive.

Building on this background, we examine the key challenges and obstacles hindering renewable energy transformation in Latin American countries, including the predominant position of fossil fuels, the huge unmet energy gap, the weak production capacity, and the lack of supporting infrastructures. Based on data and case analysis, we further examine the extent to which Chinese PDFIs address these issues. The expected roles include mission-driven policy planning on renewable energy transformation, expanding the financing scale of renewable energy investment, supporting infrastructure construction and upgrades, and supporting technological transfers to Latin American countries.

To unleash the full potential of Chinese PDFIs for supporting the renewable energy transformation in Latin America, we make policy recommendations on three levels.

On the national level, we recommend enhancing national strategic planning on renewable energy transformation. Our analysis shows that barriers to transformation go beyond the project level – which requires systemic efforts. First, Latin American countries should place emphasis on "planning first" to address systematic barriers such as fossil fuel subsidies, and the lack of supporting infrastructure like transmission and distribution lines. Latin American countries should build the long-term renewable energy pathways by starting with "what we have" —natural, human and institutional endowments — and leveraging "what we are uniquely positioned to do well" — activating our latent comparative advantages.. A long-term and comprehensive vision will help to boost the confidence of investors and garner support from stakeholders. Otherwise, piecemeal efforts developed in isolation will make transformational scaling unfeasible. Second, Chinese PDFIs are well positioned to act as a bridge to foster South-South learning between China and Latin American countries on the long-term planning under the umbrella of the BRI. For instance, CDB has accumulated rich experiences in working with local governments and stakeholders to develop the medium-/long-term planning on industry and infrastructure which is supported by a viable financing scheme. Even though such experiences cannot be directly transferrable to Latin American countries due to different political systems and country circumstances, they help to shed light on the key elements of long-term planning and ingredients for success.

On the institutional level, Latin American multilateral and national development banks, along with commercial banks, could cooperate with Chinese PDFIs to package syndicated loans to increase the financing scale of renewable energy projects in the region. Through this collaboration, institutions and companies in Latin American countries could seek more technology transfers from Chinese companies that possess advanced technologies along the value chain. From the perspective of Chinese PDFIs, they could support domestic renewable companies to make foreign direct investment to explore Latin American markets. However, Chinese PDFIs should also be mindful of the challenges present in Latin American markets such as high political risks. One recommendation is to foster triangular cooperation between Chinese PDFIs, MDBs, and Latin American countries to mitigate country-level risks. To make such triangular cooperation feasible, it is crucial to identify comparative advantages of different financial arrangements to create an ecosystem. For instance, national development banks in Latin American countries have local knowledge and can help to solve the "last mile" problems by delivering credits to the end beneficiaries, especially given the fact that solar and wind power projects are often small in scale and geographically dispersed. MDBs often enjoy the preferred creditor status and are well positioned to mitigate political risks. Chinese PDFIs can help to bring industrial expertise and long-term finance. Hence, it is important to create synergies among different financial arrangements to speed up renewable energy transformation in Latin American countries.

On the project level, an effective pre- and post-project risk management strategy is crucial for the success of Chinese PDFIs investments in renewable energy projects in Latin America, especially as some of the large hydropower projects often encounter unforeseen social and environmental risks. To ensure these projects proceed smoothly and achieve their ultimate goals, we suggest both development banks and government administrations improve their regulatory frameworks, with a special focus on strengthening the due diligence process and establishing robust monitoring and evaluation systems before, during, and after construction of renewable energy projects to ensure their long-term sustainable development in the region. Chinese PDFIs can better engage with local stakeholders to improve their selection, operation, and management of renewable energy projects in Latin America. Such engagement helps to identify potential risks throughout the project lifecycle, thereby enhancing the overall project performance.

Moving forward, Chinese PDFIs could work together with key stakeholders in host countries to balance benefits against potential risks of viable alternative options, such as small and large hydropower projects, solar, wind, and biomass, to make a renewable energy

investment plan that supports the green structural transformation in Latin America. On the one hand, Chinese PDFIs can continue to uphold and strengthen robust ESG standards to ensure compliance with the "do no harm" principle. When granting loan contracts and conducting due diligence for renewable energy projects, they could draw on commonly accepted ESG principles, as well as existing bank-level environmental and social framework. On the other hand, Chinese PDFIs should avoid falling into the pitfall of "zero tolerance/ inaction," allowing room for country-specific adaptations to reflect the diverse regulatory, social, and environmental contexts of Latin American markets, so that they would be able to finance high-risk and long-term renewable energy projects that are much needed by host countries.

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