



Eco-Alliance: Tackling Climate Change in the Caribbean with Chinese FDI

Original Paper

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Abstract

This paper explores the transformative role of Chinese FDI in catalyzing the Caribbean's transition to renewable energy amidst significant climate vulnerabilities. It investigates the economic impacts of climate-induced disasters in the region, underscoring the necessity for renewable energy solutions to ensure sustainable development. This study highlights the potential benefits for the Caribbean by examining successful Chinese FDI examples in the renewable sectors of Suriname, Brazil, and Argentina. The article is structured to first analyze the region's climate risks and economic impacts, then examine Chinese FDI's contributions to renewable energy development, and finally propose policy recommendations for leveraging these investments. Through this analysis, the paper aims to contribute to sustainable development strategies, advocating for targeted policies and international collaboration to build a resilient and sustainable Caribbean in the face of climate change.

Keywords

Chinese FDI • Renewable energy • Climate resilience • Caribbean • Sustainable development • Economic diplomacy • Climate change mitigation

JEL codes

Q54 • Q42 • Q56 • F21 • O19 • F63

1 Introduction

In the face of escalating climate challenges, the Caribbean region emerges as a critical battleground for climate resilience and sustainable development. The inherent vulnerability of these island nations to climate-induced disasters, coupled with their economic dependence on sectors like tourism, underscores the urgent need for innovative adaptation strategies. This article explores the potential of Chinese FDI as a catalyst for the renewable energy transition within the Caribbean, positing it as a cornerstone for forging a sustainable future.

Amidst the backdrop of devastating natural disasters that have historically plagued the region, this research delves into the economic ramifications of such events, quantifying their impact and highlighting the disproportionate burden shouldered by these economies. The narrative then shifts to a broader discourse on sustainable development, emphasizing the transition to renewable energy as an imperative rather than an option. It articulates the strategic importance of Chinese FDI, drawing parallels with its transformative role in the renewable energy sectors of Brazil and Argentina, to illustrate how similar investments could drive sustainable development in the Caribbean.

This article unfolds in four key sections: Section 1&2: This initial section lays the groundwork by detailing the Caribbean's susceptibility to climate risks, offering a detailed analysis of the economic impacts of recent natural disasters. It establishes the context for the subsequent discussion on renewable energy as a vital component of the region's response to climate change. Section 3: Here, the focus shifts to the role of Chinese FDI in renewable energy development, leveraging case studies to underscore the potential benefits of such investments for the Caribbean. This segment examines the dynamics of Chinese FDI, highlighting its capacity to deliver not only capital but also technology and expertise essential for the renewable energy transition. Section 4: The concluding section presents a synthesis of policy recommendations aimed at optimizing the impact of Chinese FDI in the Caribbean's renewable energy sector. It proposes a strategic framework for engaging with Chinese investments, outlining how

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targeted policies and international collaboration can facilitate a successful energy transition, thereby contributing to the region's sustainable development and climate resilience.

This paper sets forth an economic and environmental blueprint for leveraging international investment to address the Caribbean's climate challenges. Through an integrated analysis of economic impacts, investment trends, and policy frameworks, this article contributes to the scholarly discourse on sustainable development strategies, advocating for a collaborative approach to building a resilient and sustainable Caribbean in the era of climate change.

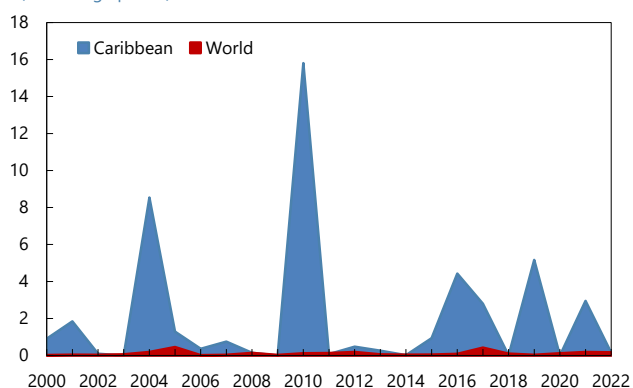
2 Economic Consequences of Climate Risks in the Caribbean

Climate change is an urgent issue in the Caribbean, where its impacts are expected to be substantial. This paper opens with a focus on the high cost of natural disasters and climate risks in this region, known for its acute susceptibility to the devastating effects of climate change. This vulnerability is not just a theoretical concern but a lived reality for Caribbean nations, as evidenced by a series of devastating natural events. Tropical Storm Erika in 2015, Hurricane Maria in 2017, and the La Soufrière volcano eruption in 2020-2021 each inflicted substantial economic damage, in some cases amounting to as much as 73%¹ of a country's GDP. These disasters have particularly undermined the tourism sector, a cornerstone of the Caribbean economy.

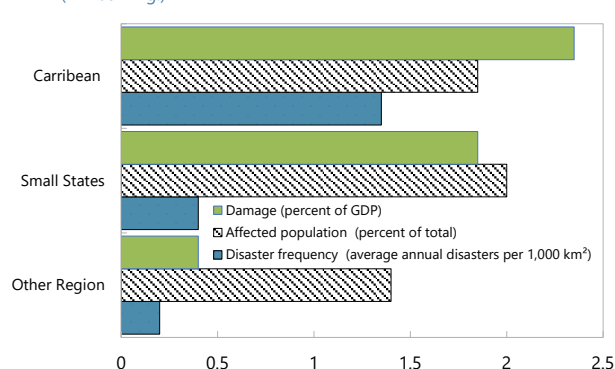
The Caribbean's experience with natural disasters is marked by disproportionately high costs when compared to other regions. Historical data underscores that the economic impact of these disasters in the Caribbean is significantly greater, both in absolute terms and when measured as a proportion of GDP. The average estimated disaster damage in the Caribbean is higher – 4.5 times greater for small states globally, but an alarming 6 times higher for Caribbean nations (Figure.1). Additionally, the likelihood of experiencing natural disasters in the Caribbean is markedly higher compared to larger states, and twice as likely as in other small states.

Fig. 1. The Urgency of Climate Change in the Caribbean

Damage of Climate-Related Natural Disasters to GDP
(Percentage points)



Nature Disasters Damage Comparison
(Annual Avg.)



Sources: EM-DAT Database, WEO, "Small states" Resilience to Natural Disasters and Climate Change-Role for the IMF, World Bank, World Development Indicator, and author's calculations.

