China Council for International Cooperation on Environment and Development (CCICED)

Promoting Sustainable Development: the role of innovative financing mechanism

CCICED Special Policy Study Report

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Executive Summary

On September 21, 2021, at the General Debate of the 76th Session of the United Nations General Assembly, Chinese President Xi Jinping announced that China will step up support for other developing countries in developing green and low-carbon energy and will not build new coal-fired power projects abroad. Since then, **renewable energy has become a key area in promoting the green development of the Belt and Road Initiative (BRI).** Marking the 10th anniversary of the Belt and Road Initiative (BRI), the year of 2023 ushers in a new phase and major opportunities for the development and cooperation of green BRI.

Based on our previous studies, this report will 1) review and summarize China's renewable energy development experience in terms of policies and practices, 2) lay out and discuss the basis and inspiration for renewable energy cooperation in key BRI participating regions, 3) propose the best practices and cooperation demands for the sustainable financing of green and low-carbon BRI development, and 4) map out the overall cooperation mechanism for green BRI. Through these efforts, this study proposes relevant policy recommendations for the innovation mechanism of green BRI.

Part one of the report draws an overall picture of BRI's green and low-carbon development, which includes the mechanism, progress and demands of international cooperation, and analyzes the green financing challenges for BRI renewable energy projects. It concludes that with financial support from China and other entities, the cumulative capacity of solar and wind energy in Asia-Pacific and Europe has been **growing almost linearly since 2010**, **though there is still a large financing gap.** From a financing perspective, BRI renewable energy cooperation projects tend to face issues concerning **insufficient upfront technical capacity and information reserves**, and some projects may also encounter challenges such as the **lack of 1) pre-feasibility funding for early development, 2) transmission infrastructure such as power grids, and 3) an efficient profit model.**

Part two looks at renewable energy cooperation to identify the policy objectives, practical basis, barriers and needs for renewable energy development in key regions, including Southeast Asia, Central Asia, Africa and Latin America. In addition, by reviewing the evolution of China's renewable energy policies, we identified China's main renewable energy development policy instruments, such as innovative and integrated **photovoltaics application scenarios**, which showcased the important role **development finance** played in expanding the production and installation of renewable energy. Part two finally proposes **intensifying target guidance, optimizing subsidy policies, simplifying entry procedures, improving investment environment, enhancing multi-channel consumption and strengthening international cooperation**, putting forward targeted cooperation proposals for Central Asia, Africa and Latin America.

The report proposes the following policy recommendations on the innovation mechanism of BRI to promote sustainable development:

1. Strengthen the innovative financing mechanism of BRI green development cooperation and promote the establishment of a support system for renewable energy projects.

First, establish a pre-feasibility research and development fund to support pre-feasibility studies and project preparation costs. The decision-making mechanism for renewable energy in China can be used as a reference to improve the efficiency of fund allocation for green BRI projects and fill the funding gap in developing countries.

Second, set up a database of pre-feasibility financing options accessible to renewable energy project developers to help better understand and adapt existing resources, which will maximize the project financing capacity for BRI participating countries. This database should provide catalogued projects with renewable energy financing portfolio, which may include financing + design, procurement, construction (EPC+F), refinancing by international financial institutions, sovereign wealth funds, BRI renewable energy bonds, international development funds, overseas industrial funds, international syndicated loans and other diversified financing support.

Third, utilize existing international cooperation platforms to promote joint renewable energy investment and formulate regional cooperation strategic policies and action plans. Through these platforms, we should push for the formation of BRI renewable energy cooperation standards, norms and guidelines for international participation and mutual recognition; strengthen digital empowerment for green development; collaborate in providing technical assistance and capacity building for emerging renewable energy markets along the Belt and Road; train more small and medium-sized renewable energy developers; and enhance the capacity of BRI participating countries to receive investment. By promoting diversified cooperation between industry organizations and stakeholders in BRI participating countries, we can establish a professional cooperation network for green transformations.

2. Strengthen the synergy among BRI's green development cooperation mechanisms in various fields and promote the establishment of a policy environment conducive for BRI green development cooperation.

First, strengthen the vertical and horizontal coordination in key areas of green development through existing BRI cooperation platforms, with a focus on cross-sectoral cooperation. We should make use of the overall cooperation mechanism for BRI construction, strengthen the communication and exchange frequency in key areas, coordinate and promote BRI green development cooperation in various fields, and build a diversified cooperation network.

Second, improve the policy environment for the development of overseas cooperative green BRI projects. We should promote the formation of a new financing system favorable to green projects; incorporate renewable energy investment into the enterprise performance tracking system; and relax performance requirements for overseas green energy investments appropriately. In addition, we should establish a BRI climate investment and green credit system and appropriately reduce the financing cost of low-carbon investment projects. A favorable policy environment will encourage financial regulators to adopt green policies to stimulate the development of green finance.

3. Implement innovative BRI demonstration projects and support the development of customized sustainable development solutions for BRI participating countries.

First, utilize existing cooperation platforms to coordinate resources from various parties for building green BRI cooperation demonstration projects in renewable energy and other fields. Combining the efficient cross-sectoral cooperation mechanism with the green investment and financing channels of financial institutions, we can provide full support for the planning, design, financing and implementation of demonstration projects. These demonstration projects will influence BRI participating countries to formulate their own corresponding green policies and develop their own green industries.

Second, explore the cooperative demonstration of "PV+" and other innovative application scenarios, as well as profit models of such projects that align with the characteristics of developing countries. We should support the preliminary feasibility study, construction and operation of "PV+X" projects, with pilot projects carried out in the BRI participating countries, such as "PV + Agriculture," "PV + Industrial Parks," and alike. In view of the challenges generally faced by energy projects, such as difficulties in collecting electricity charges in developing countries, we need to explore innovative profit modes, such as through photovoltaic supporting industries, to further promote renewable energy projects.

Key words:

Belt and Road Initiative, Green Development, Renewable Energy, Green Finance

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Foreword

Marking the 10th anniversary of the Belt and Road Initiative (BRI), the year of 2023 ushers in a new phase and major opportunities for the development and cooperation of green BRI. Meanwhile, as climate change, energy security, eco-environment conservation and other global challenges are intertwining with each other, more institutional innovations for BRI are required to drive the process of sustainable development. With global consensus on climate change, coupled with energy security risks caused by geopolitical conflicts, more and more countries are developing their own renewable energy industries to ensure the energy supply in a more low-carbon, safe and sustainable way. Most of the BRI participating countries are from the developing world. In the context of the global economic downturn caused by the Covid-19 pandemic, promoting economic, trade, technological and investment cooperation in green and low-carbon renewable energy is the best choice to accelerate economic recovery, lift low- and middle-income countries out of their economic difficulties, improve the business environment and strengthen the economic, trade and diplomatic ties among the Belt and Road countries.

On September 21, 2021, at the General Debate of the 76th Session of the United Nations General Assembly, Chinese President Xi Jinping announced that China will step up support for other developing countries in developing green and low-carbon energy and will not build new coal-fired power projects abroad. Renewable energy has become a key area in building the Green Silk Road. Based on our previous studies, this report will focus on BRI's renewable energy cooperation, to sort out the best practices and cooperation demands for sustainable financing for green and low-carbon development, and map out the overall cooperation mechanism for green BRI. Through these efforts, this study proposes relevant policy recommendations for the innovation mechanism of green BRI.

1 Best Practices and Needs for BRI Sustainable Financing for Green and Low-Carbon Development

1.1 Development of the International Cooperation Mechanism for BRI's Green and Low-Carbon Development

As an important builder, participant and leader in global ecological conservation, China has established stable international cooperation mechanisms with the BRI participating countries in ecological conservation and green and low-carbon development. Relying on dialogues and exchanges conducted across multiple levels, China has maintained stable and pragmatic **bilateral ties** with major BRI participating countries and regional organizations, which are multi-level and broad in scope. At the same time, the **multilateral mechanism**, as the best solution proposed by China for international cooperation to tackle global climate change, introduces subjects, perspectives, and voices into the construction of the green BRI. Such an approach has provided a platform for communication and cooperation between China and the BRI participating countries. In addition, **sub-regional cooperation**, which has become increasingly important, strengthens dialogue between neighboring countries and expands channels for regional exchanges, playing a unique role in promoting watershed management, ecological restoration and biodiversity conservation.

1.1.1 Bilateral Cooperation for Steady and Efficient Development

China currently maintains stable and pragmatic bilateral ties with major BRI participating countries and regional organizations, which are multi-level and broad in scope. This mutual support will ensure the constant development of eco-environmental cooperation. The two sides have established a mechanism for regular meetings between prime ministers and ministers, such as the China-ASEAN Environmental Cooperation Forum and the ASEAN+3 Environment Ministers Meeting, to provide direct channels for policy coordination and information exchange. China has also set up environmental cooperation centers with key countries in the region, such as the China-ASEAN Environmental Cooperation Center (CAEC), the China-SCO Environmental Cooperation Center (CSEC), the China-Africa Environmental Cooperation Center (CAECC), to carry out multi-sectoral events concerning ecological conservation. Through project cooperation, capacity building and other activities, the China-CEEC 16+1 Cooperation Mechanism and the China-Pacific Island Countries Economic Development and Cooperation Forum have provided platforms for green and low-carbon development in the region. South-South cooperation with developing countries has been implemented to improve their capacity to mitigate and adapt to climate change. Bilateral mechanisms focus on specific eco-environmental issues according to the needs of different partners.

1.1.2 Multilateral Cooperation to Promote Diversified Exchanges on Green and Low-Carbon Areas

The multilateral cooperation mechanism established by China and BRI participating countries is being renewed day by day. It provides cooperation platforms covering all sectors and broad themes, with a special focus on green investment and financing, green technology and other targeted fields. Such a mechanism has introduced diversified voices into low-carbon development. The Belt and Road Initiative International Green Development Coalition (BRIGC), proposed by President Xi Jinping, has been the first international environmental social organization within the green BRI framework. BRIGC has attracted more than 150 partners from over 40 countries to promote practical cooperation in areas of policy coordination, exchanges and dialogues, capacity building, and environmental technology in building the Belt and Road. BRIGC has become an international cooperation platform on environment. The BRI Green Investment Principles (GIP) has already secured the participation of 44 financial institutions from BRI participating countries and developed economies. The Green Silk Road Envoys Program and BRI South South Cooperation Plan on Tackling Climate Change has trained over 2,000 climate and environmental personnel from more than 120 countries.

1.2 Status-quo of BRI Green Energy Investment

1.2.1 Green Energy Investment and Financing

In 2022, global investment in low-carbon energy reached the same level as fossil fuels for the first time, at USD 1.1 trillion. The majority of this investment was directed to renewable energy (USD 495 billion), closely followed by electrified transport (USD 466 billion). Despite this progress, investment needs to increase significantly to limit warming to Paris-compatible temperatures, particularly in low- and middle-income countries along the BRI participating countries. However, these countries often face insufficient domestic investment and thus rely on international financial support.

Chinese financial institutions already play a pivotal role in providing cross-border green energy investment. Given the increasing demand of countries for green investment and the diminishing role of multilateral development banks (MDBs), China can leverage its experience and reputation to manifest itself as a global sustainable leader by ramping up support for countries to transition to low-carbon power, transportation and heating systems. This is in line with efforts to green the BRI while bringing economic benefits for China’s renewable energy industries, as discussed in part two of the report.

1.2.2 China’s Overseas Green Energy Investment

The BRI has become a widely-welcomed international public product and cooperation platform. From 2000 to 2021, China provided USD 235 billion in development finance for overseas energy projects, which is more than MDBs have provided in the same period. In 2022, financing and investment totaled USD 67.8

billion, with more than a third — USD 24.1 billion — going to the power, transportation, and heating sectors. Over the last decades, Chinese firms have completed several hundred foreign direct investment (FDI) deals in the energy sector, including greenfield investments (building new power plants) and mergers and acquisitions (M&A, acquiring shares of existing plants or companies).

Globally, the relatively low supply of Chinese finance for renewable energy compared to traditional energy sources is related to high perceived risk and limited demand for solar and wind, which can partly be explained by high financing costs due to risk perception. However, with a changing international policy landscape, growing awareness of climate change and drastic decreases in solar costs, recipient countries increasingly demand a supply of green finance and investment.

In terms of renewable energy, China has become a key player on international investment in recent years, signing agreements with over 100 countries to develop low-carbon electricity generation. The share of renewable energy financing and investment in total BRI-related financial commitments has been steadily increasing. In 2022, Chinese financial institutions committed around $6 billion to the renewable energy sector, though the numbers vary greatly across different sources.

Given BRI's focus on improving connectivity through infrastructure investment, it is also important to note that China's development finance institutions have provided $15 billion in loans for grid construction and upgrades and electricity transmission and distribution infrastructure. In addition, China's development finance institutions have provided $550 million for overseas energy efficiency projects. Modern and smart grid infrastructure is necessary to integrate variable renewable energy sources and expand reliable electricity access in developing countries.

Aside from renewable energy generation, China has also increased investment in battery storage facilities. In 2022, projects were implemented in Hungary, Germany and the U.S. Investment figures for other sectors such as green transportation and green heating are not available, and these sectors could be targeted in future work. However, data on solar and wind projects are available and are analyzed in the next section.

1.2.3 Chinese Overseas Financing for Solar and Wind

China's support for overseas solar and wind projects takes various forms. Historically, China mainly served as an equipment supplier and engineering contractor. In recent years, however, Chinese companies have increasingly provided FDI, including greenfield investment and M&A. Additionally, loans, guarantees, underwriting and grants are provided by China's two policy banks, China Development Bank (CDB) and the Export-Import Bank of China (CHEXIM), as well as commercial banks.

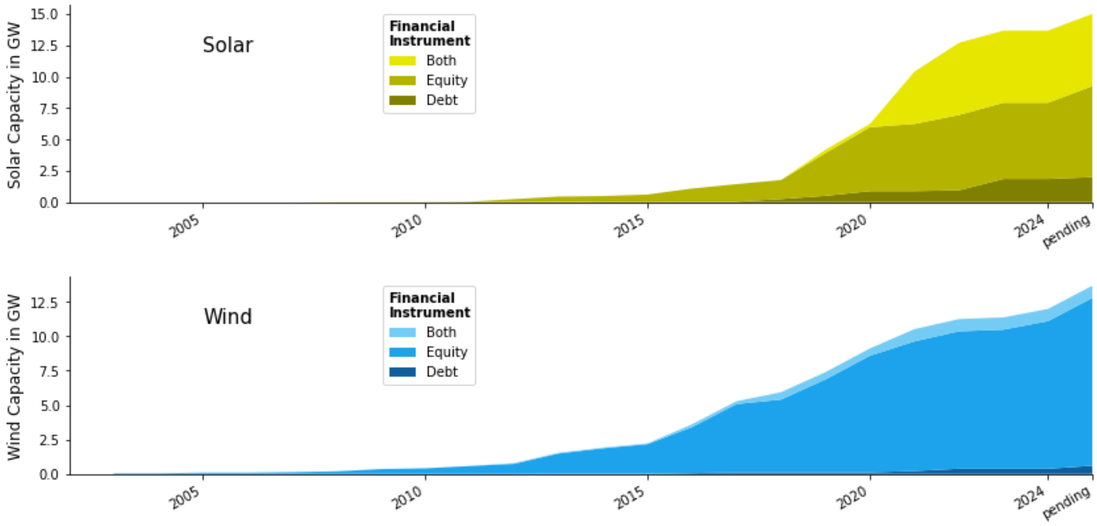

Fig. 1-1 Cumulative Installed Capacity Associated with China-financed Solar and Wind Projects in GW

China's support for overseas renewable energy projects has increased significantly in recent years, totaling 25.3 GW. The increase began around 2015 for wind and in 2018 for solar, as shown in Figure 1-1. The figure includes debt from commercial banks and the two policy banks, as well as FDI. Of the total, 6.2 GW is financed through loans, split between commercial banks (5.5 GW) and the two policy banks (0.7 GW), while 22.7 GW is equity financed by individual companies. This results in an overlap of 3.5 GW between the two forms of financing, representing projects co-financed by FDI and loans. Solar projects account for 12.1 GW, while wind projects account for 13.1 GW. Before 2020, solar projects were primarily financed through either debt or equity, but after 2020, most projects receive both forms of financing. Now, 40% of solar projects receive debt financing, while 83% receive equity financing, with a comparatively large overlap of 23% between these two forms of financing. For wind projects, only 9% receive debt financing, while 95% are financed through equity. The overlap between these two forms of financing is much smaller, at just 4%.

In contrast to the financial commitments of Chinese institutions, MDBs financed renewable energy projects with a total capacity of 39.1 GW, split almost evenly between wind and solar energy. MDBs have thus financed more renewable energy capacity than Chinese institutions. The difference is about 7.4 GW more for solar capacity and 6.4 GW more for wind capacity.

MDBs have supported around 241 GW of energy capacity worldwide (in operating and in the pipeline as of 2020). However, their total financial commitment to the power sector peaked in 2010. Chinese financing, on the other hand, has increased significantly since 2010. Chinese institutions are now among the top financiers of power projects, with 151 GW across operational and pipeline projects. In terms of composition, MDB commitments to renewable energy account for about 18% of the total associated generating capacity additions, while the figure for Chinese banks and investors is 6%, albeit increasing.

