



MOVING THE GREEN BELT AND ROAD INITIATIVE: FROM WORDS TO ACTIONS

LIHUAN ZHOU, SEAN GILBERT, YE WANG, MIQUEL MUÑOZ CABRÉ, AND KEVIN P. GALLAGHER

EXECUTIVE SUMMARY

Highlights

- Since the Chinese government proposed the Belt and Road Initiative (BRI) in 2013, Chinese investments have been increasing rapidly in the BRI countries. The trend will likely continue, supported by the Chinese government’s 2017 pledge of US\$113 billion in special funds for investments in BRI.
- The Chinese government has taken initial steps to incorporate environmentally sustainable, or green, strategies and objectives into BRI, but in very high-level and conceptual terms.
- This report provides an initial overview of the degree to which Chinese energy and transportation investments in the BRI countries from 2014 to 2017 align with the green priorities communicated in BRI countries’ Nationally Determined Contributions (NDCs). Our analysis is based on a comprehensive review of data on bank loans and cross-border investments by the Silk Road Fund and Chinese enterprises.
- The data show that most Chinese deals in energy and transportation over the period reviewed were tied to carbon-intensive sectors and did not show a strong alignment with the low-carbon priorities included in the BRI countries’ NDCs.
- Under the Paris Agreement, countries will be submitting revised NDCs in 2020, with a view to introducing greater ambition. BRI countries would benefit from updating their NDCs with sufficient granularity to provide clear signals to investors to enable a comprehensive assessment of investment needs.

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Context

With its new Belt and Road Initiative (BRI), China has offered a sweeping vision to develop infrastructure worth a cumulative \$6 trillion and spanning many countries (SCIO 2015b). As part of its effort to finance the BRI, the Chinese government pledged a total of \$113 billion in special funds in 2017, about eight times the Chinese financial sector's outward foreign direct investment (OFDI) flow in the same year (SAFE 2018). Wholly state-owned financial institutions—the Silk Road Fund (SRF), the China Development Bank (CDB), and the Export-Import Bank of China (China Eximbank)—received a majority of the funds pledged, while Chinese commercial financial institutions have been encouraged to conduct BRI investments in Chinese yuan (MFA 2017).

Chinese investments into power, transportation, and other long-lasting infrastructure assets will lock in technologies for decades and will affect the development pathways of BRI countries and their neighbors. Choosing the right type of infrastructure investment is crucial if BRI countries are to eradicate poverty and achieve the United Nations Sustainable Development Goals (SDGs). Gains in poverty alleviation will only be sustained if climate change is arrested and its impacts addressed. A recent World Bank study found that an additional 100 million people will live in poverty due to climate change by 2030 if countries fail to address these challenges (Hallegatte et al. 2016). The investment choices that Chinese financial institutions and corporations make in BRI countries will influence how China is perceived abroad with regard to climate change and the wider development agenda. Although the Chinese government has recognized the importance of incorporating green strategies into BRI, this has occurred in high-level and conceptual terms and may not be sufficiently actionable for use in investment decisions.

NDCs offer a quantifiable set of country-driven priorities that can be used to inform a concrete green BRI. NDCs are commitments made by each country to reduce national emissions and adapt to the impacts of climate change after 2020, including key goals and priority sectors. A large amount of investment will be required to implement NDCs, and the majority of countries, especially developing countries, do not have sufficient financial resources to fulfill their investment needs (IFC 2016). With newly injected government special funds, Chinese financial institutions have resources that could help BRI countries implement their NDC commit-

ments by investing in priority sectors and projects while also contributing to economic development objectives.

This paper provides a comprehensive analysis on the nature and characteristics of Chinese energy and transportation investments from 2014 to 2017 in BRI countries. Four major types of investment are included: syndicated bank loans by CDB, China Eximbank, and the four biggest state-owned commercial banks; energy-sector loans exclusively provided by CDB and China Eximbank; equity investments by the SRF; and cross-border investments by Chinese enterprises. We use both proprietary databases and publicly available information to conduct our analysis, including data from Thomson ONE, Dealogic, and Boston University's Global Development Policy Center (Thomson ONE 2018; Dealogic 2018; Boston University 2018). Energy and transportation sectors are covered by this paper on the basis of the availability of sectoral information in NDCs and sectoral relevance to BRI.

We estimate energy and transportation investment priorities and needs from BRI countries' NDCs to analyze the alignment of Chinese past investments and to provide an overview of mid- to long-term investment opportunities in the BRI region. The current NDCs are the first NDCs submitted under the United Nations Framework Convention on Climate Change (UNFCCC), and are heterogeneous in terms of their form, structure, and content. We were able to quantify the renewable energy investment opportunities in monetary terms based upon the methodology used by the International Renewable Energy Agency for 31 of 56 BRI countries, which have quantitative renewable energy contributions targets in their NDCs. However, most countries only have descriptive information for the transportation sector in their NDCs without the quantitative elements needed to estimate likely investment needs. Therefore, this paper analyzes transportation sector investment priorities on the basis of the pattern of references and commitments in 56 BRI countries' NDCs.

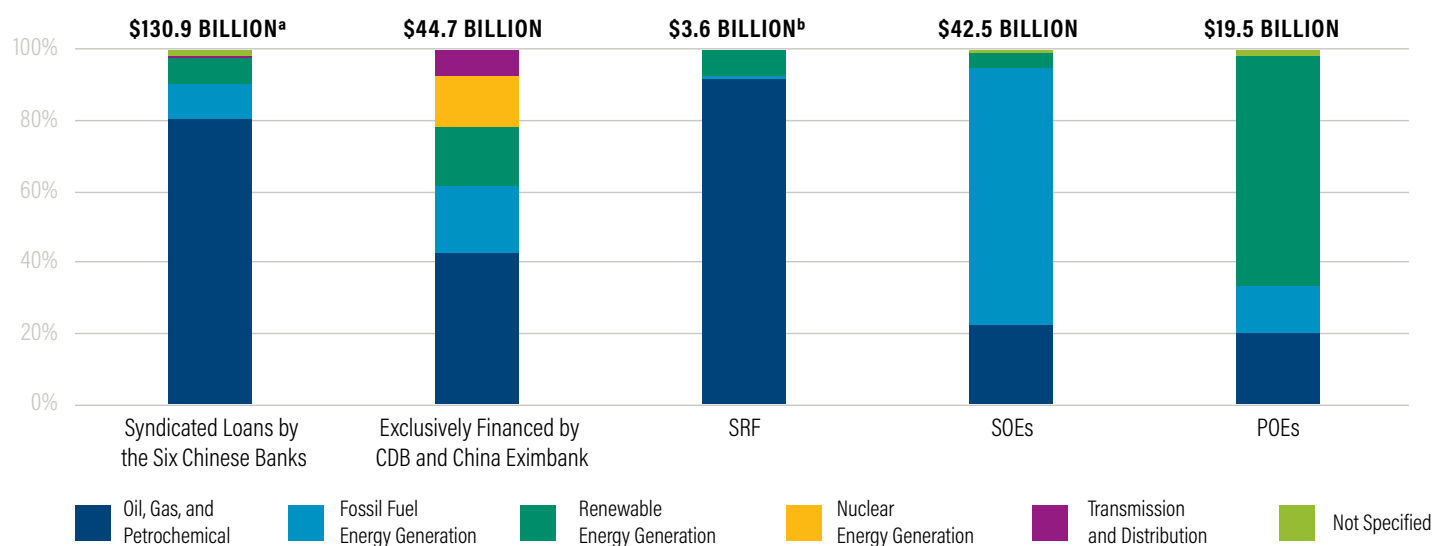
Key findings

The analysis found a clear trend of increasing Chinese investments in BRI countries over time. From 2015 to 2017, the volume of energy and transportation syndicated loans in which major Chinese banks participated was three times as large as in the period from 2012 to 2014. Although Chinese global OFDI dropped by nearly 20 percent in 2017, the OFDI to BRI countries continued growing by 31.5 percent (MOFCOM 2018).

According to the data reviewed, most Chinese deals in energy and transportation are still tied to traditional sectors and do not show a strong alignment with the low-carbon priorities included in BRI governments' NDCs. From 2014 to 2017, 91 percent of the energy-sector syndicated loans in which the six major Chinese banks included in this study participated, and 61 percent of the energy-sector loans financed entirely by China Development Bank and/or China Eximbank were in fossil fuels (see Figure ES-1). Over the same period, 93 percent of energy-sector investments by the SRF were also in fossil fuels, and 95 percent of cross-border energy investments by Chinese state-owned enterprises (SOEs) were in fossil fuels as well. In contrast, nearly two-thirds (64 percent) of cross-border energy-sector investment by Chinese privately owned enterprises (POEs) were in renewable energy. In the transportation sector, a majority of Chinese deals were in traditional transportation, such as aircraft financing, airports, road construction, and automotive manufacturing, rather than sectors more frequently promoted as lower-carbon options, such as urban public transit and railways.

If Chinese government special funds are deployed to give greater priority to green opportunities, especially in the near term, these funds could have an outsized positive impact on green growth in the BRI countries. By targeting green objectives in the coming years, China could use BRI special funds to quickly become a major catalyst for low-carbon development in the region. A substantial flow of pre-2020 green or climate-friendly investments would build a solid foundation for climate ambition as countries prepare to submit revised NDCs and implement them after 2020. Multilateral Development Banks (MDBs) have adopted targets for climate finance as a percentage of their overall portfolio; the targets exceed 25 percent (AfDB et al. 2015). If the special funds allocated for BRI were similarly deployed against a target of just 25 percent, this would channel more than \$28 billion additional dollars in support of climate finance and NDC priorities at a critical time for BRI countries. To put this figure in perspective, the \$28 billion compares favorably to the \$35 billion in climate finance that the MDBs lent out globally in 2017 (AfDB et al. 2018).

Figure ES-1 | **China's Energy-Sector Financial Flows to BRI Countries by Subsector, 2014-2017**



Notes: ^a Syndicated loans by the six Chinese banks are total loan amounts of projects in which the six Chinese banks participated. The actual loan contributions by individual banks were not available for many of the transactions. The six Chinese banks are China Development Bank, Export-Import Bank of China, Agricultural Bank of China, Bank of China, China Construction Bank, and Industrial and Commercial Bank of China.

^b SRF includes four project investments that disclose investment amounts.

Source: Authors' calculations.

NDCs demonstrate clear needs and are a natural reference point for a green BRI, but currently they are not specific enough to send sufficiently clear signals to market actors. To identify trends and investment opportunities, investors need a minimum of quantitative information about the technology and other pathways that a government envisions for achieving NDC goals. However, even for the energy sector, only a little more than half (55 percent) of the BRI countries provide quantifiable contributions in their NDCs, and even this information is not fully consistent in detail or structure. While the authors did not interview Chinese institutions to assess their level of internal understanding of NDCs, our research demonstrated the difficulties involved in estimating investments based on the NDCs alone.

Recommendations

The Chinese government should require financial institutions receiving Chinese government special funds to consider NDCs when developing their investment strategies. NDCs offer a set of country-driven priorities and objectives and are also tied under the Paris Agreement to an ongoing cycle of updating. Further, they are available for all BRI countries except Syria and are linked to national development strategies, which means that NDCs could be introduced as a reference point in standard operating procedures at Chinese financial institutions. All the multilateral development banks, including the Asian Development Bank and the World Bank Group, have begun to formally incorporate reviews of NDCs into the development of their country strategies, and Chinese financial institutions could apply a similar practice (ADB 2017a; World Bank 2016a; Larsen et al. Forthcoming).

Governments of BRI countries would be well advised to update their NDCs with sufficient granularity and quantitative information and to communicate their NDC priorities, national strategies, and associated project pipelines to financial institutions, including Chinese. This will help ensure that NDCs are used as potential points of focus for green BRI activities. Efforts could include bringing Chinese partners into BRI countries' ongoing dia-

logues with other multilateral and bilateral development finance institutions to encourage greater coordination and pooling of efforts. In addition, BRI country governments could also demonstrate their commitment to achieving NDC goals by including NDC-related expenditures in their government budgets. This would send a strong and clear signal to financial institutions and other investors that significant investment opportunities in green technologies and projects will be forthcoming.

The Chinese government should encourage state-owned financial institutions to build on their respective comparative advantages to support a green BRI. The suite of financial institutions designated by the government to drive forward BRI green financing bring with them a range of comparative strengths, risk appetites, and financial resources, including the capacity to deploy capital through development loans, equity investments, debt financing, and other instruments. When allocating special funds, the Chinese government should ask the relevant institutions to design instruments or funds that address specific green financing barriers in the BRI region in a manner that leverages their own comparative strengths.

A green BRI strategy will also need to consider how to address issues of equity and access to finance. Chinese investments in the BRI region have concentrated on the oil, gas, and petrochemical industries in a few BRI countries—mainly higher-middle-income and high-income countries. If BRI is to become a development initiative to improve connectivity and support sustainable development across many countries, more financial flows will be needed to support projects in lower-middle-income and low-income countries. For those countries, long-term equity investments, concessional loans, and development loans are especially important (OECD 2018a). Because they can provide these types of finance, the SRF, China Eximbank, and CDB will likely play a very different role, compared to the Chinese commercial financial institutions, which provide finance mostly on nonconcessional terms.

INTRODUCTION

Through its new Belt and Road Initiative (BRI), China has offered a sweeping vision to develop infrastructure worth a cumulative \$6 trillion across the BRI region, which encompasses some 68 Asian, European, and African countries (see Box 1) (SCIO 2015b).¹ As part of its effort to finance the BRI, in May 2017 at the Belt and Road Forum, the Chinese government pledged a total of \$113 billion in special funds (see Figure 1).² To put that in perspective, this represents about eight times the Chinese financial sector's outward foreign direct investment (OFDI) flow in 2017 (SAFE 2018). Of the \$113 billion, \$70 billion has been pledged to the SRF and China's two development/policy banks, CDB and China Eximbank. At the same time, the Chinese government also encouraged Chinese commercial financial institutions, especially the four biggest Chinese state-owned commercial banks, to deploy BRI investments in Chinese yuan (CNY) worth at least \$43.6 billion (MFA 2017). However, the actual investment volume could grow significantly larger if the policy and commercial banks choose to tap into their own funding sources to invest in BRI instead of relying solely on special funds from the government.³

The choice of infrastructure that is financed and built across BRI countries will have long-term lock-in effects, with significant positive or negative consequences for BRI countries, their neighbors, and the world. Choosing the right type of infrastructure investment is crucial if BRI countries are to eradicate poverty and achieve the United Nations SDGs. Gains in poverty alleviation will only be sustained if climate change is arrested and its impacts addressed. A recent World Bank study found that an additional 100 million people will live in poverty due to climate change by 2030 if countries fail to address these challenges (Hallegatte et al. 2016). On the other hand, the right investments in low-carbon, climate-resilient infrastructure can bring positive impacts, including higher productivity, enhanced innovation and efficiency in key systems such as energy and mobility, and better long-term prospects for poverty reduction (NCE 2016).

The Chinese government made clear its intention to incorporate green strategies into the BRI by releasing the *Guidelines on Promoting Green Belt and Road* and *The Belt and Road Ecological Cooperation Plan* in the same month it pledged special funds for BRI. These documents outline a vision for sustainability, but they are pitched at a high conceptual level. The *Guidelines on Promoting Green Belt and Road* provide a high-level definition of a

Box 1 | What Is the Belt and Road Initiative?

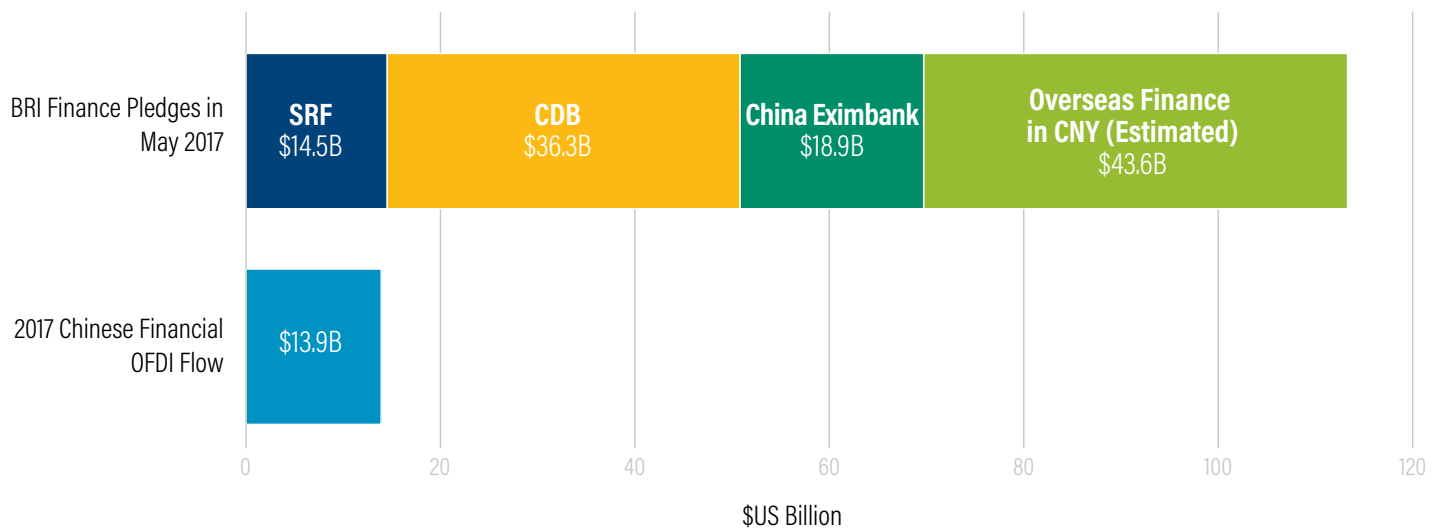
The Belt and Road Initiative was first raised publicly by Chinese President Xi Jinping in September and October of 2013 to build jointly the Silk Road Economic Belt (the Belt) and the 21st Century Maritime Silk Road (the Road). The Belt focuses on three routes linking China to Europe via Central Asia, to the Persian Gulf via West Asia, and to the Indian Ocean via South Asia. The Road is designed to connect China's coast to Europe through the South China Sea and the Indian Ocean (SCIO 2016).

Although BRI is open to all nations, infrastructure investments will likely concentrate on the 68 countries along the Belt and Road. Development levels of these countries vary greatly, from high-income (such as the Republic of Korea and the United Arab Emirates (UAE)), upper-middle-income (such as Malaysia), to lower-middle-income (such as Myanmar and Ethiopia). The geographic characteristics and natural resource endowments of BRI countries also vary. BRI countries will need to prioritize different types of infrastructure and investments depending on their own needs and circumstances.

The BRI puts transportation and energy infrastructure among its top priority areas, and it emphasizes the consideration of climate-change impacts in infrastructure development. The initiative highlights actions in transportation infrastructure, focusing on key passage-ways and junctions of land, water, and air transportation; removing transportation bottlenecks; and advancing road safety facilities and traffic management facilities. In energy infrastructure, the initiative includes both conventional and renewable energy development, including exploration and development of coal, oil, gas, hydropower, wind power, and solar power. (SCIO 2016).

green BRI: "Green 'Belt and Road' Initiative follows the principle of being resource-efficient and environmental-friendly, imbeds the concept of green into the efforts in policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds (hereinafter referred to as 'Five Goals'), and incorporates eco-environment protection into all aspects and whole process of the 'Belt and Road' building." (Belt and Road Portal 2017)

Figure 1 | **China's Official BRI Finance Pledges at the Belt and Road Forum in May 2017, Compared to the 2017 Chinese Financial OFDI Flow, in US\$ Billion**



Source: Xinhua 2017a.

