



Original research article

Inadequate demand and reluctant supply: The limits of Chinese official development finance for foreign renewable power

Bo Kong^{a,*}, Kevin P. Gallagher^b^a David L. Boren College of International Studies, University of Oklahoma, Norman, OK 73019, United States^b Pardee School of Global Studies, Boston University, Boston, MA 02215, United States

ARTICLE INFO

Keywords:

China
Official development finance
Wind power
Solar power

ABSTRACT

This paper examines the puzzle of why China has thus far channeled a tiny fraction of its massive official development finance (ODF) for energy worldwide to solar and wind power. With a supply/demand analytical framework, our empirical analysis and field research show that both the foreign demand for Chinese ODF and the supply by the country's two global policy banks face limits. The external demand is limited because foreign countries often approach non-Chinese sources for solar and wind power development finance; when they turn to China for renewable power finance, they request more Chinese ODF for their hydropower and coal-fired power expansion. Meanwhile, shaped by their experience in renewable power finance in China and worried about the bankability of the solar and wind power projects abroad, the two Chinese policy banks exhibit sharpened risk sensitizations and biases against renewable power projects abroad.

1. Introduction and overview

Since the beginning of the 2000s, China has provided billions of US dollars in official development finance (ODF) for energy worldwide through its two policy banks, i.e. the China Development Bank (CDB) and the China Export and Import Bank (CHEXIM). This ODF takes the form of low-interest loans, preferential export credit, non-concessional loans at market rates, and equity investments [1–3] for the development of energy projects abroad.¹ Taken together, these two policy banks have surpassed some of the leading development finance institutions (DFIs), including multilateral development banks (MDBs), regional or national development banks, or export credit agencies (ECAs) from the Organization for Economic Cooperation and Development (OECD) countries, to become the world's largest provider of development finance for all forms of energy combined, especially electric power projects [4–6]. However, only a minuscule fraction of the two policy banks' ODF abroad has thus far flown into renewable power projects. According to the China's Global Energy Finance dataset maintained by Boston University's Global Development Policy Center, the two Chinese policy banks have mobilized a total of \$117 billion for power projects worldwide for the past two decades, out of which solar and wind power

merely account for 4.4% of the total whereas coal-fired power and hydropower represent 44.1% and 37.2% of respectively [7]. There thus arises a question for analysts—why does the Chinese ODF for solar and wind power abroad pale in comparison with that for coal-fired power or hydropower worldwide? Is it an accident or does it reflect some structural supply and demand dynamics? To the extent the structural dynamics are at play, how do the conditions and decisions of the foreign countries that receive Chinese ODF for renewable power contribute to the pattern of how Chinese ODF for renewable power is distributed? Relatedly, what is the role of the two Chinese policy banks in shaping the global distribution of Chinese ODF for renewable power?

While few would expect Chinese ODF for renewable power to reach the same scale as that for coal-fired power or hydropower, the tiny fraction of renewable power in Chinese ODF for electric power worldwide is puzzling for two reasons. First, the two policy banks actively finance renewable power in China as part of the country's its push for solar and wind power under its Renewable Energy Law passed in 2007 and its promotion of the renewable sector as one of “strategic emerging industries” in the aftermath of the 2008 Global Financial Crisis (GFC). As a matter of fact, the policy banks are part of the reason why China has been leading the world in financing the investment, manufacturing, and

* Corresponding author.

E-mail address: bo.kong@ou.edu (B. Kong).¹ While China's major state-owned commercial banks, such as the Industrial and Commercial Bank of China (ICBC), also provide finance for renewable power projects abroad, their finance is considered commercial and different from the ODF discussed in this study.

<https://doi.org/10.1016/j.erss.2020.101838>

Received 7 April 2020; Received in revised form 28 October 2020; Accepted 29 October 2020

Available online 13 November 2020

2214-6296/© 2020 The Author(s).

Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

deployment of solar and wind power since 2008 [1,2]. CDB alone, for instance, had financed the installation of 38.6 gigawatts (GW) of wind power and 9.3 GW of solar power as of the end of the third quarter of 2015, accounting for 35% and 29% of the grid-connected solar and wind power across China respectively [3].

Second, export is critical for the Chinese renewable industry, especially solar power, because its expansion at home has been accompanied by a wide range of challenges, including the lack of coordination between renewable technology manufacturing and renewable power deployment, uneven grid connection, and renewable power curtailment [4]. Recent developments further elevated the pressure for the two policy banks to promote the export of Chinese renewable energy technologies. To begin, the 2008 GFC compelled the fiscally-strapped European countries to roll back subsidies for renewable energy consumption, which not only depressed their demand for made-in-China renewable equipment and but also increased competition for their shrinking demand, thereby giving rise to impulses of trade protection against growing Chinese export [5]. Similarly, the United States and India also imposed tariffs against renewable energy export from China. Meanwhile, there were increasing signs of excess capacity in Chinese renewable technology manufacturing, with solar PV production capacity exceeding the entire global demand by 33% in 2012 and wind power equipment manufacturing capacity surpassing two times of the country's domestic demand for the same period [6]. Consequently, the combination of decreasing demand from abroad and the growing excess capacity at home converged in 2011–2012 to plunge China's solar and wind power sector into a recession, with the country's solar PV export dropping by 35% in 2012 [6]. Against this backdrop, Liang Zhipeng, Deputy Director General of the New Energy Department of China's National Energy Administration (NEA), publicly urged the country's state-owned financial institutions to assist with the going out of its renewable energy firms that takes the form of exporting products, investing overseas, and globalizing the entire value chain of China's renewable energy industry [7]. This mantra was further echoed in the country's Belt and Road Initiative (BRI). For instance, Article 11 of the *Guiding Opinions of the State Council on Promotion of International Production Capacity and Equipment Manufacturing Cooperation* urges Chinese companies to actively participate in the investment and construction of wind power and solar photovoltaic projects abroad so as to propel international cooperation in the production capacity of wind power and photovoltaic electric power generation and in the manufacturing of equipment thereof [8]. As quasi-fiscal arms of the Chinese state [9,10], CDB and CHEXIM are expected to play the role of a kingpin in financing the globalization of the Chinese renewable energy industry under the country's "going out" strategy and BRI.