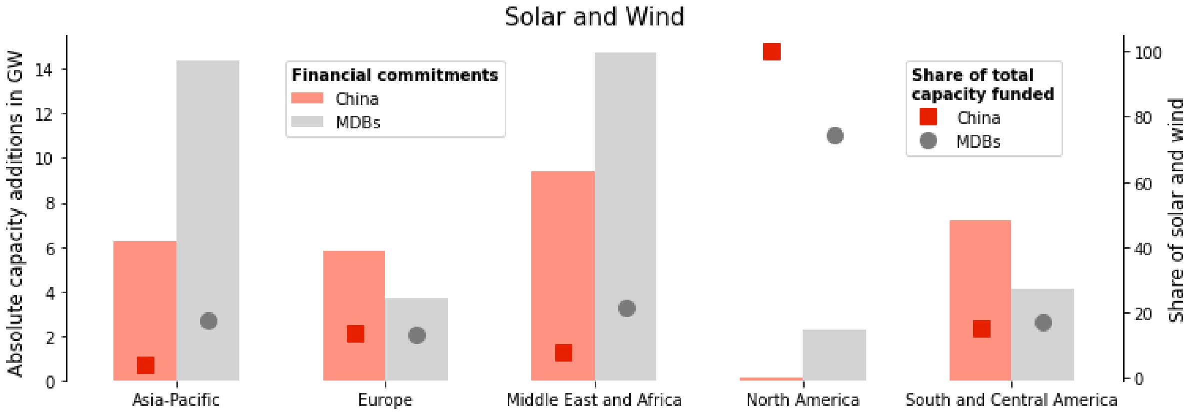

Fig. 1-2 Financial Commitments for Solar and Wind Capacity by Region in GW and as the Share of the Total Power Capacity in the Respective Region Financed by China or MDBs

The regional distribution of financial commitments shows similar patterns for both Chinese financial institutions and MDBs, although the total amount of investment varies significantly between regions. Figure 1-2 shows that most financial transactions by both China and MDBs are directed towards solar and wind energy projects in the Middle East and Africa, while the least amount is directed towards North America. MDBs are much more involved in Asia-Pacific, while Chinese institutions and firms have supported more renewable energy capacity than MDBs in Europe and South and Central America.

Figure 1-2 additionally shows the share of solar and wind projects of the total power capacity additions in each region financed by China or the MDBs. For Asia-Pacific, only 4% of the total capacity additions with loans or equity investments from China are solar or wind projects. Except for North America, where China exclusively supports solar and wind projects, the share of wind and solar projects for MDBs exceeds that of China in every region.

The share of Chinese investment in solar and wind projects varies greatly by region. In the Middle East and Africa, solar capacity is 14 times greater than wind capacity due to large solar projects in the United Arab Emirates, which is in line with the region's abundant solar radiation. In all other regions, the capacity of wind projects financed by Chinese institutions is greater than that of solar projects.

Table 1-1 Countries with the Largest China-financed Wind and Solar Capacity

Region	**Top countries**	**Capacity (MW)**	**Region**	**Top countries**	**Capacity (MW)**

Asia-Pacific	Australia	4504	North America	Canada	81
	Pakistan	848		US	55
	Bangladesh	420	South and Central America	Brazil	3587
Europe	United Kingdom	1304		Mexico	1460
	Spain	703		Argentina	951
	Sweden	644			
The Middle East and Africa	United Arab Emirates	7461			
	Ethiopia	375			
	South Africa	321			

The countries receiving the most investment from China by region are shown in Table 1-1. In some regions, including Asia-Pacific, the Middle East and Africa, investment is concentrated in a single country. Given the large capacity in the United Arab Emirates, investment in African countries accounts for less than 20% of the total capacity in the Middle East and Africa, with only 1.6 GW invested in the continent.

Looking at regional investment over time, cumulative solar and wind capacity with Chinese financial support in Asia-Pacific and Europe saw an almost linear increase starting from around 2010. Projects in the Middle East and Africa, as well as in South and Central America, saw a rapid, exponential increase in 2015. All regions witnessed a drop in capacity additions from 2020 onwards. Based on existing financial commitments, additional capacity is expected in 2024, with most capacity added in the Middle East, Africa and South and Central America.

1.2.4 Future Investment and Finance Needs

To achieve net-zero emissions globally by 2050, annual global investment in green energy needs to increase from $1.38 trillion in 2022 to around $4 trillion. This will require a 30% increase in planned energy investment by all countries as well as a shift from fossil to green energy sources. Thus, there is currently a large investment gap particularly for low-income countries, many of which are part of the BRI.

An alternative way to quantify the investment gap is to comopare current investment levels with the amount needed for countries to fulfill their Nationally Determined Contributions (NDCs) to the Paris Agreement on climate change. All developing countries combined require around USD 1 trillion (671 GW) in renewable energy investment, and for BRI participating countries it is around USD 469 million (Cabré, Gallagher, and Li 2018).

This green investment gap presents a unique opportunity for China to manifest its role as a global sustainable leader. Chinese financial institutions can provide green investment to meet the growing demand from countries. Additionally, China can proactively develop low-carbon infrastructure to meet its stated commitments. Such green investments could reduce emissions by hundreds of millions of tons of carbon dioxide.

To support other countries in their low-carbon development, China can finance research and development (R&D), equipment, and infrastructure. Urgent capital supply is needed for green transportation, sustainable buildings and renewable energy technology. Large upfront investments are particularly crucial to accelerate the deployment of low-carbon technologies such as solar and wind. To achieve net zero by 2050, global investment in solar needs to increase from USD 115 billion to USD 237 billion per year until 2050, while (onshore) wind investment should increase from USD 98 billion to USD 389 billion. Additionally, more investment is needed to facilitate a higher share of renewables in the electricity mix, such as in electricity grids (from USD 271 billion to USD 600 billion) and for flexibility measures such as storage (from USD 4 billion to USD 133 billion). Therefore, to help countries fill their investment gaps, Chinese companies and financial institutions could increase their involvement in renewable energy, grids, storage facilities and other sectors such as green transportation — all in line with the green BRI guidelines published in March 2022.

It is worth noting that not all countries require the same level of Chinese investment. Regions such as Africa and Southeast Asia are expected to see a significant increase in their electricity supply from renewable technologies far beyond their current installed power capacity. To meet projections, these regions need to increase annual mitigation investment flows by up to 16 times by 2030, compared to a two to three times increase needed in Europe. Likewise, East, South and Southeast Asia are identified as having the highest investment potential according to countries' NDCs, followed by Africa and Latin America. Many BRI participating countries need support to develop green energy infrastructure while meeting their broader development needs.

However, sustainable investment in these regions is insufficient due to underdeveloped financial markets and high financing costs, especially for solar and wind power. Underinvestment creates a climate investment trap: as climate change increases the perceived risks to investors, it raises the barriers to sustainable investment even further. As a result, low- and middle-income BRI participating countries in these regions heavily depend on Chinese finance and investment. Comparing future needs with current investment patterns, as shown in Figure 2-2, China could increase its engagement in Africa and Southeast Asia, while ensuring that it also resumes investment in Latin America. This would enable these regions to pursue low-carbon development pathways through Chinese green energy investment.

1.2.5 Management Needs of BRI Green Energy Investment and Financing Projects

The success of China's efforts to green the BRI depends not only on the amount of investment, but also on the effectiveness and longevity of each project. The previous Green BRI SPS emphasized the need for a "whole lifecycle" approach to renewable energy project development. These best practices can ensure the successful implementation of projects abroad by managing each phase of the project.

Policymakers and other entities have multiple options to improve compliance. China is actively implementing the green BRI guidelines for outbound investors and aligning with best practices. Empirical evidence also demonstrates that co-financing for China's overseas lending and development finance projects is associated with better project completion rates and environmental outcomes, suggesting that cooperation can improve practices (Lu, Springer, and Steffen 2023).

1.3 Innovative Financing Mechanisms to Promote Green and Low-carbon Development of BRI Energy Projects

The Green BRI Special Policy Study Report in 2022 outlined three innovative financing mechanisms for green and low-carbon development of BRI energy projects. First, it suggested supporting Chinese contractors and investors to participate in renewable energy projects abroad through blending grants and loans, setting up special funds for grants or loans and establishing a BRI Public-Private Partnership (PPP) Project Development Facility. Second, Chinese financial institutions can expand their portfolios by improving their capacity to provide comprehensive services, engage in project preparation and introduce country-specific financing schemes. Additionally, green financing options should be strengthened, such as through implementing ESG, offering green bonds and loans, and implementing the "Traffic Light System." Third, it suggested supporting renewable energy investors with long-term equity stakes in PPP projects. Options to do so include a range of diplomatic efforts, such as intergovernmental cooperation and economic instruments, including an investment security mechanism.

Despite the innovative mechanisms outlined in last year's Green BRI SPS, many developing countries along the Belt and Road face major challenges in financing renewable energy development projects. This section elaborates on the specific barriers for BRI participating countries in renewable energy project financing and explores in detail how Chinese financial institutions could provide innovative financing. In particular, this section highlights the importance of the project preparation phase, which is currently identified as a key barrier to renewable energy project development for developing countries. Moreover, this section's focus on targeted BRI support for the early stages of renewable energy project pipelines aligns well with BRI's increasing focus on smaller projects and a smaller scale of financing in recent years (Ray et al. 2023).

1.3.1 Renewable Energy Project Development Lifecycle

This section provides an overview of the different phases of the renewable energy project development lifecycle, the standard scope of work or tasks to be completed in each phase, and the expected outcome in terms of renewable energy deployment. It builds on the "whole lifecycle" approach expounded above. This information is a prerequisite for discussing the barriers to renewable energy development in Belt and Road countries, and solutions to overcome them.

The general project development lifecycle encompasses eight phases: creating an enabling environment; conceptualizing the project; conducting a pre-feasibility study; assessing bankable feasibility; financial close; construction; operations and maintenance; and decommissioning and repurposing. The previous Green BRI SPS emphasized the need for a “whole lifecycle” approach to renewable energy project development. The “whole lifecycle” approach involves a comprehensive and inclusive process of project selection, design, implementation, and closure. Project preparation includes consultation with government and community stakeholders to identify the type of project that is most likely to be successful and address local priorities, such as reducing air pollution by transitioning away from coal-fired power plants. Next, project design considers the environmental and social impacts of project development, including land and water use, on affected community members. As implementation begins, project managers can cultivate partnerships with local suppliers for both direct and indirect inputs. Local partnerships can increase project longevity since local companies are able to contribute to project operations and maintenance. Finally, lifecycle approach concludes with the environmentally safe disposal of hazardous material and waste, which is important for sustaining positive community relations after project completion.

Table 1-2 below shows these project development phases and summarizes the scope and outcome of each phase in a typical solar photovoltaic or wind power project.

Table 1-2 Project Development Lifecycle

Project Phase	Scope	Outcome
Enabling environment	Development of strategies, regulation	Sector white paper, policies, statutory instruments
Project Conceptualization	Selection of site or confirmation that site has reasonable solar/wind resource, access, proximity to grid and low environmental impact	Decision to secure access to site and investigate feasibility
Pre-feasibility assessment	High level review of environmental risks, grid connection, solar/wind plant capacity, solar/wind resource, energy costs and electricity price	Development plan (to cost-effectively address risks), decision to proceed to feasibility study
Bankable Feasibility Assessment	Detailed investigation of project parameters including environmental and grid connection studies, constructability study, purchase and construction cost estimates, power purchase terms and price.	Preliminary investment decision (commitment to build the project if the economics after finalization are within the

	Application for permits or environmental license.	range defined in feasibility assessment).
Financial Close/Finalization	Site optimization, contract strategy and procurement, detailed cost estimates, power purchase agreement, funding arrangements	Final investment decision (to proceed with construction)
Construction	Construction of the solar/wind farm by the selected contractor(s), design review and supervision by owner's engineer, commissioning and acceptance testing.	Commissioned solar/ wind power plant
Operations & maintenance	Operations & maintenance of the solar / wind plant at contracted performance level.	Fully operational plant
Decommissioning / Repurposing	Dismantle old plant / land redevelopment	Site restored/ repurposed

1.3.2 Challenges for Financing Green and Low-carbon BRI Energy Projects in Developing Countries

Based on this understanding of the project development lifecycle, there are clear challenges that Chinese financiers may face when seeking to support green and low-carbon energy projects in BRI participating countries, especially in the early stages of project development.

First, there may not be a sufficiently enabling environment. Successful project development starts with the creation of an enabling environment by the host government. Appropriate policies, such as renewable energy targets and a transparent framework for the procurement of the renewable energy projects, are key, as they provide potential investors with the assurance that the projects will be procured according to existing legislation or procurement frameworks.

Second, there may be limited technical capacity in the host country to carry out key steps such as environmental assessments, financial modeling, market studies and project information memoranda. This is relevant for projects based on newly commercialized and new-to-market low-carbon technologies, including renewable energy projects in most developing economies. Countries such as South Africa have had to rely on international technical expertise to build the capacity of both government and private sector advisors in the early stages of the development of the renewable energy sector.

Third, early-stage processes may be prohibitively expensive. A high-level review or assessment of a project's environmental impact, grid connectivity, resource potential, energy costs and electricity tariffs can require significant capital outlay, particularly for a small start-up or new entrant.

Fourth, there is a lack of pre-feasibility funding for early-stage project development. In the early stages of the project development lifecycle, the project is not yet de-risked and there is little interest from potential investors. There is limited seed capital available for project scoping, site acquisition and initial design, which are pre-requisites for project preparation funding. The project developer is therefore expected to finance the early stages either from its own resources or from grants from MDBs or FDIs.

Fifth, despite the availability of funds for pre-feasibility studies, project developers may have stringent requirements for access to these funds. Most funds require the developer to contribute a portion of the required funding, commonly referred to as having "skin in the game."

Sixth, there is often a lack of related infrastructure to support project development. For example, project developers in sub-Saharan Africa may lack access to the transmission grid, which is typically the responsibility of the electricity utility in most sub-Saharan African countries. This means that although the site and resources may be ideal for a solar or wind power project, the developer may not be able to transmit the power if the grid connection near the project site is not on the utility's list of priority projects.

Finally, developers may not be able to secure off-take arrangements. In order to complete the pre-feasibility study, the developer must secure indicative off-take letters of interest. This process normally requires that the developer to have a strong balance sheet and several years of relevant experience to demonstrate that the developer has a track record. This makes it very difficult for new entrants to the sector, though established and globalized Chinese companies can easily overcome this barrier. In many developing countries, however, it is hard to charge for electricity. Thus, power infrastructure projects, including renewable energy projects, cannot make a profit through traditional methods such as billing. Developing countries urgently need to explore a profit model suitable for their national conditions.

Despite a general lack of support for the early phases of the renewable energy project pipeline, there are some existing pre-feasibility funds and project preparation facilities for renewable energy projects. Annex B provides a summary of these existing funds and facilities and analyzes the following attributes: funder, size, technologies supported, their successes, failures and opportunities, and examples of the projects in which they have invested. The examples span global, multilateral and regional funds, and the funds support a wide range of clean energy technologies.

In the context of a green and low-carbon Belt and Road, there are some examples of how MDBs have helped overcome some of the aforementioned barriers in the early stages of renewable energy project pipelines, making the projects more suitable for financing by China's FDIs and other financiers. For example, MDBs have helped countries such as Argentina, Ethiopia and Pakistan put in place enabling policies and procurement systems for renewable energy (Bhandary et al. 2022).

2 Renewable Energy Development Policy, Demand and Model Innovation for Belt and Road Countries

In this chapter, we looked into China's renewable energy industry, which has made remarkable achievements from scratch and caught up with the rest of the world over the past 40 years of reform and opening-up. It has eased China's tight energy supply, provided a stable and reliable engine for economic take-off, laid the foundation for a green and low-carbon economic transformation and reduced poverty and unemployment in China's remote and rural areas. Therefore, China's renewable energy development is of great reference for BRI participating countries in their developing stages.

This chapter compares the greenhouse gas reduction and renewable energy targets and related policies in major BRI participating countries. It also studies the current practices and future demands of their renewable energy industries. By combining these findings with China's policy and implementation experience in renewable energy, this chapter summarizes and puts forth insights about renewable energy growth and green low-carbon transformation in BRI participating countries, as well as practices of some major countries and regions in launching green energy cooperation.

2.1 Renewable Energy Development Policy Objectives, Practice and Demand in Key Belt and Road Regions

As of June, 2023, China has signed more than 200 documents (in the form of cooperation agreements, cooperation documents, memorandums of cooperation, memorandums of understanding, etc.) with 152 countries and 32 international organizations, including 52 African countries (regions), 40 Asian countries (regions), 27 European countries (regions), 11 Countries (regions) in Oceania, 9 South American countries (regions), and 13 North American countries (regions). Based on indicators such as electricity access for the entire population, access for the rural population, the proportion of renewable energy and China's investment in them, this study selects the countries with great potential and urgency for renewable energy development from the BRI participating countries (Table 2-1), which are mainly located in Southeast Asia, Central Asia, Africa and Latin America. This session focus on issues of renewable energy development targets, policies and practical experiences, as well as the pressures and challenges, and with reference to China's policy experience and successful cases. This session discusses the situations in BRI participating countries, analyzes the issues that need to be addressed in these regions, and the role that China, especially China's centrally-administered state-owned enterprises, needs to play.