NDCs offer a quantifiable resource to enable China to ground its vision of a green BRI in a set of host country-driven priorities that can be found in virtually every BRI country. Developed under the framework of the Paris Agreement, NDCs are commitments made by each country to reduce national emissions and adapt to the impacts of climate change; they typically include targets and priority sectors. NDCs are at the heart of the Paris Agreement and aim to limit the increase in global average temperatures to “well below” 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the increase to 1.5 degrees Celsius. Most countries submitted their first NDCs around 2016; under the Paris Agreement, NDCs will be updated every five years beginning in 2020. The authors chose NDCs as a practical reference point for identifying mid- to long-term investment needs in BRI countries, needs that should be relevant to a green BRI.

The investments that Chinese financial institutions choose to make in BRI countries will help shape how China is viewed throughout the region and beyond. In recent years, China has made significant progress domestically in pioneering strategies for greening its financial system. However, this progress has only extended to China’s overseas investments in a limited manner (Gallagher and Qi 2018). While Chinese policymakers have called for a green BRI, internal pressures exist in China to find

markets and investment opportunities internationally for traditional industries. This can lead to perceptions that China is exporting pollution through the BRI by transferring traditional industries abroad (Li 2017; Guo 2017). To address this risk, Chinese policymakers will need to make decisions not only on the use of the government’s special funds but also on how to influence the wider flows of Chinese overseas finance.

The purpose of this paper is to assess whether and how Chinese financial flows align with the mid- to long-term energy and transportation investment priorities that BRI countries have conveyed through their NDCs. To that end, this paper analyzes the nature and characteristics of past Chinese energy- and transportation-sector investments in BRI countries, provides an overview of the needs articulated for these sectors in the NDCs of BRI countries, and discusses the prospects for alignment between Chinese investments and BRI countries’ NDC priorities. This paper covers the 56 BRI countries that have country-specific NDCs (see Appendix A for full list). The 11 countries that jointly submitted one NDC as part of the European Union are excluded from this paper. The next section describes the methodology and data.

METHODOLOGY AND DATA

This paper focuses on the energy and transportation sectors because they tend to receive the most extensive coverage in NDCs relative to other sectors. While most NDCs provide information on many sectors—including agriculture, land use, land-use change and forestry (LULUCF), and waste—renewable energy and transportation are typically treated in greater depth, and they are of special significance because they generally account for the largest share of a country’s proposed greenhouse gas emissions (GHG) reductions (UNFCCC 2016a). In addition, energy and transportation are among the top policy priority areas of BRI and are frequently mentioned in Chinese government documents related to BRI, while agriculture, LULUCF, and waste are seldom included, for example, in the foundational document *Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road*.

This paper analyzes the composition of Chinese past energy and transportation investments in 56 BRI countries starting in 2014, when countries started preparing their Intended NDCs, based on a decision by the UNFCCC Conference of the Parties at COP 19 in November 2013.⁴ Although most countries submitted their Intended NDCs in 2015, many of them already had national climate strategies or action plans in place in 2014, and these were referenced in many NDCs (IEA 2018a). The coverage of our dataset ends in 2017. As an important caveat, these data provide insights into Chinese institutions’ investment choices; they do not indicate what alternatives to these choices were or were not available at the time.

To provide a comprehensive coverage of Chinese investments in BRI countries, we created an investment-level database that captured four types of investments from 2014 to 2017 (see Table 1).

Table 1 | **Types of Chinese Investments in BRI Countries Covered and Data Sources**

TYPE	SUBTYPE	COVERED SECTORS	DATA SOURCES
DEBT	Syndicated loans ^a with participation by: <ul style="list-style-type: none"> ■ Chinese development/policy banks <ul style="list-style-type: none"> □ CDB □ China Eximbank ■ Four largest Chinese state-owned commercial banks <ul style="list-style-type: none"> □ Agricultural Bank of China (ABC) □ Bank of China (BOC) □ China Construction Bank (CCB) □ Industrial and Commercial Bank of China (ICBC) 	Energy and Transportation	<ul style="list-style-type: none"> ■ Thomson ONE ■ Dealogic ■ Bloomberg New Energy Finance (BNEF)
	Loans exclusively financed by CDB and/or China Eximbank ^b	Energy	<ul style="list-style-type: none"> ■ Boston University’s Global Development Policy Center^c
EQUITY	Silk Road Fund (SRF) ^d	Energy and Transportation	<ul style="list-style-type: none"> ■ SRF disclosures ■ Chinese government websites ■ Media reports
	Chinese nonfinancial enterprises <ul style="list-style-type: none"> ■ State-owned enterprises (SOEs) ■ Private-owned enterprises (POEs) 	Energy and Transportation	<ul style="list-style-type: none"> ■ Dealogic

Notes:

^a Syndicated loans are loans financed by at least two banks. The syndicated loans involving at least one of the six banks above (CDB, China Eximbank, ABC, BOC, CCB, and ICBC) are included in this paper.

^b Loans exclusively financed by CDB and/or China Eximbank are loans financed by CDB only, by China Eximbank only, and by CDB and China Eximbank only. There is a potential overlap between the third category and syndicated loans. After cross-checking the two datasets project by project, the authors find no overlap between the two types of loans.

^c The authors include two types of data to calculate the loan value within the dataset: (1) loan contributions by CDB and/or China Eximbank where explicit contributions are provided. The data used here do not include loans where explicit contributions are not available, which leads to underestimation. After this procedure, the dataset only contains projects financed entirely by CDB and/or China Eximbank. (2) Project costs of the projects financed entirely by CDB and/or China Eximbank are used, instead of the loan value, when the loan value is not available. This treatment overestimates loan contributions as it includes the equity part of the project. Given the high-leverage ratio of infrastructure projects, this treatment may overestimate by 10 to 20 percent.

^d SRF provides both equity and loan financing, but it is classified as an equity provider in this paper because it is strategically positioned as an equity fund; all projects that it financed include equity finance, and more than half of the projects it financed are equity-finance only.

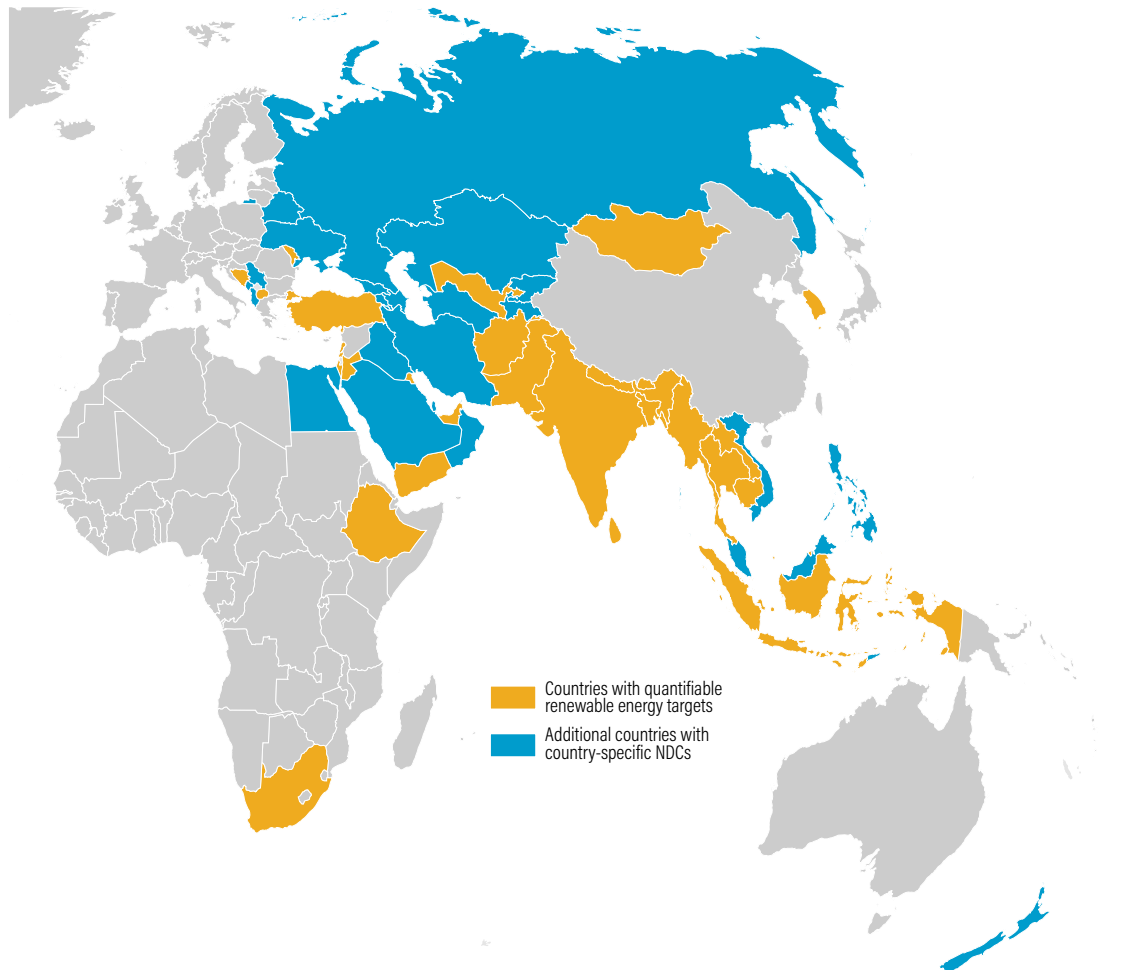
Source: Authors’ compilation based on Dealogic (2018), Thomson ONE (2018), BNEF (2018), Boston University (2018), SRF disclosures, Chinese government websites, and media reports.

Although the dataset is fairly comprehensive, there are three major gaps in data coverage: (1) transportation-sector loans exclusively financed by CDB and/or China Eximbank, (2) energy- and transportation-sector loans financed by a single state-owned commercial bank, and (3) energy- and transportation-sector loans from smaller Chinese commercial banks. Domestically, CDB has a large transportation portfolio, and given the large size of transportation-sector investments, it is possible that CDB and China Eximbank have financed a considerable volume of transportation-sector deals in the BRI countries (CDB 2018). However, the authors lacked the necessary data to make reliable assessments of the potential size of this gap. The second data gap is likely to have limited impacts on the data coverage. Commercial banks usually provide loans to infrastructure projects in a syndicate of banks, rather than individually; this helps the banks spread the

large risk of a single project across multiple financial institutions. As a result, infrastructure loans financed by a single state-owned commercial bank are likely to be very limited (Ehlers 2014). The impact of the third data gap on the data coverage is uncertain. All Chinese medium- and small-sized state-owned commercial banks combined had an outstanding balance of overseas loans equivalent to about two-and-a-half times the balance held by the four largest state-owned commercial banks combined. However, the portion of these loans in BRI countries' energy and transportation sectors is unknown. (People's Bank of China 2018a, 2018b).

This paper analyzes the NDCs of 56 BRI countries and provides insights on the renewable energy and transportation investment opportunities envisioned in the NDCs. Without standardized form or guidance, current NDCs are heterogeneous in terms of their form, structure, and

Figure 2 | **The 56 BRI Countries Covered by This Study**



Disclaimer: This map is for illustrative purposes and does not imply the expression of any opinion on the part of WRI concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

content. We therefore use different methods to estimate investment opportunities for the renewable energy and transportation sectors, depending on each NDC’s content and the robustness of available methods. Using a methodology developed by the International Renewable Energy Agency (IRENA) (2017d), this paper quantifies the lower end of the renewable-energy investment opportunities in 31 BRI countries by translating the renewable energy contributions in the NDCs into monetary terms.⁵ The 31 countries are those whose NDCs contain quantifiable renewable-energy contributions (see Figure 2). A full description of the methodology and data is included in Appendix B.

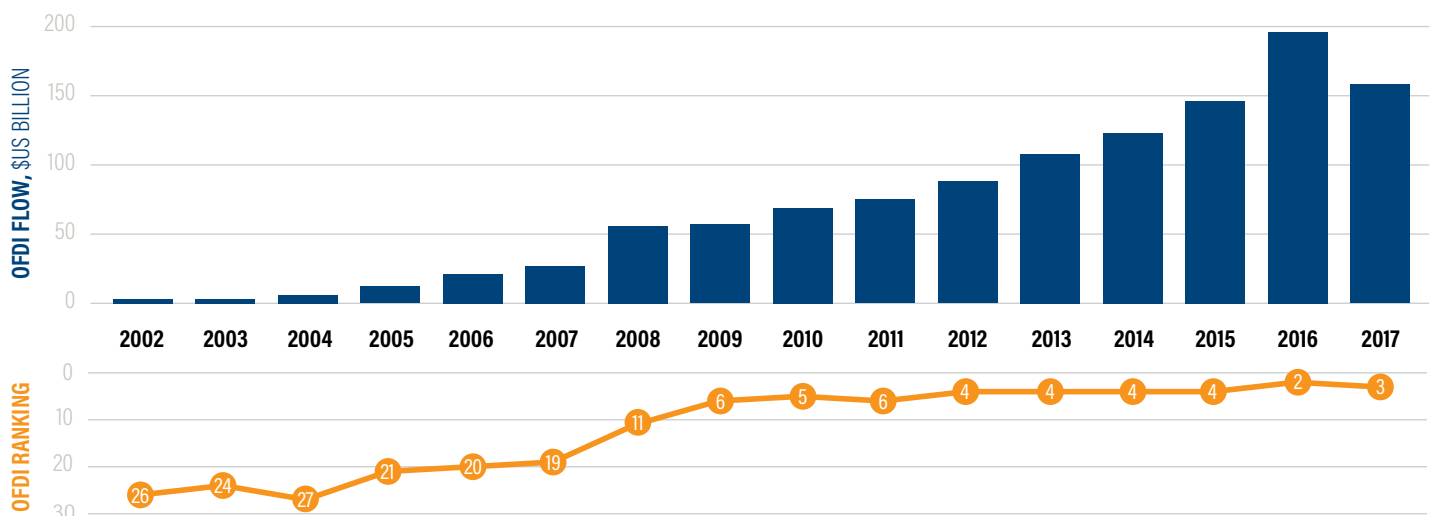
However, most BRI-country NDCs only contain qualitative information on the transportation sector without quantifiable elements. For example, Thailand’s NDC calls for “extensions of mass rapid transit lines, construction of double-track railways and improvement of bus transit in the Bangkok Metro areas,” with no further detail on the number of lines or length of railways to be constructed (UNFCCC 2015). Even for quantifiable elements included in a few BRI countries’ NDCs, there is no robust and consistent methodology to estimate and aggregate them in monetary terms. For example, Mongolia’s NDC aims to “improve Ulaanbaatar city road network to decrease all traffic by 30–40% by 2023”. (UNFCCC 2016c) Given these challenges, this paper uses a simplified method to show the general investment direction needed to implement NDCs based on numbers of countries mentioning transportation intervention measures in their NDCs.

CHINESE INVESTMENTS IN BRI COUNTRIES

China Development Bank (CDB), China Eximbank, and the Big Four state-owned commercial banks—Agricultural Bank of China (ABC), Bank of China (BOC), China Construction Bank (CCB), and Industrial and Commercial Bank of China (ICBC)—are the leading Chinese banks currently financing projects in BRI countries. The six banks have accumulated rich experience financing domestic infrastructure and have been increasingly expanding their overseas business since China issued its “Go Global” policy in 2001 (Institute of International Finance 2014). The participation of Chinese policy, development, and commercial banks in the BRI means that BRI countries have access to a wide range of financing options at different terms.

The Chinese government established the SRF, which is primarily an equity investment fund, to complement bank financing for BRI countries. In 2014, China made an initial capital contribution of \$40 billion and added another \$14.5 billion in 2017, bringing the total capital to \$54.5 billion. In addition to the SRF, Chinese enterprises are another important source of equity investments. Following the announcement of the “Go Global” strategy, China’s OFDI, a measure of overseas equity investments, has been slowly increasing. After a brief pause after the 2008–09 global financial crisis, Chinese OFDI accelerated, and in 2016, China became the second-largest country in terms of OFDI flows (Figure 3).

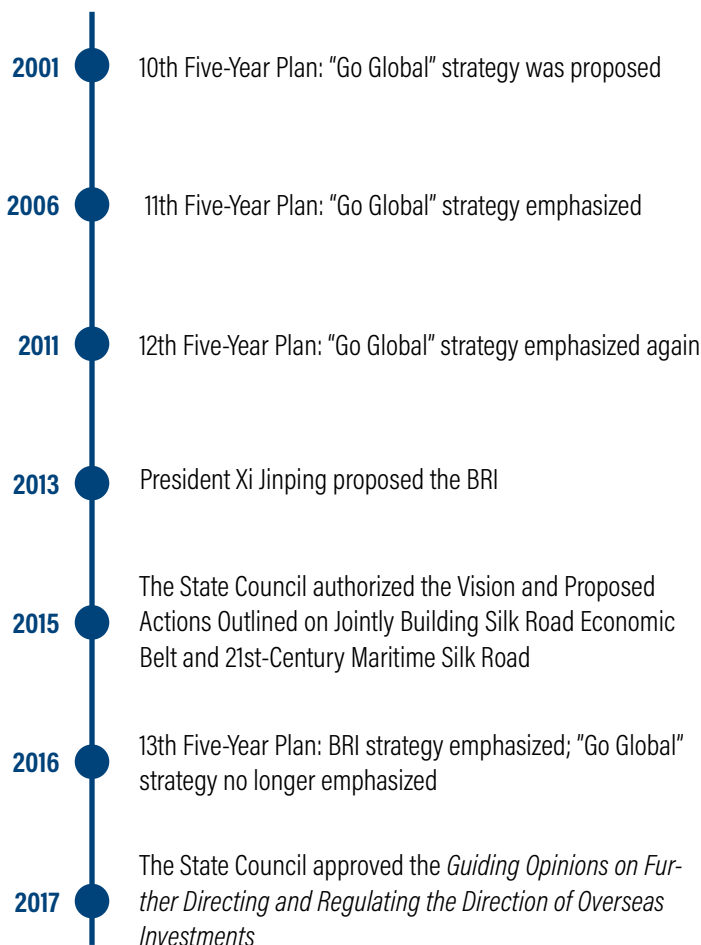
Figure 3 | China’s OFDI Flow in US\$ Billion and Global Ranking, 2002-2017



Source: MOFCOM 2018; UNCTAD 2018.

Chinese investment in BRI countries will likely continue to rise as Chinese overseas investment policy shifts from “Go Global” to BRI (Figure 4). As shown by OFDI statistics in Figure 3, China’s nonfinancial global OFDI dropped by nearly 20 percent in 2017, as the Chinese government curbed so-called “irrational investments” in activities and assets such as real estate development, hotels, and sport clubs. (MOFCOM 2018). But even then, investment in BRI countries increased by 31.5 percent as China prioritized infrastructure investment in BRI countries (MOFCOM 2018). In August 2017, four ministries issued the *Guiding Opinions on Further Directing and Regulating the Direction of Overseas Investments (the Guiding Opinions)* to provide formal policy guidance.⁶ The State Council, which rarely involves itself in policies at the ministry level, approved the *Guiding Opinions* and redistributed them to local governments and other ministries, sending a strong signal that banks and corporations should invest in BRI countries.