Note: The calculations for the right chart are based on the methodologies outlined in Alleyne, T., I. Ötoker, U. Ramakrishnan, and K. Srinivasan, eds. (2017). *Unleashing Growth and Strengthening Resilience in the Caribbean*. Washington, DC: International Monetary Fund

These frequent and severe disasters have long-term economic implications, including increased national debt due to the high costs of reconstruction and recovery. For instance, Dominica's recovery from Hurricane Maria required financial assistance exceeding \$1.3 billion², which is equivalent to approximately 224% of the country's GDP, highlighting the strain on national budgets and the reliance on international aid. The economic strain is further compounded by the loss of revenue from critical sectors such as tourism and agriculture, which are heavily impacted by these climatic events.

Given their significant exposure to climate risks, Caribbean nations are confronted with an urgent need to address these challenges head-on. In response, these countries have set particularly ambitious goals under their Nationally Determined Contributions

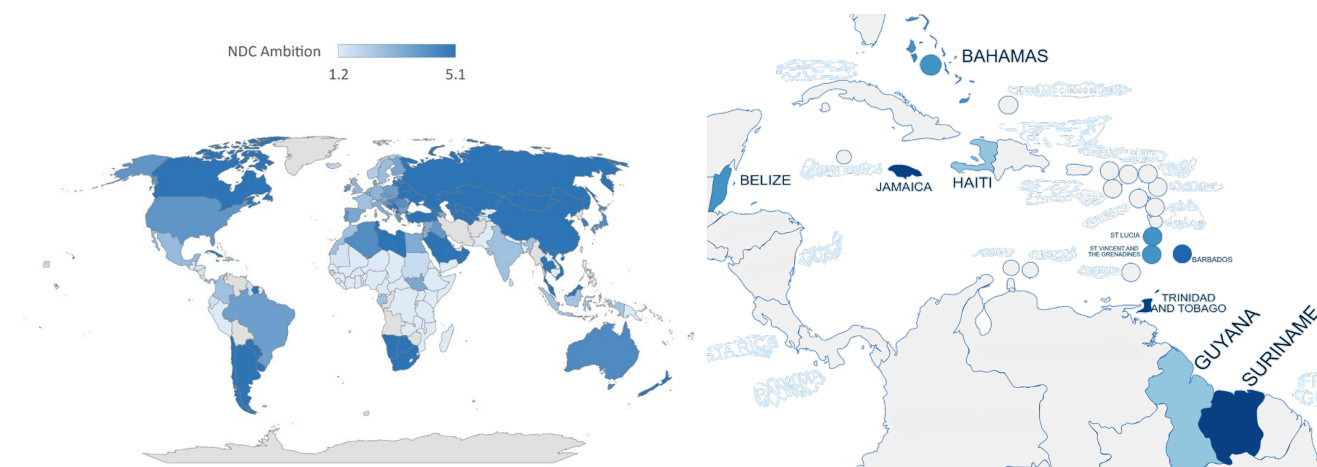
1 International Labour Organization. (2020). Tourism sector in the English- and Dutch-speaking Caribbean: An overview and the impact of COVID-19 on growth and employment. ILO DWT and Office for the Caribbean. ISBN: 978-92-2-032747-0.

2 Maryland UAS Experts, "Dominica Post Hurricane Maria Recovery Efforts," University of Maryland Department of Aerospace Engineering, <https://aero.umd.edu/news/story/maryland-uas-experts-join-humanitarian-effort-to-rebuild-a-devastated-dominica>.

(NDCs). The NDCs represent self-imposed targets by individual countries to reduce their greenhouse gas emissions, a core element of the Paris Agreement. This global accord, adopted under the United Nations Framework Convention on Climate Change (UNFCCC), commits signatories to endeavor to limit the global temperature increase to 1.5°C above pre-industrial levels.

The Caribbean nations' commitment to significantly more ambitious targets than the global average underlines a keen awareness of the existential threat posed by climate change. This level of ambition, reflected in the National Determined Contribution (NDC) goals, is shaped not only by the targets themselves but also by each country's unique political, economic, and energy landscape. Comparatively, when assessed against a global spectrum of 170 countries, the Caribbean's ambition distinctly stands out (Figure.2). In this visualization, a deeper color on the map correlates with higher ambition, clearly highlighting the Caribbean's elevated commitment. These ambitious goals are a testament to the Caribbean's resolve to transition towards sustainable practices and energy sources, a move that is both necessary and challenging. By setting such high NDC targets, Caribbean countries not only aim to mitigate the immediate impacts of climate change but also serve as a vanguard for other small island developing states grappling with similar risks. This proactive approach highlights a collective recognition of the urgency for transformative actions in response to the rapidly evolving climate scenario.

Fig. 2. Ambitious NDC Goals in the Caribbean



Sources: Robiou du Pont and Meinshausen (2018)

Note: Illustration of NDC Ambition scores for 170 countries. The calculations for both charts are based on the methodologies outlined in Tørstad, V., and H. Sælen (2020). "The Domestic Politics of International Climate Commitments: Which Factors Explain Cross-Country Variation in NDC Ambition?" *Environmental Research Letters*, Vol. 15, No. 2. DOI: 10.1088/1748-9326/ab63e0

3 Current Status and Challenges of Energy Transition in the Caribbean

In examining the energy landscape of the Caribbean small island nations, it becomes apparent that the electricity sector is a major source of greenhouse gas emissions. All Caribbean countries have recognized this by including the electricity sector in their Nationally Determined Contributions (NDCs), ambitiously aiming beyond the Caribbean Community (CARICOM) Energy Policy's target of 48% renewable electricity by 2027. For example, Antigua and Barbuda aim for 86% renewable energy generation by 2030. Dominica aspires to achieve 100% renewable energy usage by the same year. Grenada is working towards reducing emissions significantly, partly by addressing high-emission sectors like refrigeration and air-conditioning. Meanwhile, Saint Vincent and the Grenadines are developing a national Energy Action Plan with a key focus on geothermal electricity generation, expected to provide over 50% of the country's electricity needs³.