Table 2-1 Criteria for Potential Renewable Energy Cooperation Partners and Selected BRI Participating Countries

Indicator	Source/Year	Country Code

China's total investment in the country is equal or more than $10 billion.	China's Outbound Investment Data/2021	KOR, JPN, MYS, SGP, IDN, IND, KAZ, IRQ, NGA, COD, ZAF, RUS, FRA, NLD, DEU, ITA, PER, ARG, CHL
China's investment in the country's energy sector is not less than $1 billion.	Heritage Foundation/ 2020	MNG, PHL, KHM, LAO, MYS, MMR, BRN, SGP, VNM, IDN, PAK, IND, BGD, KAZ, ARE, SAU, TUR, SYR, IRQ, IRN, EGY, UGA, NGA, NGA, TCD, MOZ, AGO, ZWE, ZAF, BLR, FRA, DEU, SRB, GRC, ITA, PRT, TTO, GUY, VEN, ECU, PER, ARG, CHL
Proportion of Access to Electricity for the Entire Population (<50%)	World Bank/2020	SSD, TCD, BDI, MWI, CAF, BFA, COD, SLE, LBR, MOZ, GNB, MDG, TZA, BEN, UGA, ZMB, GIN, RWA, AGO, MRT, LSO, COG, SOM
Proportion of Rural Population with Electricity in Ascending Order (<50%)	World Bank/2020	GNQ, COD, TCD, CAF, BDI, MOZ, SLE, SSD, MWI, LBR, MDG, ZMB, COG, GNB, MLI, BEN, GIN, TZA, TGO, NGA, DJI, CMR, BWA, GAB, GMB, SOM, UGA, LSO, NAM, ZWE, RWA, ERI, ETH, SDN, CIV, SEN
Low Proportion of Renewable Energy (<20%)	World Bank/2019	OMN, BHR, BRN, SAU, QAT, TKM, KWT, DZA, IRQ, TTO, ARE, SGP, ATG, IRN, SYR, MDV, SYC, UZB, AZE, KAZ, FSM, FSM, LBY, YEM, MNG, KOR, BRB, ISR, MYS, EGY, LBN, GNQ, UKR, JPN, MLT, BLR, DMA, JOR, NLD, BOL, JAM, BEL, ARM, GRD, ZAF, MAR, ARG, GUY, TLS, CYP, POL, TUN, HUN, TUR, SUR, FRA, VEN, CZE, MKD, LUX, DEU, ITA, SVK, ECU, AFG, GRC, VNM, PAN, IDN, BGR, SLV

Source: Made by the author.

2.1.1 Renewable Energy Development Policy Objectives, Practice, and Demand in Southeast Asia

2.1.1.1 Renewable Energy Policy Objectives of Major Southeast Asian Countries

Southeast Asian countries have always been important trade and international partners of China, with great potential for cooperation in renewable energy development. Southeast Asia boasts great renewable energy resources but is highly vulnerable to climate change, which has led to an increased focus on renewable energy development in recent years. With low-cost labor and land, Southeast Asia can attract global renewable industries where it has established strong industrial advantages in terms of both equipment manufacturing and deployment. In the updated nationally determined contributions (NDCs), major Southeast Asian countries set emissions targets (see Appendix) with renewable energy targets as important emissions reduction instruments. However, IRENA's data finds that there remains a considerable gap between the current renewable energy capacity and the predefined targets. In response, governments have issued a series of policy papers such as energy white papers, power development plans, national energy policies, renewable energy strategies, national renewable energy policies and action plans and alternative energy development plans, as well as formulated phased development objectives and relevant policy support to guide renewable energy development.

2.1.1.2 Renewable Energy Practice in Major Southeast Asian Countries

Southeast Asian countries have put in place a variety of supportive policies and incentives for renewable energy development and clean energy transition. Based on different national conditions and the maturity of the renewable energy market, these countries have widely implemented various incentives (see Table 2-2). Renewable energy development targets have been widely used in Southeast Asian countries to indicate their overall renewable energy development goals. Consumption measures such as feed-in tariffs, self-consumption programs, competitive bidding/auctions, and the introduction of licensing mechanisms and technical standards have been mainly designed to increase renewable energy consumption. Fiscal policies such as tax incentives, preferential loans and capital subsidies have increased the returns from renewable energy projects and provided incentives for investment in these projects. As an emerging energy incentive tool, the mechanism for the "Green Electricity Certificate"[1] is in its experimentation and exploration stage.

Table 2-2 Renewable Energy Incentives in Major Southeast Asian Countries

Countries	Overall Goals	Consumption Measures	Fiscal Measures	Others

[1] An electronic ID card for green electricity, which is the confirmation and attribute proof of non-hydro renewable energy generation and the only proof of green electricity consumption.

	Renewable Energy Development Targets	Feed-in Tariffs	Self-consumption Programs	Competitive Bidding/ Auctions	Tax Incentives	Preferential Loans	Capital Subsidies	Green Electricity Certificate
Brunei	√							
Cambodia	√			√	√			
Indonesia	√	√	√	√	√	√		
Laos	√				√			
Malaysia	√	√	√	√	√	√		
Myanmar	√				√			
the Philippines	√	√	√		√			√
Singapore	√		√	√	√			
Thailand	√	√	√	√	√	√	√	
Vietnam	√	√	√		√			

Source: Yan Xingyu, Gao Yi. Development of Renewable Energy in Southeast Asia [J]. Sino-Global Energy, 2020, 25(05): 21-27

The feed-in tariff (FiT) is the most sophisticated and critical driver for the largest installed capacity in Southeast Asian countries. The system has been adopted by countries such as Thailand, Indonesia, Vietnam, Malaysia and the Philippines in the early stages of their renewable energy generation markets. With changes in the local renewable energy generation technologies and costs as well as incentive targets, these countries have fine-tuned FiTs to satisfy the needs of different stages. Market-based trading of renewable energy is facilitated by measures such as bidding/auctions for feed-in tariffs.

These measures vary from country to country. For instance, Vietnam has allowed power producers to bid for feed-in tariffs, while independent power producers in Indonesia can sell renewable energy directly to state-owned transmission and distribution companies. Many Southeast Asian countries have also streamlined power generation approval, market registration and settlement procedures of measures like feed-in tariffs. In addition, the investment and financing policies introduced by these countries have mobilized financial instruments such as public finances, development banks and related bonds and funds to support renewable energy. These policies represent innovative practices to promote industrial development through financial means. Despite the relatively small investment base for renewable energy in Southeast Asian countries, public finances and development banks still account for a large share and there will be more investment in the future. At the same time, the types of equity and debt financing have increased, and capital from green bonds and climate funds is gradually emerging.

2.1.1.3 Renewable Energy Development Demand of Major Countries in Southeast Asia

In recent years, Southeast Asian countries are putting more and more attention to renewable energy development, but many problems remain unaddressed due to the late start and the economic environment.

Heavy reliance on fossil energy and difficulties in achieving clean development goals. Southeast Asia boasts rich coal resources. The local energy supply is dominated by fossil energy while renewable energy meets less than 15% of demand. While renewable energy can play a vital role in Cambodia, Laos, Myanmar, and Vietnam as they can rely on hydropower, other Southeast Asian countries like Brunei, Malaysia, the Philippines, Singapore, Indonesia, and Thailand have a much smaller share of renewable electricity generation. Most countries are already behind schedule in renewable energy development, except for Thailand and Vietnam, where solar capacity has been installed as planned. In this context, it is difficult for Southeast Asian countries to achieve their clean energy targets.

Less developed mechanism. Renewable energy projects require a large amount of land, but most Southeast Asian countries lack transparent land use permitting procedures. It is complicated to acquire, retain, and transfer land use rights. On top of that, there are issues like the period and costs of land purchase. As a result, renewable energy projects are paused by procedural delays and cost overruns. Moreover, the grid connection policy of renewable energy generation in each country is complicated and fickle during the exploration stage. FiTs change frequently, so the return on investment is low. Investment has the potential to be more efficient. These institutional issues need to be addressed for renewable energy growth in Southeast Asian countries.

Insufficient transmission infrastructure. Renewable energy power generation and grid connection are universal problems. Areas that are resource-rich in renewable energies generally have limited consumption capacity. Transmitting renewable energy power relies heavily on grid transmission and regulation capacity. However, the grids of most Southeast Asian countries are less developed. Some of them have few high-voltage lines; some may mainly transmit low-voltage electricity; others have not even built a national grid. Transnational and cross-border cooperation is still in its infancy and cannot transmit clean renewable energy power to areas with great power demands, stifling renewable energy growth.

Difficulties in investment and financing. In terms of policies and regulations, some Southeast Asian countries have poor regulations, underdeveloped capital markets and relatively high commercial risks. Renewable energy projects are small in scale with poor local financial markets and insufficient protection for project refinancing, exit and investment, which makes them less attractive to investors in the private sector.

2.1.2 Renewable Energy Development Policy Objectives, Practice and Demand in Central Asia

2.1.2.1 Renewable Energy Policy Objectives of Major Central Asian Countries

Central Asian countries — Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, and Tajikistan — are rich in oil and gas and have been heavily relying on these traditional fossil energy resources. The five countries have been the major destinations of China's outbound energy investments. China has participated in the development of local energy systems in various forms, such as construction assistance, equity participation and contracting, but primarily in conventional thermal power generation facilities. However, to achieve carbon neutrality, ensure energy security and transform the economic structure, Central Asian countries are facing pressure to transform their traditional energy mix based on hydrocarbon energy.

The five Central Asian countries are also rich in renewable energy resources such as wind, solar and hydro power. Although there are no quantitative renewable energy targets in the NDC document (see Annex A), developing alternative energy resources is the primary choice for greenhouse gas emission reduction in the region, according to each country's relevant action plans, laws, and regulations.

2.1.2.2 Renewable Energy Practice in Major Central Asian Countries

Differences in the endowment of fossil energy resources in Central Asia have led to different renewable energy planning and development. In the west, Turkmenistan is rich in hydrocarbon resources. In the east, the region is poor in hydrocarbon resources, but rich in renewable energy resources, such as hydropower, wind and solar energy in Kazakhstan, hydropower and solar energy in Kyrgyzstan, hydropower resources in Tajikistan and solar energy in Uzbekistan. These countries are more flexible and adaptable in their energy transitions and thus have greater potential.[2]

The five Central Asian countries have implemented laws and regulations related to renewable energy. For example, Kazakhstan has introduced and amended the *Law of the Republic of Kazakhstan on Support for the Use of RES*, established the Financing and Settlement Center (FSC) and released a detailed action plan for renewable energy development. Kyrgyzstan introduced the *Law on Renewable Energy* to support the power generation and grid connection of renewable energy equipment and exempted imported renewable energy equipment from tariffs. Tajikistan issued the *National Development Strategy of Tajikistan for the Period till 2030* to carry out reforms in the field of hydropower, build more hydropower plants, improve energy efficiency in power generation and reduce transmission losses. Uzbekistan has guided and stimulated the renewable energy development in the country through the enactment of several government documents such as *On the Use of Renewable Energy Sources*, *On the Programme of Measures for Further Development of Renewable Energy*, *On the*

[2] Pang Guanglian, Wang Shuang, Wang Yu. Energy Transition and Renewable Energy Investment Cooperation in Central Asia [J]. International Petroleum Economics, 2022, 30(02):76-83.

Program of Measures to Ensure Structural Transformation, Modernization and Diversification of Production for 2015-2019, and *On the Program of Measures for Further Development of Renewable Energy for 2017-2021*.

In addition, various supportive measures are the foundation for renewable energy development in Central Asian countries. Kazakhstan has introduced a bidding mechanism for renewable energy; Kyrgyzstan has issued a presidential decree to carry out all-out research and promotion of dominant energy and established an energy development center; and Turkmenistan founded a specialized research center for solar energy in 2014 and promoted an energy conservation program in 2020 to develop solar and wind power generation programs in each province.

2.1.2.3 Renewable Energy Development Demand of Major Central Asian Countries

The five Central Asian countries differ greatly in terms of resources and energy, and this uneven distribution of water and oil remains prominent. Issues arising from the energy integration in Central Asia during the Soviet era compounded with the uneven distribution of water and oil resources resulted in disputes and differences in energy supply and demand among the five Central Asian countries that are now facing great challenges in energy independence. These are problems that Central Asian countries need to resolve with new mechanisms and institutional design as they transition towards a low-carbon energy system.

Fewer geopolitical conflicts and regional security are political and economic preconditions for renewable energy development. After the United States withdrew its troops from Afghanistan, Central Asian countries need to invest more energy and financial resources to maintain the regional balance of power. Due to the COVID-19 pandemic, Central Asian countries have been suffering from economic downturns, currency devaluation, inflation, and a high unemployment rate, further intensifying the regional security situation. Therefore, Central Asian countries need to maintain regional stability and peace to provide a favorable business environment for renewable energy such as photovoltaic power and hydropower.

2.1.3 Renewable Energy Policy Objectives, Practice, and Demand in Africa

2.1.3.1 Renewable Energy Policy Objectives of Major African Countries

Africa is rich in natural resources as Northern African countries like Libya, Nigeria, Algeria, Angola, Sudan, Egypt, and Chad enjoy abundant oil and gas reserves while the vast continent is abundant in solar and wind energy resources. However, Africa's economic development is extremely uneven. Northern African countries are more developed economically thanks to their oil and gas exports and technological advantages. However, a number of countries in Africa, especially those in sub-Saharan Africa suffer from poverty. Energy deficit impedes economic growth. Therefore, renewable energy has become a unanimous choice for both North and South Africa.

Like the uneven economic development, there is a huge gap between Northern Africa and Southern Africa in renewable energy policy objectives. Northern Africa is more ambitious as it has a stronger economic foundation while Southern Africa set lower targets, most of them being demonstration projects, as their priority is to tackle the energy access deficit (see Annex A).

2.1.3.2 Renewable Energy Practice in Major African Countries

To realize the renewable energy targets, African countries adopted a series of policy measures which are as follows[3]:

Eliminate fossil fuel subsidies. By the end of 2020, African countries like Egypt, Ethiopia, Ghana, Morocco, Rwanda, and Togo have committed to or already started removing fossil fuel subsidies, which has since relieved governments from huge fiscal burdens and rid the countries of dependence on fossil fuels, reducing political corruption and social injustice.

Introduce carbon pricing. The economically more developed South Africa introduced carbon pricing, which covers over 41% of energy-related carbon emissions, reduces negative externalities of burning fossil fuels, and brings new opportunities for renewable energy development.

Reduce fossil fuel investments. Egypt and South Africa have made commitments to abandon coal, and the international community has also promised to stop funding coal plants, including those in Africa. Meanwhile, many coal-fired power projects have been shelved or canceled due to pressure exerted by local and international environmental groups. as Also, increased competitiveness of solar and wind energies results in higher financing costs for coal-fired power plants. These has made room for renewable energy development.

Boost renewable energy investments with fiscal policies and safeguard mechanisms for energy consumption. Countries like Ethiopia, Senegal, Zambia, Morocco, and South Africa attract private investment with structured procurement programs such as feed-in tariffs and auctions, financing support like subsidies or grants, risk management instruments as well as technical aids. Kenya has reduced import tariffs on raw materials used in the production of solar equipment and implemented a zero-tariff policy and zero VAT rate on imported solar products to enhance the competitiveness of the local solar industry.

2.1.3.3 Renewable Energy Demand of Major African Countries

Africa still faces many challenges in renewable energy development.[4]

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[3] Wu Fang. Renewable Energy Development in Africa and China-Africa Cooperation[J]. Practice in Foreign Economic Relations and Trade, 2022, No.401(06): 4-8.

[4] Wu Fang. Renewable Energy Development in Africa and China-Africa Cooperation[J]. Practice in Foreign Economic Relations and Trade, 2022, No.401(06): 4-8.

A weak industrial base. Africa's renewable energy industry lacks a strong industrial base and supporting sectors. Therefore, many supporting facilities are imported from overseas, result in increasing project costs and decreasing project Return On Investment(ROI).

Insufficient grid infrastructure. Renewable energy-generated power is delivered through transmission and distribution (T&D) networks. However, except for North Africa and Southern Africa, there are very few national lines and they mainly serve capitals and major cities. Without T&D lines, power generated by renewable energy cannot be delivered which is unhelpful to further renewable energy development.

Incoherent and inconsistent renewable energy policies in most African countries. Most countries in Africa do not have detailed energy planning and policies that are coherent and consistent, and this has greatly discouraged investment and entrepreneurship in the renewable energy industry.

Talent shortages. Africa suffers greatly from talent shortages both in renewable energy and equipment maintenance, which significantly limit the sustainable development of renewable energy. Without professionals working in renewable energy research, production, and maintenance, the advanced equipment (mostly imported) is more likely to be worn out. Africa needs to address talent shortages by improving general education and eliminating discrimination and prejudice in vocational education.

Lack of funding. Renewable energy development requires substantial investment, which is currently not in place because government funding in most African countries are insufficient and foreign investments are not enough due to the unfavorable investment environment in Africa. Therefore, African countries need to revitalize foreign and local investment, increase funding for research and foreign experts, and invest more in production to boost renewable energy development.

Inadequate marketization. African governments monopolize electricity production for its high tax revenue. Although it may help to pool resources together, it can lead to low efficiency and management based on mandatory administrative orders. As a result, some renewable energy projects cannot operate smoothly and efficiently.

2.1.4 Renewable Energy Policy Objectives, Practice, and Demand in Latin America

2.1.4.1 Renewable Energy Policy Objectives of Major Latin American Countries

Many Latin American countries have set renewable energy targets, especially long-term ones with clear targets in energy production, consumption, and installed capacity. Long-term, reliable policies are essential to attract developers to invest in the renewable energy industry, which also shows great commitment to renewable energy development

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Wang Tao, Cui Yuanyuan. Potential, Status Quo, and Future of Wind Power in Africa[J]. Journal of China-Africa Studies, 2020, 1(02):117-136 from the government side. Although most Latin American countries did not specify their renewable energy targets in their NDCs (see Annex A), most of them have set phased targets and plans in their domestic policies to guide renewable energy development according to their potential, technology readiness level, investment expectations, and political will.