Figure 4 | **China’s Policy Shift from “Go Global” to BRI**



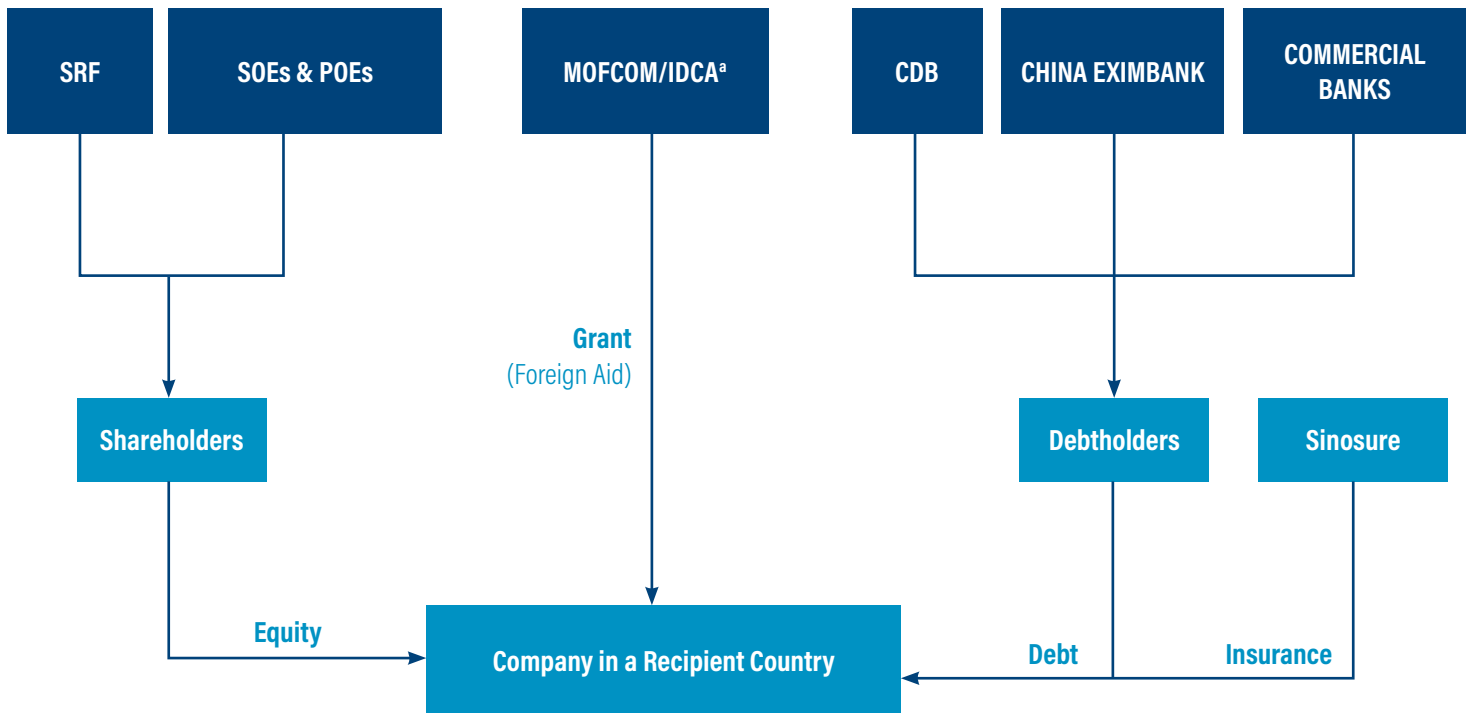
Source: Authors’ compilation from Chinese government documents.

Chinese financial institutions and enterprises offer different types of financing, and it is important to note how these investments can flow into a company in a recipient country. Building on Lin and Wang (2017), Chin and Gallagher (2019), and Moody’s (2017), Figure 5 depicts the possible interactions that can occur across different types of Chinese overseas financial flows. Some projects and companies may have only one type of Chinese overseas financial flow, but various types can be implicitly blended together in many ways.

This chapter analyzes four types of Chinese investments, as listed in Table 1: (1) syndicated bank loans provided by the six Chinese banks, which serve as debtholders of a company in a recipient country and often collaborate with other non-Chinese banks; (2) energy-sector loans exclusively provided by CDB and/or China Eximbank, which serve as debtholders; (3) equity investments by the SRF, which serves as a shareholder; and (4) equity investments by Chinese SOEs and POEs, which serve as shareholders.

While grant finance (foreign aid) is also potentially important for many BRI countries, data on Chinese foreign aid are scattered, and official datasets do not provide detailed information on destination countries. Also, current OECD statistical standards allow governments to provide a single aid figure that combines grants and concessional loans (OECD 2018b). Combining official aid figures for a country or a project with data from other sources on policy bank loans runs the risk of double-counting. Therefore, we do not try to incorporate any estimates of grant-based foreign aid.

Figure 5 | A Simplified Illustration of Potential Involvement across Types of Chinese Overseas Financial Flows



Note: ^a MOFCOM was responsible for foreign aid until the newly established International Development Cooperation Agency took over the responsibility on April 18, 2018 (State Council 2018).
 Source: Authors' analysis based on Lin and Wang (2017), Chin and Gallagher (2019), and Moody's (2017).

Syndicated Bank Loans

Infrastructure projects, including in the energy and transportation sectors, are typically financed through bank loans. Large projects in particular are usually financed by a syndicate of banks rather than by a single bank. The risk involved in these projects is large, partly because the period between construction and the generation of positive cash flows is long. Syndication helps diversify the risk borne by any single financial institution. Although syndicated loans are only a subset of all bank loans for infrastructure projects, they likely represent the bulk of the loan financing volume, as syndicated loans are more likely to be used for larger projects (Ehlers 2014). Therefore, we focused this part of our analysis on syndicated loan data.

To comprehensively analyze the energy- and transportation-sector syndicated loans in which the six Chinese banks participated, we created a master dataset by obtaining data from two proprietary financial service firms, Dealogic and Thomson ONE (Dealogic 2018; Thomson ONE 2018). It is likely that the two sources do not provide complete coverage of the syndicated loan universe,

especially in developing countries where transparency is sometimes lacking (IMF 2015). However, academics and financial sector analysts recognize these two sources as the best available for syndicated loans.⁷ To further improve the coverage, we complemented the two sources with renewable-energy project finance data from BNEF and eliminated duplicative data (BNEF 2018).

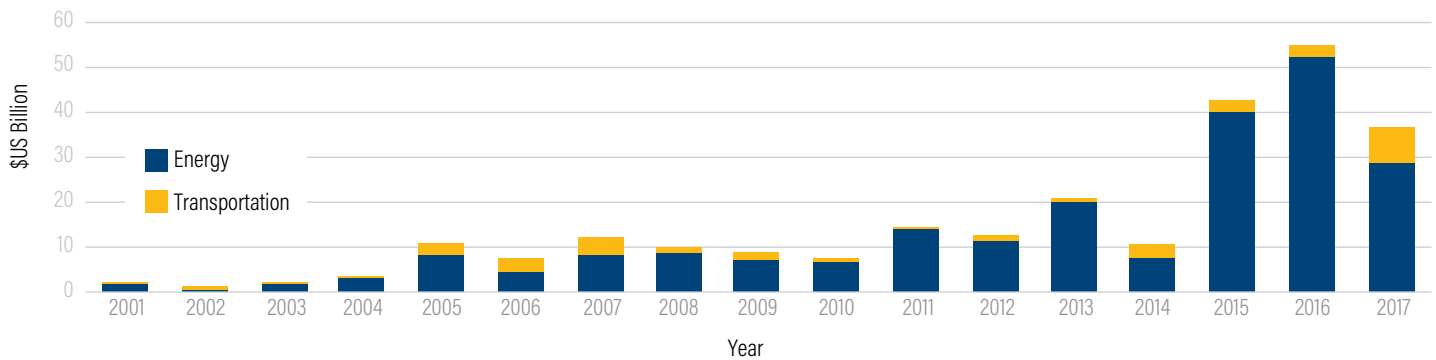
The actual loan contributions by individual banks within the consortia were not available for many transactions. For example, CDB, BOC, CCB, and ICBC were among 18 banks in a \$592 million syndicated loan in Indonesia, while ICBC was the only Chinese bank among 14 banks in a \$200 million syndicated loan in Bangladesh (Thomson ONE 2018). However, neither transaction provided a detailed breakdown of contributions by individual banks. The data do, however, provide a reliable insight into the frequency with which Chinese banks participate in syndicated loans in BRI countries and the scale of the transactions in which they participate.

Participation by the six Chinese banks in energy- and transportation-sector syndicated loans has picked up

considerably since 2015, coinciding with the strong policy signal sent by the State Council through the *Vision and Proposed Actions Outlined on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road* (Figure 6). The six Chinese banks participated in \$36 billion to \$54 billion worth of syndicated loans annually in the energy and transportation sectors from 2015 to 2017. That is three times more than in the period 2012 to 2014.

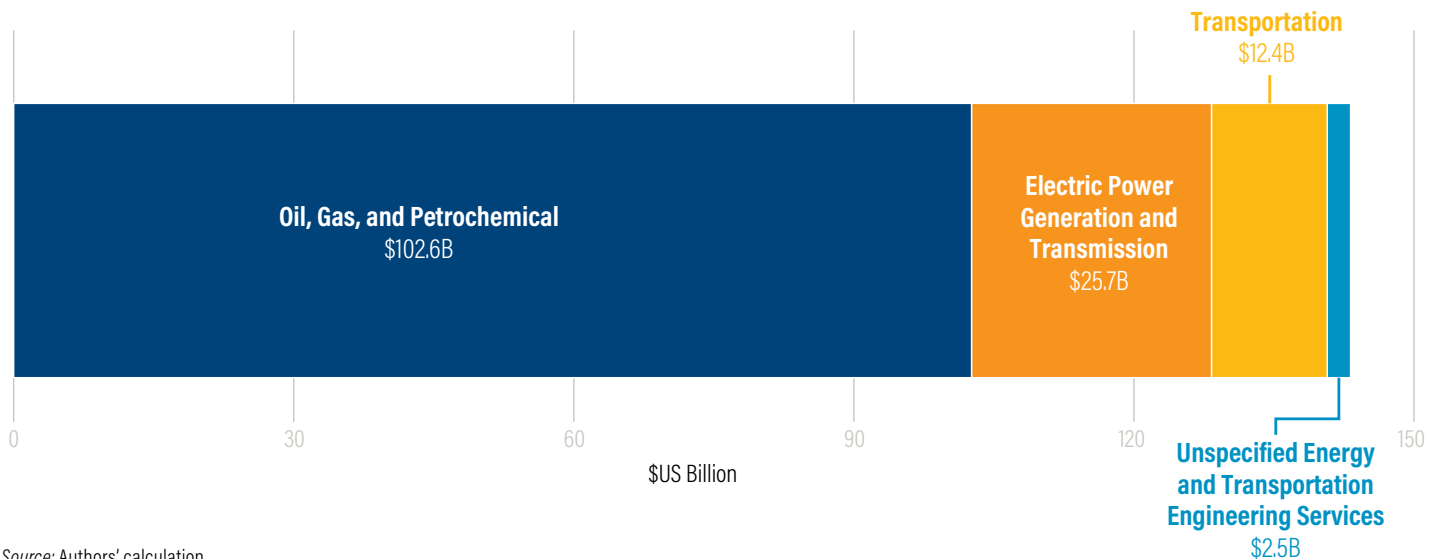
From 2014 to 2017, the six Chinese banks participated in syndicated loans worth \$143 billion for 165 energy and transportation projects in 32 BRI countries. The loan portfolio is heavily concentrated in energy projects (90 percent of total syndicated loan volume), especially in the oil, gas, and petrochemical industries (72 percent of the total syndicated loan volume; see Figure 7). Transportation syndicated loans represented only 9 percent of the total syndicated loans in which the six Chinese banks participated.

Figure 6 | **New Energy- and Transportation-Sector Syndicated Loans with Participation from CDB, China Eximbank, ABC, BOC, CCB, or ICBC per year in BRI Countries, in US\$ Billion, 2001-2017**



Source: Authors' calculation.

Figure 7 | **Sector Distribution of Syndicated Loans with Participation from CDB, China Eximbank, ABC, BOC, CCB, or ICBC in BRI Countries, in US\$ Billion, 2014-2017**

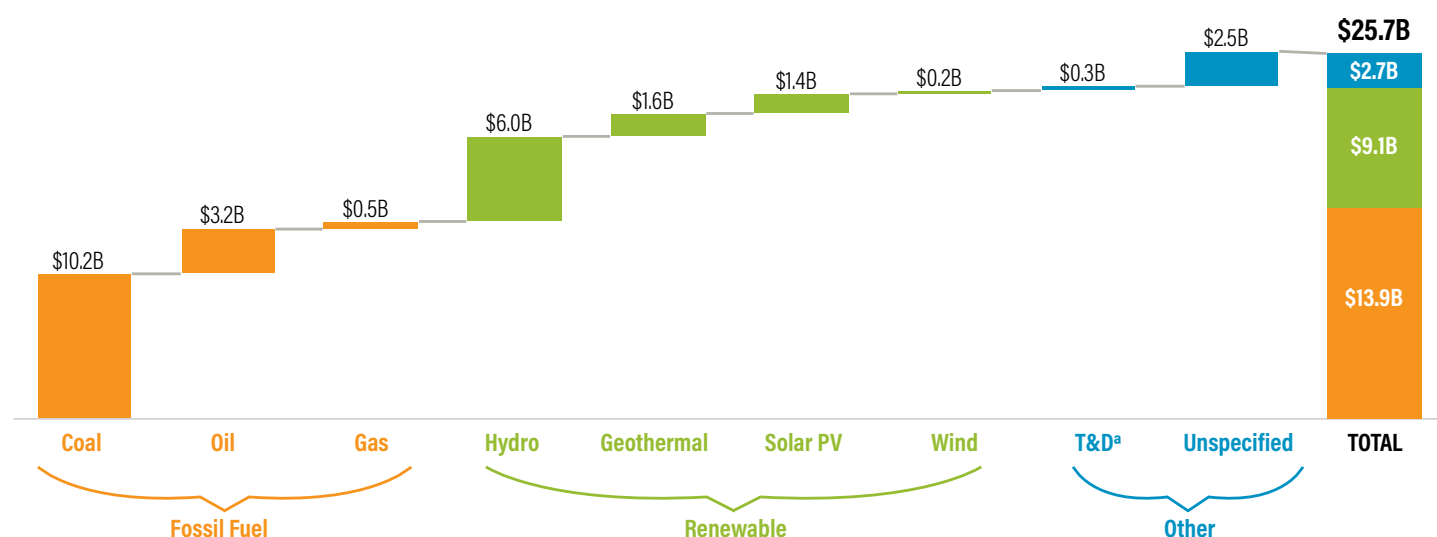


Source: Authors' calculation.

Within the electric power generation and transmission sector, over half (54 percent, or \$14 billion) of the syndicated loans were used to finance fossil-fuel power plants, including \$10 billion for coal-fired power plants (see Figure 8). About a third of the syndicated loans were used to finance renewable energy; two-thirds of that amount was for hydropower in Pakistan (see Figure 9). Apart from hydropower, the six Chinese banks supported syndicated loans of geothermal power in Indonesia, solar PV in Egypt and the Republic of Korea, and wind power in Pakistan and India.

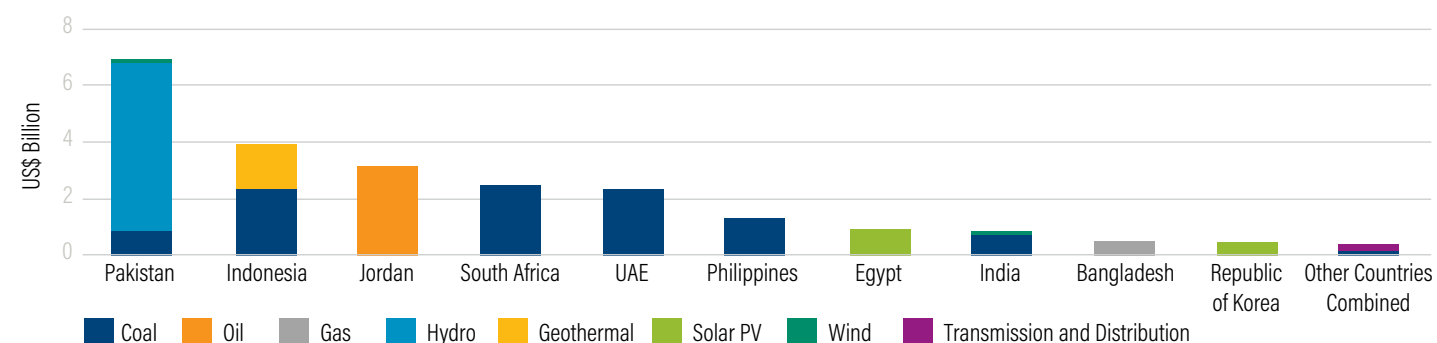
Some of the countries in which Chinese financial institutions focused their investments on fossil-fuel projects have ambitious plans to develop renewable energy. For example, South Africa and India have put forward ambitious renewable-energy plans in their NDCs. South Africa already approved 5.2 GW of renewable-energy projects with private investment, totaling \$16 billion, and 6.3 GW of renewable energy projects were under consideration when South Africa submitted its NDC in November 2016 (UNFCCC 2016d). India, the largest GHG emitter among the 56 BRI countries, has committed to decarbonizing its energy sector and aims to have 100 GW of solar by 2022

Figure 8 | Subsector Distribution of Syndicated Loans in the Electric Power Generation and Transmission Sector with Participation from CDB, China Eximbank, ABC, BOC, CCB, or ICBC in BRI Countries, in US\$ Billion, 2014-2017



Note: ^a T&D: Transmission and Distribution.
Source: Authors' calculation.

Figure 9 | Subsector, Country-Level Distribution of Syndicated Loans in the Electric Power Generation and Transmission Sector with Participation from CDB, China Eximbank, ABC, BOC, CCB, or ICBC in BRI Countries, in US\$ Billion, 2014-2017



Source: Authors' calculation.

(from 4 GW in 2015) and 60 GW of wind by 2022 (from 24 GW in 2015) (UNFCCC 2016b).⁸

The transportation-sector syndicated loans in which the six Chinese banks participated focused primarily on air transportation, including aircraft financing and airport operation (60 percent), as well as road construction (27 percent). Public transportation systems (railway and local and suburban transit) only represented 8 percent of the total transportation syndicated loan volume (see Figure 10). The six Chinese banks only participated in one local and suburban transit syndicated loan for a New Zealand company, valued at \$16 million.