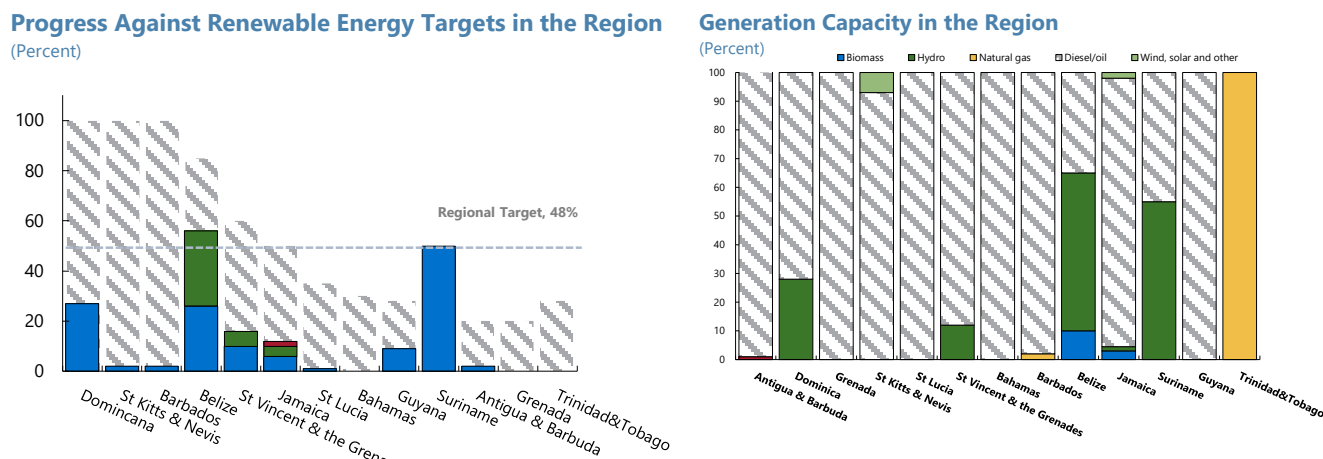
Despite these lofty goals, the actual progress in transitioning to renewable energy is markedly behind schedule (Figure.3). A closer analysis of the current energy mix reveals a diverse picture. Trinidad and Tobago primarily depend on natural gas, while Suriname and Belize have made notable strides in renewable energy adoption. In contrast, most Caribbean countries, particularly those reliant on tourism, continue to heavily depend on imported fossil fuels. This is particularly concerning, as data shows that out of 11 Caribbean countries with available data, nine rely on imported fuels for over 80% of their electricity generation, and five of these countries import 90% of their energy needs⁴.

³ UNDP Climate Promise.

⁴ Lilia Burunciuc, "Clean energy in the Caribbean: a triple win," World Bank Blogs, June 21, 2022, <https://blogs.worldbank.org/latinamerica/clean-energy-caribbean-triple-win>.

This discrepancy between the high ambitions of the NDCs and the existing energy reliance on imported fossil fuels underscores a critical challenge for the Caribbean. It highlights the urgent necessity for enhanced efforts and targeted investments in renewable energy to bring their energy practices in line with their climate commitments. Such a transition is not just pivotal for achieving NDC targets but is also crucial for the region's energy security, economic resilience, and long-term sustainability.

Fig. 3. Lag in Renewable Target Progress



Sources: UNFCCC 2016, Castalia 2019

Notes: The numbers at the top of each grey bar indicate the renewable energy target set by each country

The transition to renewable energy in the Caribbean holds not only environmental significance but also presents a compelling economic case, particularly in terms of electricity pricing. A comparison with global averages reveals that, except for Trinidad and Tobago and Suriname, electricity prices in the Caribbean are higher. On average, these nations face electricity costs of around US\$ 0.25 per kWh, more than double the price in the United States, with some countries even experiencing rates over US\$ 0.40 per kWh (Figure.4).

The high cost of electricity is a significant economic burden, particularly for the business sector. Approximately 40%⁵ of Caribbean firms cite electricity expenses as a major operational constraint. This is especially impactful in the tourism sector, the region's primary economic driver, where hotel power bills can range from US\$ 13 to US\$ 18⁶ per room per day. Given the importance of tourism to the Caribbean economy, the urgency for reducing these costs is palpable.

The ongoing advancements in renewable energy technology, marked by decreasing Levelized Costs of Energy (LCOEs), have significantly lowered the costs associated with renewable energy (Figure. 4). A complete transition to renewable energy sources in the Caribbean could reduce the average electricity price to around 10 cents per kilowatt-hour. This dramatic reduction would not only alleviate the financial strain on businesses and the tourism sector but also contribute to a more sustainable and economically resilient Caribbean. The shift towards renewables, therefore, emerges as a strategic necessity, offering both environmental benefits and crucial economic relief.

Transitioning to renewable energy, if executed effectively, could lead to a significant reduction in electricity costs across the Caribbean region. This shift would not only offer economic advantages but also enhance climate resilience. A pertinent example is the Bahamas' response to Hurricane Irma. In the aftermath of the devastation, the government established solar power microgrids on Ragged Island, providing a renewable energy solution that bolstered both energy security and environmental sustainability. Additionally, reducing reliance on imported fuels is a strategic move for these countries, particularly in light of their efforts to curb national budget deficits.

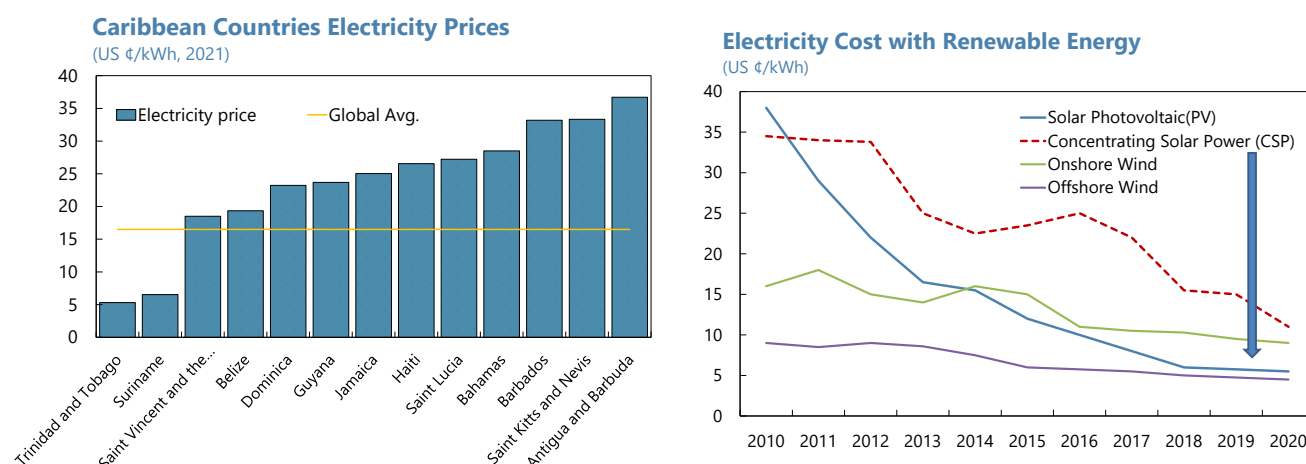
Understanding the relatively low adoption of renewables in the Caribbean requires examining various factors. Historically, renewable energy sources were comparatively more expensive, and the capital costs for photovoltaic (PV) systems and wind energy were higher than for diesel power plants. However, this cost dynamic has shifted in recent years, making renewable options more financially viable. Another factor influencing the region's energy choices has been the PetroCaribe⁷ arrangement,