Further, in the case of oil, gas, coal, and hydropower, China has abundant firms and capabilities at home that ODF helps 'globalize' through its policy banks. Yet, China also boasts among the world's most impressive solar and wind firms, why has the renewable sector not received the support from the policy banks that the fossil fuel sector has? Given China's outsized importance in global development finance for energy, the scant analytical attention this puzzle has received represents a glaring gap in the broad literature. Viewed from a policy perspective, this lack of understanding hampers the endeavor to understand the role of Chinese ODF in facilitating a transition toward carbon-free electricity worldwide. More importantly, unraveling the puzzle will help jumpstart a dialogue about how countries around the world could take advantage of China's growing engagement in ODF for foreign energy to simultaneously meet their demand for power and reduce their carbon footprint.

To tackle the puzzle, we will adopt a supply/demand framework to evaluate how the demand pull from foreign countries and the supply push from China have affected Chinese ODF for foreign solar and wind power projects. We structure the study as follows. Following introduction, we will first discuss our analytical framework and the data we depend on to carry out our analysis in Section 2. Then we will apply the framework in Section 3 to examine both the demand pull and supply

push of Chinese ODF into foreign solar and wind power projects. Section 4 will distill our findings and draw out the corresponding theoretical and policy implications. We will end with some concluding remarks in Section 5.

2. Analytical framework and data

2.1. Analytical framework

One way to investigate why Chinese policy banks have provided such a small amount of ODF to foreign wind and solar power worldwide is to see it as a financial service. Its provision, like any other product or service, is expected to follow the basic laws of supply and demand. Viewed from this perspective, we could attribute the shortage of this financial service to one of the following three possibilities: the lack of supply, the lack of demand, or both. Our investigation thus becomes one to evaluate the strength of the supply push and demand pull of Chinese ODF for foreign renewable power. From a demand perspective, our task is not only to assess the scope and strength of the pull factors but also to provide the assessment against the alternatives available to the countries that have received Chinese renewable power ODF. From a supply perspective, the inconsequential scale of Chinese ODF for renewable power suggests that the push factors in the form of the "going out" campaign and BRI alone are insufficient to mobilize the two policy banks to supply a large scale of ODF to foreign renewable power. To move beyond this general discussion of policy and industry push, we will examine what shapes the two policy banks' decision-making and the specific form of financing they provide when it comes to foreign renewable power projects.

2.2. Data

In addition to secondary sources in both English and Chinese, this study relies on two types of primary data. First, we draw our data on Chinese ODF from the China Global Energy Finance dataset, which one of the co-authors assembles and maintains through his research team at Boston University's Global Development Policy Center.² The only adjustment we make is to remove the projects we cannot independently

Table 1
Solar and wind projects financed by CDB and CHEXIM (2010–2017).

Year	Country	Project	Installed capacity (MW)	\$ million
2010	Italy	Global Solar Fund Sicar	142	730
2011	Ethiopia	Adama Wind Farm	51	99.45
2013	Ethiopia	Adama Wind Farm II	153	293.25
2013	Bulgaria	PV plants built by Haeron Solar and Chaori Solar	103	180
2013	Romania	Ucea de Sus solar Park and ESPE	59.1	112
2014	Pakistan	Three Gorges Second & Third Wind Power	49.5	34
2015	Pakistan	Quaid-e-Azam Solar Park Phase II	300	247.4
2015	Pakistan	UEP Wind Power Plant in Jhampir, Thatta	99	187.5
2017	Kenya	Garissa solar	50	135.7
2017	Argentina	Cauchari Solar I, II and III	315	332
2017	Ethiopia	Aysha I wind farm	120	218.45
Total			1441.6	2522.75

Source: [11].

² For a description of the methodology behind the compilation and verification of the dataset, please refer to <https://www.bu.edu/gdp/files/2018/08/Coding-Manual.pdf>.

confirm using both Chinese and English language sources. Table 1 lists the seven countries that have received Chinese ODF for their solar and wind power projects. To make sense of the Chinese renewable power ODF and put it in a comparative context, we also source data from by the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA), and the World Bank. Further, we set the time frame of our study to be 2001–2017 to ensure time consistency and data availability when making comparisons.

Second, to supplement the quantitative estimates, we also incorporate into our analysis the findings we made on the basis of our three separate field research trips, including two to Beijing from May to November 2019 and one to Botswana in October of 2019, during which we conversed with Chinese policy bank officials and analysts. Appendix I provides the list of interlocutors we had dialogue with and their institutional affiliations, all of whom agreed to talk to us on the condition that we keep them anonymous. To facilitate corroboration, we raised the same set of questions in our dialogues, but our interlocutors had the complete freedom as to what part of the question and how many questions they chose to answer. As a result, not everyone we spoke with answered every question we posed.