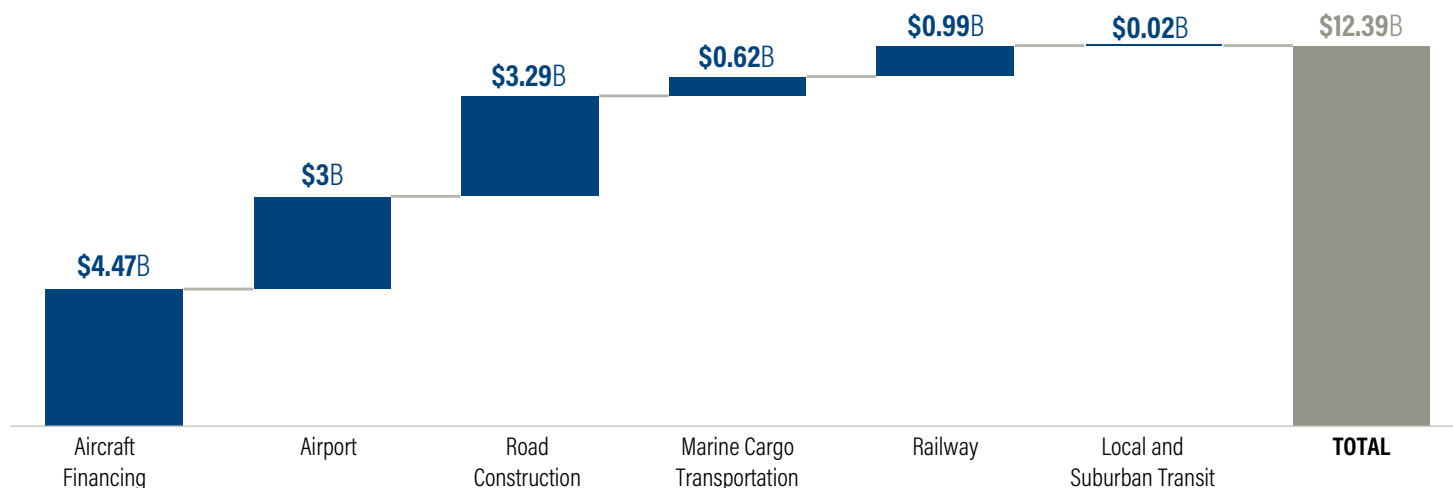
Energy-Sector Loans Exclusively Provided by CDB and China Eximbank

Bilateral aid agencies, national development banks, and export credit agencies finance infrastructure in developing countries, usually providing loans at lower costs and/or longer terms than commercial banks. For example, the Japan Bank for International Cooperation and the

Korea Export-Import Bank are large players in infrastructure financing in Asian developing countries (Ehlers 2014). CDB, China’s national development bank, and China Eximbank, the Chinese export credit agency, are increasingly becoming some of the largest providers of energy-sector finance among development banks (Kong and Gallagher 2017). The two banks are also increasingly important providers of energy financing to BRI countries. We used the dataset of CDB and China Eximbank energy finance created by Boston University’s Global Development Policy Center to analyze energy-sector loans exclusively provided by CDB and China Eximbank in BRI countries (Boston University 2018). The dataset used for this section contains deals exclusively financed by CDB and/or China Eximbank, and we ensured that there is no overlap with the syndicated loans reviewed in the previous section.⁹

From 2014 to 2017, CDB and China Eximbank provided an estimated \$44.7 billion worth of energy-sector loans to BRI countries. The share of lending to oil, gas, and petrochemical projects in the two banks’ energy-sector

Figure 10 | **Distribution of Syndicated Loans in the Transportation Sector with Participation from CDB, China Eximbank, ABC, BOC, CCB, or ICBC in BRI Countries, in US\$ Billion, 2014–2017**

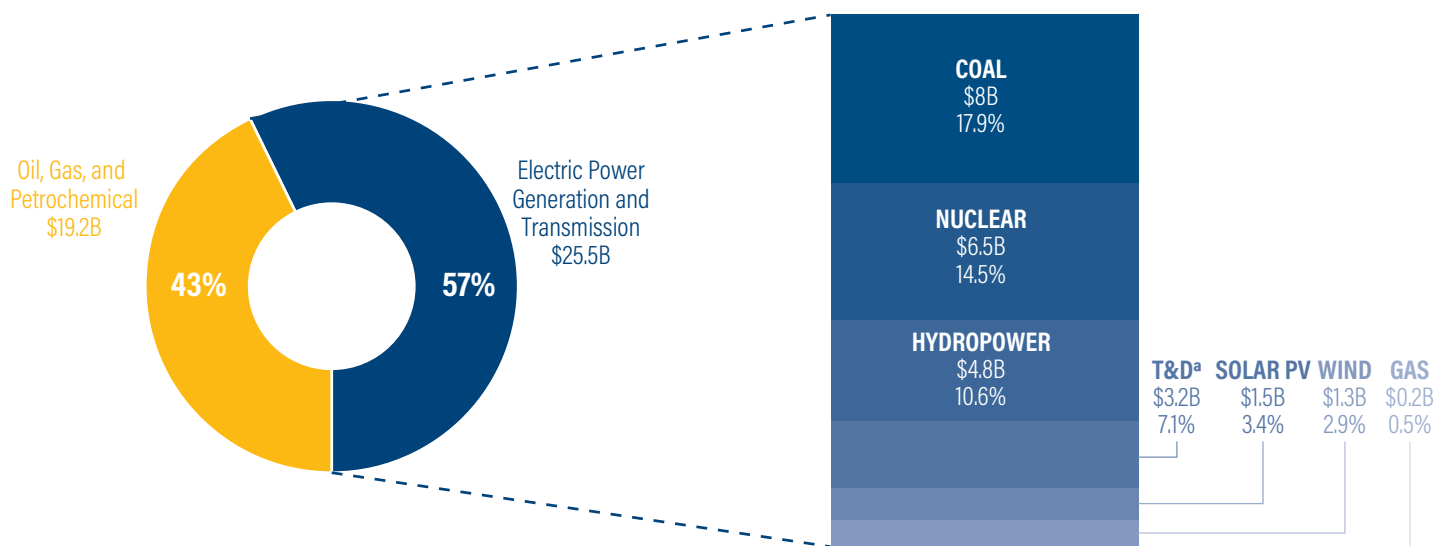


Source: Authors' calculation.

portfolios was smaller than was the case with the syndicated loans discussed earlier, but at 43 percent, it was still very significant. CDB and China Eximbank did most of their energy-sector lending to electric power generation and transmission projects (Figure 11). Of those, coal-fired power generation projects received the most loans, reflecting a similar emphasis on fossil fuels as we saw in syndicated-loan participation. The second-largest power generation technology was nuclear; the figure reflects a single large loan (\$6.5 billion) from China Eximbank to build a nuclear power plant in Pakistan (China Daily 2014). Solar PV and wind power combined received only 5.3 percent (\$2.4 billion) of the two banks' total energy lending.

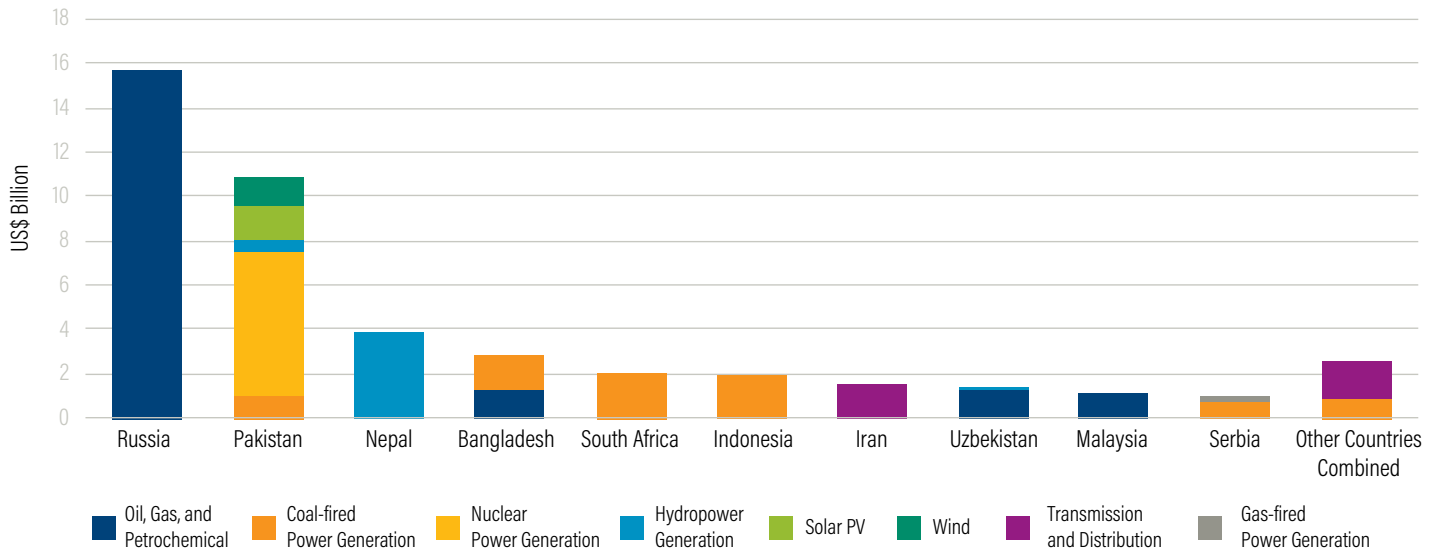
In contrast to the syndicated loans mentioned earlier, which mostly went to borrowers in high-income BRI countries, CDB and China Eximbank lent primarily to the energy sectors of developing BRI countries (see Figure 12). This is probably explained by the fact that CDB and China Eximbank are willing to take larger risks than commercial banks given their development- and policy-oriented objectives. In terms of geographic focus, CDB and China Eximbank invested most heavily in Russia, followed by Pakistan (see Figure 12).

Figure 11 | Energy-Sector Loans Provided Exclusively by CDB and China Eximbank in BRI Countries, in US\$ Billion and Percentage, 2014-2017



Note: ^a T&D: Transmission and Distribution.
 Source: Authors' calculation.

Figure 12 | Energy-Sector Loans Provided Exclusively by CDB and China Eximbank to BRI Countries, by Country, in US\$ Billion, 2014-2017



Source: Authors' calculation.

Equity Investments from the Silk Road Fund

As mentioned earlier, the Chinese government has so far contributed a total of \$54.5 billion to the SRF. Almost two-thirds of the initial capital installment of \$10 billion came from China's foreign reserves, and the rest came from the China Investment Corporation (15 percent), China Eximbank (15 percent), and CDB (5 percent) (SCIO 2015a). The SRF was conceived as a strategic arrangement to diversify China's foreign reserves and earn long-term equity investment returns while China keeps 65 to 70 percent of foreign reserves in U.S. debt securities (Yu 2013). The SRF has positioned itself as a medium- to long-term private-equity fund with an investment horizon of 15 years. The goal is to go beyond the time horizons of most private equity funds, which tend to be 7 to 10 years, and bridge the long-term infrastructure equity investment gap (Yicai 2015). Equity financing from the SRF adds another financing option to the instruments available from CDB, China Eximbank, and the state-owned commercial banks.

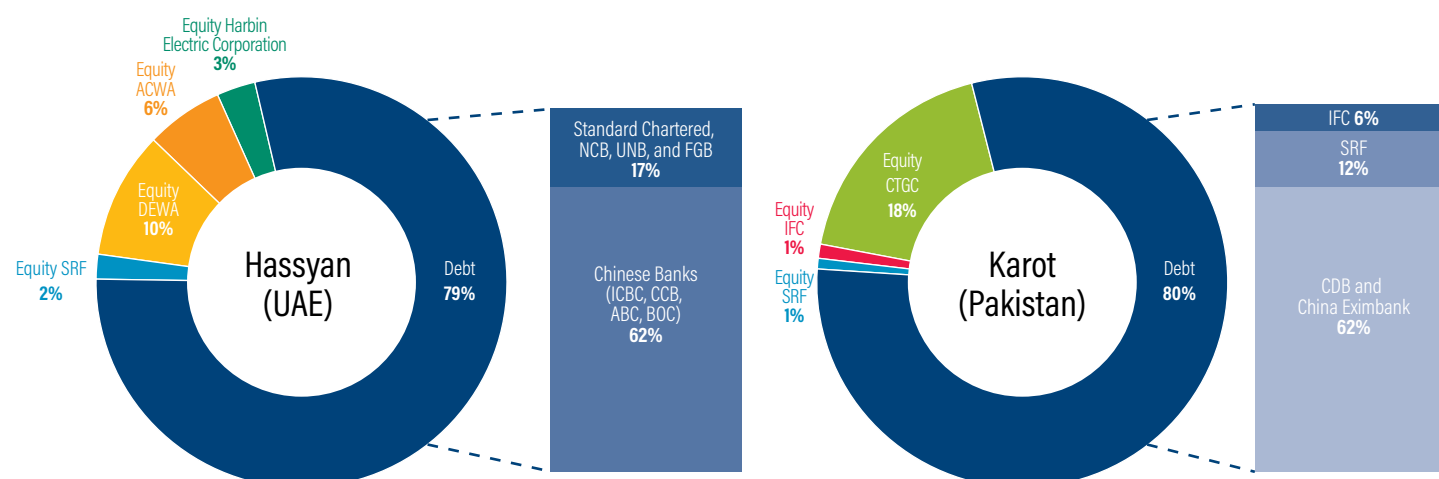
By the end of 2017, the SRF had signed 17 projects and had committed \$7 billion (Xinhua 2017b). Five of the 17 projects are in the energy sector and none are in the transportation sector of BRI countries. About half of the commitments (\$3.4 billion) went to oil, gas, and petrochemical companies in Russia (Table 2). SRF also invested in three electric power-generation projects, including a coal-fired power plant in the UAE, a hydropower plant in Pakistan, and a Combined Cycle Gas Turbine (CCGT) power plant in Egypt. The SRF contributed equity to all the projects above as a minority shareholder. Figure 13 illustrates the financing structure of the Karot hydropower plant in Pakistan and the Hassyan coal-fired power plant in the UAE. According to SRF Chairman Qi Jin, even though the SRF's equity investments were relatively small, they had significant credit-enhancement effects that helped attract debt financing, especially from Chinese banks (Ma 2017). The two power-plant projects reached financial closure with a total \$3 billion in loans from Chinese banks following the SRF's equity investment.

Table 2 | Energy-Sector Investments Made by SRF in the BRI Countries, 2014-2017

TARGET COMPANY	COUNTRY	YEAR	AMOUNT (\$ BILLION)	INSTRUMENT	SECTOR
Novatek	Russia	2015	2.00	Equity and Debt	Oil, Gas, and Petrochemicals
PJSC Sibur Holding	Russia	2016	1.26	Equity	Oil, Gas, and Petrochemicals
Karot Hydropower Plant	Pakistan	2015	0.25	Equity and Debt	Hydropower Generation
Hassyan Coal-fired Power Plant	UAE	2016	0.05	Equity	Coal-fired Power Generation
Dairut CCGT Power Plant	Egypt	2016	NA	Equity and Debt	Gas-fired Power Generation

Source: Authors' compilation based on SRF disclosure and publicly available sources.

Figure 13 | Financing Structures of Hassyan Coal-fired Power Plant and Karot Hydropower Plant



Note: ACWA = Saudi Arabia utility developer ACWA Power; DEWA = Dubai Electricity and Water Authority; CTGC = China Three Gorges Corporation; NCB = Saudi Arabia National Commercial Bank, UNB = UAE Union National Bank, FGB= First Gulf Bank.

Source: MOFCOM 2016a; World Bank 2017.

The complete and detailed SRF energy and transportation portfolio could not be obtained, as the SRF made several investments in funds that do not disclose sufficiently detailed project-level information. By the end of 2017, the SRF had set up or joined four funds partnering with development finance institutions, the private sector, and government (Table 3). These funds usually focus on specific sectors or geographic regions. However, none of them provide detailed information that would enable subsectoral analysis, including by-type-of-fuel analysis in power generation.

Cross-Border Investments by Nonfinancial Enterprises

Chinese nonfinancial enterprises have been major providers of cross-border investments since China launched its “Go Global” strategy. The two main types of cross-border investments by these companies are greenfield investments and mergers and acquisitions (M&A).¹⁰ Between 2014 and 2017, Chinese corporations made \$72.3 billion worth of greenfield and M&A investments in the energy and transportation sectors of 56 BRI countries (Dealogic 2018). The vast majority (86 percent) of Chinese corporations’ cross-border investments were in the energy sector, and most of them were in electric-power generation and transmission (Figure 14). Most transportation-sector investments by Chinese corporations were in automotive manufacturing, rather than infrastructure.

In electric power generation and transmission, Chinese enterprises mainly invested in new power plants rather than acquiring existing ones. This likely reflects high demand in BRI countries for new power plants. For example, most countries in Asia and the Middle East saw double-digit growth in electricity generation between 2014 and 2017. Vietnam, Bangladesh, and the Philippines saw growth exceeding 20 percent, much above the world average of 6.8 percent (BP 2018). High demand for new power plants was also coupled with Chinese enterprises’ transition from international contractors to overseas operators and investors (MOFCOM 2016b).

The investment choices of Chinese SOEs and those made by Chinese POEs vary in some clear respects (see Figure 15). Chinese SOEs invested overwhelmingly in fossil-fuel power generation; that type of generation accounted for 90 percent of their total investments over the period under study. The SOEs invested less than \$1 billion in solar PV and wind over the same period. In contrast, Chinese POEs invested heavily in solar PV and wind power, reaching \$7 billion and \$5.5 billion, respectively, over the four-year period, with India and Pakistan being the top investment destinations. The SOEs’ strong focus on fossil-fuel investments resembles that of CDB, China Eximbank, the four large state-owned commercial banks, and the SRF.

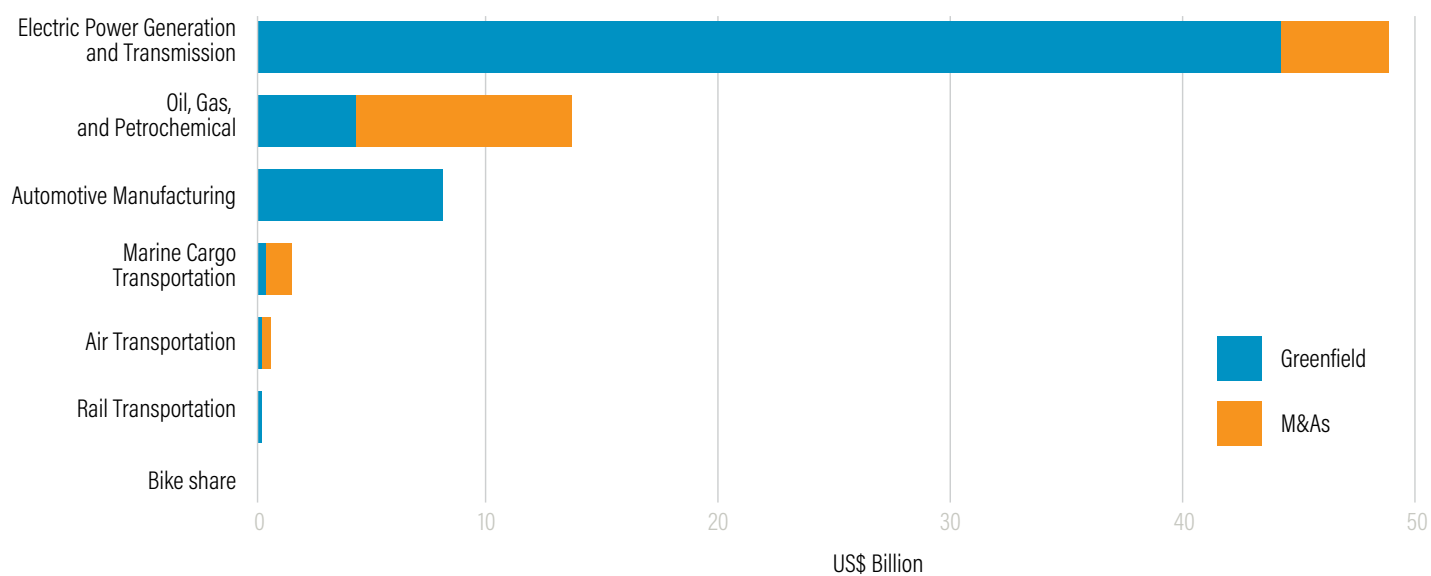
Table 3 | SRF Invested Funds, 2014–2017

FUND	PARTNER	PARTNER TYPE	ANNOUNCED YEAR	INVESTMENT TARGET	FUND SIZE (\$ BILLION)
China-Kazakhstan Cooperation Fund	Kazakhstan	Government	2015	Industrial capacity cooperation projects in Kazakhstan	2
IFC Emerging Asia Fund	International Finance Corporation (IFC) ^a	Developmental Financial Institution	2016	Asia emerging economies	NA
The China-EU Co-investment Fund	European Investment Bank	Developmental Financial Institution	2017	European small- and medium-sized enterprises	0.5
Energy Investment Platform with General Electric	General Electric	Private Enterprise	2017	Energy infrastructure in power generation, power grid, new energy, and oil & gas	NA

Note: ^a IFC is a member of the World Bank Group.