5 Data sourced from CHENACT (Caribbean Hotel Energy Efficiency Action Programme), a project enhancing energy efficiency in Caribbean hotels, implemented by CTO and CHTA.

6 McIntyre, A., A. El-Ashram, M. Ronci, J. P. M. Reynaud, N. Che, K. Wang, S. Acevedo Mejia, M. S. Lutz, F. Strodel, A. Osueke, and H. Yun (2016). "Caribbean Energy: Macro-Related Challenges," IMF Working Paper No. 16/53 (Washington, DC: International Monetary Fund).

7 PetroCaribe, energy initiative launched by Venezuelan Pres. Hugo Chávez in 2005 to supply Venezuelan crude oil to countries in the Caribbean region at discounted prices. Members of PetroCaribe include Antigua and Barbuda, The Bahamas, Belize, Cuba, Dominica, Dominican Republic,

Fig. 4. High Electricity Costs and Potential Savings from Renewable Shift



Sources: Global Electricity Pricing Study, IERNA, Power Generation Costs Reports 2020 and author's calculation

initiated by Venezuela in 2005. This program enabled many Caribbean countries to purchase Venezuelan oil on favorable credit terms, repaying a portion of the purchase over 25 years at a low-interest rate of 1%. Such arrangements, while economically advantageous in the short term, may have inadvertently delayed the transition to more sustainable energy sources. As the global energy landscape evolves, the Caribbean region faces a pivotal moment to reassess its energy strategies and fully embrace the potential of renewable technologies.

4 Chinese FDI's Role in Overcoming Renewable Energy Challenges in the Caribbean

The transition to renewable energy in Latin America and the Caribbean, a key factor in sustainable development, has been shown to significantly influence carbon emissions and economic growth in the region. Research (Anser et. al., 2020) examines how the consumption of fossil fuels, alongside the use of renewable energy and industrial growth, impacts carbon emissions in these developing economies. Technological advancements and increased consumption of renewable energies offer a dual benefit: meeting the rising demand for goods and energy while controlling carbon emissions. Additionally, Chinese Foreign Direct Investment (FDI) has emerged as a pivotal factor in this transition. (Ahmad et. al., 2022) highlight the significant role of Chinese FDI, particularly in renewable energy, as a determinant of economic growth. This underscores the potential of renewable energy, coupled with strategic international investments, to drive sustainable economic development in Latin America and the Caribbean.

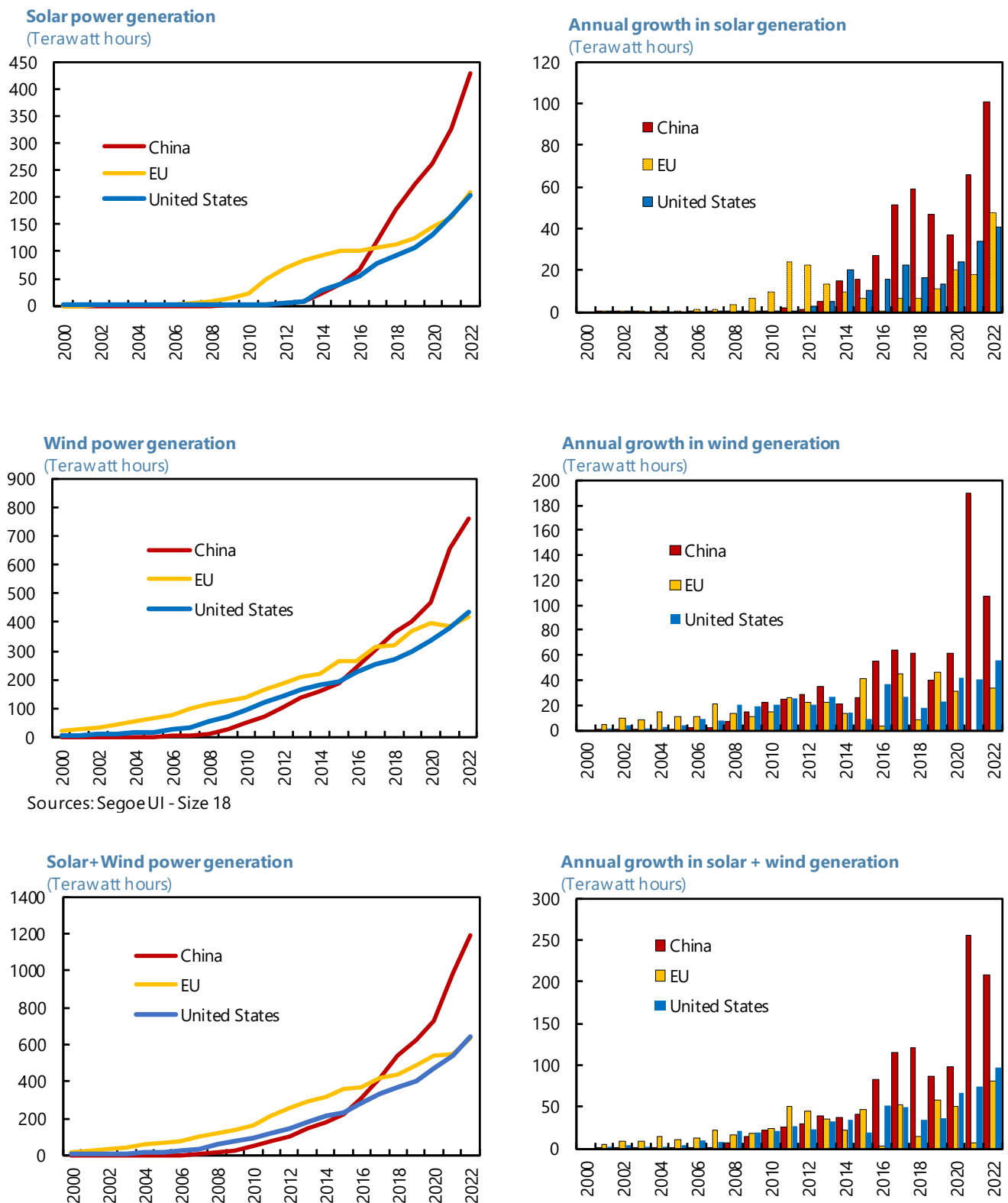
The Latin American and Caribbean (LAC) region, according to the Global Energy Monitor, has the potential to increase its wind and solar power capacity by more than 460 percent by 2030. This projection raises critical questions about the market's scale and the extent of investment required. The region's electricity demand is estimated to grow from 60 TWh to 92 TWh by 2050, representing a 50% increase over the next three decades. To meet this growing demand, an investment of approximately 226 billion USD is necessary, with 14 billion USD specifically earmarked for solar photovoltaic (PV) installations.