3. Results and analysis

3.1. Chinese ODF for renewable power is demand-driven

A careful evaluation of the Chinese ODF for solar and wind power projects in the seven countries listed in Table 1 reveals that the Chinese policy banks' provision of foreign renewable power finance is largely a byproduct of external demand that has two manifestations—market pull and government request. In the case of the three member countries of the European Union (EU), the demand pull for Chinese ODF comes out of their national commitment to comply with the Renewable Energy Directive 2009/28/EC, which mandates that 20% of the bloc's final energy consumption should be produced from renewable energy sources by 2020 [12]. As the target is pooled among the member states, all three countries are legally bound to develop a National Renewable Energy Action Plan, according to which Bulgaria is obligated to increase the share of energy from renewable sources in the country's gross final energy consumption from 9.3% in 2005 to 16% in 2020, Italy from 5% to 17%, and Romania from 17.8% to 24% respectively for the same period [13]. To meet their obligations, all three countries have rolled out a variety of favorable policies for renewable power, such as feed-in-tariffs, purchase guarantees and purchase subsidies. Together, these policy mandates and support contributed to the favorable outlook and market conditions that were attractive to foreign direct investment (FDI). In this sense, the FDI made by the four leading Chinese solar firms as shown in

Table 2
CDB loans to Suntech, Risen Energy, Chaori Sola, and Haeron Solar for expansion in Bulgaria, Italy, and Romania.

Date	Borrower	Location of borrower	Guarantor	CDB loans (€ million)
May 2010	GSF	Italy	Suntech	554.2
September 2011	RisenSky Solar	Bulgaria	Risen Energy	26.2
March 2012	ChaoriSky Solar	Bulgaria	Chaori Solar	43.1
March 2012	Helios	Bulgaria	Haeron Solar	95
December 2012	Cherganovo	Bulgaria	Haeron Solar	48
October 2013	S.C. Green Vision Seven S.R.L. (GV7)	Romania	Haeron Solar	83
October 2013	S.C. Green Vision Seven S.R.L. (GV7)	Romania	Haeron Solar	83
	Total			932.5

Source: [14–16].

Table 2, including Suntech Power Co., Ltd. (Suntech), Haeron Solar Technology Co., Ltd. (Haeron Solar), Shanghai Chaori Solar Energy & Science Technology Co., Ltd. (Chaori Solar), and Risen Energy Co., Ltd. (Risen Energy) were part of the expected derivative of these countries' aggressive push for renewable power rather than an exception. Further, while all four Chinese solar firms obtained their funds from CDB, there was no intervention from the recipient governments or the Chinese government. Thus, CDB's involvement was entirely a function of market pull.

By contrast, the Chinese policy banks' financing of renewable power in Ethiopia, Kenya, Argentina and Pakistan was largely a response to these governments' direct requests for assistance with their struggle to provide adequate and affordable power. This struggle has four manifestations. First, it is an energy poverty challenge. For instance, with 82%, 69% and 30% of the population having no access to electricity in Kenya, Ethiopia, and Pakistan in 2010, the per capita electricity consumption of three countries merely represented 2%, 5%, and 15% of the world average respectively [17]. Second, it poses an energy security challenge. With zero coal-fired power [17], Ethiopia and Kenya depend primarily on hydropower and biomass for power supply. However, this overwhelming dependence on hydropower leads to power shortages for Ethiopia during the dry seasons [18] and results in degradation of its forest and vegetation stocks in Kenya [19]. With less than 2% of their total electricity sourced from coal-fired power in 2015 [17] and less abundant hydropower resources, Pakistan and Argentina had to rely on imported oil and natural gas for power generation, which not only constituted a drain on their scarce foreign exchange reserves but also raised energy security concerns. Third, it represents an obstacle to economic development. The World Bank estimated that serious power shortages in Pakistan, which represented one quarter of the country's total demand in fiscal year 2012–2013, reduced the country's GDP growth by 2% per year for the past several years [20]. Similarly, without adequate and affordable power, Ethiopia and Kenya are unlikely to realize their dream of building a viable manufacturing sector and sustain their economic growth. Finally, it also translates into a political problem in that the inability to alleviate energy poverty, improve energy security, and meet growing demand for power would weaken support for the incumbent. Thus, it came as no surprise that Nawaz Shariff campaigned under the promise to end power shortages in Pakistan, which was part of the reason that helped him win the elections in 2013. Similarly, President Kenyatta made electrification a national priority in Kenya upon taking office [21].

Recognizing these implications, all four governments developed national plans to expand power supply. For instance, Ethiopia rolled out the Growth and Transformation Plan (GTP) I and II, according to which it would increase its renewable power generating capacity by five-fold from 2000 megawatts (MW) in 2011 to 10,000 MW in 2015, add another 17,000 MW in 2016–2020, and issued a National Electrification Program, according to which it would achieve universal access to electricity by 2025 [18]. President Kenyatta announced a target to build 5000 MW of renewable power generating capacity in 2013–2017 and connect all homes to power in Kenya by 2020 [21]. Argentina adopted the Renewable Energy Act in 2015, according to which renewable energy will account for 16%, 18%, and 20% of the country's total electricity supply by 2021, 2023, and 2025 respectively [22]. Similarly, after winning the 2013 election, the Shariff government embarked on an ambitious plan to build a massive 21 energy projects as part of the China-Pakistan Economic Corridor (CPEC), of which seven are renewable projects [23].