2.1.4.2 Renewable Energy Practice Basis in Major Latin American Countries

Most Latin American countries have set phased targets and plans in their domestic policies to guide renewable energy development according to their potential, technology readiness level, investment expectations, and political will. In order to realize the renewable energy development targets, some Latin American countries, including Argentina, Colombia, Chile, Honduras, and Mexico, have enacted renewable energy laws. In addition, they have also adopted several specific legislations for renewable energy resources like the geothermal law and the biomass law, which are expected to provide a legal framework for the sustainable development of renewable energy. They have also used policy tools such as auctions, feed-in tariffs, renewable energy quotas, net metering, and fiscal incentives to support renewable energy in terms of quantity and price.[5]

Auctions. Latin America has seen great interest in auction schemes which are great drivers for renewable energy development. Currently, 13 Latin American countries have deployed renewable energy auctions but focus on different aspects. For example, Uruguay seeks bidders for installed capacity, Peru for electricity generation, and Guatemala for both. Auction schemes are improving across Latin America as countries like Peru, Uruguay, Brazil, Costa Rica, Guatemala, Nicaragua, and Panama have established margin systems to avoid delayed or incomplete projects by developers who lower prices to win bids.

Feed-in tariffs. Subsidizing low-income residents and power utilities with feed-in tariffs puts a huge fiscal burden on governments. Therefore, only Argentina, Dominica, Honduras, Panama, Uruguay, Nicaragua, Brazil, and Ecuador have made such attempts as opposed to other Latin American countries.

Renewable energy quotas. Renewable energy quotas define the minimum shares of renewable energy sources in the energy mix of power utilities and are often implemented together with “Green Electricity Certificates.” Latin American countries such as Chile adopted the scheme. Starting from 2010, renewable energy should take up 5% of the energy mix in any new electricity contract and increase by 0.5 percentage points per year from 2014 to 2025. By 2020, power utilities with installed capacity over 200 MW must generate 20% of their power with renewable energy.

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[5] Jiao Yuping, Cai Yu. Clean Energy Cooperation Between China and Latin America Amid Energy Transition[J] Journal of Latin American Studies, 2022, 44(04): 117-135+157-158

Net metering. Net metering is a billing mechanism that allows utility customers to install their own renewable energy generating systems and export that power to the grid to reduce their future electric bills. Countries in Latin America that have implemented this mechanism include Brazil, Mexico, Ecuador, Chile, Colombia, Costa Rica, Panama, and Uruguay. Brazil primarily targets consumers who generate less than 1 MW for retail, while Costa Rica has opened net metering to individual consumers whose credits are equal to their annual electricity consumption.

Fiscal incentives. Most Latin American countries offer tax breaks, such as exemption from VAT (e.g. Argentina, Colombia, Uruguay, and Chile), income tax (for example, Argentina, Guatemala, Honduras, and Uruguay), fuel tax (e.g. Brazil, Chile, and Panama), and import and export tax (e.g. Argentina, Brazil, Ecuador, and Honduras). Five countries, including Argentina, Colombia, and Mexico, have also implemented accelerated depreciation policies to encourage renewable energy investments. In addition, many Latin American countries have established public funds to support the sustainable development of renewable energy.

2.1.4.3 Renewable Energy Demand of Major Latin American Countries

Despite rapid growth, renewable energy development in Latin America still faces many barriers, including technical barriers, market barriers, and social barriers[6].

Technical barriers. Major technical barriers to renewable energy development in Latin American countries are insufficient information and integration barriers. Insufficient information refers to the fact that Latin American governments, with the assistance of international organizations, NGOs, and private consultants, have done basic assessments of renewable energy resources, technologies, topography, land use, grid transformation, etc., but these data are not publicly available. Integration barriers mean that the intermittency of renewable energy takes a toll on the stability of connection and power supply, posing great challenges to power system management.

Market barriers include barriers to entry, transaction costs, contractual risks, subsidies to fossil fuels, lack of financing instruments, and political and economic instability. Electricity markets in Latin America vary greatly in their openness to private or independent power producers and are not friendly to international and local investors. The markets and project scales for renewable energy in Latin America are relatively small, which can result in higher transaction costs and less appeal to investors. Independent power producers and the electricity sector face greater uncertainty and risk because utility contracts are often not legally enforced. Most Latin American countries are still offering direct or indirect subsidies to fossil fuels, which are to the detriment of renewable energy development. Renewable energy projects often have payback periods that exceed the scheduled repayment period of debt financing and do not meet the high equity ratio requirements for equity financing. Therefore, it is difficult to obtain

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[6] Wei Wei, Renewable Energy Policies and Best Practices in Latin America[J] Journal of Latin American Studies, 2016, 38(06): 77-94+156-157

financing through these means, and few competitive financial products are available from the public and private sectors.

Social barriers include public misconceptions, complacency, “NIMBY (not in my back yard)” effects and lack of human resources. People in Latin America generally believe that only traditional large-scale electricity production can satisfy electricity demand and that miniaturized and distributed renewable energy plants cannot adapt and meet the electricity demand. Apart from that, they have little understanding of the costs, opportunities, and environmental impacts of renewable energy. Fossil fuels dominate energy consumption in Latin American countries, and some countries are accustomed to maintaining this status quo; residents oppose the construction of large-scale renewable energy projects in their neighborhoods out of concern for people's health and negative impacts on the environmental quality and economic development; people without adequate qualifications and training may fail to deliver in management and application of renewable energy projects, and even bring negative influence to renewable energy policy design.

Policy Evolution, Innovation Models, and the Experience of China’s Renewable Energy Development Since the beginning of this century, China’s promotion policies for renewable energy have gradually taken root and matured, forming a renewable energy policy tool system with the *Renewable Energy Law* as the core, which includes policies and measures such as overall targets, fiscal and financial policies, fixed electricity rates, and guaranteed purchase (see Figure 2-1). This has provided strong support for the steady development of renewable energy in China.

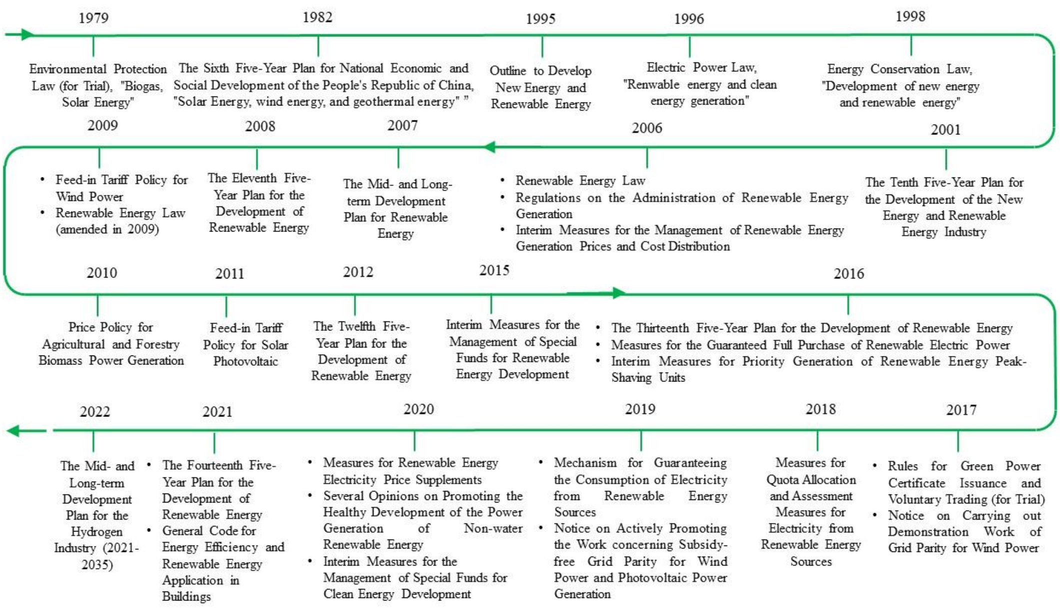

Fig. 2-1 Evolutionary Path of China’s Renewable Energy Policy

Source: *Research on the Improvements of China’s Renewable Energy Policy System under the Dual Carbon Goals[J]*, Yu Shiwei, Sun Yafang, Hu Xing, Journal of Beijing Institute of Technology (Social Science Edition), 2022, 24(04):93-102.

2.1.5 Evolution of China's Renewable Energy Development Policy

China currently holds a leading position in solar and wind power manufacturing worldwide. The development of the solar and wind energy industries is attributed to China's constantly strengthening industrial strength and expanding domestic energy demand. The solar and wind energy industries in China exhibit different growth patterns. This section highlights the evolution of policy concerning solar and wind power generation in three distinct stages, namely early technology development, manufacturing scale-up, and industrial globalization.

2.1.5.1 Early Stage of Technology Development

In 1995, the *Electricity Law* officially encouraged and supported the use of renewable energy including solar and wind energy for power generation. In terms of solar energy, in 2000, the Western Development Strategy set the agenda for rural electrification; in 2002, the Brightness Program allocated 2.6 billion yuan for solar production and installation, while the Delivering Power to Villages project achieved nearly 20 MW of installed PV capacity (Zhi et al. 2014; S. Zhang, Andrews-Speed, and Ji 2014). In 2001, the *10th Five-Year Plan* made an explicit request for the annual capacity of solar photovoltaic cells, and in 2003, the *Catalogue of High-tech Products* encouraged foreign investment in solar energy, offering tax incentives to potential market entrants (Zhi et al. 2014). These early policy proposals linked solar energy with rural electrification and development. Correspondingly, the Torch Program in 1988 and the "863 Program" in 1986 (usually referred to as the "National High-tech Research and Development Program") provided funding for high-tech industries and attracted top research talent in China who had experience working in or with foreign institutions (Nahm 2017).

The wind energy industry in China has been jointly promoted by the central and local governments. The first 200-kW wind turbine generator was successfully developed in China with funding from the central government. Between 1992-1995, China imported 300-kW wind turbine technology from Danish companies, Bonus and NTK. 1995 saw the issuance of the *Outline to Develop New Energy and Renewable Energy (1996-2010),* which formalized measures such as tax reduction and exemption, electricity price subsidies, and demonstration projects for wind and solar energy (World Bank 2001). In 1996, the "Riding the Wind" program was developed, focusing on the introduction and integration of advanced foreign technologies (Urban and Nordensvard 2013).

In September 1997, the *Mid- and Long-term Development Plan for Renewable Energy* was released, setting the guiding target that 10% of all electricity should be generated from renewable sources by 2010 (Zhang et al. 2009). The year 2000 marked a turning point in demand-driven wind power deployment, with the National Bond Wind Power program providing financing for 80-MW of domestically produced wind turbine generators. In the meantime, the *11th Five-Year Energy Development Special*

Plan focused on supporting large-scale demonstration projects and local innovation (Ru et al. 2012). Driven by external expertise and R&D financing, the early planning laid the foundation for wind power development. Table 2-3 summarizes the relevant policies for wind and solar energy industries during this period.

Table 2-3 Policies to Support Early Technology Development in China's Wind and Solar Industries

Technology	Period	Policy
Solar Energy	1995-2005	*Outline to Develop New Energy and Renewable Energy (1996-2010),* (1995); *Electricity Law* (1995); Western Development Strategy (2000); the *10th Five-Year Plan* (2001); Brightness Program (2002); Delivering Power to Villages project (2002); *Catalogue of High-tech Products* (2003)
Wind Energy	1980s-2003	Torch Program (1988); "863 Program" (1986); *Outline to Develop New Energy and Renewable Energy* (1995); "Riding the Wind" program (1996); *Mid- and Long-term Development Plan for Renewable Energy* (1997); "National Bond Wind Power" program (2000); the *10th Five-Year Plan* (2002); *Catalogue of High-tech Products* (2003)

Compile from open sources.

2.1.5.2 Stage of Scaling up

Like the early stage of development, the growth of leading local players in wind and solar has benefited from different factors. In the solar sector, the introduction of local production incentives and early demand-side measures between 2005-2008 facilitated the scale development of the photovoltaic industry. In 2005, the National Development and Reform Commission launched a "special project" for solar component and cell production (Zhi et al. 2014); the *Renewable Energy Law* officially implemented in 2006 (amended in 2009) stipulated that grid enterprises must fully purchase renewable energy-generated electricity (Andrews-Speed et al. 2013). The *Mid- and Long-term Development Plan for Renewable Energy* further clarified the target for the proportion of installed solar and wind power capacity to total electricity generation (Campbell 2014). Driven by the policy, several PV industry leaders completed their initial public offerings in the global market.

In 2001, Goldwind obtained a license for a 750-kW turbine from REpower based in Switzerland; in 2004, it designed a 1.2-MW wind turbine collaborating with the German company Vensys. Several small European companies established joint ventures with Chinese companies, including Nantong CASC Wanyuan Acciona, XEMC Darwin Co., Ltd, REpower North (China) Co., Ltd, Harbin Hafei-Winwind and AVANTIS YINHE (Lewis 2007; Zhang et al. 2009). In 2006, China proposed to enhance its independent innovation capability, and independent innovation as a national strategy was given an important place in the *11th Five-Year Plan*. In 2006, China proposed to enhance its capacity for independent innovation, and independent innovation became a national strategy occupying an important position in the *11th Five-Year Plan* (Nahm 2017). Table 2-4 summarizes the wind and solar energy-related policies during this period.

Table 2-4 Policies to Support Large-scale Production in China's Wind and Solar Industries

Technology	Period	Policy
Solar Energy	2005 - 2008	Renewable Energy Law (2005); the 11th Five-Year Plan (2006); Mid- and Long-term Development Plan for Renewable Energy (2007)
Wind Energy	2003 - 2008	Wind Power Concession Projects (2003); Renewable Energy Law (2005); Mid- and Long-term Development Plan for Renewable Energy (2007)

Source: Public Information

2.1.5.3 Stage of Globalization

After 2008, the government prioritized demand-led growth in the wind and solar sectors, focusing on improving the efficiency of existing leading companies and actively implementing policies to boost domestic demand and drive solar component consumption (Zhang and Gallagher 2016). In 2009, the implementation of the Solar Rooftop Program and the Golden Sun Demonstration Project laid the groundwork for the development of a nationally unified benchmark feed-in tariff for solar PV power in 2011. In 2013, the Ministry of Industry and Information Technology (MIIT) set performance standards and capacity requirements, for example, mandating that manufacturers invest at least 3% of their revenues in R&D (Ball et al. 2017). By 2015, China's domestic installed capacity of solar had reached 43,500 MW.

The wind energy industry also actively deployed demand-led incentives. After 2008, the Chinese government increased the incentive for domestic companies to invest through tax reductions and exemptions. In 2009, the National Development and Reform Commission's *Notice on Improving the Feed-in Tariff Policy for Wind Power* implemented a VAT rebate policy for domestic companies (NDRC, 2009). In 2010, MIIT issued regulations focusing on supporting the independent R&D of wind turbines with a capacity of 2.5 MW and above (Kang et al. 2012; Nahm 2017). At the same time, industry leaders hit overseas markets, continuously establishing expertise through mergers and acquisitions. For example, in 2009, Goldwind acquired the German company Vensys, and in 2014, AVIC Huiteng acquired the Dutch company CTC (Dai et al. 2014). Table 2-5 summarizes the policies related to the stage of globalization of China’s renewable energy industry.

Table 2-5 Policies to Support China’s Wind and Solar Industries at the Stage of Globalization

Technology	Period	Policy
Solar Energy	2008 to present	the “Solar Rooftop Program” (2009); the “Golden Sun Demonstration Project” (2009); *Feed-in Tariff* (2011)
Wind Energy	2008 to present	Notice on Improving the Feed-in Tariff Policy for Wind Power (2009); Feed-in Tariff (2011)

Compiled from open sources.

2.1.6 Policy Tool for Renewable Energy Development in China

After decades of exploration, learning and innovation, China’s renewable energy promotion policies have gradually become systematic and mature, providing a solid institutional guarantee for the development of the renewable energy industry. With stable guidance from the Renewable Energy Target Policy, and support from financial, taxation, and fixed pricing policies as well as guaranteed purchase policies, China's renewable energy industry has made significant progress: its renewable energy installed capacity, including wind and solar power, ranks first in the world, making it the "No.1 country of renewable energy"; the level of renewable energy technology and equipment has been significantly improved, with key components basically achieving domestic production and the number of newly added patents ranking high in the world, and a complete internationally leading industrial chain has been built; the progress of China's renewable energy, including improvements in technology and market expansion resulting in a reduction in costs, has greatly lowered the threshold for the development and utilization of renewable energy, contributing significantly to the vigorous development of renewable energy worldwide.[7]

2.1.6.1 Renewable Energy Target Policy

The Renewable Energy Target Policy refers to the policy of setting specific strategic goals and plans for the development and utilization of renewable energy resources, covering the development goals, construction layout, key tasks and innovative development methods concerning various aspects of the renewable energy industry such as power generation equipment production, infrastructure construction, power generation plans and grid-connected utilization for a certain period of time in the future. It is the guiding policy for the development of renewable energy in China. The

[7] People’s Daily Overseas Edition. China is leading global renewable energy development [EB/OL].2023-04-27. http://www.nea.gov.cn/2019-08/21/c_138326148.htm.

goal of non-fossil energy or renewable energy development has been at the core of China’s energy structure reform and the green and low-carbon transformation of economic development, and a gradual approach with phased targets has been put forward in policy documents at different stages to support the sustainable supply-side transformation in China’s energy sector. Table 2-6 reviews China’s renewable energy development goals laid out in key policy documents.

