

# Overseas Investment in Bangladesh's **Renewable Energy Sector** *Case of Chinese Investment*

**Khondaker Golam Moazzem  
Mashfiq Ahasan Hridoy**

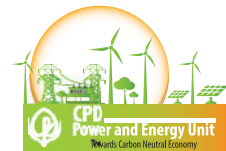


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## Abstract

The paper 'Attracting Overseas Investment in the Renewable Energy Sector of Bangladesh: Case of Chinese Investment' provides a comprehensive analysis on the strategic approaches for Bangladesh to attract Chinese investment in its burgeoning renewable energy sector. It delves into the current renewable energy landscape, identifying key challenges that impede Chinese investment, including policy, regulatory, infrastructural, and financial barriers. Drawing on China's vast experience and success in renewable energy development, the report outlines actionable policy recommendations for Bangladesh. These recommendations are designed to address the identified challenges, facilitating a conducive environment for Chinese investments. The study underscores the importance of bilateral co-operation, technological transfer, and knowledge sharing in achieving Bangladesh's renewable energy goals. Through a synthesis of empirical data and policy analysis, the report aims to contribute to the discourse on sustainable energy transition in developing countries, offering a roadmap for enhanced international investment collaboration in the renewable energy sector.



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## Key Findings

- **Current State and Aspirations in Renewable Energy Generation:** Bangladesh has a total renewable energy-led power generation capacity of 1195 MW, which is only 4.6 per cent of the country's total power generation capacity. The country aims to achieve 40 per cent of its power generation from renewable energy sources by 2041, but due to the lack of investment and existing infrastructure, reaching this target might be challenging.
- **Overseas Investment in Bangladesh's Power Sector:** Bangladesh has attracted significant overseas investment in its power and energy sector, with the power sector receiving USD 512 million from the United States and USD 667 million from China. Only a minuscule amount of overseas investment is targeted to the renewable energy sector - a total of 172 MW worth of overseas investment/loan based renewable energy projects is in operation. The country has the potential to attract overseas investment in its renewable energy sector, but various challenges need to be addressed to tap into these opportunities.
- **Navigating Challenges Confronted by the Chinese Investors is the Priority to Attract Chinese Investment:** Chinese investors confronted different types of challenges in Bangladesh while implementing their infrastructure projects. The challenges are more complex in the case of investment in the renewable energy sector. According to the Chinese investors invested in Bangladesh, broadly six types of challenges are experienced by Chinese investors in the case of investing in the renewable energy sector. These include – (a) infrastructure deficits, (b) financing challenges, (c) administrative difficulties; (d) legal intricacies, (e) human resource deficiencies, and (f) technological weaknesses and quality assurance concerns.
- **Fiscal and Financial Incentives and Opportunities are yet to get Shape to Attract Overseas Investment in the Renewable Energy Sector:** Local and overseas investors are offered a set of traditional fiscal and financial packages. These include – (a) tax holidays for a certain period, (b) tax exemptions on royalties, technical know-how, and technical assistance fees, (c) granting exemptions on capital gains arising from the transfer of shares by investing businesses, (d) offering comprehensive infrastructure for the repatriation of invested capital, profits, and dividends, (e) allowing remitting up to 50 per cent of salary for foreign workers, in addition to providing provisions for the repatriation of their savings and retirement benefits, (f) allowing issuance of work permits to foreign nationals and employees involved in project-related activities and (g) facilitating a streamlined and secure mechanism for implementing their exit strategy for foreign individuals and investors. However, Bangladesh has yet to practice various innovative financing models/schemes in order to attract overseas investment.
- **Learning from China's Renewable Energy Advancements is Essential to Attract Overseas Investment Across the World:** China has made significant advancements in renewable energy, with a notable 29.4 per cent share of renewable energy in its overall power generation in 2021, up from 7 per cent a decade earlier. Chinese success in the areas of policies, laws and other regulatory issues in case of generation, transmission, distribution, manufacturing, and financing related to the renewable energy could be good learning areas for Bangladesh. Similarly, China's success in institution building both in public and private sector to cater to the need of the renewable energy sector is worth learning. Technological success to improve efficiency and cost effectiveness, grid integration, to ensure reliability and resilience, strengthening maintenance and operation is world-class. Similarly operational success



in case of decommissioning and repurposing of renewable energy institutions, workforce development and training, community engagement and stakeholder involvement is highly important areas to learn for other developing countries like Bangladesh.