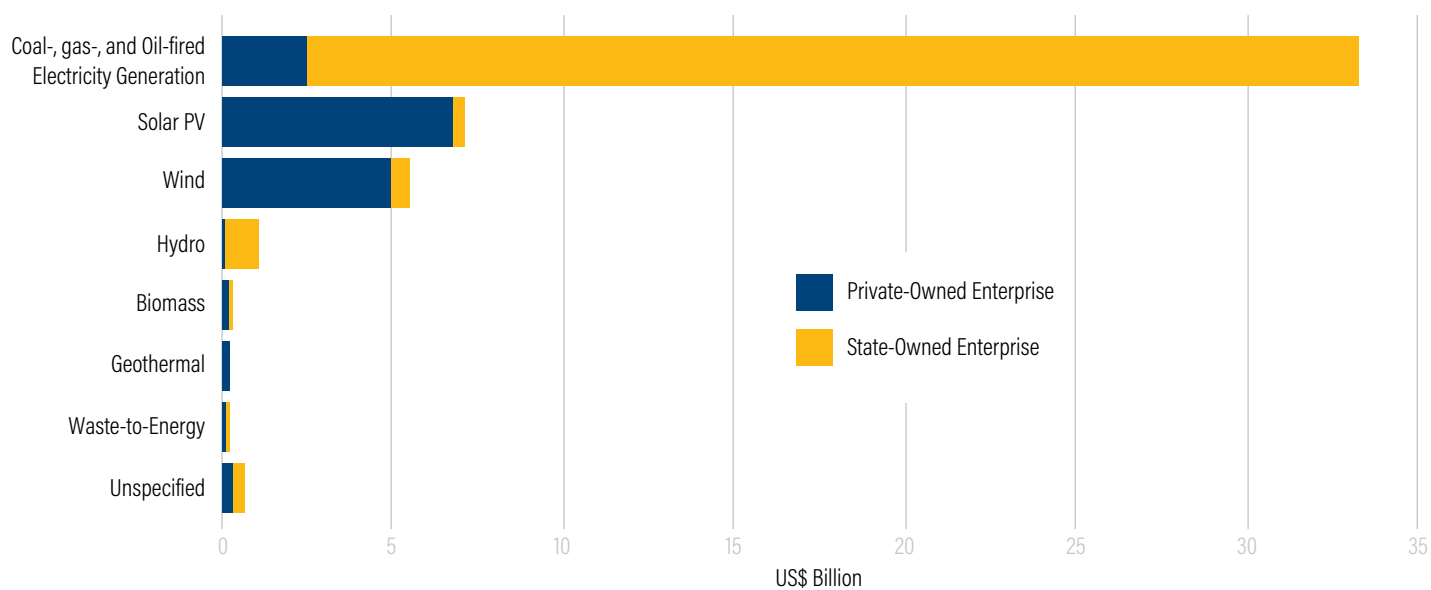
Source: Authors’ compilation based on SRF disclosure and publicly available sources.

Figure 14 | Sector Distribution of Energy and Transportation Greenfield Investments and M&As by Chinese Corporations in 56 BRI Countries, in US\$ Billion, 2014-2017



Source: Authors' calculation.

Figure 15 | Greenfield Investments and M&As by Chinese Corporations in the Electric Power Generation and Transmission Sector by Ownership in 56 BRI Countries, in US\$ Billion, 2014-2017



Source: Authors' calculation. Ownership information is obtained from publicly available sources.

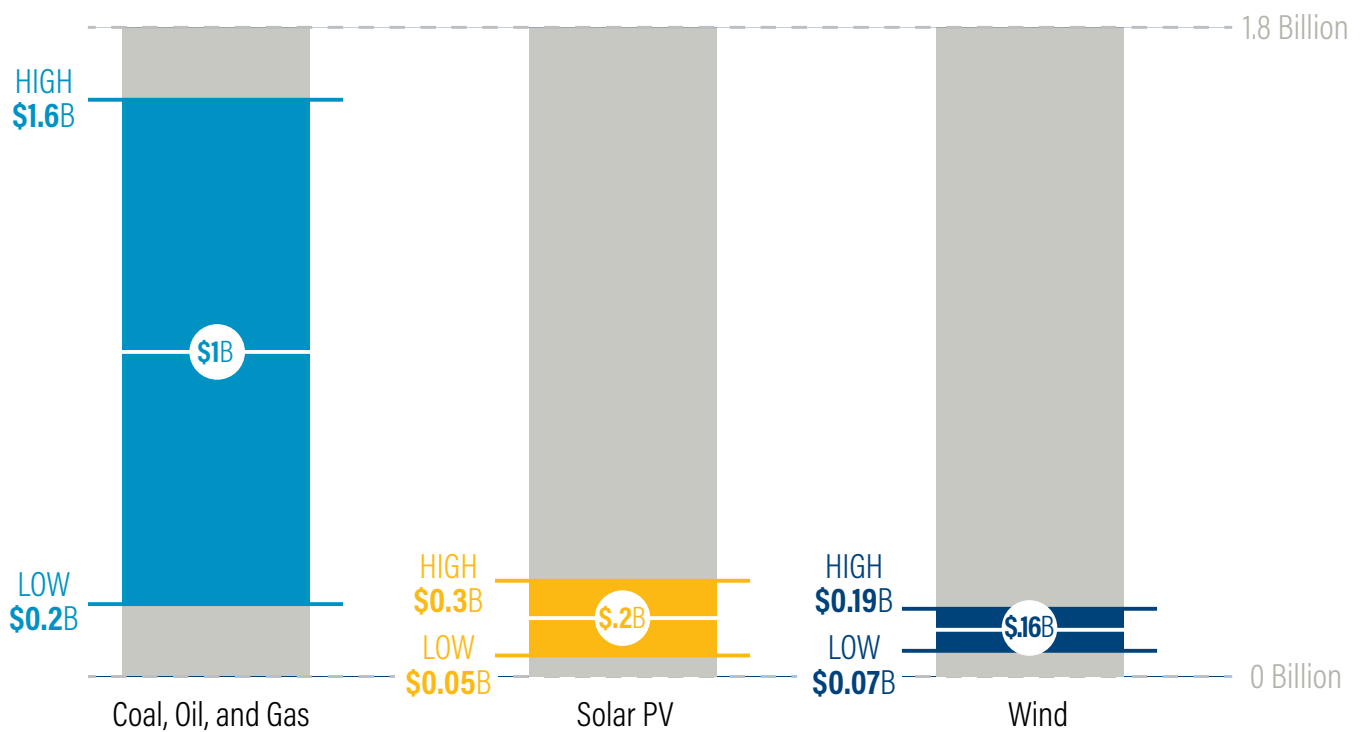
Chinese POEs' preference for investments in renewables in BRI countries could reflect several things. On average, Chinese POEs have more modest internal financial resources than SOEs, and it is comparatively difficult for them to obtain bank loans, especially for cross-border investments (CPPCC 2016). As a result, solar PV and wind projects, which tend to be significantly smaller in financial terms than fossil-fuel power generation projects, may be a more natural fit for POEs (Figure 16). In addition, the transaction costs for cross-border investments may be higher for SOEs than POEs because of SOEs' complex corporate structures and decision-making processes (SDIC 2013). Chinese SOEs may therefore prefer to invest in larger projects to cover high transaction costs, while POEs are less constrained by those costs.

NATIONALLY DETERMINED CONTRIBUTIONS: INVESTMENT OPPORTUNITIES IN RENEWABLE ENERGY AND TRANSPORTATION

NDCs are national climate plans that national governments aim to implement to combat climate change. NDCs typically include climate-related contributions, policies, and measures. Most NDCs include emissions-reduction commitments and have mitigation objectives for 2030 or earlier. Collectively, these country-driven contributions and objectives lay out the global path toward low-carbon development, and they are increasingly recognized by multilateral development banks and incorporated into their strategy and planning processes with client countries (World Bank 2016b; Larsen et al. Forthcoming).

The current crop of NDCs is the first to be submitted to the UNFCCC, and they only amount to about a third of the emissions reductions needed to put the world on a least-

Figure 16 | Greenfield Investments and M&As Deal Value Ranges and Median Deal Values by Chinese Corporations in Coal-, Gas-, and Oil-fired Power Plants, Solar PV, and Wind Power Generation in 56 BRI Countries, in US\$ Billion, 2014-2017



Source: Authors' calculation.

cost pathway for achieving the goal of staying well below 2 degrees Celsius (UN Environment 2017). NDCs are to be updated every five years, and they are intended to become increasingly more ambitious and specific. Given that NDCs are developed by national governments for use by the international community, they are a natural reference point for pursuing a green BRI.

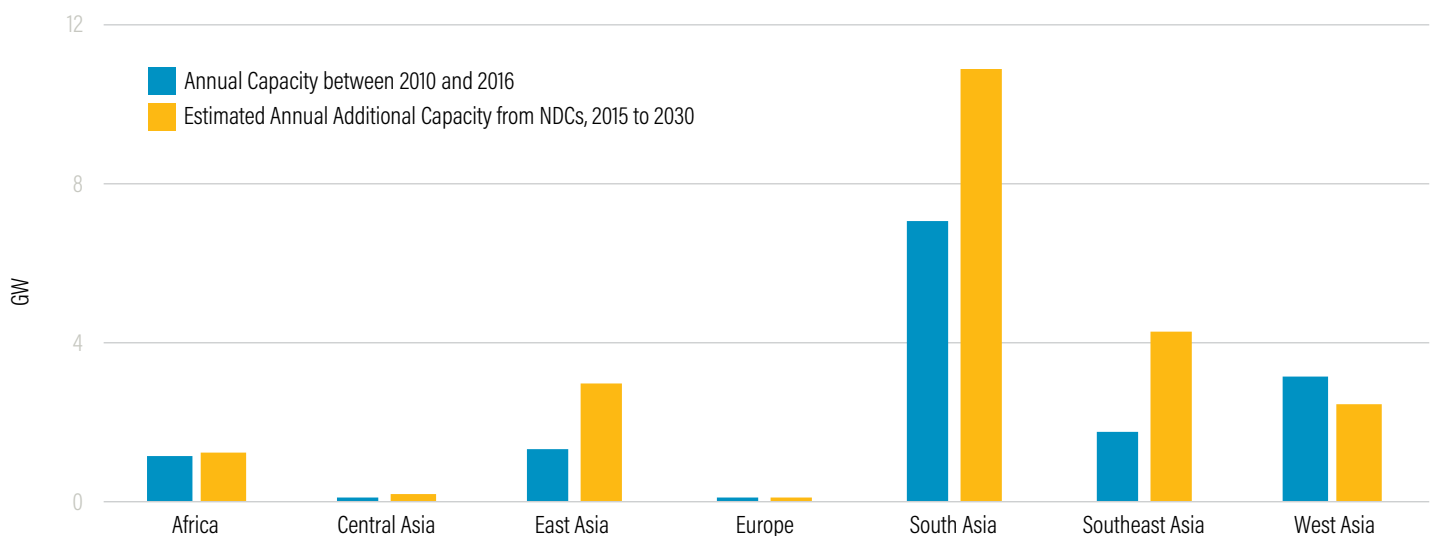
The Renewable Energy Sector

NDCs include a diverse array of qualitative and quantitative commitments regarding renewable energy. Of the 56 BRI countries’ NDCs that we analyzed, 48 contain renewable energy commitments. Of those, 17 are only qualitative, with language such as promoting “greater use of renewable energy sources,” “increasing the share of renewables in the energy system,” or referring to existing national policies. These statements indicate national interest and likely growing future demand for renewable energy, but they are not sufficiently detailed to enable further analysis from the NDC alone. In some cases, countries may have developed more detailed energy-sector strategies but chose not to include the details in the NDCs. The remaining 31 NDCs include contributions with quantitative elements, such as targets for installed renewable capacity in megawatts (MW), or percentages of electricity consumption by a target year. Many NDCs contain a combination of qualitative and quantitative commitments.

We evaluated the quantitative renewable energy contributions of the 31 BRI countries’ NDCs (Figure 2 and Appendix B) in monetary terms. The methodology used was adopted from Munoz Cabré and Sokona (2016), IRENA (2017a), Munoz Cabré et al (2018), and suggestions by Agha et al (2018). A full description of the methodology is included in Appendix B. Appendix C includes renewable energy contributions in each country’s NDC, while Appendix D provides the estimation of additional installed capacity and investments needed by country by technology based on the methodology and BRI countries’ NDCs.

We estimate that the cumulative renewable energy commitments identified in the 31 BRI countries’ NDCs up to 2030 would lead to at least 327 GW of newly installed capacity,¹¹ or about at least 22 GW annually, if linearly deployed.¹² According to the NDCs, accelerated renewable energy deployment is expected in six of the seven regional markets: Africa, Central Asia, East Asia, Europe, South Asia, and South-east Asia (Figure 17). Countries in South Asia are estimated to have the largest absolute growth, from 7 GW annually in the period 2010–2016, to 10.8 GW annually in the period 2015–2030 as a result of NDC implementation. Southeast Asia is estimated to experience significant growth from 1.7 GW annually in the period 2010–2016, to 4.3 GW annually in the period 2015–2030.

Figure 17 | Average Annual Renewable Energy Installed Capacity Added from NDCs as Compared to 2010 to 2016, by Region in 31 BRI countries, in GW



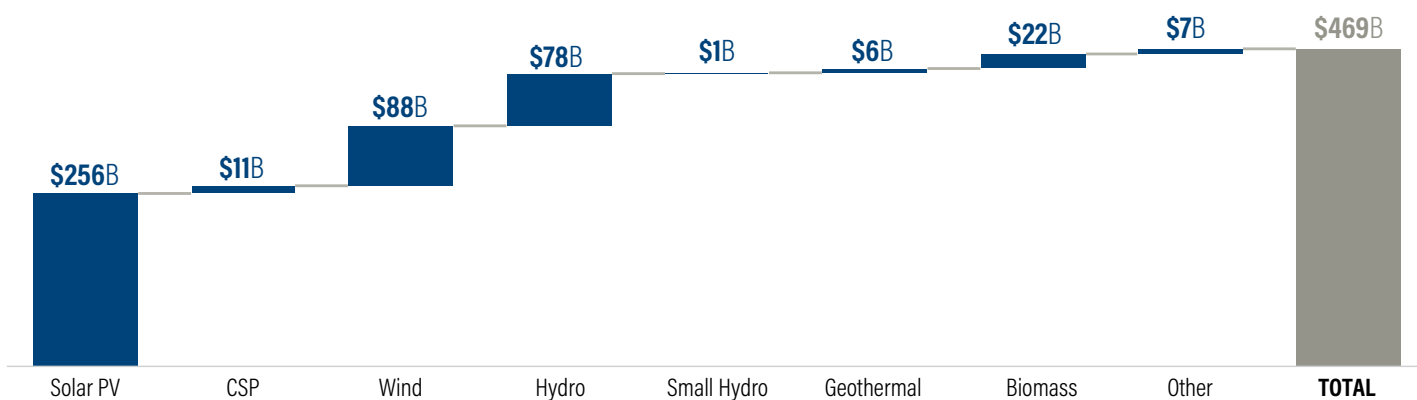
Note: This chart only includes 31 BRI countries having quantitative renewable energy contributions in NDCs. Africa: Ethiopia, South Africa; Central Asia: Uzbekistan; East Asia: Republic of Korea, Mongolia; Europe: Bosnia, Macedonia, Moldova; South Asia: Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka; Southeast Asia: Brunei, Cambodia, Indonesia, Laos, Myanmar, Singapore, Thailand; West Asia: Bahrain, Israel, Jordan, Kuwait, Lebanon, Palestine, Turkey, UAE, Yemen.

Source: Authors’ calculation based on IRENA (2017c).

To implement the renewable-energy commitments in the 31 BRI countries' NDCs, those countries will require about \$469 billion in investments (Figure 18), or \$32 billion annually.¹⁹ Of the \$469 billion, \$256 billion (55 percent) would be for solar PV, \$88 billion (19 percent) for wind, and \$79 billion (17 percent) for hydropower. Biomass, geothermal, and concentrated solar power (CSP) account for a small portion of the total investment needs. This demand is consistent with the least-cost basis measured by levelized cost of electricity benchmark value, as solar PV, onshore wind, and hydropower are the cheapest renewable energy sources.

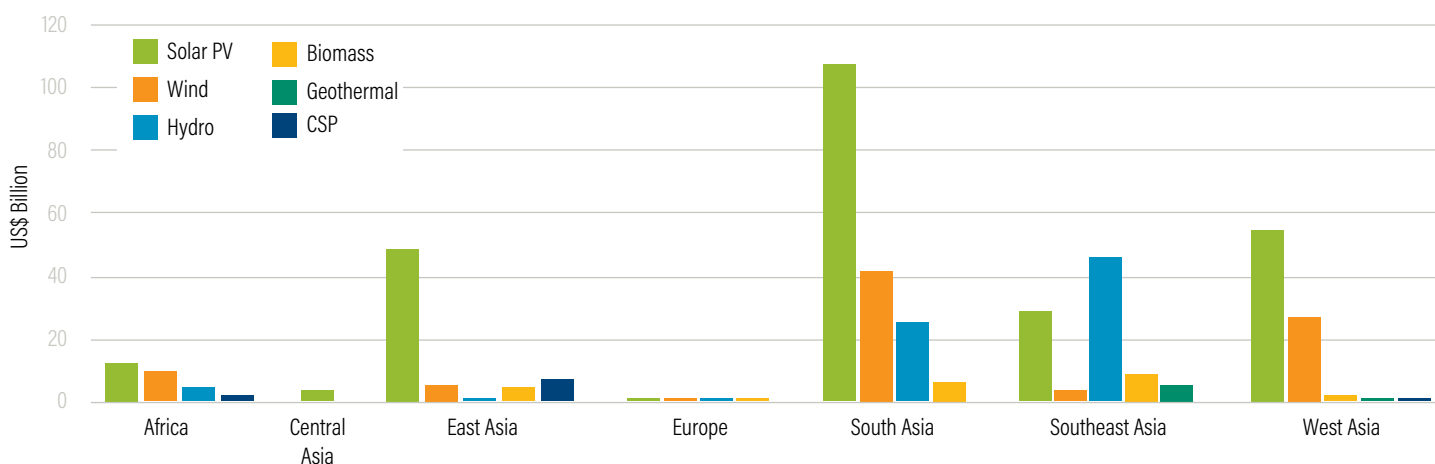
The scale of investment needs to achieve BRI countries' NDC commitments vary significantly by region (see Figure 19). Investment needs for solar PV are the largest in the major regions, ranging from \$108 billion in South Asia to \$3.2 billion in Central Asia. Most investment needs for wind power are in South Asia and West Asia, while the investment needs for hydropower arise predominately in Southeast Asia and South Asia, both of which have large hydropower resources. The high investment needs of solar and wind in South Asia stem from the ambitious renewable energy commitments made by India in its NDCs, including reaching 40 percent non-fossil-fuel electricity

Figure 18 | Investment Needs for Renewable Energy in 31 BRI Countries' NDCs, up to 2030 by Technology, in US\$ Billion



Source: Authors' calculation.