Table 2-6: Renewable Energy Development Goals in Key Chinese Policy Documents

Policy Document	No./ Release Time	Development Goals
Mid- and Long-term Development Plan for Renewable Energy	NDRC Energy [2007] No.2174	The overall goal of China's renewable energy development in the next fifteen years is as follows: increase the proportion of renewable energy in energy consumption, address electricity shortages in remote areas and fuel shortages in rural areas, promote the energy utilization of organic waste, and advance the industrialization of renewable energy technology; fully utilize mature and economically viable renewable energy technologies, such as hydropower, biogas, solar thermal utilization, and geothermal energy, and accelerate the industrialization of wind power generation, biomass power generation, and solar power generation to gradually increase the proportion of high-quality clean renewable energy in the energy structure, with the target of renewable energy consumption achieving 10% of the total consumption by 2010, and 15% by 2020; use renewable energy according to local conditions to solve the power supply problem for people in remote areas and fuel shortage for rural living, and effectively protect the ecological environment; promote the energy utilization of organic waste in accordance with the circular economy model, and basically eliminate the pollution caused by organic waste; actively promote the industrialization of new renewable energy technologies, establish an innovation system for renewable energy technology, and form a more complete renewable energy industrial system. By 2010, China aims to basically realize its equipment capacity mainly relying on domestically manufactured equipment; and by 2020, to achieve that the renewable energy equipment capacity mainly relies on independent intellectual property rights.
The Thirteenth Five-Year Plan for the	NDRC Energy [2016]	By 2020 and 2030, the proportions of non-fossil fuels in primary energy consumption are targeted to reach 15% and 20% respectively. By 2020, the annual utilization of all

Policy Document	No./ Release Time	Development Goals
Development of Renewable Energy	No.2619	renewable energy will be 730 million tons of standard coal, of which the utilization of commercial renewable energy will be 580 million tons of standard coal. By 2020, the total installed capacity of renewable energy will be 680 million kilowatts, and the generated power will be 1.9 trillion kilowatt-hours, accounting for 27% of the total power generation. By 2020, various renewable energy sources for heating and civilian fuels will replace approximately 150 million tons of standard coal of fossil energy. By 2020, the electricity price of wind power projects will be able to compete with that of local coal-fired plants, and the electricity price of photovoltaic projects will be close to the retail electricity price. With the reform of the electricity market, the problem of abandoned hydropower by 2020 will be basically solved, and the annual utilization hours of wind power and solar power generation in areas with power restrictions will fully meet the requirement of fully guaranteed purchase.
The Fourteenth Five-Year Plan for the Development of Renewable Energy	NDRC Energy [2021] No.1445	To meet the target of non-fossil energy consumption accounting for approximately 20% of the total by 2025, vigorously promote the development and utilization of renewable energy for power generation and actively expand the non-electric use of renewable energy. The goal is to achieve a total consumption of renewable energy of around 1 billion tons of standard coal by 2025. During the 14th Five-Year Plan period, the proportion of renewable energy in the increment of primary energy consumption is targeted to exceed 50%, and the wind and solar power generation will double. In 2025, the renewable electricity consumption quota in China is targeted to reach nearly 33%, the non-hydropower consumption quota of renewable electric reach 18%, and the renewable energy utilization rate be maintained at a reasonable level. In 2025, the scale of the non-electric use of renewable energy including geothermal heating, biomass heating, biomass fuels, and solar thermal utilization will be above 60 million tons of standard coal.
Enhanced Actions on Climate Change:	2015	Nationally determined targets by 2030: achieve peak carbon dioxide emissions around 2030 and strive to reach the peak as early as possible; reduce carbon dioxide emissions per unit of GDP by 60%-65% compared to 2005;

Policy Document	No./ Release Time	Development Goals
China's Intended Nationally Determined Contributions		have the proportion of non-fossil energy in primary energy consumption reach about 20%; increase the forest stock volume by about 4.5 billion cubic meters compared to 2005.
China's Achievements, New Goals and New Measures for Nationally Determined Contributions	2021	By 2030, China's carbon dioxide emissions per unit of GDP will drop by more than 65% compared to 2005, non-fossil energy will account for about 25% of primary energy consumption, forest stock volume will increase by 6 billion cubic meters compared to 2005, and the total installed capacity of wind and solar power will exceed 1.2 billion kilowatts.

Source: By the author.

2.1.6.2 Fiscal and Financial Policy

Fiscal and financial policies refer to the policies that support the development of renewable energy through fiscal subsidies, tax incentives, capital subsidies, loan support, etc. These policies aim to reduce the production cost, lower the threshold for investment and financing in the renewable energy industry, and alleviate competitive disadvantages concerning technology and cost in the early stages of renewable energy development, thus promoting the rapid growth of the renewable energy industry, especially those small and medium-sized enterprises in the market.

2.1.6.3 Feed-in Tariff Policy

The fixed power tariff policy is a regulation or scheme for feed-in tariffs or related adjustments for different renewable energy technologies and power generation projects within a certain period. It also contains policies on renewable power price formation mechanisms, tariff reform programs, grid transmission and distribution, etc.

2.1.6.4 Guaranteed Purchase Policy

The guaranteed purchase policy refers to relevant measures and methods for grid connection, dispatching support, and consumption promotion of renewable power, aiming at increasing the proportion of renewable energy in total energy consumption and ensuring the fulfillment of tasks and commitments proposed in target-planning policies.

In addition, there is a series of regulatory documents that make detailed rules on renewable energy resources development and the grid-connected process, or on renewable energy products and the supporting production and operation process of its infrastructure. These documents not only involve industry monitoring and early warning, regulation preparation and evaluation system, but also cover technical specifications and standards for basic industrial elements (raw materials, power generation equipment, operation, and end-user applications). They form the foundation for ensuring the sustainable and healthy development of the renewable energy industry.

2.1.7 Integrated Development and Utilization Mode of Renewable Energy

In the practice of renewable energy development, the Chinese government actively promotes an integrated mode of RE development and utilization, applying in diversified and innovative scenarios, such as "photovoltaic plus portfolio" (PV+X) to support the solar PV industry and modern agriculture, forestry, animal husbandry, fishery, control of desertification, building integration, green hydrogen manufacturing and even rural vitalization, so to improve the comprehensive efficiency of land use, boost local residents' well-being, and help achieve the goal of carbon peak and neutrality.

The *Plan for Modern Energy System during the 14th Five-Year Period*[8], issued by the Chinese government, proposes to develop a "PV+X" mode according to local conditions, to enable a coordinated development of sand control, forestry, agriculture, animal husbandry, and fishery. The *Plan for Renewable Energy Development during the 14th Five-Year Period*[9] also brought up actions to drive "PV+X", encouraging integrated development modes such as agriculture or animal husbandry-solar and fishery-solar hybrid system. The National Energy Administration (NEA) also put forward that by 2025, the scale of agriculture-PV, fishery-PV and the like will account for more than 10 million kilowatts[10].

Most of the BRI participating countries are developing countries. While realizing green transformation, it is necessary to take into account the fairness of the transformation and the protection of the vulnerable, to facilitate economic development, poverty reduction in rural areas, increase green employment and enhance people's livelihoods. Some typical "PV+X" modes widened the space for further application of renewable energy, extending the paths for profits. Mode replicable, the "PV+X" application has certain reference significance for the green transformation of the Belt and Road countries.

2.1.7.1 PV + Agriculture

Many regions in China have carried out pilots and operations of "PV+agriculture" projects that were applied in new scenarios, laying photovoltaic panels in rice fields, terraced fields, greenhouses and other scenarios for power generation. Relevant projects need to pay attention to light and land resources at the spot, coordinate the cleaning of panels and farm water, and design solar systems according to the conditions of crops to

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[8]https://www.gov.cn/zhengce/zhengceku/2022-03/23/5680759/files/ccc7dffca8f24880a80af12755558f4a.pdf

[9] NDRC [EB/OL]. (2021-10-21) https://www.ndrc.gov.cn/xwdt/tzgg/202206/P020220602315650388122.pdf

[10] National Energy Administration (EB/OL) [2022-08-04] http://zfxxgk.nea.gov.cn/2022-08/24/c_1310668797.htm

ensure that the yields are immune from impacts. Among these projects, some planted low-light crops under PV panels; some were integrated with greenhouses to grow flowers, vegetables, and cash crops, improving land outputs, and effectively increasing peasants' income. Such a mode enables higher economic value of unit land resources, and provides energy security for the secondary processing of agricultural products at the same time, which elevates the competency of the agricultural industry to a certain extent, and boosts local employment in the green industry through the maintenance of related equipment. Fig. 2-3 shows the agricultural-solar complementary project found in Pogen Village, Kaole Township, Dongxiang County, Gansu Province.

In addition, there were also fish farming projects explored, which combines PV greenhouses with fishery and vegetables-growing technology. Excrement and residual feeds produced in the fish farming process are transformed into nutrients needed for vegetable growth, thus turning waste in water into treasure. The water for fish farming is absorbed and purified by the plant roots, and then the water is reinjected into the ponds, delivering a recycling of water resources.

Fig. 2-3 The Agricultural-Solar Complementary Photovoltaic Power Generation Project in Pogen Village, Kaole Township, Dongxiang County, Gansu Province[11]

2.1.7.2 PV + Livestock Breeding

"PV + livestock breeding" is also a commonly seen application. In areas that enjoy flat, open and unsheltered terrains and sound irradiation, some projects took the space of greenhouses and animal houses, livestock shed roofs, and between greenhouses and sheds to install PV sets and raise large livestock like cattle and sheep. And there are some poultry breeding projects, as poultries such as geese are fed with forage, helping

[11] Chinese government website [EB/OL].(2021-05-13). https://www.gov.cn/xinwen/2021-05/13/content_5606266.htm#1

remove weeds for PV plants. Being clean energy, solar power can ensure that the operation of plant is environmentally friendly and pollution-free, maintaining the balance of the pastoral ecosystem while providing power to remote areas.

2.1.7.3 PV + Desertification Control

Deserted areas often enjoy sufficient sunlight and flat terrains, suitable for photovoltaic power generation. However, facing natural challenges such as sandstorms and water shortage, it is of greater difficulty to take care of PV equipment. What China achieved in desertification control was recognized by the entire world, in which the deeds of Saihanba Forest Farm has won the title of "Guardian of the Earth", the highest honor in the field of environmental conservation of the United Nations. China's desert has continued to decrease for 20 consecutive years, with constantly reduced level, making a historic turnaround from "sand forcing humans to retreat" to "trees forcing sand to retreat". On this basis, China is exploring the establishment of PV power plants in desertified areas to promote the synergy between photovoltaics and sand control. Shading light and shielding wind, PV panels help reduce the evaporation of soil moisture, and effectively keep down the wind speed. Sand-fixing plants and economic crops were grown under and between the panels, to strengthen biological nitrogen fixation, increase soil fertility, stabilize quicksand and resist sandstorms. A PV power station built in the Kubuqi Desert of Inner Mongolia took 196,000 panels to form a pattern of a galloping horse, covering an area of 1.3 million square meters, which has been recognized as owner of a Guinness World Record (see Fig. 2-4).

Fig. 2-4 The Horse-shaped Solar Power Station at the Kubuqi Desert, Inner Mongolia Autonomous Region

2.1.8 Muti-effect Synergy of China’s Innovative Renewable Energy Development Model

Renewable energy is a green, low-carbon energy source that plays an important role in China’s “multi-wheel drive” energy supply system, and it is crucial for ensuring energy security, improving the energy structure, protecting the ecological environment, coping with climate change, and achieving sustainable economic and social development.

Renewable energy has yielded fruitful results in benefiting and serving the people, contributing green power to the building of a moderately prosperous society in all respects. Over the past decade, China has made solid progress in extending power grids to areas without electricity. It has completed the upgrading of power grids in 6 Provinces and Regions, and completed the upgrading ahead of schedule in manyremote villages. It has also effectively improved the production and household electricity utilization of over 210 national-level poverty-stricken counties. China has actively implemented independent renewable energy supply projects, providing access to green power for millions of people without electricity. Since 2012, 31 large hydropower stations have been built in poverty-stricken areas, contributing to local economic development and migrant poverty alleviation. The innovative implementation of photovoltaic poverty alleviation projects has benefited 4.15 million impoverished households, and the annual benefits of power generation is around 18 billion yuan, creating 1.25 million public welfare posts. Photovoltaic poverty alleviation has become one of China's excellent poverty alleviation programs, and it is also listed among the "Top 10 Targeted Poverty Alleviation Programs". Moreover, new energy has become a major force in driving investment and employment and promoting the economic and social development of western regions. In 2022, China's new investment in wind and photovoltaic power generation exceeded 500 billion yuan, with 2.6 million people employed in related industries, and the upstream and downstream sectors of the industrial chain paying 120 billion yuan annually for taxes and fees. Take the new energy base of 10 million-kilowatt-level in Hainan Prefecture, Qinghai Province as an example. In 2021, it achieved a tax revenue of 900 million yuan, becoming the main engine which drives the economic and social development of Hainan Prefecture.

Significant achievements have been made in reducing pollution and carbon emissions, providing solid support for ecological civilization and green, low-carbon development. In 2021, China’s development and utilization of renewable energy reached a scale of 530 million tons of standard coal, equivalent to replacing 1.05 billion tons of raw coal, which was 3.5 times the average annual import of coal in China over the past three years. In the meantime, it reduced carbon dioxide, sulfur dioxide, and nitrogen oxide emissions by approximately 2.07 billion tons, 400,000 tons, and 450,000 tons, respectively. It has become a strong force to reduce pollution and carbon emissions and ensure energy security in China. Additionally, China actively promotes the clean utilization of biomass energy such as organic waste in urban and rural areas, which contributes to improving the living environment. China is also exploring the photovoltaic sand control model, which combines photovoltaic power generation with ecological restoration for coordinated development of renewable energy and ecological civilization construction.

With growing international cooperation, China is making its contribution to tackling climate change. As the world's largest market for renewable energy and a leading manufacturer of renewable energy equipment, China has continued to deepen international cooperation in this field. Its hydropower business extends to multiple countries and regions worldwide, and the photovoltaic industry supplies over 70% of the components for the global market. The widespread application of renewable energy in China has effectively promoted the decrease in renewable energy costs, further driving the development and utilization of renewable energy all over the world and accelerating the global transition to green energy. Meanwhile, China's investment in renewable energy projects in countries and regions of the BRI has continued to grow in recent years to help promote and apply advanced green energy technologies in underdeveloped countries and regions, presenting China's wisdom and approach to building a green Belt and Road of high quality.

2.2 Insights from China's Renewable Energy Development Experience to the BRI Participating Countries

2.2.1 China's Renewable Energy Development Experience

Despite facing numerous challenges, China's framework and path for green and low-carbon transformation provide a reference for global sustainable development. China is willing to use BRI as an opportunity to share its experience with participating countries, help eliminate their reliance on the traditional high-carbon growth models, and encourage them to pursue an innovative, efficient development path with lower emissions and pollution, thus promoting global low-carbon transformation. In the process of "going global", relying on its leading manufacturing capability sufficient capital, and huge potential domestic market, China continuously deepens its global supply chain layout and specialization-based division of labor. China has strengthened innovation in renewable energy technology research and business models, lowered the application cost of renewable energy technology, and explored potential market opportunities, which resulted in reducing greenhouse gas emissions and contributes to the recovery of global economy.

Following the success of domestic wind and solar manufacturing, Chinese companies have expanded their investments in overseas manufacturing. Outbound investment in solar manufacturing is driven both by international tariffs and by the incentive to access global demand centers. For example, by establishing joint ventures with local companies in Turkey, JinkoSolar can supply the European, Middle Eastern and North African markets, as well as provide components for the fast-growing solar market in Turkey (Jackson, Lewis, and Zhang 2021). In the process, local Turkish manufacturers could learn from established Chinese leaders, and supply components to local solar project investors at lower costs.

By contrast, the wind power supply chain remains less globalized. Wind turbine generators have higher transportation costs and involve more complex production processes. However, the growing demand among BRI participating countries could present expanding opportunities, especially as components become increasingly modular and lightweight (Goldwind, 2021). For instance, after 20 years of supplying the market through imports, Goldwind opened its first manufacturing plant in Brazil in 2022 (Reuters, 2022). Currently, project financing by China Development Bank is driven by local demand for renewable energy, and as the demand grows, this financing could be supplemented by manufacturing facilities to serve the local market (Bhandary et al. 2022). Further manufacturing investment in key areas of growing energy demand could be a cost-effective strategy that benefits both Chinese companies and local BRI economies.

The progress of China's renewable energy industry is first and foremost due to its relatively abundant natural resources, and the sound industrial production system. On this basis, a highly strategic and relatively comprehensive supportive policy system has provided a solid guarantee for the starting and prosperity of the renewable energy industry. In addition, the huge renewable energy technology and product market in China, together with the increasingly strong manufacturing capabilities, form a virtuous cycle. By focusing on the integration of multiple factors such as R&D, capital, market, and products, and continuously learning from international leading renewable energy technologies and management experience, China gradually moves towards the higher end of the global value chain.