To carry out their ambition to expand their power supply, all of the four countries turned to China for financial help. For instance, when planning the Adama I wind project, the Ethiopian government deliberately approached the two Chinese contractors—Hydro China and CGCOC—and requested preferential export credit from CHEXIM [24]. In Kenya, the Rural Electrification Authority (REA) awarded the 55 MW Garissa Solar Park to China Jiangxi Corporation for International

Economic & Technical Corporation (CJIC) and Jinko Solar and requested concessional loans from CHEXIM [25]. Similarly, the Argentine Ministry of Finance sent an official delegation to Beijing to seek funds from CHEXIM after its local government won the bid to build the 300 MW Cauchari Solar Park and awarded the project to Shanghai Electric Power Construction and Talesun [26]. As for the renewable projects in Pakistan, the Chinese policy banks financed them as part of the official CEPC agreement between Beijing and Islamabad. Thus, in all four cases, the Chinese policy banks provided renewable power ODF in response to the recipient governments' intervention and the active pull.

The decisions of the four governments make sense on two fronts. On a project level, as illustrated by the decision-making over the Adama I wind farm, the Ethiopian government's decision to turn to CHEXIM for renewable power ODF has a lot to do with its favorable interest rates, its quick disbursement of funds, the lack of political conditionalities associated with its loans, and the ability of Chinese contractors to complete the projects on schedule [24]. As none of the four countries possess the needed capital to finance project development, the necessary industrial capacity to manufacture wind turbines or solar panels, or the required engineering capability to deliver projects on schedule, it is thus natural for them to turn to China that has been leading the world in investment, manufacturing and deployment of renewable power. Beyond project implementation, Ethiopia also saw Adama I wind project as an opportunity to diversify its dependence on French contractors and as a bridge to a new area of cooperation with China [24]. This perception is consistent with how all four countries have been deepening their economic and political ties with China and increasing their dependence on China as a trading partner and investor for their overall infrastructure and industrial development. Their request for Chinese renewable ODF is thus part of their increasing leaning toward China for broad development assistance both on a bilateral level and in the case of their participation in China's BRI.

3.2. The demand for Chinese ODF is limited

Contrary to the conventional wisdom, the international demand for Chinese ODF for solar and wind power is actually quite modest. The IRENA maintains a database that tracks public finance flows from a wide range of DFIs into 160 countries worldwide for renewable power development. According to this dataset [27], only seven, as listed in Table 1, out of these 160 countries have turned to CDB and CHEXIM for solar and/or wind power finance from 2001 to 2017. In terms of magnitude, these seven countries secured a total \$4.7 billion worth of ODF from these two Chinese policy banks in 2001–2017³, which account for 6.3% of the global flows of public finance for solar and wind power. In contrast, the European Investment Bank (EIB), the Brazilian Development Bank (BNDES), and the World Bank Group (WRG) are responsible for 24%, 17%, and 16% of the global public finance inflows into solar and wind projects for the same time frame [27]. It is thus clear that Chinese policy banks are not the first provider of public finance countries around the world turn to when seeking development finance for their solar and wind power expansion. For instance, Ethiopia turned to the French banks before CHEXIM for wind power projects; when it approached CHEXIM, it only requested funds for three projects but sourced finance from elsewhere for the other five wind power projects identified in its GTP [28]. Similarly, to execute its 2015 Renewable Energy Act, Argentina organized two rounds renewable power auctions, i.e. RenovAR 1 and RenovAR 1.5, in October and November 2016, which together awarded 2400 MW of renewables capacity and attracted around \$4 billion of investment [29]. In comparison, it turned to CHEXIM for a \$332 million loan for the construction of 315 MW Cauchari Solar Park in 2017.

Our field research in Beijing also confirms this limited external

demand for Chinese solar and wind power ODF. When presented with the data about the small scale of Chinese ODF for solar and wind power overseas, a mid-level CHEXIM official said the following to one of the co-authors: "as a supplier of financing, we are simply on the receiving end of loan applications. We have no influence whatsoever over how our sovereign or corporate clients select their projects and what they request financing for. Instead, we evaluate their loan applications on the basis of their profitability, risks, and compatibility with local development" [Dialogue No. 1, 2019]. A junior CHEXIM loan officer responsible for Latin America went one step further, saying that: "Not every government turns to us for finance. When they do, many of them are governments of Asian, African, and Latin American countries. When they approach us for loans, they frequently prioritize financing for the development of their industrial economy and their endeavor to improve access to public housing, public health, and clean water. In contrast, requests for loans to develop renewable power often occupy a very low priority in these countries' loan applications" [Dialogue No. 2, 2019].

Indeed, even amongst the four countries that turned to China for solar and/or wind power ODF, renewable power received a lower priority than coal-fired power or hydropower. For instance, as part of CEPC, Pakistan turned to the two Chinese policy banks for assistance with its solar and/or wind power expansion. However, out of the 21 energy projects totaling more than 10,000 MW, solar and wind only account for 13% whereas coal-fired power and hydropower represent 71% and 14% respectively [23]. Similarly, Ethiopia identified eight wind projects and three hydropower projects as part of its GTP but the total power generating capacity of the wind projects is much smaller than its three hydropower projects [18]. Further, both Ethiopia and Argentina requested Chinese ODF for their wind power and hydropower development but they requested much more for hydropower than for wind power [11].