Given the significant projected demand for renewable energy, understanding the current dynamics of the international market is crucial, particularly with China's prominent role in this sector. Over the past five years, China has ascended to become the largest producer of wind and solar power, showcasing an impressive growth trajectory in renewable energy development. (Figure.5). In this period, China has not only become the largest producer of wind and solar power but also continued its remarkable growth trajectory in renewable energy. On the production front, the nation is poised to achieve 1200 GW from wind and solar by 2025, potentially reaching its target of one-third renewable energy five years early. By the first half of 2023, China's renewable capacity had already surpassed 228 GW, exceeding the total of other countries combined. This expansion includes 379 GW of solar projects and 310 GW of wind power currently under construction, plus an additional 371 GW of new wind projects.

From an investment perspective, China's commitment is equally significant. Its \$890 billion investment in clean-energy sectors nearly matches global investments in fossil fuel supply in 2023 and is comparable to the GDPs of Switzerland or Turkey.

Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Venezuela.

Fig. 5. China's Ascendancy: A Five-Year Leap in Wind and Solar Production

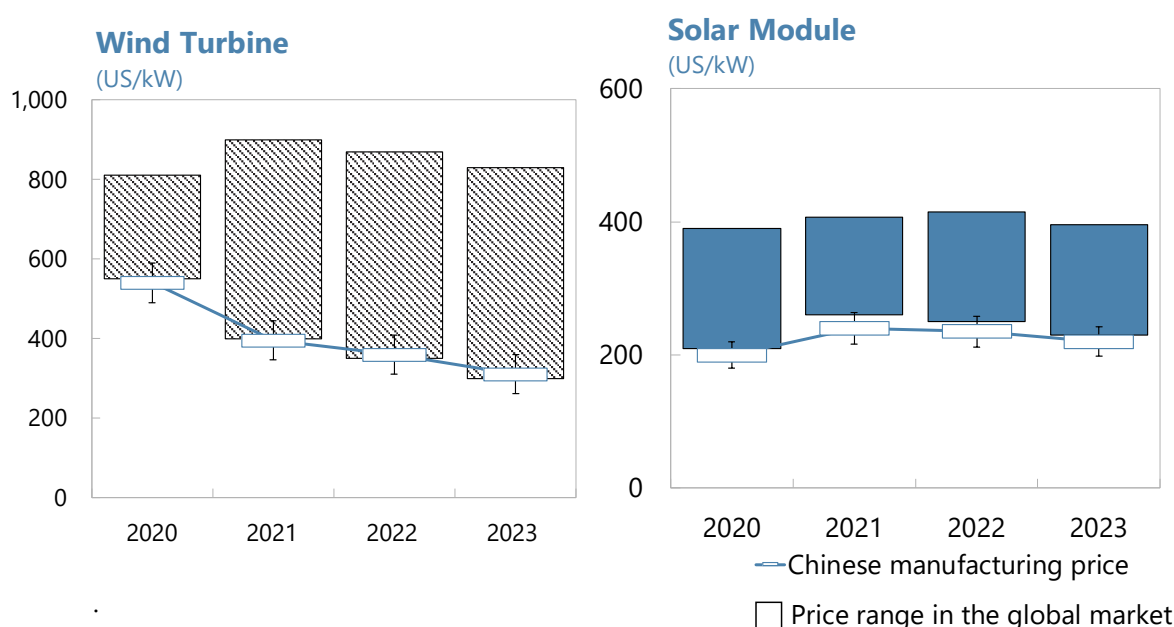


These investments have made a substantial economic impact: in 2023, the value of production from clean-energy sectors contributed 11.4 trillion yuan (\$1.6 trillion) to the Chinese economy, a 30% increase year-on-year. Consequently, clean-energy sectors have become the primary driver of China's economic growth, accounting for 40% of the nation's GDP expansion in 2023. This comprehensive approach to renewable energy development underscores China's pivotal role in shaping the global energy landscape.

This rapid development in renewable energy capacity, particularly in China, signifies a transformative shift in the global energy landscape. For the LAC region, these developments offer both challenges and opportunities. The region needs to navigate this evolving market effectively to secure the necessary technology and investments to meet its ambitious renewable energy goals and cater to its growing electricity demand. This scenario underscores the importance of strategic planning and international collaboration for the LAC countries in harnessing the potential of renewable energy sources.

The advancements in Chinese renewable energy technology, characterized by cost-competitiveness and enhanced energy efficiency, are reshaping the global market dynamics. Analyzing the comparative data, it becomes evident that Chinese manufacturers are offering solar panels and wind turbines at significantly lower prices than their global counterparts. As depicted in the chart, both solar panels and wind turbines from China are positioned at the lower end of the global pricing spectrum.