Development finance can play an important role in supporting the expansion of renewable energy production and installation in BRI participating countries. Based on China's experience, development finance can bridge the gap between the capacity of local enterprises and the renewable energy goals, giving new market entrants time to expand their business. Manufacturing is highly capital-intensive. Development finance can help local businesses cover high upfront capital costs and get paid back once the facilities are put into operation. In China's experience, development finance can also facilitate the implementation of emerging renewable energy technologies that face higher risks and capital costs. For example, China Development Bank supported the forest-photovoltaic hybrid power project in Jiangshan, and the Longyangxia solar hydropower plant, the first hybrid photovoltaic power project in China, providing significant support for technologies in the demonstration phase (Xu and Gallagher 2022). As the cost of solar energy in China reaches grid parity, the future will see a greater focus on developing innovative solar power applications, such as constructing large-scale new energy projects in Gobi Desert regions. These new multipurpose development models can benefit from development finance and may be introduced into China's green BRI overseas partnerships.

2.2.2 Policy Recommendations for Supporting the Development of Renewable Energy in the BRI Participating Countries

Enhancing quantitative guidance. BRI participating countries need to review and update national energy plans and set up development targets for different types of renewable energy based on research.

Optimizing subsidy policies. BRI participating countries need to improve the on-grid power tariff system that is composed of levelized cost of energy (LCOE) and power price premium to provide market incentives for investors. Meanwhile, with the renewable energy sector gradually entering the stage of commercialized development, the phase out of favorable policies and subsidies should be considered, so that a system integrating government guidance and market mechanisms could be formed.

Streamlining access procedures. BRI participating countries need to establish transparent renewable energy information management systems to optimize the procedures for the application and allocation of subsidies. The system allows governments to keep track of information on power generation and project construction, adjust industrial policies accordingly and improve development rights acquisition system. Meanwhile, governments should also set up platforms for tracking the process of application procedures that are open to the public, so as to ensure sustainable development and avoid profiteering through regular examination and adjustment.

Improving the environment for investment. BRI participating countries need to further streamline access procedures, lower the threshold for investors, help local governments to get access to capital from a variety of sources, and attract green bonds and climate funds to reduce the risk of investment. In terms of laws, policies and regulations, governments should formulate comprehensive and clear legal and regulatory frameworks and implement transparent contract procedures that are up to international standards to improve the return on risk of related projects.

Improving power accommodation through multiple channels. BRI participating countries need to coordinate power grid planning and power source construction through the innovative application of multi-energy complementation. The "dual coordination" between power source and power transmission and between distributed power generation and power distribution could effectively ensure the safe and stable operation of power grids. Efforts should also be made in promoting cross-border grid interconnection. A connected power grid system enables the optimized allocation of clean energy on a large scale with Ultra High Voltage(UHV) power transmission systems, effectively solve the problem of the mismatch between resources and needs, and lay the groundwork for the large-scale development and cross-border accommodation of renewable energy.

Enhancing international cooperation. BRI participating countries need to strengthen international cooperation in renewable energy, especially in the development of technical standards, demonstration projects for the application of technologies and R&D cooperation centers, to support the development of hydrogen fuel cells, electric vehicles and ships, biofuels and biomass pellet fuels that are used for energy efficient stoves. Joint talent training and capacity building programs should also be carried out to support the development of renewable energy technologies in the region.

2.2.3 Issues for Special Attention in Renewable Energy Cooperation with Some BRI Participating Countries or Regions

2.2.3.1 International Cooperation with Central Asia

Endowed with huge reserves of energy and natural resources, Central Asia is playing an increasingly important role in the international energy landscape. Meanwhile, the security of Central Asia is affected by international and regional geopolitical landscape. Businesses engaging in the development of renewable energy projects in Central Asia need to pay close attention to the political situation to avoid risks. Project investors should keep track of international politics, carefully study local laws, regulations and policies, and carry out risk assessment.

Besides, it is important to engage in cooperation with third parties to develop renewable energy in Central Asia. For example, it is possible to enhance green energy cooperation under the framework of Eurasian Economic Union and Shanghai Cooperation Organization through jointly implementing the *Agreement between the Governments of the SCO Member States on Cooperation in the Utilization of Renewable Energy*, the *Joint Action Plan for the Development of Intraregional Trade of the SCO*, *SCO Infrastructure Development Plan* and other documents, in order to ensure the sound development and operation of renewable energy projects with the balance of interests among multiple parties.

Technology R&D and trade cooperation in the field of hydrogen energy should be prioritized to help Central Asian countries to turn oil and natural gas into hydrogen. It is also feasible to help Central Asian countries to reduce the tension between water resources and energy. Through building hydropower stations and reservoirs for seasonal pumped energy storage and developing water electrolysis for hydrogen production, Central Asian countries could realize the dual storage of water resources and energy, fulfilling the demand for both energy and water resources.

2.2.3.2 International Cooperation with Africa and Latin America

China should 1) assist African and Latin American countries to carry out capacity building and actively engage in cooperation projects initiated by IEA, IRENA and other international organizations; 2) help Africa to formulate long-term plans and measures for the development of renewable energy, including development goals, financial and taxation policies, supporting policies for technology transfer and standards to ensure the continuity and stability of policies; 3) make full use of the “10-100-1000 Initiative” for South-South Cooperation on Climate Change under the Framework of the BRI and other cooperation platforms to train talents for the development of renewable energy and improve the understanding and acceptance of renewable energy in the local area.

To solve the problem of financing in Africa and Latin America, China should work together with African Development Bank, the World Bank and the Special Climate Change Fund to explore innovative means of financing, establish investment and financing platforms, and set up special funds to guarantee financing for the development of renewable energy in African and Latin American countries and bridge the financing gap in most countries.

3 Policy Suggestions on the Innovation Mechanism of BRI to Promote the Process of Sustainable Development

3.1 Strengthen the innovation of BRI Green Development cooperation mechanisms and promote the establishment of a support system for renewable energy projects.

Promoting the green and low-carbon development of energy in BRI participating countries is an essential means of supporting their sustainable development, and its core is strengthening renewable energy investment and financing. At present, many BRI participating countries, especially developing countries, are facing huge financial and technological gaps in their renewable energy, whereas China has precisely the cooperation demands and production capacity advantages in this regard. Thus, the following policy recommendations are proposed:

First, leverage and activate market-oriented cooperation in renewable energy through innovative measures. Technical assistance and capacity building cooperation are needed for the emerging renewable energy markets along the Belt and Road, to train more small-and-medium developers. Special funds for BRI's green development projects are to be set up, providing financial support for the cost of the pre-feasibility study and project preparation stage, to leverage the project development process. The decision-making mechanism for renewable energy in China can be used as a reference to improve the efficiency of fund allocation for green BRI projects and fill the funding gap in developing countries.

Second, China can join hands with the BRI participating countries to set up a database of pre-feasibility financing options accessible to renewable energy project developers to help better understand and adapt existing resources, which will maximize the project financing capacity for BRI participating countries. This database should provide catalogued projects with renewable energy financing portfolio, which may include financing + design, procurement, construction (EPC+F), refinancing by international financial institutions, sovereign wealth funds, BRI renewable energy bonds, international development funds, overseas industrial funds, international syndicated loans and other diversified financing support.

Third, utilize existing international cooperation platforms to promote joint renewable energy investment and formulate regional cooperation strategic policies and action plans. Through these platforms, we should push for the formation of BRI renewable energy cooperation standards, norms and guidelines for international participation and mutual recognition; strengthen digital empowerment for green development; collaborate in providing technical assistance and capacity building for emerging renewable energy markets along the Belt and Road; train more small and medium-sized renewable energy developers; and enhance the capacity of BRI participating countries to receive investment. By promoting diversified cooperation between industry organizations and stakeholders in BRI participating countries, we can establish a professional cooperation network for green transformations.

3.2 Strengthen the synergy among BRI’s green development cooperation mechanisms in various fields and promote the establishment of a policy environment conducive to BRI green development cooperation.

At present, most of the BRI participating countries are still on the fast track of both economic development and carbon emission growth. Full and effective environmental and climate cooperation under the BRI framework is the cornerstone of enhancing mutual trust, reducing differences and developing cooperation, and it will make an important contribution to global climate governance. During the last ten years of cooperation under BRI, the Chinese government has established BRI green development cooperation mechanisms and worked with other countries in the areas of environment, energy, green finance, transportation and communications to build the Belt and Road. The aforementioned mechanisms are important driving forces for promoting BRI’s green development. In this regard, the following policy recommendations are proposed:

First, strengthen vertical and horizontal coordination in key areas of green development through existing BRI cooperation platforms. Currently, there are independent green BRI mechanisms in different regions and sectors, and information sharing is not sufficient among those mechanisms. With a focus on cross-sectoral cooperation, we should make use of the overall cooperation mechanism for BRI construction and strengthen the communication and exchange frequency in the key areas of green infrastructure, green energy green transportation, green industry, green finance and green technology, coordinating and promoting BRI green development cooperation in various fields. Exchanges and cooperation mechanisms should be further improved at multiple sectors and levels, with policy discussions conducted on a regular basis and an information sharing institution established. More non-state actors are encouraged to be included in the scope of cooperation, to help construct a network with diverse subjects.

Second, improve the policy environment for the development of overseas cooperative green BRI projects. We should promote the reform of the overseas investment approval system; form new financing system favorable to green projects; incorporate renewable energy investment into the enterprise performance tracking system; and relax performance requirements for overseas green energy investments appropriately. In addition, we should establish a BRI climate investment and green credit system and appropriately reduce the financing cost of low-carbon investment projects. A favorable policy environment will encourage financial regulators to adopt green policies to stimulate the development of green finance.

3.3 Implement innovative BRI demonstration projects and support the development of customized sustainable development solutions for BRI participating countries.

Finding suitable paths for sustainable development and realizing green, low-carbon and sustainable development is the only option for humankind and a challenge that developing countries must overcome. Previously, the Green BRI Special Policy Studies have highlighted the close relationship between the Green Belt and Road and the realization of the United Nations sustainable development agenda. In the future, cooperation on BRI's green development can and should bring important opportunities and solutions for the realization of green, low-carbon and sustainable development in participating countries. To this end, the following policy recommendations are proposed:

First, utilize existing cooperation platforms to coordinate resources from various parties for building green BRI cooperation demonstration projects in renewable energy and other fields. On the basis of previous policy recommendations, we should urge the Chinese government and BRI participating countries to jointly build a number of green BRI cooperation demonstration projects. Combining the efficient cross-sectoral cooperation mechanism with the green investment and financing channels of financial institutions, we can provide full support for the planning, design, financing and implementation of demonstration projects. These demonstration projects will influence BRI participating countries by providing customized greens solutions for developing countries, encouraging the formation of their own corresponding green policies, and promoting the development their green industries.

Second, explore the cooperative demonstration of "PV+" and other innovative application scenarios, as well as profit models of such projects that align with the characteristics of developing countries. On the basis of the aforementioned demonstration projects, we should strengthen the demonstration role of renewable energy projects. We should support the preliminary feasibility study, construction and operation of "PV + X" projects, with pilot projects carried out in the BRI participating countries, such as "PV + Agriculture," "PV + Aquaculture," "PV + Industrial Parks," and the like. In view of the challenges generally faced by energy projects, such as difficulties in collecting electricity charges in developing countries, we need to explore innovative profit modes, such as through PV supporting industries, to further promote renewable energy projects.

Annex A

Greenhouse gas reduction and renewable energy development targets of major BRI participating countries and regions based on NDC documents

Country	Country code	Emission reduction target	Renewable energy development target
South Korea	KOR	Reduce emissions by 40% by 2030 compared with 2018 levels	/
Mongolia	MNG	Reduce emissions by 22.7% by 2030, compared to the business as usual (BAU) scenario in 2010; and reduce emissions by 44.7% if conditional mitigation measures such as carbon capture and storage (CCS) and waste-to-energy technologies are implemented	Reduce emissions by 8340.5Gg CO2-eq in the energy production sector (including renewable energy use and energy production efficiency improvements)
Philippines	PHL	Reduce emissions by 75% by 2030 compared to the business as usual (BAU) scenario (3340.3MtCO2e) (of which 2.71% is unconditional and 72.29% conditional)	/
Cambodia	KHM	Reduce emissions by 42% by 2030 compared to the BAU scenario (125.2MtCO2e), of which the energy sector will reduce emissions by 40%	The proportion of renewable energy in the energy sector will reach 25% by 2030
Laos	LAO	Unconditional target: reduce emissions by 60% c2030 compared to the BAU scenario (62,000ktCO2e)	Unconditional target: hydropower installed capacity will reach 13GW; conditional target: solar and wind energy installed capacity will reach 1GW, and biomass installed capacity will reach 300MW

Country	Country code	Emission reduction target	Renewable energy development target
Malaysia	MYS	Cut carbon intensity against GDP by 45% by 2030 compared to 2005 levels	/
Myanmar	MMR	The unconditional emission reduction target is 244.52Mt, and the total conditional emission reduction target is 414.75MtCO2e.	Increase the proportion of renewable energy (solar and wind) to 53.5% (from 2000MW to 3070MW)
Thailand	THA	Be 555MtCO2e	/
Brunei	BRN	Reduce emissions by 20% compared to the BAU scenario by 2030(29.5MtCO2e); reduce overall emissions in the industrial sector by 2035	In 2035, renewable energy power generation will reach more than 30% of the total installed capacity
Singapore	SGP	Peak emissions by 2030, and reduce GHG emissions to around 60MtCO2e.	In 2030, the PV installed capacity will reach 2GWp (the level in 2020 was 350MWp), and the power generation will reach 3% of the domestic demand
Vietnam	VNM	The unconditional emission reduction target is 15.8%, and the conditional target is 43.5% (emissions to 927.9MtCO2e compared to BAU scenario by 2030)	The installed capacity of hydropower will reach 22,022MW (of which small hydropower will reach 3,674MW), the installed capacity of wind power will reach 630MW, biomass energy will reach 570MW, and solar energy (including rooftop solar energy) will reach 16,491MW
Indonesia	IDN	The unconditional emission reduction target is 31.89%, and the conditional emission reduction target is 43.20% (emissions to around 2.869GtCO2e compared to BAU scenario by 2030)	The proportion of new energy and renewable energy in the primary energy mix will reach 23% (2025), and 31% (2030)
Pakistan	PAK	Conditional target of 50%, and unconditional goal of 15% (1603MtCO2e based on the BAU scenario)	60% of renewable energy, 30% of electric vehicles

Country	Country code	Emission reduction target	Renewable energy development target
Maldives	MDV	3,284.92GgCO2e based on the BAU scenario and the conditional emission reduction target is 26%.	Increase the proportion of renewable energy to 15%
Nepal	NPL	The power sector will achieve carbon neutrality by 2050 and the proportion of renewable energy will be 70% by 2030	The installed capacity of clean energy power generation will reach 15,000MW, of which the proportion of micro and small hydropower, solar energy, wind energy and biomass energy will reach 5-10%
Sri Lanka	LKA	The unconditional target is 4.0%, and the conditional target is an additional 10.7%	In 2030, renewable energy power generation will account for 70% of the total power generation; the installed capacity of renewable energy will increase by 3867MW on the basis of the BAU scenario, with an unconditional target of 950MW and a conditional target of 2,917MW
Bangladesh	BGD	The unconditional emission reduction target is 27.56Mt, and the conditional emission reduction target is additional 61.9Mt (GHG emission of 409.4MtCO2e by 2030 based on the BAU scenario)	Unconditional target: implement 911.8MW of renewable energy projects, including 581MW of on-grid solar energy, 149MW of wind energy, 20MW of biomass energy, 5MW of biogas, and 100MW of new hydropower; conditional target: implement 2,277MW of renewable energy projects, of which 2,277MW of on-grid solar energy and 597MW of wind energy , 50MW of biomass energy, 5MW of biogas, 1,000MW of new hydropower, 56.8MW of solar microgrid, and 128.5MW of waste incineration power generation
Kazakhstan	KAZ	Unconditional target: reduce emissions by 15% by 2030 relative to the base year (1990), conditional target: reduce emissions by 25% relative to the base year; reduce emissions by 34% compared to the BAU scenario (unconditional target)	/

Country	Country code	Emission reduction target	Renewable energy development target
Kyrgyzstan	KGZ	Unconditional target: reduce emissions by 35% by 2030 relative to the base year (1990, 137.8 million tons of CO2e-- not including the LULUCF sector, 117.2 million tons of CO2e-- including the LULUCF sector); conditional target: reduce emissions by 35% by 2030 relative to the base year	/
Tajikistan	TJK	Unconditional target: 60-70% of 1990 levels by 2030 (1.9-2.2tCO2eq per capita), conditional target: 50-60% of 1990 levels by 2030 (1.5-1.9tCO2eq per capita)	/
Turkmenistan	TKM	Reduce carbon intensity against GDP (PPP) to 47% of 2000 levels	/
Uzbekistan	UZB	Reduce GDP carbon intensity against GDP by 35% compared with 2010	The proportion of renewable energy power generation will reach at least 25% by 2030. To achieve this target, build 10GW of new renewable energy facilities, including 5GW of solar energy, 3GW of wind energy, and 1.9GW of hydropower
Afghanistan	AFG	Reduce emissions by 13.6% compared to the BAU scenario	25% of the rural population shifts to alternative and renewable energy (compared to current level of 15%)
Oman	OMN	Reduce emissions by 7% by 2030 compared to the BAU scenario (125.254MtCO2e in BAU scenario), commitment of 4% is unconditional target and commitment of 3% is conditional target.	/