## Policy Recommendations

- **Navigating Land-related Challenges Confronted by Chinese Investors:** The most common complaints of the Chinese investors are about geographical ones e.g., acquisition of land, land quality, flood from the upstream, etc. Because of the lack of low-cost suitable land, the project cost increased substantially which even made the projects unviable. To optimise land utilisation, the Department of Land aims to refine land use policies, particularly by offering incentives to reduce land costs for renewable energy projects. Managing riverbanks through strategic vegetation and rock bed arrangements also stands as a key initiative.
- **Navigating Finance related Challenges Confronted by Chinese Investors:** The decline in foreign reserves coupled with currency depreciation poses challenges. The bank guarantee structure following the Letter of Intent (LOI) complicates matters for international banks, deterring their investment. Moreover, delayed bill payments by the Bangladesh Power Development Board (BPDB) exacerbate these issues. Flexibility in negotiating certain clauses within PPAs and IAs while maintaining essential terms can streamline project financing. Instituting measures for timely bill payments by BPDB is crucial to instill investor confidence and ensure smoother project operations.
- **Navigating Institution related Challenges Confronted by Chinese Investors:** Expanding agency capacity beyond SREDA, mirroring China's NEA and CREI models, improving decision-making efficiency within agencies, and fostering inter-ministry collaboration are highly required. The prolonged development period stems from the inefficiency in government approvals, significantly impeding progress. The absence of clear policies governing the renewable energy market further exacerbates the situation. Establishing comprehensive policies that incentivise and support the renewable energy market will be pivotal. Implementing targeted laws concerning power generation, transmission, distribution, and financial frameworks is essential to strengthen the legal foundation within the energy sector. Licensing should be digitalised to attract investors and hasten project implementation. Strengthening Intellectual Property Rights (IPR) laws is imperative to stimulate innovation and technological advancement within the energy sector, akin to China's strategy.
- **Developing Manufacturing Strategies for Renewable Energy Advancement:** Manufacturing recommendations suggest digitising administrative processes to ease overseas investment hurdles and focusing on research and technology advancements to position Bangladesh as an attractive hub for renewable energy investments and manufacturing, aligning with China's successful strategies.

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## Acronyms

ADB	Asian Development Bank
AGM	Annual General Meeting
BOOT	Build-Operate-Own-Transfer
BPDB	Bangladesh Power Development Board
BRI	Belt and Road Initiative
CBIRC	China Banking and Insurance Regulatory Commission
CCDMF	China Clean Development Mechanism Fund
CDB	China Development Bank
CEIC	China National Energy Investment Group
CEM	Clean Energy Ministerial
CNIS	China National Institute of Standardization
CNREC	China National Renewable Energy Center
CO <sub>2</sub>	Carbon Dioxide
CPPPC	China Public Private Partnerships Centre
CREEI	China Renewable Energy Engineering Institute
CRES	China Renewable Energy Society
CSP	Concentrated Solar Power
CWEA	China Wind Energy Association
FDI	Foreign Direct Investment
FYP	Five-Year Plan
GEI	Global Environmental Institute
GoB	Government of Bangladesh
GW	Gigawatts
IA	Implementation Agreement
IEA	International Energy Agency
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency-
KIIs	Key Informant Interviews

LOI	Letter of Intent
MEE	Ministry of Ecology and Environment
MoPEMR	Ministry of Power, Energy and Mineral Resources
MW	Megawatt
NDB	National Development Bank of China
NDRC	National Development and Reform Commission
NEA	National Energy Administration, China
NGOs	Non-Governmental Organisations
PPA	Power Purchase Agreement
PPPs	Public-Private Partnerships
REEI	Rock Environment and Energy Institute
SGCC	State Grid Corporation of China
SREDA	Sustainable and Renewable Energy Development Authority
UNEP	United Nations Environment Programme
USD	United States Dollar
VAT	Value Added Tax
VPPs	Virtual Power Plants

# 1. Introduction

## 1.1 Background and Objectives

Bangladesh and China present contrasting cases in their development of the renewable energy sector. In 2022, Bangladesh ranked 187th out of 196 countries in renewable energy use, whereas China claimed the top spot as the leading nation in renewable energy utilisation. China's success in the renewable energy sector development could be good test case for the developing countries, like Bangladesh to develop their renewable energy sector and thereby contributing towards reducing global warming. In a span of 40 years, China became the global champion of renewable energy from a lagger.