Figure 19 | Regional Investment Needs of Renewable Energy in 31 BRI Countries' NDCs, up to 2030 by Technology



Note: This chart only includes 31 BRI countries having quantitative renewable energy contributions in NDCs. Africa: Ethiopia, South Africa; Central Asia: Uzbekistan; East Asia: Republic of Korea, Mongolia; Europe: Bosnia, Macedonia, Moldova; South Asia: Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka; Southeast Asia: Brunei, Cambodia, Indonesia, Laos, Myanmar, Singapore, Thailand; West Asia: Bahrain, Israel, Jordan, Kuwait, Lebanon, Palestine, Turkey, UAE, Yemen.

Source: Authors' calculation.

generation by 2030, 100 GW for solar, and 60 GW for wind by 2022. Investment needs for geothermal are predominately in Southeast Asia given the high geothermal potential in Indonesia (Box 2).

Greenfield renewable energy projects, like other infrastructure projects, rely heavily on debt financing, especially bank loans. Based on BNEF data for greenfield renewable energy projects in the 31 BRI countries, the debt-to-equity ratio for renewable energy projects was within the 60 percent to 90 percent range in 2016 and 2017 (BNEF 2018).¹⁴ Most greenfield solar projects have debt ratios between 70 percent and 78 percent, while most wind projects have lower debt ratios (between 63 percent and 75 percent) than solar projects. Geothermal and biomass projects typically have lower debt levels because of higher perceived risk (Frankfurt School-UNEP Centre/BNEF 2017).

On the basis of these ratios, achieving the solar-energy commitments in the NDCs for the 31 countries would require around \$171 billion to \$190 billion (\$11.4–12.7 billion annually) in debt financing.¹⁵ Reaching the wind-energy commitments would require \$49 billion to \$58 billion (\$3.3–3.9 billion annually) in debt financing. Most of the debt financing for solar and wind projects is likely to continue to rely on bank loans (BlackRock 2017).

The projected high demand for bank loans suggests important opportunities for Chinese banks in financing renewable energy in BRI countries. Despite the rich experience that Chinese banks have accumulated in financing renewable energy in their home base, the syndicated loans for renewables in which the six Chinese banks have participated in the BRI region amount to only \$37 million and \$27 million, respectively, from 2014 to 2017—less than 1 percent of annual investment needs. In contrast, the six banks participated in an annual average of \$29 billion in loans in fossil-fuel energy projects over the same period.

The NDCs also suggest rich opportunities for equity investors in renewable energy projects in BRI countries. Equity investment needs in order to reach solar PV and wind commitments in 31 BRI countries are \$54 billion to \$73 billion and \$19 billion to \$28 billion, respectively, if future solar and wind projects maintain similar equity ratios. The \$54.5 billion managed by the SRF could significantly advance BRI countries' transition to lower-carbon economies if the fund invests heavily in low-carbon projects. There are also opportunities here for equity investments by Chinese corporations.

Box 2 | Demand Signals from Indonesia

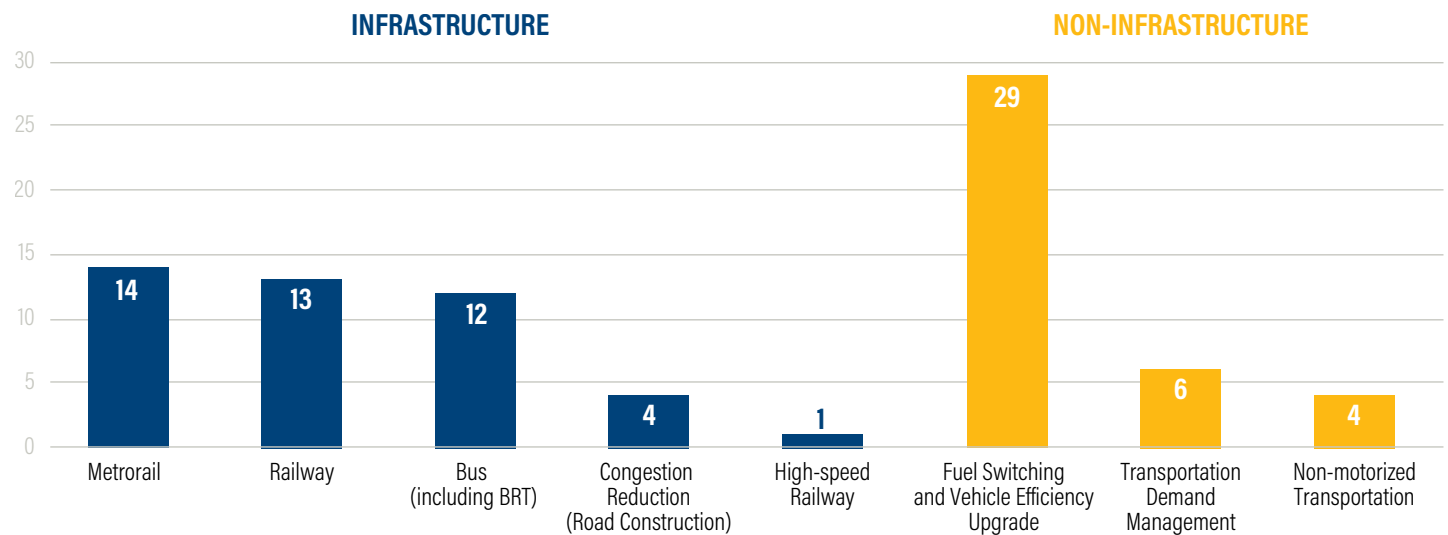
Indonesia's NDC includes a GHG emission-reduction commitment of 29 percent below the business-as-usual scenario by 2030. As part of its mitigation efforts, Indonesia plans to increase renewable energy's share in primary energy consumption from 6.2 percent in 2015 to 23 percent by 2025. This would require an estimated \$23 billion investment in renewable energy by 2030, with about a quarter (\$5.4 billion) going into geothermal energy. Indonesia boasts about 40 percent of the world's geothermal potential and currently has the most geothermal projects under development (ThinkGeoenergy 2017). A large proportion of the geothermal investment is expected to come from the private sector, given insufficient government resources.^a

^a The world's largest geothermal project, the Sarulla Geothermal Power Project, is already receiving 42 percent of the investment from the private sector. The Indonesian government is also setting up risk-mitigation funds with help from development banks and permitting full foreign ownership for more than 10 MW geothermal power plants to further attract private and global capital.

The Transportation Sector

The transportation sector is the second most frequently mentioned sector after energy in BRI countries' NDCs. Of the 56 BRI countries, 46 directly referenced transportation as a sector for mitigation action. Although only 9 countries have quantitative transportation emission-reduction commitments, 34 countries address transportation more explicitly by including specific intervention measures to reduce emissions. Most countries describe intervention measures in qualitative terms, such as “upgrading and modernization of rail services” in Pakistan and “encourage and introduce low emission vehicles such as electric and hybrid” in Sri Lanka. Although a few countries include quantitative elements in intervention measures, there is no robust methodology to quantify the investment needs in commitments such as this one by Mongolia: “Improve Ulaanbaatar city road network to decrease all traffic by 30–40 percent by 2023.” While no doubt imperfect, this paper uses the number of countries mentioning each intervention measure as a proxy for intention to pursue development pathways associated with investment needs addressable by a green BRI.

Figure 20 | Number of Countries Including Transportation Measures in Their NDCs, by Type of Measure



Source: Authors' analysis of 56 BRI countries' NDCs.

The transportation measures can be broadly classified into infrastructure and non-infrastructure. Twenty-four countries mention specific infrastructure measures, including metro, railway, bus (including BRT), congestion reduction (road construction), and high-speed railway, while 29 countries have specific non-infrastructure measures, including fuel-switching and vehicle efficiency upgrades (excluding biofuel), transportation demand management, and non-motorized transportation (Figure 20). More than half of the countries with specific intervention measures (20 of 34 countries) take both infrastructure and non-infrastructure approaches to reduce emissions.

In many BRI countries, metrorail, railway, and bus have been chosen to address urbanization and to mitigate transportation emissions in the coming decades (Table 4). In addressing intracity travel, metrorail and bus are almost equally favored by BRI countries, proposed by 14 and 12 countries, respectively. Upper- middle- and high-

income countries (e.g., Israel, Saudi Arabia, and the UAE) prefer the more capital-intensive metrorail solution. Many BRI countries included in their NDCs railways, which are the most energy-efficient transportation mode for intercity travel (IEA and UIC 2012).¹⁶ However, only Turkey's NDC includes high-speed railway. One reason could be the limited demographic and economic circumstances that could support high-speed railways in BRI countries (Bullock et al. 2010). In addition, countries may have chosen not to include those projects in their NDCs. Saudi Arabia, for example, is building a high-speed rail and did not mention it in its NDC (Saudi Railway Organization 2018).

The majority of BRI countries included non-infrastructure transportation measures in their NDCs. Among those measures, fuel-switching and vehicle efficiency upgrades were included by 29 countries. Specific interventions include the adoption of new energy vehicles (e.g., hybrid and electric vehicles) and regulations (e.g., emission taxes

Table 4 | List of Countries by Proposed Infrastructure Intervention Measures in NDCs

INTERVENTION MEASURE	COUNTRY
Metro	Azerbaijan, Bahrain, Bangladesh, Egypt, India, Israel, Kuwait, Macedonia, Pakistan, Saudi Arabia, Sri Lanka, Thailand, Turkey, UAE
Railway	Bahrain, Bhutan, Egypt, Ethiopia, India, Jordan, Kuwait, Nepal, Pakistan, Sri Lanka, Thailand, UAE, Vietnam
Bus (including BRT)	Bahrain, Bangladesh, Brunei Darussalam, Egypt, Jordan, Lao PDR, Mongolia, Pakistan, Palestine, Sri Lanka, Thailand, Timor-Leste
Congestion Reduction (Road Construction)	Azerbaijan, Bahrain, Bangladesh, Mongolia
High-speed Railway	Turkey

Source: Authors' analysis based on NDCs.

and emission standards). Several countries also mentioned zero-emission, non-motorized transportation, such as biking, to tackle climate change and improve traffic conditions.

Although there is no comprehensive estimate of the cost of financing transportation needs in all BRI countries, some estimates are instructive reference points. The IFC and the Asian Development Bank (ADB) have developed estimates for groups of countries that partially overlap with the BRI region, and those estimates can be helpful here. The IFC estimates that private, climate-related investment opportunities in the transportation sectors of 17 BRI countries amount to \$2.44 trillion from 2016 to 2030 (IFC 2016, 2017).¹⁷ According to the ADB, 45 developing countries in the Asia region need an \$8.4 trillion investment in transportation infrastructure from 2016 to 2030 based on historical investment patterns and climate adaptation needs (ADB 2017b).

Chinese financial institutions and corporations could put to work in BRI countries their rich home-base experience in transportation infrastructure financing and enable those countries to pursue opportunities in low-carbon infrastructure development. Although China has financed and built the world's second-longest railway network and the longest total metro network domestically, it has not expanded these practices to BRI countries (Metrobits 2017; Xinhua 2016). From 2014 to 2017, transportation-sector investments by the six Chinese banks (CDB, China Eximbank, ABC, BOC, CCB, and ICBC) in BRI countries largely concentrated on air transportation, road transportation, and high-speed railway (Figure 10), which are far less frequently mentioned in NDCs than metrorail, regular railway, and bus by BRI countries (Figure 20).

FINDINGS AND CONCLUSIONS

Different types of Chinese investors face different priorities, drivers, and opportunities. Chinese outward investment to BRI countries has been growing, even with the sharp drop in Chinese global OFDI in 2017. While the data show a consistent direction in terms of the focus of Chinese investment as a whole, there are clear differences in their choices, the most obvious being the differences between SOE and POE energy portfolios; SOEs showed a stronger focus on financing fossil-fuel projects, while POEs were more active in renewable energy investments. However, there are also other variations in their choices of geographies and sectors. Understanding these variations is important to identify effective means for mobilizing green investments.

Most NDCs are currently insufficiently specific to enable a comprehensive assessment of investment opportunities and are not sending sufficiently clear signals to market actors. To identify trends and investment opportunities, investors need a minimum of quantitative information about the technology and other pathways that a government envisions for achieving NDC goals. However, even for the energy sector, only a little more than half (55 percent) of the BRI countries provide quantifiable contributions in their NDCs, and even this information is not fully consistent in detail or structure. While the authors did not interview Chinese institutions to assess their level of internal understanding of NDCs, our research demonstrated the difficulties in estimating investments based on the NDCs alone.

According to the data reviewed, most Chinese deals in energy and transportation are still tied to traditional sectors and do not show a strong alignment with the low-carbon priorities included in BRI governments' NDCs. We found a consistent trend toward financing fossil-fuel-related projects in the energy sector and traditional options in the transportation sector. The Chinese government issued the *Guidelines for Promoting Green Belt and Road* in May 2017, which presumably is seeking to redirect at least a portion of Chinese financial flows. However, much will depend on

the detailed policies and interventions intended to translate the vision of a “green BRI” into more concrete actions. Importantly, in the absence of strong new drivers or incentives, it would be reasonable to expect that Chinese investment portfolios will remain focused on traditional transportation and energy opportunities, with significant implications for technology lock-in. While this paper has not analyzed the economic, social, and environmental impacts of Chinese-funded BRI projects, other research literature suggests that addressing these impacts may well be a key element to ensure the long-term sustainability of a green BRI (Ascensão et al. 2018; Lu et al. 2018).

If Chinese government special funds are deployed to give greater priority to green opportunities, especially in the near term, these funds could have an outsized positive impact on green growth in the BRI countries. By targeting green objectives in the coming years, China could use BRI special funds to quickly become a major catalyst for low-carbon development in the region. A substantial flow of pre-2020 green or climate-friendly investments would build a solid foundation for climate ambition as countries prepare to submit revised NDCs and implement them after 2020. MDBs have adopted targets for climate financing as a percentage of their overall portfolio; the targets exceed 25 percent (AfDB et al. 2015). If the special funds allocated for BRI were deployed against a target of just 25 percent, this would channel more than \$28 billion additional dollars in support of climate finance and NDC priorities at a critical time for BRI countries. To put this figure in perspective, the \$28 billion compares favorably to the \$35 billion in climate finance that the MDBs lent out globally in 2017 (AfDB et al. 2018). The potential volume of green investments financed by Chinese financial institutions could be even higher if they go beyond the special funds and use their own balance sheets. For example, CDB had more than \$110 billion in outstanding loans in the BRI countries at the end of the third quarter in 2017, which is almost equal to the \$113 billion in Chinese government special funds. If CDB were to invest 32 percent of its loans in climate-related actions, as the World Bank Group did in fiscal year 2018, it would deploy about \$35 billion.

RECOMMENDATIONS

The Chinese government should require financial institutions receiving Chinese government special funds to consider NDCs when developing their investment strategies. NDCs offer a set of country-driven priorities and objectives and are also tied under the Paris Agreement to an ongoing cycle of updating. Further, they are available for all BRI countries except Syria and are linked to national development strategies, which means that NDCs could be introduced as a reference point in standard operating procedures at Chinese financial institutions. All the multilateral development banks, including the ADB and the World Bank Group, have begun to formally incorporate reviews of NDCs into the development of their country strategies, and Chinese financial institutions could apply a similar practice (ADB 2017a; World Bank 2016a; Larsen et al. Forthcoming).

Governments of BRI countries would be well advised to update their NDCs with sufficient granularity and quantitative information and to communicate their NDC priorities, national strategies, and associated project pipelines to financial institutions, including Chinese. This will help ensure that NDCs are used as potential points of focus for green BRI activities. Efforts could include bringing Chinese partners into BRI countries' ongoing dialogues with other multilateral and bilateral development finance institutions to encourage greater coordination and pooling of efforts. In addition, BRI country governments could also demonstrate their commitment to achieving NDC goals by including NDC-related expenditures in their government budgets. This would send a strong and clear signal to financial institutions and other investors that significant investment opportunities in green technologies and projects will be forthcoming.

The Chinese government should encourage state-owned financial institutions to build on their respective comparative advantages to support a green BRI. The suite of financial institutions designated by the government to drive forward BRI green financing bring with them a range of comparative strengths, risk appetites, and financial resources, including the capacity to deploy capital through development loans, equity investments, debt financing, and other instruments. When allocating special funds, the Chinese government should ask the relevant institutions to design instruments or funds that address specific green financing barriers in the BRI region in a manner that leverages their own comparative strengths. For example, the SRF may be better positioned than some of the other institutions to provide early venture capital funding to green enterprises as a bridge to becoming "bankable" with special funds received.

A green BRI strategy will also need to consider how to address issues of equity and access to finance. Chinese investments in the BRI region have concentrated on the oil, gas, and petrochemical industries in a few BRI countries, mainly higher-middle-income and high-income countries. If BRI is to become a development initiative to improve connectivity and support sustainable development across many countries, more financial flows will be needed to support projects in lower-middle-income and low-income countries. For those countries, long-term equity investments, concessional loans, and development loans are especially important (OECD 2018a). Because they can provide these types of finance, the SRF, China Eximbank, and CDB will likely play a very different role compared to the Chinese commercial financial institutions, which provide finance mostly on nonconcessional terms.

AREAS FOR FURTHER RESEARCH AND ANALYSIS

Conduct research on drivers of financing decisions by different types of Chinese financial institutions and enterprises; this will help inform effective policies and interventions to promote green investments. While the datasets demonstrated inconsistencies between NDC objectives and current investment patterns, there are many potential underlying causes that may be linked to market factors rather than institutional policies and strategies. Also, there is considerable diversity among Chinese investors in terms of their mandates, incentives, deal requirements, institutional capabilities, and business models. Similarly, institutions face different barriers and requirements when entering a foreign market, and options available to an enterprise may not be open to a financial institution and vice versa. Developing effective strategies for unlocking a greater volume of green financial flows requires a deeper understanding of these different factors and should be a focus of future research.

Improve data on Chinese financial flows to the BRI countries. Detailed, disaggregated data on cross-border financial flows are not easily available, nor do financial institutions disclose much data on their green investment portfolios. Although the dataset compiled by the authors is fairly comprehensive, three major gaps of data coverage remain: transportation sector loans exclusively financed by CDB and/or China Eximbank, energy and transportation sector loans financed by a single

state-owned commercial bank, and energy and transportation sector loans from smaller Chinese commercial banks. Additional efforts are needed to build a more complete picture of financial flows in the BRI countries and roles of different types of Chinese financial institutions and enterprises, particularly concerning loans. This will provide a better insight into patterns and trends in the supply of Chinese finance. One option would be to assess the feasibility of using China's existing Green Credit Guidelines and Green Credit Statistics Forms to capture overseas finance. Further research could provide analysis on how and how much different types of Chinese investments can leverage additional financing. In addition, data on the assessment and management of social and environmental impacts at the project level are not easily available, nor usually disclosed by project developers. Further research to collect this type of data could provide a more comprehensive picture of financial flows in the BRI region and facilitate the development of tools and criteria for addressing and minimizing social and environmental impacts.

Improve assessments of low-carbon investment needs in BRI countries. NDCs supplemented by other national policies provide a starting point for understanding the country's vision for its low-carbon development. However, further research needs to be done to better understand the demand side and the degree to which an NDC-aligned pipeline of projects already exists. To date, existing information is scattered, and there are limited resources that outline the range of needs implied by NDCs as a whole.