3.3. Chinese policy banks are reluctant to supply ODF for foreign renewable power

A senior manager at a Beijing-based NGO held that China, as the world's largest electric power market, can literally help other countries build whatever form of electric power generating capacity they want to develop; the reason behind the underwhelming scale of Chinese solar and wind ODF overseas is that many of the renewable power projects are deemed to be not bankable and therefore shunned by Chinese companies, especially in places that have plenty of coal or natural gas deposits [Dialogue No.3, 2019]. To begin, this perceived bankability risk seems to predispose the policy banks to turn away from small and distributed renewable projects. A senior CDB official provided the following explanations to one of the co-authors: "Renewable energy, such as solar and wind, overseas is difficult for me to finance because in many of the countries you speak of the only feasible renewables would be distributed rather than grid connected. We do not have as much experience with distributed wind and solar. And, these by definition are very small deals. We look to do deals that are very large—500 MW and a few hundred million dollars. Distributed can be 10 MW and 'pocket change'" [Dialogue No.5, 2019]. A look at the size of the solar and wind power projects appears to provide support for Chinese policy banks' bias against small projects.

Next, the Chinese policy banks saw technical and infrastructural bottlenecks in many developing countries as a source of bankability risk for renewable power projects. When explaining the bank's limited financing for solar and wind power abroad, a mid-level CHEXIM official attributed it to the following three inhibiting factors: first, its sovereign clients, especially those in Asia, Africa, and Latin America, often lack the necessary fiscal largesse to subsidize the development of renewable power; second, in absence of these subsidies, the renewable electricity generated is not as competitive as that is generated from coal or natural gas; third, many of these countries are in need of base-load power, but without affordable and reliable storage technologies solar and wind power are unable to provide base-load electricity [Dialogue No. 1,

³ Note this includes projects that have not been completed.

2019]. Beyond utility-scale solar and wind power, the poor infrastructure in many renewable-rich developing countries also makes it costly to expand distributed renewable power. When making this point, a senior CHEXIM official in Botswana said the following to one of the co-authors: “another problem is that the grid here is very poor, even for the cities. Renewable energy is most applicable in rural areas where hardly any people have access to electricity. But unlike China these people live very far away from each other, so distributed solar and wind is very costly” [Dialogue No. 6, 2019].

Finally, the Chinese policy banks worry about financial risks associated with renewable power projects overseas. According to a mid-level CDB official responsible for overseas energy projects, the bank bases its decision of a loan application for a solar or wind project overseas on both key financial indicators pertinent to the project, including profitability, future cash flows, and debt-paying ability, and technical indicators, such as grid connectivity and electricity transmission capacity; a failure to meet these financial and technical thresholds leads to CDB’s rejection of a loan application [Dialogue No.4, 2019]. This concern about the financial risks associated with overseas solar and wind power projects is also echoed by the above-mentioned senior CHEXIM official in Botswana, who sees the lack of off-taker risk guarantees in many of the developing countries that have high levels of debt as the biggest impediment to the bank’s readiness to provide public investment [Dialogue No.6, 2019]. As an illustration of the Chinese policy banks’ risk sensitization, CHEXIM entered into a memorandum of understanding with the Ethiopian government for financing the Adama I wind farm in July 2009 but did not approve of the loan until May 2011 [24]. In other words, it took CHEXIM nearly two years to complete its due diligence to evaluate and hedge against the potential risks associated with the project, such as default, insolvency and political unrest. At the end of the 22-month review process, CHEXIM closed the loan only after the China Export and Credit Insurance Corporation extended credit insurance to Chinese contractors and subcontractors [24].

Two factors may account for the high level of reluctance CDB and CHEXIM harbor about solar and wind projects overseas. On the one hand, the two banks’ heavy emphasis on the issue of bankability has a lot to do with how they raise their funds. As we have discussed elsewhere, both of the policy banks raise the overwhelming majority of their funds through the financial bonds they sell at home [30,31] against the backdrop of the growing interest rate liberalization [32]. What this means is that their primary fundraising is marketized and the cost of this fundraising has been on the rise over the time. It thus comes as little surprise that CDB and CHEXIM closely scrutinize the financial viability of the renewable projects when evaluating the corresponding loan applications. Indeed, the interlocutors we spoke to in Beijing kept referring to the importance of “bankability” when discussing whether to finance renewable power projects overseas. To make sure they are able to recover their loans, the two policy banks frequently condition their loans on the presence of reliable revenue streams, credible collaterals, government guarantees, or mortgage them on a client country’s future commodities export and resource exploration [33]. Coincidentally, both policy banks, especially CDB, have long adopted a similar practice at home [9] before engaging in public investment for energy worldwide.

On the other hand, the two policy banks’ experience in promoting renewable power at home may very well have contributed to their reservations about getting involved in renewable projects overseas. When asked to explain this reluctance, a seasoned NGO-based analyst characterized it as an implicit bias that is derived from the two policy banks’ sharpened sensitivity toward the typical problems, including intermittency, grid connectivity, high dependence on subsidies for grid parity, and its boom and bust cycle, that have complicated their promotion of solar and wind power expansion in China [Dialogue No.7. 2019]. As a result, China’s renewable push really rode on the back of state subsidies. For instance, solar power did not reach grid-parity until 2019 [34]. We hear an echo of this implicit bias when the above-mentioned CHEXIM official drew a parallel between China and other developing countries

that strive to expand renewable power, contending: “considering the amount of problems the renewable power expansion has experienced in China, it is only natural that these developing countries will have more problems in light of their stage of development. Because of these problems, renewable power for the moment will only remain at a demonstration stage in these countries” [Dialogue No.1, 2019].