The current renewable energy mix of Bangladesh is less than 5 per cent, while the government has made a commitment to reach 40 per cent of the mix to be renewables by 2040. However, due to the lack of investment and existing infrastructures, reaching this target might be tough. Bangladesh receives a substantial amount of FDI in the power and energy sector. In 2022, the power and energy sector attracted notable attention, receiving USD 854.2 million, a quarter of the total FDI. Most of this investment, USD 512 million, went into the power sector, while USD 342.5 million was allocated to the energy sector<sup>1</sup> (Foreign Direct Investment and External Debt, January-June 2023, Bangladesh Bank).

The power and energy sector in Bangladesh have attracted investments from major developed and developing countries. These include the United Kingdom, Hong Kong, the Netherlands, the United States, and China. Among these, the United States led the pack with a significant investment of USD 2.9 billion, primarily focused on Gas and petroleum. China followed with USD 667 million, mainly directed at the power segment. The United Arab Emirates also contributed significantly, investing USD 233 million, further fueling growth in the sector.

Bangladesh has the potential to attract overseas investment in its renewable energy sector.

However, multiple challenges hinder tapping into those opportunities. Provided China has multiple successful evidence of outward FDI in BRI countries, Bangladesh can utilise this opportunity to attract Chinese overseas investment in the renewable energy sector. But to attract that, the existing challenges need to be mitigated first.

China's success could be a good lesson for developing countries like Bangladesh in achieving their renewable energy goals. At present, Bangladesh is lagged in developing its renewable energy sector. However, Bangladesh has expressed its strong political commitment in developing the renewable energy sector in the coming decades. Hence, Bangladesh needs to develop as well as to strengthen its legal, institutional, infrastructural and operational structures for facilitating investment in different types of renewable energy sources including solar, wind, hydro, bio, wave and other alternatives. Experiences of China in strengthening renewable energy related legal, institutional, operational and infrastructural issues would be good lessons for Bangladesh.

President Xi Jinping of China made a significant pledge at the 75th session of the UN General Assembly, stating that China will strive to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060. This commitment involves not only halting new coal-fired power projects abroad but also scaling up China's support for other developing countries in developing green and low-carbon energy. The pledge has been described as a 'gamechanger' and is expected to have a substantial impact on global efforts to address climate change. While the details of how China will achieve this goal are still to be fully outlined, the announcement has been widely welcomed and is seen as a significant step in the global fight against climate change.

The objective of this study is to review the renewable energy market of Bangladesh including its potentials and barriers for financing particularly for overseas investment from China and thereby put forward a set of recommendations taking into account China's success in the renewable energy sector development both nationally and globally.

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<sup>1</sup>However, disinvestment in the gas sector led to about USD 91.8 million being withdrawn during 2022.

## 1.2 Methodology

The study is based on primary and secondary data collected from national and international sources on overseas investment in the renewable energy sector of Bangladesh and its challenges. The study analysed data and information on China's policies, rules, and operational issues related to the renewable energy sector as well as Chinese overseas investment in the renewable energy sector of Bangladesh.

To gain deeper insights into different critical aspects, a structured questionnaire was prepared to solicit detailed information, perspectives, and data related to China's renewable energy policies, strategies, and experiences. In addition to the questionnaire survey, the research incorporated Key Informant Interviews (KIIs) as a pivotal component. These interviews involved engagement with various stakeholders and experts in the field, including two KIIs with Chinese specialists focused on renewable energy. These interactions provided valuable firsthand knowledge, expert insights, and a deeper understanding of the intricacies of China's renewable energy landscape. The comments and feedback of the experts and participants during the kick-off dialogue on 'China-Bangladesh Renewable Energy Partnership' held on 23 October 2023 have been extensively used in the study.

An extensive review of global literature on China's renewable energy sector, encompassing reports from influential institutions such as the World Bank, the International Energy Agency (IEA), and the International Renewable Energy Agency (IRENA). The review focused on the key sectors instrumental in China's accomplishments in the renewable energy sphere. Simultaneously, the study delved into the latest reports regarding the Belt and Road Initiative (BRI), acknowledging its significance in shaping China's international renewable energy collaborations.

Based on information, comments, and feedback on challenges and opportunities for attracting Chinese overseas investment in Bangladesh as well as the Chinese lessons on renewable energy development, this paper put forward recommendations on pathways for attracting Chinese overseas investment in Bangladesh in the renewable energy sector.