APPENDIX A. LIST OF 56 COUNTRIES STUDIED IN THIS REPORT

Afghanistan, Albania, Armenia, Azerbaijan, Bahrain, Bangladesh, Belarus, Bhutan, Bosnia, Brunei Darussalam, Cambodia, Egypt, Ethiopia, Georgia, India, Indonesia, Islamic Republic of Iran, Iraq, Israel, Jordan, Kazakhstan, Republic of Korea, Kuwait, Kyrgyz Republic, Lao People's Democratic Republic (Lao PDR), Lebanon, Macedonia, Malaysia, Maldives, Republic of Moldova, Mongolia, Montenegro, Myanmar, Nepal, New Zealand, Oman, Pakistan, Palestine, Philippines, Qatar, Russia, Saudi Arabia, Serbia, Singapore, South Africa, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Turkey, Turkmenistan, Ukraine, United Arab Emirates, Uzbekistan, Vietnam, Republic of Yemen.

Notes:

1. Eleven of 67 BRI countries are European Union member states, which jointly submitted one NDC. Syria does not submit an NDC.
2. As of May 29, 2018, Iran, Iraq, the Kyrgyz Republic, Lebanon, Oman, Russia, Turkey, Uzbekistan, and the Republic of Yemen have not yet ratified the Paris Agreement, thus their Intended Nationally Determined Contributions have yet to be converted to NDCs. In addition, Brunei Darussalam and the Philippines have not officially submitted their NDCs to the NDC registry (UNFCCC 2018). In the context of this study, those countries' INDCs are analyzed together with the NDCs.

APPENDIX B. METHODOLOGY TO QUANTIFY RENEWABLE ENERGY COMMITMENTS INCLUDED IN THE NDCS

This appendix provides quantified estimates for the renewable energy commitments contained in the NDCs of BRI countries. The estimates are quantified both in terms of investment requirements, measured in U.S. dollars, and in terms of newly installed renewable energy electricity generation capacity, measured in MW. Non-electric renewable energy commitments are described but not quantified, unless the NDC itself contains an investment estimate.

NDCs are very heterogeneous. They do not follow a consistent structure or methodology, do not have common metrics or timelines, and offer a mixture of quantitative and qualitative commitments. The renewable energy commitments in NDCs usually consist of either one or a combination of: electric capacity in MW, investment in U.S. dollars or local currency, electric generation in kWh, percentage of current/future demand/supply for electricity/primary energy, GHG emissions reductions, number of units, and specific projects. Commitments can include goals per technology (e.g., wind, solar PV, biomass), aggregating several or all renewable energy technologies, and, in some cases, combinations with other energy technologies and measures (e.g., nuclear, natural gas, and energy-efficient technology).

Translating the wide range of renewable energy commitments included in the NDCs to U.S. dollars and MW requires a series of assumptions and estimates, explained next. The methodology used was initially developed by

Munoz Cabré and Sokona, (2016), adapted for IRENA (2017a), and further refined in Munoz Cabré et al. (2018), including approaches suggested by Agha et al. (2018). Renewable energy commitments for each NDC have been calculated individually, often using a combination of the methods described next.

List of 31 Countries Covered by This Methodology

Afghanistan, Bahrain, Bangladesh, Bhutan, Bosnia, Brunei Darussalam, Cambodia, Ethiopia, India, Indonesia, Israel, Jordan, Republic of Korea, Kuwait, Lao PDR, Lebanon, Macedonia, Moldova, Mongolia, Myanmar, Nepal, Pakistan, Palestine, Singapore, South Africa, Sri Lanka, Thailand, Turkey, United Arab Emirates (UAE), Uzbekistan, Republic of Yemen.

Data Sources

About one-fifth of the data used in the quantification of the renewable energy commitments originates from the NDCs themselves, be it explicit commitments or other information used to calculate investment and capacity, such as capacity factors, emission factors, and technology allocations. Cost estimates and capacity factors come from IRENA's Renewable Cost Database (2017b). Data on renewable energy capacity and generation come from IRENA (2017a, 2017c). Data on electricity consumption come from the International Energy Agency (IEA) (2017). For those countries where national policies other than NDCs have been explored, official governmental or intergovernmental documents have been used. In the case of specific projects where the NDC provides no additional information, such as Mocha Wind Farm in Yemen, project proposal documentation from official intergovernmental sources is used to estimate the capacity. As needed, emission factors from the Intergovernmental Panel on Climate Change (IPCC) (2012) have been used.

Renewable Energy Capacity Estimates

One of the results provided in this paper is an estimate, in capacity terms (MW) of the total additional capacity represented by renewable energy commitments. In some cases, this information is available as an aggregate; in most, it requires separate calculations per technology. Many NDCs describe their commitments in terms of installed capacity. For example, Mongolia's NDC includes commitments of 675 MW of hydro, 354 MW of wind, and 145 MW of solar. In this case, estimating the total capacity is a simple matter of addition. Others describe their commitments as a percentage growth over existing capacity for a technology (e.g., hydro), which results in a straightforward calculation.

A number of NDCs define their renewable energy's commitment as a percentage in electricity consumption by a target year, or a variant related to current or future electricity consumption. In those cases, future electricity demand has been projected using IEA's country data for electricity consumption (GWh) as a starting point (IEA 2018b).¹⁸ The annual energy consumption growth rate is calculated using the compound annual growth rate for a particular country between 2004 and 2014, again using IEA's country data. If the growth rate is negative (e.g., Moldova), it is considered to be zero. Once the absolute amount of renewable electricity in the target year is determined, we subtract the renewable energy generation in 2014 and thus obtain the additional renewable energy generation as part of the NDC commitment.¹⁹ When no information is provided by the NDC, a technology

mix is set using the relative weights of renewable energy in the electricity mix, with yearly growth rates averaged over the last five years, as found in IRENA (2017c). With the overall renewable electricity to be produced (GWh), the technology mix, and the capacity factors per technology (Table B1), the installed capacity per technology is calculated.

Some renewable energy commitments are stated in terms of CO₂eq emissions reductions. In those cases, emission factors are used to estimate the renewable energy equivalent. Emission factors can often be estimated from information contained in the NDC. In the case of Cambodia, an emission factor of 410g CO₂/kWh is used, combining data from IPCC and Cambodia's electricity mix (IPCC 2012).

All capacity commitments are calculated as net of existing renewable energy capacity. For example, India committed to 60 GW of wind by 2022. Of those, 23.7 GW were already installed as stated in NDC, leaving a net commitment of 36.3 GW by 2022.

Some NDCs provide aggregate commitments that include other nonrenewable energy commitments (for example, nuclear in UAE and energy efficiency in Afghanistan). In those cases, ad hoc assumptions based on external research have been used (such as completion timeline for Barakah nuclear power plant units in the UAE) to allocate the renewable energy portion. Ad hoc assumptions are used in less than 0.5 percent of the total estimate.

Renewable Energy Investment Estimates

The investment estimates of renewable energy commitments in NDCs have been calculated as follows. For those commitments already expressed in U.S. dollars, that amount has been used. For example, Bangladesh's renewable energy commitments include \$1.3 billion of solar PV, a solar home system (SHS) program at a cost of \$1.2 billion, other off-grid solar (e.g., pumps, minigrids, nanogrids, pico solar) at a cost of \$1.23 billion, \$600 million for wind, and \$200 million for electricity generation from bagasse. For all other commitments, where an installed capacity per technology is estimated, the average installed cost factors shown in Table B2 below are used. Those cost factors, from IRENA's Renewable Cost Database, are based on thousands of existing projects (IRENA 2017b). Other cost factor estimates used include 4\$/w for off-grid, 100w–10\$/w for solar home systems, 5kW per petrol pump (4\$/w), and \$2,000 for a 500w (4\$/w) water solar pump.

Whenever an NDC contains information relative to investment, the NDC data are used. In most cases, this falls within the cost estimates reflected above, but in some NDCs, particularly for off-grid, figures differ significantly.

All investment needs expressed in monetary terms in BRI NDCs use U.S. dollars.²⁰ It is important to note that cost is considered as absolute cost in present dollar value. No discount rate or different patterns of deployment over time are considered.

Table B1 | Average Renewable Energy Capacity Factor per Region and Technology, 2017

REGION	CAPACITY FACTOR						
	WIND	SOLAR PV	HYDRO	BIOMASS	GEOTHERMAL	CSP	
Africa	0.374	0.195	0.428	0.618	0.84	0.4	
Asia	0.245	0.161	0.472	0.67	0.85	0.275	
China	0.25	0.173	0.5	0.618	N/A	0.26	
Eurasia	0.352	0.138	0.54	0.831	0.8	N/A	
Europe	0.282	0.119	0.384	0.86	0.66	0.308	
India	0.24	0.19	0.44	0.77	N/A	0.276	
Middle East	0.336	0.256	0.357	0.566	N/A	0.22	
Oceania	0.347	0.228	0.454	N/A	0.8	0.12	

Source: IRENA 2017b.

Table B2 | Average Renewable Energy Installed Cost per Region and Technology, 2017

REGION	INSTALLED COST (\$/KW)					
	WIND	SOLAR PV	HYDRO	BIOMASS	GEOTHERMAL	CSP
Africa	1,924	2,344	1,593	1,654	3,818	8,392
Asia	1,263	1,414	1,446	1,318	3,116	4,423
China	1,244	1,083	1,273	1,215	1,94	3,004
Eurasia	1,891	2,537	1,530	1,756	3,113	N/A
Europe	1,866	1,370	1,847	3,423	5,209	8,839
India	1,120	1,064	1,519	1,043	2,169	4,328
Middle East	2,531	2,554	1,526	2,895	N/A	3,705
Oceania	2,150	2,477	3,689	N/A	3,796	9,829

Source: IRENA 2017b.

Definitions and Scope

For this study, the IRENA definition of renewable energy is used. IRENA defines renewable energy as all forms of energy produced from renewable sources in a sustainable manner, including bioenergy, geothermal, hydropower, ocean energy, solar energy, and wind energy. Renewable energy technologies analyzed in this study include solar, wind, hydropower, bioenergy, and geothermal. For bioenergy, electricity generation from landfill biogas recovery is included in the analysis, whereas waste-to-energy commitments (e.g., incineration) are not. Charcoal and clean or improved cook stove commitments are not included. Biogas and biofuels (other than for electricity generation), as well as solar water heating, are not included.²¹ Large hydropower is included in the analysis. Commitments from transmission lines that can be used to import, export, or develop renewables are not included.

Timeline

The target years set to measure renewable energy commitments vary from NDC to NDC. The most common target year is 2030, but many NDCs use other dates, such as 2020 or 2025. In some cases, different renewable energy commitments within the same NDC have different target years. For this study, the year with the most ambitious commitment up to 2030 has been used when the NDC contains more than one target year. The target year is applicable to all the calculations described previously where future energy demand and other factors need to be determined.

Regional Groupings

For the purposes of calculating installed capacity costs and capacity factors (as shown in Table B1 and Table B2), countries are grouped into regions in Table B3.

Table B3 | BRI Countries' Regional Distribution

ASIA	Afghanistan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; Democratic People's Republic of Korea; India; Indonesia; Japan; Kazakhstan; Kyrgyzstan; Lao PDR; Malaysia; Maldives; Mongolia; Myanmar; Nepal; Pakistan; Philippines; Republic of Korea; Singapore; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Turkmenistan; Uzbekistan; Vietnam
AFRICA	Egypt; Ethiopia; South Africa
EURASIA	Armenia; Azerbaijan; Georgia; Russia; Turkey
EUROPE	Albania; Belarus; Bosnia and Herzegovina; Montenegro; Republic of Moldova; Serbia; the former Yugoslav Republic of Macedonia; Ukraine
MIDDLE EAST	Bahrain; Iran; Iraq; Israel; Jordan; Kuwait; Lebanon; Oman; Qatar; Saudi Arabia; Syria; United Arab Emirates (UAE); Yemen
OCEANIA	New Zealand

Source: IRENA 2017c.

APPENDIX C. RENEWABLE ENERGY COMMITMENTS IN NDCS

Afghanistan

Afghanistan's NDC includes the commitment of achieving 25 percent rural electrification with renewable energy, at an estimated cost of \$105 million from 2020 to 2030. The NDC also states a conditional commitment of \$188 million per year for energy, including renewable energy. Afghanistan's NDC includes unquantifiable commitments on power generation from hydro, solar, wind, and biomass, as well as biogas recovery from landfill.

Albania

In its NDC, Albania states that its electricity system is based completely on renewable electricity, mostly hydropower, with no room for further decarbonization. Albania seeks to maintain the low GHG emissions of its electricity generation.

Armenia

In its NDC, Armenia describes energy, including renewable energy and energy efficiency, as one of the main sectors in the mitigation commitment. There are, however, no quantifiable data on renewable energy commitments in its NDC.

Azerbaijan

In its NDC, Azerbaijan mentions renewable energy sources for electricity and heat, including small hydro, biomass, solar, wind, and geothermal. The NDC also discusses capture of biogas from livestock. The NDC does not include quantifiable data on renewable energy commitments.

Bahrain

Bahrain's NDC includes one solar PV project of 5 MW and another solar/wind project of 5 MW.

Bangladesh

Bangladesh's NDC includes the commitment of achieving 10 percent renewable electricity by 2020. The NDC also includes the following renewable energy commitments until 2030: 1 GW of solar at a cost of \$1.3 billion, an SHS program at a cost of \$1.2 billion, other off-grid solar (e.g., pumps, minigrids, nanogrids, pico solar) at a cost of \$1.23 billion, \$600 million for wind, and \$200 million for electricity generation from bagasse.

Belarus

Belarus does not include renewable energy commitments in its NDC, although it notes that, during the period 2010–2015, 5 percent of its GDP was invested in energy efficiency, energy conservation, and renewable energy. Thirty percent of that investment was from public sources.

Bhutan

Bhutan's NDC includes the renewable energy commitment of offsetting 22.4 million tons of CO₂eq per year through hydroelectricity exports by 2025. Given that the country's electricity generation comes completely from hydropower, the NDC articulated an unquantified commitment to diversify the energy supply mix through the promotion of solar, wind, small hydro, and biomass. An unquantified commitment from small-scale biogas from livestock is also included.

Bosnia

Bosnia's NDC includes the following renewable energy commitments by 2030: 175 MW of wind, 120 MW of small hydro, 70 MW of biomass, 4 MW of solar PV, and an unspecified amount of renewable energy district heating.

Brunei Darussalam

Brunei Darussalam's NDC sets the target to reach 10 percent renewable electricity in the electricity mix by 2035, including solar, wind power, hydropower, and bioenergy.

Cambodia

Cambodia's NDC includes the following renewable energy commitments by 2030: 1.8 million tons of CO₂eq reductions from solar, hydropower, biomass, biogas, and off-grid systems; 0.727 millions tons of CO₂eq reductions by 2030 from renewable energy and energy efficiency in rice mills, brick kilns, and garment factories; and less than 0.155 million tons of CO₂eq reductions from bio-digesters, solar pumps, and solar lamps.

Egypt

Egypt's NDC includes increased use of renewable energy as one of its five pillars of mitigation policies. The NDC does not include quantifiable data on the renewable energy commitments.

Ethiopia

Ethiopia's NDC includes the unconditional commitment of the Grand Renaissance Dam, a \$4 billion large hydropower project of 6 GW under construction. The NDC also defines developing renewables as one of the four pillars for mitigation. It also includes unquantified commitments for the expansion of geothermal, solar, and wind.

Georgia

Georgia did not mention renewable energy in its NDC.

India

India's NDC conditional commitments include reaching 40 percent non-fossil-fuel electricity by 2030. This includes 100 GW of solar by 2022 (from 4.06 GW in 2015), 60 GW of wind by 2022 (from 23.7 GW in 2015), 10 GW of biomass by 2020 (from 4.06 in 2015), and 55,000 solar petrol pumps. Other conditional commitments include to "aggressively" develop the country's hydro potential and to reach the 20 percent target of biofuels usage (including 5 percent biodiesel) in diesel locomotives. India's NDC also includes the unconditional commitment of installing 100,000 solar pumps.

Indonesia

Indonesia's NDC includes a commitment of 23 percent new and renewable electricity by 2025. This 23 percent, according to the National Energy Plan 2014, would be distributed as follows: 10 percent bioenergy, 7 percent geothermal, 3 percent small hydro, and 3 percent other renewables.

Iran

Iran's NDC includes renewable energy as part of its unconditional commitment to reduce GHG emissions by 4 percent with respect to a business-as-usual scenario. The NDC does not include quantifiable data on renewable energy commitments.

Iraq

Iraq's NDC does not contain renewable energy commitments.

Israel

Israel's NDC includes a commitment of 17 percent renewable electricity by 2030. The NDC also notes Israel's high use of solar water heaters.

Jordan

Jordan's NDC includes the commitment of transforming the energy mix to a larger proportion of primary energy supplied from renewable energy sources, reaching 11 percent of primary energy by 2025. The NDC also includes a commitment of 10,000 zero-emission vehicles powered by renewable energy, as well as an unquantified commitment to use hydropower, solar, wind, and biogas from sludge to meet energy needs of the water sector. Other commitments include unquantified solar water heating and solar cooling, as well as subsidies for solar PV for poor households.

Kazakhstan

Kazakhstan's NDC defines the greater use of renewable energy sources as a long-term objective. The NDC does not include quantifiable data on the renewable energy commitments.

Korea, Republic of

Korea's NDC includes Korea's mandate for a renewable energy quota in electricity generation, as well as unquantified government support for the installation of renewable energy power generation facilities. While not explicitly stated in its NDC, a renewable energy quota has in fact been established at 11 percent by 2030.

Kuwait

Kuwait's NDC includes the commitment of fulfilling the increasing demand of energy from renewable energy sources by 2030, including solar PV, CSP, and wind.

Kyrgyzstan

Kyrgyzstan's NDC does not include renewable energy commitments. It does, however, note that 90 percent of electricity generation is from hydropower, and it is expected that hydropower generation will be negatively affected by climate change.

Lao PDR

Lao PDR's NDC includes several renewable energy commitments. For large-scale hydropower, mostly destined for export, Lao PDR's commitments include developing 2.3 GW of large-scale hydropower by 2020 to reach a total of 5.5 GW installed capacity, and an additional 20 GW by 2030. The NDC also includes the commitments to increase the share of small-scale renewables (<15MW, including small hydro, solar, biomass, biogas, and wind) in energy consumption to 30 percent by 2025, as well as a 10 percent target for biofuels by 2025. The NDC estimates the cost of implementing the small-scale renewable energy commitments and biofuels at \$658.75 million. The NDC notes that electricity generation in Lao PDR is almost 100 percent renewable.

Lebanon

Lebanon's NDC includes a conditional renewable energy commitment to reach 20 percent renewable electricity and heat by 2030. The unconditional commitment is to reach 15 percent renewable electricity and heat by 2030.

Macedonia

Macedonia's NDC contains the following unconditional renewable energy commitments: 65.4 MW small hydro, 50 MW wind, 18 MW solar power, 7 MW biogas, and 5 percent biofuels. It also includes an unspecified solar thermal collectors' commitment. As part of its conditional commitment, the NDC includes 10 percent biofuels and an unspecified amount of geothermal. Macedonia's NDC explicitly states the commitment not to build new large hydropower plants due to lack of investor interest and local opposition.

Malaysia

Malaysia's NDC does not include renewable energy commitments. It does, however, note existing renewable energy policies to promote renewable energy investment, including feed-in tariffs and palm biodiesel blending mandates.

Maldives

The Maldives' NDC contains no renewable energy commitments. Although the NDC states that "the main area of focus for mitigation is fuel switching to alternative energy options," it concludes that "unfavorable conditions and barriers severely limit the use of alternative energy sources in the Maldives," noting the cost of solar PV and the low wind potential.

Moldova

Moldova's NDC includes the commitment of 20 percent renewable electricity by 2020, 10 percent of which is to be locally produced. This includes hydro, solar, wind, and biomass.