Fig. 6. Chinese Manufacturing: Solar and Wind Cost Efficiency



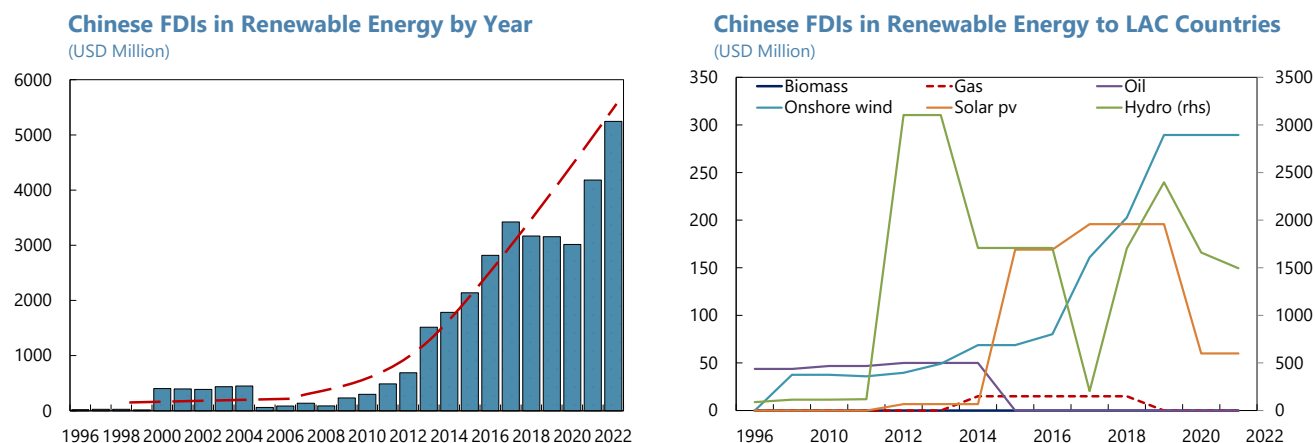
Sources: WoodMackenzie and author's calculation

A survey conducted by Forbes on manufacturers reveals a stark cost difference: Chinese solar panels are priced at an average of 15.3 cents per watt, compared to 25 cents per watt for U.S. manufactured panels. This price advantage is further bolstered by improvements in the energy efficiency of newer Chinese solar panels, which surpass the performance of panels produced elsewhere. The combination of lower costs and higher efficiency underscores the growing influence of Chinese renewable energy technology in the global market and highlights its potential role in accelerating the transition to sustainable energy sources worldwide.

In the context of its expanding manufacturing capabilities and technological advancements, China has been progressively increasing its foreign direct investment (FDI) in renewable energy, a trend observable even in the wake of the COVID-19 pandemic. Over the past decade and a half, China has experienced remarkable growth in renewable energy, a trend that gained momentum following the introduction of the Renewable Energy Law in 2005. Since 2015, this growth has been especially pronounced, with annual increases of 50-60 GW⁸ in wind and solar power capacity. Additionally, the World Resources Institute's Climate Finance database (COFI) reveals a consistent yearly rise in Chinese Foreign Direct Investment (FDI) in the renewable energy sector, further underscoring China's commitment to expanding its renewable energy capabilities.

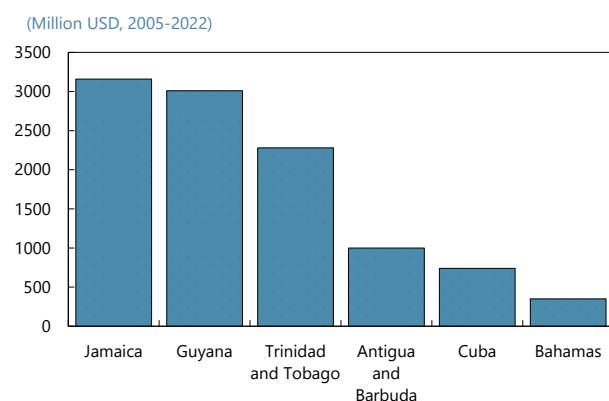
8 Huang, L. (2023). Why China's renewables push fuels coal power investment. China Dialogue. URL: Why China's renewables push fuels coal power investment (chinadialogue.net)

Fig. 7. Rise in Chinese Renewable Energy FDI



Sources: COFI Database and author's calculations

Fig. 8. China 10 Billions' Investment in the Caribbean



Sources: China Global Investment Tracker

Despite the global economic slowdown triggered by the pandemic, the momentum of Chinese investment in renewable energy has remained robust. This trend is particularly evident in Latin America and the Caribbean, where the primary focuses of Chinese FDI in renewables have been hydroelectric power, onshore wind, and solar photovoltaic energy. Additionally, in non-renewable energy sources, such as gas, has remained relatively minimal in these regions.

This strategic allocation of Chinese FDI underscores a clear preference for sustainable energy projects, aligning with global trends towards cleaner energy sources. The sustained investment in hydroelectric, wind, and solar photovoltaics indicates a long-term commitment to these technologies and suggests a strategic approach by China in fostering renewable energy development in Latin America and the Caribbean. This pattern of investment not only contributes to the global transition towards sustainable energy but also strengthens economic and technological ties between China and these regions.

Chinese renewable energy investments, initially focused on South American countries like Brazil and Argentina, indicate a potential similar trend in the Caribbean. In Brazil, Chinese investment has strategically emphasized renewable energy, diverging from its global pattern of focusing more on hydro and gas. This approach excludes investment in nuclear power, aligning with Brazil's energy profile where nuclear accounts for only 2.6% of the energy mix. Significantly, the New Development Bank, led by BRICS, has facilitated these ventures, lending US\$300 million for renewable power projects in Brazil. Concurrently, Chinese direct investments in overseas renewable energy, particularly solar, have escalated rapidly, from US\$140 million in 2018 to US\$800 million in 2022. This investment surge has boosted Brazil's photovoltaic sector, creating 130,000 jobs from 2012 to 2019, especially in the geographically favorable Northeast region. The pattern of Chinese investment in Brazil, focusing on renewables and facilitated by international agreements, offers a blueprint for potential developments in the Caribbean's renewable energy sector.

China's economic involvement in the Caribbean has been substantial, particularly in six key countries, where it has invested over \$10 billion between 2005 and 2022. These nations include the Bahamas, receiving \$350 million; Cuba, \$750 million; Antigua and Barbuda, \$1 billion; Trinidad and Tobago, \$2.28 billion; Guyana, \$3.01 billion; and Jamaica, with the highest at \$3.16 billion. The focus of these investments spans various sectors, including tourism, transportation, energy, and agriculture, reflecting a diverse and strategic approach to economic engagement in the region.

However, Chinese investments in the Caribbean's renewable energy sector lag behind those in Suriname, Brazil, and Argentina. This disparity is due to several factors. Suriname, Brazil, and Argentina benefit from supportive government policies, strong commitments to climate governance, and strategic alignment with China's renewable energy focus. Brazil's national energy

policy emphasizes hydro, wind, and solar power, aligning with Chinese investment interests. Additionally, Brazil and Argentina's participation in international agreements like the Paris Agreement further attracts Chinese investments.