4. Discussion

Applying a supply/demand framework, we have shown in our analysis above that Chinese ODF for solar and/or wind power abroad is primarily a function of external demand. This demand took the form of market pull in Bulgaria, Italy, and Romania, where CDB was pulled into the solar markets there by four leading Chinese solar firms that were attracted by the favorable outlook and market conditions in the three countries. CDB’s involvement took place without any intervention from the government of the three countries. Instead, CDB provided FDI financing to the four Chinese solar firms that had long established ties with the policy bank back in China.

In Ethiopia, Kenya, Argentina and Pakistan, the demand for Chinese renewable power ODF took the form of direct government request. Determined to promote economic growth, expand electricity access, and enhance electricity supply security, these four countries rolled out specific plans to expand power supplies. Renewable power was a prominent focus of these plans because coal-fired power occupied no role whatsoever or represented such a negligible share in their power supply mix. Absent the necessary capital to procure and the expertise to engineer and construct grid-level solar and/or wind power projects, these governments turned to the Chinese policy banks for finance because of their favorable interests, their quick disbursement of funds and their close ties with Chinese contractors that are able to bring projects online promptly.

However, the external demand for Chinese solar and/or wind power ODF is limited. With respect to the market pull from rapidly growing markets, the attraction is not specifically tailored to any firms. Instead, to the extent it exists it is available to all competitors and represents a neutral opportunity that awaits to be tapped by any interested player. While the direct request from the government of Ethiopia, Kenya, Argentina and Pakistan for Chinese ODF represents targeted demand, it, as discussed earlier, merely accounts for a small portion of the renewable power finance they receive. Two factors seem to be at work. First, alternatives abound. Not only is there plenty of asset finance and private sector investment, as illustrated by the influx of funds into the two rounds renewable power auctions in Argentina, but the DFIs also actively finance renewable power around the world. Second, when approaching Chinese policy banks for energy finance, governments seem to demonstrate a bias in favor of coal-fired power, as in the case of Pakistan, or hydropower, as in the case of Ethiopia and Argentina, against solar and/or wind power. This may suggest that the Chinese policy banks are faced with a lot more competition in the renewable power sector than in the coal-fired power and hydropower sector, where the West-led DFIs, especially the MDBs and their ECAs, have to abide by the Common Approaches on Environmental and Social Due Diligence adopted under OECD in the late 1990s and early 2000s. In contrast, operating outside ECA governing regime, the two Chinese policy banks faced little constraint. As a result, as the West-led DFIs gradually moved away from coal-fired power and hydropower into renewable power, two Chinese policy banks filled the vacuum and began to finance more and more coal-fired power and hydropower after the GFC.

On the push side, two factors constrain the supply of Chinese solar and wind ODF worldwide. To begin, in spite of the push from the central government to finance the implementation of the “going out” strategy and BRI, our analysis shows that both CDB and CHEXIM harbor concerns and reservations about the bankability of solar and/or wind power projects abroad. This reluctance directly translates into their sharpened risk sensitizations toward renewable power projects overseas, which prompt them to require their loans to be brokered or guaranteed by the

recipient governments of the Chinese ODF, insured by Sinosure, and go through a lengthy due diligence review process that last up to two years as illustrated by CHEXIM's financing of Ethiopia's Adama I wind farm. Next, the Chinese policy banks' bias in favor of coal-fired and hydro-power financing abroad undoubtedly constrains the extent to which they are able and willing to finance renewable power abroad assuming their total loan resources are finite. However, it is important to note this bias is also shared by the countries that have turned to the Chinese policy banks for renewable power finance as illustrated by their simultaneous request for Chinese ODF to finance their solar and/or wind power and for an even larger amount of Chinese ODF to finance their hydropower in Ethiopia and Kenya or coal-fired power in Pakistan.

Our findings carry both theoretical and practical implications. Theoretically, our analysis exposes the fundamental flaws associated with the reductionist approach that tends to make simplistic assumptions. They assume a robust demand for Chinese solar and wind ODF from the developing countries, which are struggling to meet their growing demand for power, in light of the declining costs of solar and wind power generation technologies and their adoption of National Determined Contributions (NDC) under the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015. Similarly, they take it for granted that the two Chinese policy banks will be ready to supply renewable ODF as part of their mandate to execute Beijing's "going out" strategy and BRI and their incentive to promote Chinese renewable energy technology export. However, our analysis proves both assumptions wrong. On the demand side, resource endowment, path dependence, alternative options, cost considerations and relations with China have all played an important role in shaping whether they turn to the two Chinese policy banks for financial assistance with their solar and/or wind power expansion. In the case of Ethiopia, Kenya, Argentina and Pakistan, all have demonstrated a preference to go for the lowest cost options and give priorities to their most abundant indigenous resource endowments, which is hydropower in Ethiopia and in Kenya and coal-fired power in Pakistan. On the supply side, the two Chinese policy banks' experience with renewable power financing in China, their concerns about bankability of renewable projects in developing countries, their risk sensitizations, and their activities outside the OECD ECA governing regime have together led to a strong bias against solar and wind power in favor of coal-fired and hydropower abroad.