Mongolia

Mongolia's NDC includes the commitment to reach 30 percent renewable electricity by 2030. To achieve this, the NDC includes commitments for 675 MW of hydro at a cost of \$1,350 million, 354 MW of wind at a cost of \$584 million, and 145 MW of solar PV at a cost of \$573 million.

Montenegro

Montenegro's NDC includes increasing the share of renewables as one of the means to achieve its GHG reduction target. The NDC states that Montenegro is in the process of accession to the European Union, which involves the gradual transposition and implementation of the European Union's climate and energy legislation. This includes renewable energy commitments. The NDC does not include quantifiable data on the renewable energy commitments.

Myanmar

Myanmar's NDC includes the renewable energy commitment to reach 9.4 GW of hydro by 2030. It also includes rural electrification to benefit 6 million people, at least 30 percent of which will come from renewable energy mini-grid technologies such as mini-hydro, biomass, solar, and wind.

Nepal

Nepal's NDC includes the commitment of 20 percent renewable electricity by 2020. Nepal's renewable electricity commitments also include 12,000 MW of hydro by 2030; 2,100 MW of solar by 2030; 220 additional MW of biomass by 2030; and 50 additional MW of small hydro. Nepal seeks to achieve the 80 percent electrification rate by using renewables, including 600,000 solar home systems, 1,500 institutional solar systems, and 25 MW of small hydro. A commitment to reach 10 percent biogas energy for cooking in rural areas includes deploying 13,000 household bio-digesters, 1,000 institutional bio-digesters, and 200 biogas community plants.

New Zealand

New Zealand's NDC makes no reference to renewable energy.

Oman

Oman's NDC includes the commitment to increase the share of renewable energy. The NDC, however, does not include quantifiable data on the renewable energy commitments.

Pakistan

Pakistan's NDC includes large-scale and distributed grid-connected solar, wind, and hydroelectricity as a high priority in mitigation options. It also includes biogas from agriculture waste as a medium priority in mitigation options. No quantifiable information for those mitigation options is provided by the NDC. The NDC also includes subnational commitments, including the 1,000 MW Quaid-e-Azam solar park in Punjab.

Palestine

Palestine's NDC includes the commitment of 5 percent renewable electricity by 2020. This includes \$255.5 million in solar power. The NDC also includes an unquantified commitment to promote solar heating and solar dryers (agriculture). A conditional commitment includes capturing 14,000 tons of landfill gas per year for power generation.

Philippines

The Philippines NDC includes energy as one of the sectors where CO₂ emission reductions will come from, noting the need for technology transfer in renewable energy. The NDC, however, does not include explicit or quantifiable renewable energy commitments.

Qatar

Qatar's NDC includes unquantified efforts to deploy solar energy for electricity generation, contingent on technology transfer. The NDC also notes investment on research and development of renewable energy technologies to power desalination plants. The NDC does not include quantifiable renewable energy commitments.

Russia

Russia's NDC describes an increasing share of renewables in the energy balance as a general objective. The NDC, however, does not include explicit or quantifiable renewable energy commitments.

Saudi Arabia

Saudi Arabia's NDC includes the commitment for "ambitious" programs to increase renewable energy in the energy mix, including solar PV, solar thermal, wind and geothermal energy, and waste-to-energy systems. The NDC notes that the renewable energy procurement process is under way. The NDC does not include quantifiable renewable energy commitments.

Serbia

Serbia's NDC makes no reference to renewable energy.

Singapore

Singapore's NDC includes the commitment of generating 8 percent peak demand with solar PV by 2030. This is estimated to represent an additional PV capacity of 1,040 MW, at a cost of \$1,470 million.

South Africa

South Africa's NDC includes unconditional commitments for 11,543 MW of renewables. Of those, 5,243 MW were already approved at the time of submission, at an estimated cost of \$16 billion. The remaining 6,300 MW are under consideration.

South Africa's renewable energy commitments are similar but smaller than existing policies. For example, in the 2010–2030 Integrated Resource Plan, South Africa plans to develop 17.8 GW of renewables by 2030, including 8.4 GW of solar PV, 8.4 GW of wind, and 1 GW of solar CSP.

Sri Lanka

Sri Lanka's NDC includes the following renewable energy commitments: 514 MW wind, 176 MW small hydro, and 115 MW solar by 2030, as well as 104.6 MW of biomass by 2025. The NDC also includes unquantified targets of fuel switching to biomass in the industrial sector.

Tajikistan

Tajikistan's NDC includes the commitment of promoting and diversifying renewable energy sources, contingent on international support. The NDC notes Tajikistan's 90 percent hydropower in the electricity mix. The NDC, however, does not include explicit or quantifiable renewable energy commitments.

Thailand

Thailand's NDC includes the commitment to reach 20 percent renewable electricity by 2036, as well as 30 percent renewable energy in total energy consumption by 2036.

Timor-Leste

Timor Leste's NDC includes renewable energy in its mitigation options. Considered renewable energy mitigation options include electricity from micro-hydro, bioenergy, solar PV, and wind; rural electrification with renewables; and biogas recovery from agriculture and landfill. The NDC does not include quantifiable data on the renewable energy commitments.

Turkey

Turkey's NDC includes the commitments to reach 16 GW of wind and 10 GW of solar by 2030, as well as "tapping the full hydroelectric potential" and an unquantified amount of landfill biogas recovery.

Turkmenistan

Turkmenistan's NDC describes the increased use of alternative energy sources as one of the main priorities for limiting GHG emissions. It also includes increasing the share of renewables in the energy balance of Turkmenistan as a general objective. The NDC, however, does not include explicit or quantifiable renewable energy commitments.

UAE

The United Arab Emirates' NDC includes 24 percent clean energy by 2021, as well as an unquantified commitment for renewable-energy-powered water desalination. It is important to note that "clean energy" in the UAE's NDC includes nuclear power. The UAE is currently building the 4-reactor APR-1400 Barakah nuclear power plant, scheduled to enter into operation before 2021.

Ukraine

Ukraine's NDC notes the existing National Action Plan on Renewable Energy through 2020. The NDC, however, does not include explicit or quantifiable renewable energy commitments.

Uzbekistan

Uzbekistan's NDC includes the commitment to "intensive construction" of large solar photovoltaic power plants to reach 6 percent of electricity with solar in 2030. It also includes unquantified commitments for biogas power plants and wind power.

Vietnam

Vietnam's NDC includes the promotion of new and renewable energy sources in energy production and consumption as one of Vietnam's nine mitigation strategies. It also includes encouraging the use of renewables in transportation and of biogas from agriculture. The NDC, however, does not include quantifiable renewable energy commitments.

Yemen, Republic of

Yemen's NDC unconditional renewable energy commitments include the 60 MW Mocha Wind farm, at a cost of \$144 million, and \$50 million for solar. Yemen's conditional commitment includes reaching 15 percent renewable electricity by 2025, including 400 MW of wind, 160 MW of geothermal, and 6 MW of landfill gas. It also includes 110,000 solar home systems (around 5.5 MW) by 2025, and 200,000 solar water heating units, as well as unquantified rural electrification with renewables, unquantified solar water pumping, and unquantified biogas from landfill and water treatment.

APPENDIX D. ADDITIONAL INSTALLED CAPACITIES AND INVESTMENTS NEEDED BY COUNTRY BY TECHNOLOGY, 2015–2030

Table D1 | **Estimated Additional Installed Capacities Needed in 31 BRI Countries, in GW, 2015–2030**

COUNTRY	SOLAR PV	CSP	WIND	HYDRO	SMALL HYDRO	GEOTHERMAL	BIOMASS	OTHER	TOTAL
Afghanistan	-	-	-	-	-	-	-	0.53	0.53
Bahrain	0.01	-	-	-	-	-	-	-	0.01
Bangladesh	1.00	-	0.40	-	-	-	0.15	0.43	1.98
Bhutan	-	-	-	6.09	-	-	-	-	6.09
Bosnia	0.00	-	0.18	-	0.12	-	0.07	-	0.37
Brunei	0.14	-	0.02	0.01	-	-	0.03	-	0.22
Cambodia	0.16	-	-	0.96	-	-	0.04	-	1.15
Ethiopia	-	-	-	6.00	-	-	-	-	6.00
India	95.94	-	36.30	-	-	-	5.60	0.33	138.17
Indonesia	3.88	-	2.55	2.29	-	1.75	3.98	-	14.44
Israel	4.79	-	-	-	-	-	0.03	-	4.82
Jordan	0.90	-	0.46	-	-	-	-	0.01	1.37
Korea, Republic of	34.15	1.67	3.74	-	-	-	3.42	-	42.97
Kuwait	4.06	0.34	1.11	-	-	-	-	-	5.51
Lao PDR	-	-	-	22.30	-	-	-	-	22.30
Lebanon	1.48	-	-	-	-	-	0.55	-	2.02
Macedonia	0.02	-	0.05	-	0.07	-	0.08	-	0.21
Moldova	0.11	-	0.05	0.03	-	-	0.02	-	0.20
Mongolia	0.15	-	0.35	0.68	-	-	-	-	1.17
Myanmar	-	-	-	6.33	-	-	-	0.09	6.42
Nepal	2.10	-	-	11.10	0.08	-	0.22	0.06	13.56
Pakistan	1.00	-	-	-	-	-	-	-	1.00
Palestine	0.10	-	-	-	-	-	-	-	0.10
Singapore	1.04	-	-	-	-	-	-	-	1.04
South Africa	5.19	0.58	5.19	0.58	-	-	-	-	11.54
Sri Lanka	0.12	-	0.51	-	0.18	-	0.10	-	0.91
Thailand	15.26	-	0.40	-	-	-	2.71	-	18.38
Turkey	9.75	-	11.50	-	-	-	-	-	21.25
UAE	0.42	-	-	-	-	-	-	-	0.42
Uzbekistan	2.27	-	-	-	-	-	-	-	2.27
Yemen	0.02	-	0.46	-	-	0.16	0.01	0.01	0.65
TOTAL	184.05	2.58	63.27	56.35	0.44	1.91	17.01	1.45	327.06

Table D2 | Estimated Additional Investments Needed in 31 BRI Countries, in US\$ Billion, 2015-2030

COUNTRY	SOLAR PV	CSP	WIND	HYDRO	SMALL HYDRO	GEOTHERMAL	BIOMASS	OTHER	TOTAL
Afghanistan	-	-	-	-	-	-	-	1.61	1.61
Bahrain	0.03	-	-	-	-	-	-	-	0.03
Bangladesh	1.30	-	0.60	-	-	-	0.20	2.43	4.53
Bhutan	-	-	-	8.80	-	-	-	-	8.80
Bosnia	0.01	-	0.33	-	0.22	-	0.24	-	0.80
Brunei	0.21	-	0.03	0.02	-	-	0.05	-	0.31
Cambodia	0.22	-	-	1.38	-	-	0.05	-	1.65
Ethiopia	-	-	-	4.00	-	-	-	-	4.00
India	102.08	-	40.66	-	-	-	5.84	1.30	149.88
Indonesia	5.48	-	3.22	3.31	-	5.45	5.25	-	22.71
Israel	12.23	-	-	-	-	-	0.09	-	12.32
Jordan	2.31	-	1.16	-	-	-	-	0.03	3.50
Korea, Republic of	48.29	7.37	4.72	-	-	-	4.51	-	64.89
Kuwait	10.38	1.25	2.80	-	-	-	-	-	14.43
Lao PDR	-	-	-	32.25	-	-	-	0.66	32.91
Lebanon	3.77	-	-	-	-	-	1.58	-	5.35
Macedonia	0.02	-	0.09	-	0.12	-	0.26	-	0.49
Moldova	0.15	-	0.09	0.06	-	-	0.05	-	0.35
Mongolia	0.57	-	0.58	1.35	-	-	-	-	2.50
Myanmar	-	-	-	9.15	-	-	-	0.36	9.51
Nepal	2.97	-	-	16.05	0.11	-	0.29	0.61	20.03
Pakistan	1.41	-	-	-	-	-	-	-	1.41
Palestine	0.26	-	-	-	-	-	-	-	0.26
Singapore	1.47	-	-	-	-	-	-	-	1.47
South Africa	12.18	2.14	9.99	0.92	-	-	-	-	25.23
Sri Lanka	0.16	-	0.65	-	0.25	-	0.14	-	1.20
Thailand	21.58	-	0.51	-	-	-	3.58	-	25.67
Turkey	24.74	-	21.75	-	-	-	-	-	46.49
UAE	1.07	-	-	-	-	-	-	-	1.07
Uzbekistan	3.21	-	-	-	-	-	-	-	3.21
Yemen	0.05	-	1.31	-	-	0.61	0.02	0.06	2.05
TOTAL	256.13	10.76	88.48	77.28	0.71	6.06	22.15	7.05	468.62

ABBREVIATIONS

ABC	Agricultural Bank of China	LULUCF	Land use, land-use change and forestry
ADB	Asian Development Bank	M&A	Mergers and acquisitions
AFD	French Development Agency	MENA	Middle East and North Africa
BIS	Bank for International Settlements	MFA	Ministry of Foreign Affairs of the People's Republic of China
BNEF	Bloomberg New Energy Finance	MOFCOM	Ministry of Commerce of the People's Republic of China
BOC	Bank of China	MW	Megawatt
BRI	Belt and Road Initiative	NDC	Nationally Determined Contribution
BRT	Bus Rapid Transit	NDRC	National Development and Reform Commission of the People's Republic of China
CCB	China Construction Bank	NEV	New energy vehicles
CCGT	Combined Cycle Gas Turbine	OFDI	Outward foreign direct investment
CDB	China Development Bank	POE	Private-owned enterprise
China Eximbank	Export-Import Bank of China	SAFE	State Administration of Foreign Exchange of the People's Republic of China
COP	Conference of the Parties	SCIO	State Council Information Office of the People's Republic of China
CSP	Concentrated solar power	SDG	United Nations Sustainable Development Goals
GCC	Gulf Cooperation Council	SOE	State-owned enterprise
GHG	Greenhouse gas	SRF	Silk Road Fund
GW	Gigawatt	UAE	United Arab Emirates
GWh	Gigawatt hour	UIC	International Union of Railways
ICBC	Industrial and Commercial Bank of China	UNCTAD	United Nations Conference on Trade and Development
IEA	International Energy Agency	UNFCCC	United Nations Framework Convention on Climate Change
IFC	International Finance Corporation	WBG	World Bank Group
IMF	International Monetary Fund		
IPCC	Intergovernmental Panel on Climate Change		
IRENA	International Renewable Energy Agency		

ENDNOTES

1. Obtained on December 15, 2017, via https://www.yidaiyilu.gov.cn/info/iList.jsp?cat_id=10037.
2. One U.S. dollar = 6.8843 CNY, the average rate of exchange between the U.S. dollar and Chinese yuan in May 2017 (Board of Governors of the Federal Reserve System 2018). All monetary values of China's pledge in May 2017 are converted to U.S. dollars using the exchange rate above.
3. For example, CDB has committed \$250 billion in BRI countries with \$110 billion in outstanding loans at the end of 2017.
4. In preparation for COP19, Parties submitted Intended Nationally Determined Contributions (INDCs). Upon entry into force of the Paris Agreement on November 4, 2016, INDCs became NDCs for all those parties that had ratified the Agreement. As of May 29, 2018, Iran, Iraq, the Kyrgyz Republic, Lebanon, Oman, Russia, Turkey, Uzbekistan, and the Republic of Yemen had not yet ratified the Paris Agreement; thus their INDCs have yet to be converted to NDCs. In addition, Brunei and the Philippines have not officially submitted their NDCs to the NDC registry; in the context of this study, those countries' INDCs are analyzed together with the NDCs.
5. Using NDC explicit contributions provides a robust yet noncomprehensive assessment of country investment demand. Because NDCs are nationally developed and countries were not mandated to include renewable energy contributions, those contributions are a strong indicator of political priority. However, not all existing renewable energy contributions were necessarily included in NDCs, nor do all NDCs cover the period until 2030. For those reasons, the renewable energy investment figures presented in this paper must be understood as an "at least" amount and are not directly comparable to scenario estimates, such as IRENA's Remap and IEA's World Energy Outlook.
6. The four ministries are the National Development and Reform Commission, the Ministry of Commerce, the People's Bank of China, and the Ministry of Foreign Affairs.
7. For example, Dealogic is used by the Bank for International Settlements, an international financial organization that serves central banks, to pursue financial stability and to study infrastructure financing; Thomson ONE is recognized by the University of Chicago to study project financing.
8. At the time of writing, India reportedly does not consider itself part of BRI (Reuters 2018).
9. The authors include two types of data to calculate the loan value within the dataset: The first type is loan contributions by CDB and/or China Eximbank where explicit contributions are provided. The data used here do not include loans where explicit contributions are not available, which leads to underestimation. After this procedure, the dataset only contains projects financed entirely by CDB and/or China Eximbank. The second type, project costs of the projects financed entirely by CDB and/or China Eximbank, is used instead of the loan value when the loan value is not available. This treatment overestimates loan contributions as it includes the equity part of the project. Given the high-leverage ratio of infrastructure projects, this treatment may overestimate by 10 to 20 percent.
10. Greenfield investments establish a new entity in a foreign country, while M&As involve the acquisition of existing foreign firms.
11. It is important to note that the quantification estimated by the authors is exclusively of those contributions that can be quantified from information in the NDCs alone. As such, the estimate is significantly underestimating the actual demand for renewable energy in BRI countries, including from contributions not included in NDCs and from deployment beyond the NDC target year for those contributions earlier than 2030.
12. As noted earlier, these figures should be considered as "at least" and are not directly comparable to scenario estimates. For example, IRENA's Remap 2030 and IEA World Energy Outlook scenarios for India consider deployment until 2030 and beyond, while the figure estimated for this paper only includes deployment until 2022.
13. It is important to note that renewable energy estimations in this report are not comprehensive numbers for the BRI region as the estimations do not cover all BRI countries. As a matter of fact, they only cover 31 of 68 countries. The total demand for renewable energy is larger, since the estimations do not include countries that, despite having national renewable energy targets, did not include them in their NDCs.
14. That is, how much they borrow versus how much their own capital developers contribute to a project
15. Seventy percent and 78 percent (first and third quartiles) debt ratios are used, respectively.
16. Measured by average GHG emission per passenger km.
17. The IFC studies do not include country breakdowns for estimates. Thus, regions with great overlap with BRI are included, including East Asia Pacific, South Asia, Europe and Central Asia, and Middle East and North Africa. The estimate for South Asia is from 2018 to 2030. Sources: IFC (2016 and 2017).
18. 2014 data were used unless a different reference year was specified in the NDC.
19. This assumes that no renewable energy capacity will be decommissioned during that period and that capacity factors will remain stable. There were no cases with large hydro penetration requiring this estimate; otherwise, yearly hydro fluctuation would be considered.
20. Except for a small contribution in Jordan, less than \$200,000.
21. Unless the cost itself was quantified in the NDC.

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ABOUT THE AUTHORS

Lihuan Zhou is an associate in WRI's Sustainable Finance Center.
Contact: lihuan.zhou@wri.org

Sean Gilbert is a senior associate in WRI's Sustainable Finance Center.
Contact: sean.gilbert@wri.org

Ye Wang is a research analyst in WRI's Sustainable Finance Center.
Contact: ye.wang@wri.org

Miquel Muñoz Cabré is a senior research scholar at Boston University's Global Development Policy Center.
Contact: miquel@bu.edu

Kevin P. Gallagher is a professor at the Pardee School of Global Studies at Boston University, where he directs the Global Development Policy Center.
Contact: kpg@bu.edu

ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



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