Country	Country code	Emission reduction target	Renewable energy development target
Azerbaijan	AZE	Reduce emissions by 35% from the base year 1990 (emission reduction 25.666Gg CO2e-- not including LULUCF, 24.374Gg CO2e-- including LULUCF)	/
Bahrain	BHR	/	The installed capacity of renewable energy will reach 5% and 10% by 2035
Qatar	QAT	Reduce 25% of emissions by 2030 compared to the BAU scenario (BAU scenario is 2019 scenario)	/
Kuwait	KWT	Reduce 7.4% of greenhouse gas emissions by 2035 compared to the BAU scenario (base year is 2015)	Increase the proportion of clean energy and strive to increase demand from renewable energy in 2030
Lebanon	LBN	Reduce 20% of emissions (unconditional target) / 31% of emissions (conditional target) compared to BAU scenario	18% of electricity demand comes from renewable energy, 11% of heat demand comes from renewable energy (unconditional target); 30% of electricity demand comes from renewable energy, 16.5% of heat demand comes from renewable energy (conditional target)
Saudi Arabia	SAU	Reduce 278Mt CO2e of emissions based on the base year (2019)	Renewable energy accounts for 50% of the energy mix by 2030
Turkey	TUR	Reduce 21% of emissions compared to the BAU scenario (246Mt CO2e)	In 2030, the installed capacity of solar power will reach 10GW, and the installed capacity of wind power will reach 16GW. Fully tap the potential of hydropower and build a nuclear power plant
Syria	SYR	/	The proportion of renewable energy in electricity production will reach 10% in 2030 (with international assistance)
Armenia	ARM	Reduce emissions by 40% by 2030 compared to 1990 levels	The proportion of renewable energy in energy production will be doubled by 2030, and Armenia will reach the target of 1,000MW by

Country	Country code	Emission reduction target	Renewable energy development target
			2030 on the basis of its existing solar installed capacity 59.7MW. The proportion of green energy in the power generation mix is at least 15%
Iraq	IRQ	Achieve a 1-2% reduction in total emissions by 2030 compared to the expected scenario	Promote the localization of renewable energy technologies, especially solar energy
Israel	ISR	Unconditional target: reduce 27% of emissions by 2030 compared to 2015 (equivalent to reducing 81.65MtCO2e), and reduce 85% of emissions by 2050 compared to 2015	The proportion of renewable energy power generation will reach 20% by 2025 and 30% by 2030
Jordan	JOR	Reduce 31% of emissions by 2030 compared to the BAU scenario (43,989Gg CO2e in the BAU scenario)	Increase the proportion of renewable energy power generation to 35% in 2030. AAWDCP project 185MW solar photovoltaic. Introduce 100MW and 300MW concentrated solar power (CSP)
Cyprus	CYP	Reduce emissions by at least 40% by 2030 compared to 1990 levels	The proportion of renewable energy in energy end-use will reach at least 32% by 2030
Egypt	EGY	Reduce 33% of emissions by 2030 compared to the BAU scenario (214,740Gg CO2e)	According to Egypt's Integrated Sustainable Energy Strategy 2035 plan, increase the installed capacity of renewable energy so that its contribution to power generation will reach the target of 42% (2035). Renewable energy installed capacity will reach 40% by 2030
Sudan	SDN	Compared to the BAU scenario, reduce emissions by 38% (BAU is 33,181,563t CO2e) in the energy sector (excluding biomass energy), reduce emissions by 45% (BAU scenario is 29,450,936t CO2e) in the forest and biomass energy sectors, and	Large-scale deployment of solar and wind farms (replacing 5,056GWh of fossil fuel power generation), independent or micro-grids for residential, agricultural and industrial sectors (replacing 1,529GWh grid electricity), hydropower (replacing 37GWh grid electricity)

Country	Country code	Emission reduction target	Renewable energy development target
		reduce emissions by 20% (BAU scenario is 6,394,907 t CO2e) in the waste sector	
Tunisia	TUN	Compared to 2010 levels, reduce carbon intensity by 45% (the target is 55% under international support)	/
Algeria	DZA	Compared to BAU scenario, reduce GHG emissions by 7% (unconditional target) and by 22% (conditional target)	In 2030, the proportion of renewable energy power generation will reach 27%
Morocco	MAR	Reduce emissions by 45.5% by 2030 (including conditional target) relative to the baseline scenario (2010, the baseline emission level is 72,979kgCO2e), of which the unconditional target is 18.3%	Achieve 52% of installed electricity from renewable sources by 2030, of which 20% comes from solar power, 20% from wind power and 12% from hydropower
Kenya	KEN	Reduce emissions by 32% relative to BAU scenario (143MtCO2eq)	/
South Sudan	SSD	Compared to the BAU scenario, reduce emissions of 109.87Mt CO2e, and increase carbon sink by 45.06 Mt CO2e	In the next 10 years, plan to build 6 hydropower stations (2,635.5MW), 57MW of solar power, 11.41MW of wind power, and 5.7MW of biomass power stations. By 2030, renewable energy (including hydropower) will reach 92% (excluding hydropower: 3%)
Ethiopia	ETH	The unconditional target is the absolute emission level of 347.3MtCO2e (14% reduction compared to the BAU scenario), and the conditional target is to reduce the absolute emission level to 125.8Mt	Increase the number of residents using renewable off-grid energy for lighting

Country	Country code	Emission reduction target	Renewable energy development target
		(emission reduction of 68.8%). Emission reduction 15Mt (unconditional target) / 10.5Mt (conditional target) in the energy sector	
Somalia	SOM	Reduce 30% of emissions compared to the BAU scenario (107.39MtCO2e in BAU scenario)	/
Djibouti	DJI	Reduce 40% of emissions compared to the BAU scenario (equivalent to 2Mt CO2e), and a further 20% reduction can be achieved if there is international support (conditional target)	Unconditional target: build high-voltage transmission lines in Ethiopia (90% of Ethiopia's electricity comes from renewable energy), 60MW offshore wind power projects, three wind farms (expected to produce 250MW), and geothermal energy heat pumps (reserves of 1200MW). Conditional target: 250MW of high-voltage transmission projects in Ethiopia, and other targets not related to renewable energy. Further targets (under study): 10MW of biomass energy, 5MW of tidal power plants, and 30MW of onshore wind power projects
Tanzania	TZA	Reduce emissions by 30-35% compared to BAU scenarios (approx. 138-153Mt CO2e)	Geothermal energy (potential 650MW), average sunshine duration of 9 hours, hydropower potential 4.7GW (installed capacity is only 562MW), wind energy in most parts of the country meets the development requirements (wind speed 0.9-9.9m/s). The Five Year Development Plan II (FYDPII) states that the proportion of renewable energy and green energy will reach 50% in 2020/2021 and 70% in 2025/2026 (including LPG)
Uganda	UGA	The unconditional target is 8.78 MtCO2e (equivalent to 5.9% of the BAU scenario), and the	New installed capacity from 2015 to 2030: 756.8MW of hydropower, 25MW of bagasse power generation, 20MW of solar power generation,

Country	Country code	Emission reduction target	Renewable energy development target
		conditional target is 27.97MtCO2e (equivalent to 18.8% of the BAU scenario)	and 20MW of wind power generation (0.0003Mt CO2e emission reduction by electricity energy substitution)
Rwanda	RWA	Unconditional target: reduce 16% of emissions compared to BAU scenario (approximately 1.9Mt CO2e), conditional target: additional 22% reduction (2.7Mt)	No specific target
Burundi	BDI	Compared to the BAU scenario (business as usual in 2015), reduce emissions by 23% by 2030, with unconditional target of 3% (1958GgCO2e) and conditional target of 20% (14,897GgCO2e)	Increase installed hydropower capacity (of which 45.4MW is installed, 19.25 under development under a public-private partnership framework, 300kW of micro-power stations under private development); increase photovoltaic installed capacity (of which 7.5MW is installed, 200kW of off-grid solar PV under development by 50 public institutions); promote the use of biogas digesters in schools
Seychelles	SYC	Reduce emissions to 817kt CO2e (reduce 26.4% of emissions compared to the BAU scenario)	In 2030, the proportion of renewable energy will reach 15%. 37.4MW of solar PV will meet electric vehicle demand
Nigeria	NGA	Reduce 20% of emissions compared to the BAU scenario (unconditional target) and 47% of emissions (conditional target) compared to BAU scenario (BAU scenario is 453Mt CO2e)	The proportion of on-grid renewable energy will reach 30% (increase installed capacity - 12GW of large hydropower, 3.5GW of small hydropower, 6.5GW of solar photovoltaic, and 3.2GW of wind power), 13GW of off-grid renewable energy (5.3GW of microgrid, 2.7GW of solar home systems and street lamps, 5GW of self-generated electricity)
Mauritania	MRT	Reduce 11% of emissions by 2030 compared to the BAU scenario (2018 as usual) and reduce 92% of	In 2030, the proportion of renewable energy will reach 50.34%, and the introduction of green hydrogen and desert power generation will reach 93% of renewable energy

Country	Country code	Emission reduction target	Renewable energy development target
		emissions compared to the BAU scenario in order to achieve economic carbon neutrality	
Senegal	SEN	Compared to the BAU scenario (2010), reduce emissions by 5% in 2025 and 7% in 2030	NDC strategic action: by 2030, the cumulative installed capacity of solar energy will be 235 MW, wind power will be 150 MW, and hydropower will be 314 MW; the total power of renewable energy injection will be 699 MW by 2030; the installed capacity of renewable energy power generation on the grid in 2019 (excluding hydropower)) penetration reached 13.68%; install 6.18MWp as part of solar electrification rollout, at isolated system level outside the interconnection network. NDC+ strategic actions: 100 MW of solar, 100 MW of wind, 50 MW of biomass and 50 MW of CSP additional installed capacity by 2030; a total of 300 MW of additional renewable energy capacity injection, and the total renewable energy (CDN and CDN+) will reach 999 MW; replace oil with natural gas in dual thermal power plant (oil/gas) and 320 MW coal-fired Jindal power plant and intergrated cycle gas-fired power plant, which will bring 600 MW of natural gas installed capacity between 2025 and 2030; penetration of renewables (excluding hydro) in the electricity system will reach 18% by 2022; reach rural solar electrification by 2025: 2,292 places will be connected via mini-networks ; 4,356 regional solar home systems (SHS)
Gambia	GMB	Unconditional target: reduce 169GgCO2e of emissions in the forest and energy sectors	/

Country	Country code	Emission reduction target	Renewable energy development target
		(equivalent to 2.6% compared to the BAU scenario); conditional target: reduce 3121 GgCO2e of emissions in all sectors (equivalent to 47.2% emission reduction compared to the BAU scenario)	
Sao Tome and Principe	STP	Reduce emissions by 27% compared to the 2012 BAU scenario, which is equivalent to reducing 109kTCO2eq of emissions	The proportion of renewable energy in the national grid will reach 50%, and the installed capacity will reach 49MW, including 32.4MW of solar energy, 14MW of hydropower, and 2.5MW of biomass energy
Burkina Faso	BFA	Compared to the BAU scenario, reduce emissions by 10.77% (unconditional target)/5.47% (conditional target) by 2025, 19.60% (unconditional target)/9.82% (conditional target) in 2030, and 15.50% (unconditional target)/18.93% (conditional target) by 2050	Build solar power plants with a capacity of 30 MWp in Koudougou (20 MWp) and Kaya (10 MWp), including reinforcement of the 220 km network (Yeleen); build a photovoltaic solar power plant with a capacity of 15 MWp in Essakane; build a 14 MWp in Matourkou Photovoltaic solar power plant (KFW) with MWp and energy storage of 6 MWh; expansion project of Zagtouli solar photovoltaic power plant (17MWp); project for procurement and installation of solar energy equipment in public buildings; build a photovoltaic solar power plant in Dori (Yeleen) with a capacity of 6.29MWp; build a photovoltaic solar power plant in Diapaga with a capacity of 2.2 MWp (Yeleen); build a photovoltaic solar power plant with a capacity of 1.13 MWp (Yeleen) in Gaoua; off-grid CSPS solar projects; 300 projects for the electrification of social community infrastructure solar systems in rural areas; build a photovoltaic solar power plant in Ouagadougou with a power of 43 MWp (North Ouaga) (Yeleen)

Country	Country code	Emission reduction target	Renewable energy development target
Benin	BEN	Compared to the BAU scenario (based on projections of sector activity data on observed historical trends from 2010 to 2017), reduce emissions by 20.15% in the period 2021-2030	Planned renewable energy developments (construction of hydroelectric power plants; Dogo bis (128 MW and 337 GWh/year); Vosa (60.2 MW and 188.2 and 57 GWh/year) installed solar PV plants with a total capacity of 112 MWp, 15 MW in the structure of the biomass fuel sector). Unconditional contribution: power station hydropower (electricity and other infrastructure, 51.5% of investment) + solar 87 MW (DEFISSOL, MCA II and others) + 4 MW of biomass sector structure + promotion of 30% of investment in biomass power generation . Conditional contribution: hydroelectric power plant (total civil works 48.5% of investment) + solar 25 MW + biomass 11 MW + promotion of biomass power generation (70%)
Ghana	GHA	Unconditional emission reduction target: 24.6Mt CO2e; conditional emission reduction target: additional 39.4Mt CO2e	10% of renewable energy penetration
Cote d'ivoire	CIV	Compared with the reference scenario (2012 as the base year), reduce emissions by 30.41% by 2030 (taking into account the conditional target of 98.95%)	Increase the proportion of renewable energy to 45%
Liberia	LBR	Unconditional emission reduction target: relative to BAU emission reduction 11187Gg CO2e (10%), conditional emission reduction target: reduce 4537Gg of additional emissions CO2e (54%)	Equip a 100MW renewable energy power plant with a load rate of 40% (annual power production of 300GWh); develop large off-grid small hydropower and on-grid small hydropower with a power purchase agreement, with an installed capacity of 20MW; hydropower output of 50GWh/year, load rate will reach 50%; develop large-scale solar

Country	Country code	Emission reduction target	Renewable energy development target
			photovoltaic (support the construction of photovoltaic power plants with a total of 10MW, and the annual output will reach 2GWh in 2025)
Sierra Leone	SLE	Reduce 10% of emissions by 2030 (reduce 25% of emissions by 2050)	Conditional target: Increase the availability of off-grid microgrids by 27%, and increase the availability of solar off-grid systems by 10%
Guinea	GIN	In 2030, compared with the base year (2018), the unconditional target is to reduce emissions by 9.7%, and the conditional target is to reduce emissions by 17.0% (excluding the LULUCF sector)	The proportion of renewable energy will reach 70% in 2025 and 80% in 2030
Guinea-Bissau	GNB	Reduce emissions by 30% relative to BAU (10% of which is an unconditional target) (BAU scenario is 18.2MtCO2e)	The proportion of renewable energy in the power generation mix will increase from 5% to 58%, of which 40% will come from hydropower, and the rest will come from solar photovoltaic and wind power (the installed capacity of renewable energy will increase from the current 3MW to 90MW)
Cape Verde	CPV	Unconditional goal: reduce 18% of emissions compared to the BAU scenario (equivalent to 180,000tCO2eq of emission reduction); conditional target: reduce 24% of emissions compared to BAU (equivalent to 242,000tCO2eq of emission reduction)	In 2025, the installed capacity of wind power will reach 51.4MW, and that of solar energy will reach 63.0MW; in 2030, the installed capacity of wind power will reach 91.2MW, and that of solar energy will reach 160.6MW
Niger	NGA	Reduce 20% of emissions compared to BAU scenario (unconditional target); reduce 47% of emissions (conditional target)	30% of on-grid electricity will come from renewable energy (12GW of new large hydropower, 3.5GW of small hydropower, 6.5GW of solar photovoltaic, 5GW of self-generated power)

Country	Country code	Emission reduction target	Renewable energy development target
Chad	TCD	Unconditional target: reduce 0.5% of emissions in 2030 compared to the BAU scenario (as usual in the 2010-2018 policy scenario); conditional target: reduce 19.3% of emissions compared to the BAU scenario	Identified priority selections include measures to promote and support the use of renewable energy sources such as biogas and solar energy. Increase the share of renewable energy in the energy mix: increase the contribution of renewable energy to the grid; promote solutions for rural electrification; promote renewable energy electrification projects of a social nature; strengthen local renewable energy technology skills and improve market control procedures
Central African Republic	CAF	Unconditional target: reduce 9.03% and 11.82% of emissions by 2025 and 2030 compared to trend scenarios (based on 2010 projections); conditional target: reduce 14.64% and 20.28% of emissions by 2025 and 2030 compared with trend scenarios (based on 2010 projections), respectively	The proportion of households equipped with solar lighting equipment will reach 5% and 50% in 2025 and 2030, and the proportion of households equipped with solar stoves will reach 5% in 2025
Democratic Republic of the Congo	COD	Reduce emissions by 21% compared to the BAU scenario (with conditional target of 19% and unconditional target of 2%)	Use renewable energy to electrify rural, suburban and urban areas; increase the proportion of renewable energy in the national energy mix
Gabon	GAB	In 2030, total emissions from the forest sector will be controlled at 30.4 million tons, total removals will reach 152.5 million tons, and emissions from the energy and agricultural sectors will be controlled at 3.8 million tons; carbon neutrality will be maintained in 2050 and beyond.	The installed capacity of hydropower will reach 260MW in 2030 and 630MW in 2050. Add 115MW grid-connected solar photovoltaic power plants and 330,000 solar water heaters by 2030.