Practically, our analysis points to two scenarios where countries that receive Chinese ODF choose to build renewable power. In the case of Ethiopia, Kenya, Pakistan, and Argentina, the minimal penetration of coal into their electricity supply mix and the lack of indigenous coal mining, turn to be out a blessing in disguise as they have provided these countries with both the pressure and incentive to turn to low-carbon sources of electricity. However, one must be aware of the caveat that as long as significant indigenous coal reserves exist in a country, its decision to expand renewable power does not automatically translate into an abandonment of coal-fired power. As a matter of fact, Pakistan, which has not built any coal-fired power plants between 2006 and 2015, installed 4940 megawatts of coal-fired power from 2016 to 2019 [35] while Kenya mulled over a plan to build the country's first ever coal-fired power plant before aborting it due to oppositions by local and international activists. Ironically, Chinese ODF from CDB and CHEXIM is the primary source of capital for Pakistan's coal-fired power expansion under the CEPC framework while the Industrial and Commercial Bank of China (ICBC), one of China's leading state-owned commercial banks, had planned to finance the now aborted coal-fired power plant in Kenya.

Thus, an important agenda for future research will be to study the

decision-making in places like Pakistan that receive Chinese ODF for both renewable power and coal-fired power expansion. A key task will be to understand how much of their decision-making speaks to the agency the host country governments exercise when confronted with the trade-offs between different technologies of electricity supply and how much of their decisions reflect the influence of actors from China, especially its policy banks and energy companies.

Furthermore, our analysis also casts doubt over the prospect of China providing renewable power ODF at a scale that is remotely sufficient to make its BRI energy projects green. Colored by their experiences with the boom and bust of the country's renewable power industry and concerned about the various bottlenecks complicating the financial viability of renewable power projects abroad, China's two policy banks are neither enthusiastic nor accommodating suppliers of renewable power ODF, which may have very well played a role in suppressing its external demand. Added to the reluctance and reservations on the part of CDB and CHEXIM to provide renewable power ODF abroad is an often-overlooked reality—the leading Chinese renewable power companies that are competitive globally tend to be privately owned enterprises (POEs) rather than state-owned enterprises (SOEs). Unlike those powerful SOEs active in coal-fired power or hydropower, these renewable power POEs have yet to gain more economic and political power at home that allows them to leverage the capital from the two Chinese policy banks to expand overseas.

5. Concluding remarks

This paper dampens the view that if China could simply be more aggressive in promoting renewable energy at home, then the BRI would be much greener—so much so that it could help trigger a global transition to green energy. Our study shows that many countries actually pursue non-Chinese sources of financing for their renewable power expansion. When they do turn to the Chinese policy banks for renewable power ODF, they also request for ODF for hydropower and coal-fired power expansion. Further, neither of the two providers of Chinese renewable ODF is enthusiastic and accommodating about renewable power projects abroad. Thus, the renewable power projects China finances overseas through its ODF are the result not just of a "push" from China but also a "pull" from host countries. Neither is pull nor the pull is strong enough to incentivize more Chinese ODF for renewable power abroad. Hence, contrary to the conventional wisdom, we find it hardly surprising that Chinese ODF for renewable power worldwide is underwhelming.

Finally, 2018 and 2019 saw a decline in overall Chinese global energy ODF, though its composition remained the same. This was largely due to the lack of host countries to take on more dollar-denominated finance, and the shrinking amount of financing available on the Chinese side. If those trends continue in the wake of the coronavirus disease (COVID-19) crisis, the glory days of Chinese ODF may be in the rear-view mirror and the BRI may not prove to be a source of massive amounts of new finance, green or brown. If that is the case, the analysis of the great surge in Chinese ODF up to 2017 that is the subject of this paper, may show that from a climate change perspective this surge was a missed opportunity.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix I: Dialogues with CDB and CHEXIM officials and observers

Dialogue	Interlocutor	Date	Location
Dialogue No. 1	A mid-level official in charge of lending for renewable power projects at CHEXIM	23-Nov-19	Beijing
Dialogue No. 2	A junior official in charge of loans for Latin America at CHEXIM	22-Nov-19	Beijing
Dialogue No. 3	A senior program manager of an NGO that interacts closely with CDB and CHEXIM	22-Nov-19	Beijing
Dialogue No. 4	A mid-level official in charge of corporate clients at CDB	23-Nov-19	Beijing
Dialogue No. 5	A senior CDB official	28-May-19	Beijing
Dialogue No. 6	A senior CHEXIM official	15-Oct-19	Gaborone, Botswana
Dialogue No. 7	President of an NGO that keeps tracks of the environmental impact of Chinese overseas investment	24-Nov-19	Beijing