Geographic advantages also play a role, with Brazil's Northeast region being particularly favorable for wind and solar energy projects. Moreover, the economic stability and larger market size of Brazil and Argentina offer substantial investment returns, making them more appealing for Chinese FDI.

In contrast, the Caribbean's smaller market size, different economic conditions, and higher vulnerability to climate change present unique challenges. The varying levels of government support and financial mechanisms for renewable energy projects further hinder investment. To attract more Chinese FDI, Caribbean nations need to develop consistent regulatory frameworks and collaborate with international financial institutions to secure project funding, thereby enhancing their renewable energy infrastructure.

Box 1: China's Renewable Energy Investment in Suriname: The Solar PV Microgrid Project

A prominent instance of China's Foreign Direct Investment (FDI) in the Caribbean can be seen through the Solar PV microgrid initiative in Suriname. This venture underscores China's dedication to fostering renewable energy in this region and has been carried out in two distinct stages:

Initial Stage (2020): Suriname's government formed a partnership with China Power Construction Corporation to develop two solar microgrid projects. This stage laid the groundwork for future advancements in renewable energy in the area.

Subsequent Stage: After the successful implementation of the first phase, PowerChina entered into a contract to handle the Engineering, Procurement, and Construction (EPC) of five more solar PV facilities in Suriname. This stage involves designing, acquiring, and building five solar PV microgrid power stations in the interior regions of Suriname. The project comprises 4160 KW of solar PV capacity, 13.24 MWh for energy storage, a 66.7 km 12KV high-voltage transmission line, and a 29 km low-voltage distribution system. Projected to be completed in 36 months, these power plants are expected to generate 6.24 million kWh of electricity annually for the local population, positively impacting over 15,000 individuals.

In the Caribbean's push towards renewable energy, Chinese Foreign Direct Investment (FDI) often serves as a critical technology and service provider but does not fully meet the financial needs of the region's expansive projects. This shortfall is addressed through significant reliance on Multilateral Development Banks (MDBs), as exemplified by the "Consolidating a Sustainable Energy Sector" agreement between the Inter-American Development Bank (IDB) and Suriname's Ministry of Finance & Planning. With an allocation of US\$ 30 million towards modernizing sustainable electricity, companies like SINOSOAR⁹, awarded tenders for design, supply, and operational services, illustrate Chinese involvement, the comprehensive financing necessary for these projects largely depends on MDBs.

The expansion of Chinese Foreign Direct Investment (FDI) in the Caribbean's renewable energy sector faces a challenge due to the uneven distribution of financial resources. Gallagher et al. (2018) noted that from 2000 to 2017, China's energy development finance amounted to US\$226 billion, with these funds being distributed globally, often to higher risk-rated countries typically excluded from traditional long-term energy financing from conventional banks. Nearly half of these Chinese loans were secured with commodity-backed clauses, primarily involving oil, and were predominantly directed towards power generation projects, especially in coal and hydro. In contrast, solar and wind projects have received a relatively small portion of China's global financing, accounting for only 2.6%, as explored by Kong and Gallagher (2020). This disparity underscores the need for more focused investment in these areas.

Additionally, Chinese capacity in renewable energy is largely constrained by financing resource, currently these projects require external financing from Multilateral Development Banks (MDBs). Larsen et al. (2022) highlight that while 77% of power generation investment in renewables domestically (excluding medium and large hydro) is substantial, only 22% is allocated for overseas projects. A primary obstacle for Chinese renewable energy firms expanding internationally is their limited access to finance, underscoring the necessity for enhanced financial support to bolster the overseas deployment of renewable energy technologies. This scenario presents an opportunity for increased investment, particularly in the Caribbean, to accelerate the shift towards sustainable energy sources.

⁹ Sino Soar Hybrid (Beijing) Technology Co., Ltd. (SINOSOAR) specializes in solar hybrid and off-grid solutions, providing comprehensive services, valued over one billion Chinese Yuan, with more than 30 hybrid projects and 400,000 off-grid installations

Box 2: China's Renewable Energy Investment in Brazil and Argentina: A Model for Caribbean Collaboration

China's investments in the renewable energy sectors of Brazil and Argentina illustrate the pivotal role these countries serve as principal recipients of Chinese financial engagement in renewables. From 2007 to 2021, Chinese electric companies channeled \$32 billion into Brazil's energy sector, diversifying from mergers and acquisitions (M&A) to greenfield projects. This strategic shift has propelled the growth of Brazil's photovoltaic sector, especially in the Northeast, leveraging geographic strengths for wind and solar energy generation.

Noteworthy investments include Energy China International's \$10 billion commitment to transmission and wind power, and PowerChina International's collaboration with Pontoon Clean Tech for \$360 million solar projects in Ceará. SPIC Brasil's strategic focus on wind, solar, and green hydrogen projects underscore Brazil's significance in SPIC Global's growth plan, aiming for a 20 GW annual expansion worldwide. State Grid's involvement in transmission auctions and potential M&A activities, such as the acquisition of Enel Ceará, highlights the strategic importance of transmission infrastructure in Chinese investment portfolios.

Similarly, Argentina's renewable energy sector has seen substantial Chinese investment, through the Cauchari Solar Park project. The Cauchari solar project in Argentina, one of South America's largest photovoltaic (PV) installations and the world's highest-altitude solar power project, exemplifies the strategic deployment of Chinese FDI and technology within the Belt and Road Initiative (BRI). Initiated in October 2017 with a £301m (\$390m) investment, the 300MW phase one of the project, situated over 4km above sea level, was completed in October 2019. Expected to generate 660GWh annually, it will power over 160,000 households. Plans for a 200MW expansion aim to increase capacity to 500MW, serving around 260,000 homes. This expansion is underpinned by Chinese funding, with 85% of the initial investment financed by China Eximbank and the remainder through a green bond by Jujuy province. The project underscores the collaboration between the Jujuy provincial government, Chinese firms PowerChina and Shanghai Electric, and various other contractors, highlighting a multifaceted approach to fostering renewable energy development and economic growth in Argentina. This industrial park exemplifies Chinese FDI, demonstrating similar potential to current international practices through strategic international partnerships and financial models, such as the Scaling Solar Initiative¹⁰ and Public-Private Partnerships (PPPs), to advance renewable energy projects.