Country	Country code	Emission reduction target	Renewable energy development target
Mozambique	MOZ	Reduce 40Mt of emissions in 2020-2025	Build 67.995MW of new hydropower, 240MW of wind power, 258.913MW of solar photovoltaic; 50,000 solar photovoltaic or wind power lighting systems
Zambia	ZMB	Conditional target: reduce 25% of emissions by 2030 relative to the base year 2010 (equivalent to 20,000Gg CO2eq)- reduce 47% of emissions with alternative international support (equivalent to 38,000Gg CO2eq) at the level of international assistance received in 2015	/
Angola	AGO	Unconditional target in 2025: reduce 15% of emissions compared to 2015 BAU scenario, conditional target: 25%, 2030 unconditional target is to reduce 21% of emissions, conditional target is to reduce 36% of emissions	Unconditional target: 500MW of biomass energy installation machines, 100MW of small hydropower, 700MW of large hydropower, 104MW of large scale photovoltaic, 100MW of small photovoltaic, 2MW of small industrial photovoltaic, 100MW of wind farms; conditional target: 500MW of biomass energy installation machines, 150MW of small hydropower, 2,050MW of large hydropower, 104MW of large scale photovoltaic, 187MW of small photovoltaic, 2MW of small industrial photovoltaic, 15MW of Nama small photovoltaic, 100MW of wind farms
Zimbabwe	ZWE	Compared to the BAU scenario (based on 2011, 2015, 2017 and taking into account the impact of Covid-19), reduce 2.3tCO2eq per capita carbon emissions by 40% by 2030	/

Country	Country code	Emission reduction target	Renewable energy development target
Botswana	BWA	Take 2010 as the base year, reduce emissions by 15% in 2030	/
Namibia	NAM	Reduce emissions by 91% based on the BAU (24.167MtCO2e) scenario in 2030 (mainly relying on AFOLU), with an unconditional target of 77% and a conditional target of 14%	Solar photothermal route map-20,000 solar water heaters, 45MW of solar roof photovoltaic system, REFIT120MW solar photovoltaic, 13MW solar photovoltaic of embedded power generation, 20MW of Muburu photovoltaic, 20MW of solar IPP power plant, 300MW of Baynes hydroelectric 600MW, 40MW of Luderitz wind power and 50MW of IPP wind farms, and 40MW of biomass power plant
Republic of South Africa	ZAF	Emissions will be 398-510MtCO2e in 2025 and 350-420MtCO2e in 2030	As of March 2020, 112 renewable energy IPP projects have been approved, 4 large and 3 small working 6,422MW installed capacity, renewable energy installed capacity of 4,201MW has been connected to the grid, absorbing investment in ZAR209.7M; in the next decade, NDC needs larger investment projects, about ZAR 860M to 920M
Lesotho	LSO	Unconditional target: reduce emissions by 10% on the basis of BAU (2000 scenario) by 2030, and conditional target: reduce an additional 25% of emissions based on BAU by 2030	Improve access to clean energy, reaching 35% in 2015, 40% in 2020 and 50% in 2030
Madagascar	MDG	In 2030, based on the BAU scenario (2000), reduce emissions by 14% (30MtCO2), and increase LULUCF absorption by 61MtCO2	Strengthen renewable energy (hydropower and solar energy) from 35% to 79%
Comorin	COM	Compared to the BAU scenario, reduce emissions by 442kt CO2e by 2030	Continue to develop photovoltaic power plant projects; start the first geothermal phase (exploration drilling and operational drilling)

Country	Country code	Emission reduction target	Renewable energy development target
Malawi	MWI	Unconditional target: reduce 6% of emissions in 2040 compared to the BAU scenario (2017), equivalent to 2.1 MtCO2e; conditional target: reduce an additional 45% of emissions by 2040 compared to the BAU scenario, about 15.6MtCO2e of emission reduction	List the investment requirements of renewable energy such as hydropower grid, off-grid small photovoltaic grid, large photovoltaic grid and wind power grid, but there is no specific installed capacity or capacity level
Estonia	EST	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Latvia	LVA	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Republic of Lithuania	LTU	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Moldova	MDA	2030 emission reduction is equivalent to 100% relative to the base year (counted as 44.9Mt in NDC2) (achieving net zero emissions)	17% of energy end-use in 2020 comes from renewable energy
Poland	POL	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Czech Republic	CZE	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Slovakia	SVK	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Hungary	HUN	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)

Country	Country code	Emission reduction target	Renewable energy development target
Albania	ALB	In 2030, emissions will increase by 20.9% compared with those in 2016, and reduce emissions by16,828ktCO2e compared with the BAU scenario (2016)	Assuming that the Energy Community Treaty commitment is met through the implementation of Albanian National Renewable Energy Action Plan, the renewable energy target of 38% will be reached by 2020, and the renewable energy target of 2030 will be set at 42.5%.
Bulgaria	BGR	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Bosnia and Herzegovina	BIH	Unconditional target: reduce 12.8% of emissions by 2030 relative to 2014 (compared to 33.2% of emission reduction in 1990), conditional target: reduce 17.5% of emissions in 2030 relative to 1990 (compared to 38.5% of emission reduction in 1990). The 2050 emission reduction target is 50.0% (unconditional) and 55.0% (conditional) relative to 2014, and 61.7% (unconditional) and 65.6% (conditional) compared to 1990	Construction of alternative energy/new coal-fired power plants for 1050MW will be completed by 2030
Republic of Montenegro	MNE	Reduce emissions by at least 35% in 2030 compared to the base year (1990)	58.5+172MW of hydropower, 50+213GWh of contribution, 54.6+100MW of wind farm, 150+277GWh of contribution, 250+50+10MW of solar power plant, 450+90+18GWh of contribution
Croatia	HRV	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Romania	ROU	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)

Country	Country code	Emission reduction target	Renewable energy development target
North Macedonia	MKD	Reduce 7,603Gg CO2e of emissions by 2030 compared to the BAU scenario (EU overall target)	The proportion of renewable energy in total energy end-use will reach 38%; the proportion of renewable energy in total electric power production will reach 66%; the proportion of renewable energy in terminal heating and cooling will reach 45%, and the proportion of terminal energy consumption in transportation sector will reach 10%
Serbia	SRB	Reduce emissions by 13.2% by 2030 compared to 2010 and by 33.3% compared to1990x	/
Slovenia	SVN	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Greece	GRC	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Italy	ITA	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Malta	MLT	Reduce emissions by at least 40% relative to 1990 levels by 2030 (EU overall target)	The proportion of renewable energy will be at least 32% of energy end-use in 2030 (EU overall target)
Papua New Guinea	PNG	Reduce net emissions by 38% from 2015(1,716.46 Gg CO2 eq)	Increase the installed capacity of renewable energy to 78% of the total installed capacity of power generation from 30% in 2015
Samoa	WSM	In 2030, reduce emissions by 26% (91Gg CO2e) from the 2007 level, of which the energy sector will reduce emissions by 30% (53Gg CO2e) compared to 2007	100% of renewable energy generation by 2025
Tonga	WSM	In 2030, reduce emissions by 26% (91Gg CO2e) from the 2007 level, of which the energy sector will	100% of renewable energy generation by 2025

Country	Country code	Emission reduction target	Renewable energy development target
		reduce emissions by 30% (53Gg CO2e) compared to 2007	
Micronesia	FSM	/	By 2030, the proportion of renewable energy generation will exceed 70%, and carbon dioxide emissions from electricity production will be at least 65% lower than the 2000 level
Kiribati	KIR	Unconditional target: Compared with the BAU forecast scenario (based on historical data forecast from 2000-2014), reduce emissions by 13.7% by 2025 and 12.8% by 2030; conditional target: reduce an additional 48.8% of emission by 2025 and additional 49% of emission by 2030 (reduce emissions by 60% and 61.8% by 2025 and 2030, respectively)	Emission reduction options for local and current international assistance: southern Tarawa 1.3MW online photovoltaic, off-island and rural electrification (off-grid photovoltaic); projects requiring new and additional international assistance: maximize the use of renewable energy and energy efficiency
Federated States of Micronesia	FSM	/	By 2030, the proportion of renewable energy generation will exceed 70%, and carbon dioxide emissions from electricity production will be at least 65% lower than the 2000 level
Fiji	FJI	On the basis of the base year (2341ktCO2e in 2030 under the predicted baseline scenario in 2013), the energy sector will reduce emissions by 30% in 2030, of which 10% is an unconditional target and 20% is a conditional target	Renewable energy electricity production (grid electricity) will reach 100% by 2030
Solomon Islands	SLB	Compared to the BAU forecast scenario based on emissions in 1994-2010, reduce emissions by	Unconditional renewable energy projects: 7794kW of photovoltaic installed capacity, 15,000kW of hydropower; conditional renewable

Country	Country code	Emission reduction target	Renewable energy development target
		55,347.31tCO2e by 2025, and reduce emissions by 246,793.73tCO2e by 2030	energy development goals: 10,650MW of hydropower, 4,224,982kW of photovoltaic, 150MW of geothermal energy
El Salvador	SLV	Reduce annual greenhouse gas emissions to between 819 and 640ktCO2e by 2030, with annual greenhouse gas emission reduction target between 485 and 306ktCO2e	By 2030, the installed capacity of renewable energy will increase by 50% over 2019 (base year) to 2,222 megawatts, which means that renewable energy accounts for 64% of the national installed capacity matrix. In the base year, the installed capacity of renewable energy is 1,482 megawatts (the share of renewable energy in the national energy matrix is 66 per cent); by 2025, the installed capacity of renewable energy will increase by 14% over 2019 (base year) to 1,684 megawatts, which means that renewable energy accounts for 58% of the national installed capacity matrix. In the base year, the installed capacity of renewable energy is 1,482 megawatts (renewable energy accounts for 66% of the national energy matrix). By 2030, 86.1% to 85.7% of electricity will come from renewable energy, compared with 70% of renewable energy generation in 2019. By 2025, 83.7% to 82.7% of electricity will come from renewable energy, compared with 70% of renewable energy generation in 2019.
Nicaragua	NIC	Under the BAU scenario, it is estimated that greenhouse gas emissions in 2030 will reach 77 million tons of CO2e, and the emission reduction target is 8% (emissions are controlled at 71 million tons), and the emission reduction target in the	The proportion of renewable energy (such as solar, wind and biomass) will increase to 60% in 2030 (35% more than in 2007)

Country	Country code	Emission reduction target	Renewable energy development target
		enhanced ambition scenario is 10% (emissions are controlled at 69 million tons)	
Cuba	CUB	No overall emission reduction target	Renewable energy accounts for 24% of electricity generation in 2030 (sugarcane biomass: 14%, wind energy + solar photovoltaic + hydropower: 10%)
Dominica	DMA	Reduce emissions by 45% by 2030 relative to 2014 levels	Achieve 100% of renewable energy use by 2030 (mainly geothermal energy)
Jamaica	JAM	Reduce emissions by 25.4% (unconditional target) to 28.5% (conditional target) by 2030 compared to the BAU forecast scenario in 2005	/
Barbados	BRB	2025: reduce emissions by 20% (unconditional target) compared to BAU scenario, and by 35% (conditional target); 2030; reduce emissions by 35% (unconditional target), and by 70% (conditional target) compared to the BAU scenario	Conditional target: 95% of renewable energy in power mix
Trinidad and Tobago	TTO	Compared with the BAU scenario (2013) in 2030, reduce emissions by 30% (unconditional target) / an additional emission by 15% (conditional target)	/
Grenada	GRD	Reduce emissions by 40% relative to 2010 emission levels	/
Antigua and Barbuda	ATG	Achieve net zero emissions by 2040	Conditional target: 86% of the local resources in the power sector in 2030 will come from renewable energy, 100MW of installed capacity of renewable energy generation grid, 50MW of rural renewable energy

Country	Country code	Emission reduction target	Renewable energy development target
			installed capacity and can be sold to power contractors; social investors have 100MW renewable energy installed capacity, 20MW of wind power installed capacity, 100% of government facilities electricity will come from renewable energy
Guyana	GUY	Conditional target: the proportion of renewable energy will reach 100% by 2025	Unconditional target: build wind, light, biomass and hydropower energy mixes in the hinterland of Guyana to meet the national grid and rural energy needs; conditional target: 100% of renewable energy by 2025
Surinam	SUR	Cover four of the six emission sectors, with sub-sector targets	Unconditional target: 35% of renewable energy by 2030
Venezuela	VEN	Reduce greenhouse gas emissions by 20% in 2030 compared to the baseline scenario	Promote changes in the power generation matrix to facilitate the use of renewable energy. Expand this energy matrix by including new sources of energy
Ecuador	ECU	Relative to the baseline scenario (base year 2010 for the energy, agriculture, industrial processing and waste sectors and 2008 for the USCUSS sector), the emission reduction target by 2025 is 9% (unconditional target)/20.9% (with condition target)	Promote the use of renewable energy (hydroelectric power stations, unconventional renewable energy-promote the use of wind, solar and landfill gas)
Peru	PER	Net greenhouse gas emissions in 2030 will not exceed 208.8MtCO2e (unconditional target)/179.0MtCO2e (conditional target)	/
Bolivia	BOL	Strive to transition national power generation matrices to renewable energy-based systems by	79% of energy consumption in 2030 comes from renewable energy plants (50% of installed capacity); 19% of energy consumption in 2030

Country	Country code	Emission reduction target	Renewable energy development target
		2030; improve energy efficiency and comprehensive and sustainable forest management so as to promote the reduction of greenhouse gas emissions	comes from alternative energy-based power plants (13.25% of installed capacity)
Uruguay	URY	Unconditional target: by 2030 reduce CO2 emissions by 9267Gg, reduce CH4 emissions by 818Gg, reduce N2O emissions by 32Gg, reduce HFC emissions by 10%; conditional target: by 2030 reduce CO2 emissions by 960Gg, reduce Ch 4 emissions by 61Gg, reduce N2O emissions by 2Gg, and reduce HFC emissions by 5%	Replace some fossil fuels in the industrial, trade and service sectors with renewable power surpluses in 2030, especially 20% of alternative fuel oil consumption; 6% of petroleum coke consumption in the cement industry will be replaced by rice husks or other low-or zero-emission fuels
Argentina	ARG	Net carbon dioxide equivalent emissions in 2030 will not exceed 359 million tons	/
Chile	CHL	Emissions will not exceed 95MtCO2e in 2030, and will peak in 2025, carbon emission budget in 2020-2030 will not exceed 1100MtCO2e, and carbon neutralization will be achieved in 2050.	Carbon neutralization scenario, renewable energy will replace the phase-out of 5,500MW power plants

Source: produced based on the NDC documents submitted by all countries (https://unfccc.int/NDCREG); “/” indicates that the specific targets in this regard are not explicitly mentioned in the NDC documents.

Annex B

Pre-feasibility Funding

Funding	Host	Purpose	Success/Failures	Fund Size	Grant (Y/N)	Technology
Project Development Facility	South African National Treasury	Funds pre-feasibility studies for Government projects, e.g., procurement of Govt advisors to develop project to be awarded as PPP.	Fund targets projects that aim to deliver a government service and has been applied towards funding government advisors on RSA PPPs.	TBC	Y	Mostly for PPPs
The Global Environmental Fund (GEF)	Accredited agents such as the DBSA	Early development capital	Some funding earmarked for RSA's Small Scale IPP Programme for funding feasibility studies for small medium enterprises. Funding has not yet been disbursed. Delays in securing approval and committing funds.	TBC	Y	Environmental projects, biodiversity, sustainable cities, transportation
The Green Fund (GF)	DBSA	Prefeasibility, project preparation, implementation funding	New Fund. Projects currently in due diligence.	500 million ZAR	Y	Renewable energy, sustainable waste and water management, energy efficiency

Energy and Environment Partnership Trust Fund (EEP Africa)	Energy and Environment Partnership Trust Fund (EEP Africa)	EEP Africa provides early-stage grant and catalytic financing to innovative clean energy projects, in Botswana, Burundi, Eswatini, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda Seychelles, South Africa, Tanzania, Uganda, Zambia, Zimbabwe	EEP Africa's current portfolio consists of 67 projects approved for financing from 2018 to 2020. These diverse projects cover 9 technologies in 14 countries and represent a total investment of €26 million in committed grants and repayable grants.	TBC	Y	
InfraCo Africa	InfraCo Africa	Investing directly into early-stage projects which need the financial commitment and support to reduce risks and costs.	Developed 27 projects through to financial close. Of these, successfully exited five projects and is overseeing the construction and operation of the rest. Invested US$200m and supported 34 projects.	US$200 million	Y	Power generation, transmission and distribution projects, prioritizing off-grid renewable power development.
IFC Global Infrastructure Project Development Fund (IFC InfraVentures)	International Finance Corporation	Global infrastructure project development fund created to increase the pipeline of bankable projects in developing countries and includes early stage risk capital and experienced project development support in order to	US$320 million, 100 MW Kipeto Wind power project in Kipeto, Kenya with GE, Craftskills and Kipeto Energy between 2013 and 2015; 100MW wind energy project in Kenya; 40 MW hydro	US$150 million	N	Wind, solar, gas, hydro

		address the key constraints to private investment in infrastructure projects in frontier markets.	power project in Mali; 33MW solar PV project in Mali			
Seed Capital Assistance Facility (SCAF)	Seed Capital Assistance Facility (SCAF)	Helps low-carbon project developers and entrepreneurs access enterprise development support and early-stage seed capital financing from mainstream energy investors.	7 investment funds in Asia and Africa, total capitalization of US$52 renewable energy project developments.	US$790 million	Y	Low-carbon projects

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