References

- [1] REN21, Renewables 2018 Global Status Report, REN21 Secretariat, Paris, France, 2019, p. 324.
- [2] T. Ajadi, R. Boyle, D. Strahan, M. Kimmel, B. Collins, A. Cheung, L. Becker, Global Trends in Renewable Energy Investment 2019, The Frankfurt School – UNEP Collaborating Centre for Climate & Sustainable Energy Finance, Frankfurt am Main, Germany, 2019, p. 75.
- [3] 中国国家开发银行, 新能源产业圈行独具一片“风光”, 2015. http://www.cdb.com.cn/xwzx/tpxw/201512/t20151221_1187.html. (Accessed October 20 2020).
- [4] Y. Cai, Y. Aoyama, Fragmented authorities, institutional misalignments, and challenges to renewable energy transition: A case study of wind power curtailment in China, *Energy Res. Social Sci.* 41 (71–79) (2018).
- [5] L. Curran, P. Lv, F. Spigarelli, Chinese Investment in the EU renewable energy sector: Motives, synergies, and policy implications, *Energy Policy* 10 (2017) 670–682.
- [6] KPMG Global China Practice, *Zhongguo Xinnengyuan Qiye de Quanguo Jihui (Global Opportunities for China's Renewable Energy Companies)*, Beijing, KPMG, 2014, p. 34.
- [7] 段雯娟, 中国可再生能源如何“走出去”——国家能源局新能源司副司长梁志鹏谈中国可再生能源发展趋势, *地球*, 北京, 2015, pp. 52-53.
- [8] 中华人民共和国国务院, 国务院关于推进国际产能和装备制造合作的指导意见, 国发[2015] 30号, 国务院, 北京, 2015, p. 8.
- [9] H. Sanderson, M. Forsythe, *China's Superbank: Debt, Oil and Influence-How China Development Bank Is Rewriting the Rules of Finance*, Bloomberg Press, Singapore, 2013.
- [10] 李若谷, *全球化中的中国金融*, 社会科学文献出版社, 北京, 2008.
- [11] K.P. Gallagher, *China's Global Energy Finance*, Boston University Global Development Policy Center, Boston, 2020.
- [12] Official Journal of the European Union L(140) (2009) 16–62. Directives 2001/77/EC and 2003/30/EC.
- [13] European Commission, *National Renewable Energy Action Plans, 2019*, Accessed November 29 2019, <https://ec.europa.eu/energy/en/topics/renewable-energy/national-renewable-energy-action-plans-2020>, 2020.
- [14] Suntech Power Holdings Corporation LTD., Form 20: Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of for the Fiscal Year Ended December 31, 2011, United States Securities and Exchange Commission, Washington DC 2012 (1934) 192.
- [15] Sky Solar Holdings Limited, Form 20: Annual Report Pursuant to Section 13 or 15 (d) of the Securities Exchange Act of, for the Fiscal Year Ended December 31, 2014, Washington DC 2014 (1934) 198.
- [16] L. Haeron Solar Technology Co., Annual Report of Haeron Solar Technology Co., Ltd., <file.sina.com.cn>, 2017, p. 249.
- [17] World Bank, *World Bank Development Indicators*, Washington D.C, World Bank, 2020.
- [18] M.B. Assres, A. Simonovic, D. Komarov, S. Stupar, Wind energy resource development in Ethiopia as an alternative energy future beyond the dominant hydropower, *Renew. Sustain. Energy Rev.* 23 (2013) 366–378.
- [19] J.K. Kiplaga, R.Z. Wang, T.X. Li, Renewable energy in Kenya: Resource potential and status of exploitation, *Renew. Sustain. Energy Rev.* 15 (2011) 2960–2973.
- [20] World Bank, *Implementation Completion and Results Report on a Series of Credits in the Amount of SDR 744 Million (US\$1.1 Billion) to the Islamic Republic of Pakistan for Power Sector Reform Development Policy Credits I & II*, World Bank, Washington D.C., 2017, p. 30.
- [21] M. Boule, The hazy rise of coal in Kenya: The actors, interests, and discursive contradictions shaping Kenya's electricity future, *Energy Res. Social Sci.* 56 (101205) (2019) 1–10.
- [22] Anonymous, Argentina is expected to add almost 700 MW of solar capacity in 2020, *Energy Monitor Worldwide*, SyndiGate Media Inc, Amman, 2020, p. 1.
- [23] China-Pakistan Economic Corridor, CPEC-Energy Priority Projects, 2020. <http://cpec.gov.pk/energy>. (Accessed October 26 2020).
- [24] F. Chiyemura, The Winds of change in Africa-China relations? Contextualising African agency in Ethiopia-China Engagement in Wind energy Infrastructure Financing and Development', in: *Development Policy and Practice*, The Open University, Milton Keynes, UK, 2019, p. 291.
- [25] Timetric, REA – Garissa Photovoltaic Power Plant 55 MW – North Eastern Province: Construction Project Profile, Timetric, London, UK, 2018, p. 7.
- [26] Anonymous, Argentina seeks to secure Chinese support for 300 MW solar project in Jujuy province, *Energy Monitor Worldwide*, SyndiGate Media Inc, Amman, 2017, p. 1.
- [27] IRENA, *Public Investment Trends in Renewables*, Int. Renewable Energy Agency, Abu Dhabi (2019).
- [28] Y. Chen, Comparing North-South technology transfer and South-South technology transfer: The technology transfer impact of Ethiopian, *Wind Farms* 116 (2018) 1–9.
- [29] Anonymous, New Market Rules Set to Enable US\$ 6bn in Investment in Argentina's Renewable Power Sector, *Energy Monitor Worldwide*, SyndiGate Media Inc, Amman, 2017, p. 1.
- [30] B. Kong, K.P. Gallagher, Globalizing Chinese energy finance: The role of policy banks, *J. Contemp. China* 26 (108) (2017) 834–851.
- [31] B. Kong, *Modernization through Globalization: Why China Finances Foreign Energy Projects Worldwide*, Palgrave MacMillan, New York, 2019.
- [32] T. Feyzioğlu, N. Porter, E. Takáts, Interest Rate Liberalization in China, *IMF Work. Paper* 09 (171) (2009) 1–28.
- [33] D. Bräutigam, Bartering Globalization: China's Commodity-Backed Finance in Africa and Latin America, *Global Policy* 5 (3) (2014) 346–352.
- [34] J. Yan, Y. Yang, P.E. Campana, J. He, City-level Analysis of Subsidy-free Solar Photovoltaic Electricity Price, Profits and Grid Parity in China, *Nature Energy* (4) (2019) 709-717.
- [35] Global Coal Plant Tracker, *New Coal Plants By Country, 2006–2018 (MW)*, ENDCOAL.ORG, Global Energy Monitor, 2020.