These investments illustrate a comprehensive Chinese approach, integrating technology transfer and financial support to elevate the renewable energy landscape. The shift from mergers and acquisitions (M&A) to greenfield investments by Chinese investors, a response to the pandemic's economic downturn, suggests a viable strategy for the Caribbean to enhance and attract investment by strengthening existing renewable energy assets. Furthermore, the Caribbean can learn from the comprehensive regulatory frameworks developed in response to large-scale renewable investments in Latin America, ensuring environmental and social integrity.

The substantial investments by China in Brazil's solar and wind energy sectors, particularly highlighted by the supply of photovoltaic modules, emphasize the importance of technology transfer in promoting renewable energy development. The influx of Chinese FDI into Brazil, totaling USD 48,701 million between 2000 and 2019, suggests a promising avenue for the Caribbean to engage in similar partnerships that provide both technological and financial support.

The Caribbean stands to greatly enhance its renewable energy capabilities by learning from the experiences of Brazil and Argentina with Chinese investment. This includes exploring financing options for solar industrial parks, engaging in mergers and acquisitions of local companies, and forming partnerships with State-Owned Enterprises (SOEs).

5 Strategic Policy Recommendations for Enhancing Caribbean Sustainability

In light of China's strategic investments in renewable energy across South America, particularly in Brazil and Argentina, the Caribbean region presents a significant opportunity for similar collaborative endeavors. The evolution of Chinese investment from mergers and acquisitions (M&A) to greenfield projects, alongside substantial funding in renewable energy initiatives, offers valuable insights for Caribbean nations seeking to bolster their renewable energy sectors through international partnerships.

1. Explore Diverse Scaling Financial Models: Encourage Caribbean governments to explore and adopt varied investment models that have proven successful in South America, such as greenfield projects and industrial parks dedicated to renewable energy. These models can leverage the Caribbean's unique geographic and natural resources for renewable energy production,

¹⁰ The Scaling Solar initiative is a World Bank Group solution, led by the International Finance Corporation (IFC), designed to make it easier for countries to quickly procure and develop large-scale solar energy projects. Launched to address the challenges many developing countries face in attracting investment for solar projects.

This comprehensive package includes expert advice, project development tools, competitive auctions, and financial instruments. The initiative aims to create a standardized procurement process that makes it faster, easier, and cheaper for governments to procure solar energy. By providing a one-stop shop for governments to procure solar projects, Scaling Solar enables rapid and transparent selection of developers and investment in solar energy projects.

Key aspects of the initiative include offering pre-designed documents and contracts, pre-negotiated financing, insurance products, and guarantees. This approach reduces risks and uncertainties for both governments and investors, thereby lowering the cost of solar power development and making renewable energy more accessible and affordable.

particularly in solar and wind energy. Emulating China's approach to scaling up financial investment in renewable sectors, such as solar parks, could offer valuable lessons alongside models like the "one-stop" solution employed by MDBs. However, financial constraints remain a significant obstacle, as limited access to funding can impede project implementation. Additionally, banking systems in the Caribbean region are characterized by relatively high real interest rates, which discourage investment and growth. In some countries, this is due in part to large borrowing by the public sector, which has crowded out private sector borrowing and increased sovereign credit risk. To address these financial challenges, Caribbean nations should enhance financial support by collaborating with international financial institutions to secure necessary funding and explore public-private partnerships (PPPs) to leverage private sector investment.

2. Facilitate Technology Transfer and Financial Support: Seek partnerships with Chinese investors that extend beyond financial investments to include technology transfer. This approach not only enhances the region's renewable energy infrastructure but also builds local capacity in renewable energy technologies. In Brazil's case, the partnership with China in the renewable energy sector is marked by a shared commitment to RD&D. This collaboration exemplifies a co-evolutionary approach to advancing the energy transition in Brazil, closely aligned with China's technological and developmental strides. Additionally, regulatory challenges and technical capacity constraints pose significant obstacles. To overcome these, Caribbean nations should strengthen regulatory frameworks by developing consistent and transparent policies that streamline project approvals and provide clear guidelines for investors. Investing in training and capacity-building programs will enhance local expertise in renewable energy technologies.

3. Enhance Local Policy Framework: Establishing comprehensive policy framework is essential for creating a conducive investment environment, thereby accelerating the attraction of investments, and enabling sustainable project development aligned with the Caribbean's socio-economic objectives. An econometric analysis, based on the first systematic database of renewable energy policies across 31 Caribbean islands from 2000 to 2018 (Kersey et. al., 2021), evaluates the effectiveness of policy interventions such as investment incentives, tax incentives, feed-in tariffs, net-metering and net-billing programs, and regulatory restructuring to facilitate the entry of independent power producers in promoting renewable deployment. Ensuring policy continuity by establishing stable and long-term frameworks resilient to political changes will help maintain support for renewable energy projects over time.

4. Leverage Strategic Commodities: Utilize the Caribbean's strategic commodities, such as bauxite, to attract Chinese FDI focused on commodities crucial for renewable energy development. This strategy should aim to integrate the Caribbean more deeply into the global renewable energy supply chain. For instance, between 2017 and 2021, Latin America and Caribbean (LAC) exports to China of aluminum, which is produced from Caribbean bauxite deposits and has numerous applications in renewable energy, grew 28-fold compared to the period from 2012 to 2016. This trend underscores the growing interconnection between renewable energy development and the strategic utilization of regional commodities.

5. Strengthen International Cooperation: To meet the significant financial needs of transitioning to renewable energy, diversify investment strategies by leveraging direct Chinese FDI, alongside funding from MDBs and other global financial entities. Implementing a blended finance approach and fostering Public-Private Partnerships (PPPs) can significantly facilitate the development and financing of renewable energy projects. This method could expedite solar project implementation, enhancing the affordability and accessibility of renewable energy. Additionally, enhancing diplomatic and economic ties with China is pivotal for building productive relationships with State-Owned Enterprises (SOEs). These efforts should focus on identifying shared interests to further attract Chinese investments that align with the Caribbean's aspirations for sustainable development and energy security.

By adopting these strategic policy directions, the Caribbean can leverage Chinese investment and expertise in renewable energy, following the successful models implemented in Brazil and Argentina. Such an approach will not only advance the region's renewable energy initiatives but also contribute to sustainable development, economic resilience, and climate change mitigation, positioning the Caribbean as a leader in renewable energy within the global community.

Disclaimer

The views expressed in this paper are those of the author and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

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