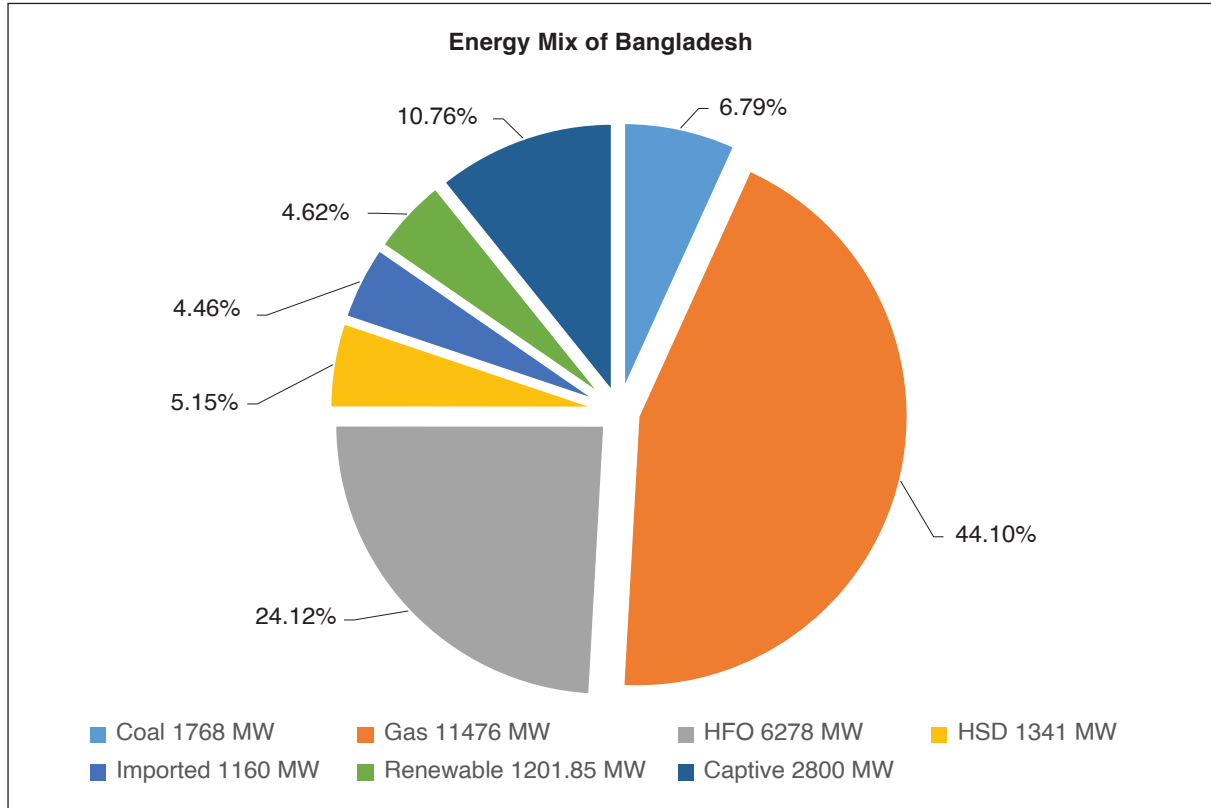
## 2. Overview of the Power and Energy Sector of Bangladesh: Case of Renewable Energy

In Bangladesh, renewable sources contribute to a mere 4.59 per cent of the generated electricity, accounting for 1194.78 MW of power (Figure 1). Breaking down the renewable energy distribution, the figures stand as follows in the energy mix table: Solar power contributes 960.71 MW, with 366.07 MW from off-grid and 594.64 MW from on-grid installations. Wind energy comprises a smaller fraction, amounting to 2.9 MW, with 2 MW from off-grid and 0.9 MW from on-grid sources. Hydroelectricity stands at 230 MW, exclusively from on-grid sources. Additionally, biogas to electricity contributes 0.69 MW (0.69 MW from off-grid), while biomass to electricity contributes 0.4 MW (all off-grid).

Bangladesh has a total renewable energy-led power generation capacity of 1195 MW. This includes both off-grid and on-grid power. However, this capacity is only 4.6 per cent of the total power generation capacity of the country (27,834MW, September 2023). In other words, Bangladesh is far behind its targeted renewable energy-based power generation – 40 per cent by 2041. Bangladesh has been proactively engaged in the implementation of renewable energy programmes, driven by its favourable geographical positioning, escalating energy requirements, and mounting environmental apprehensions. Currently, the status of all kinds of renewable energy projects is shown below (Tables 1 and 2).

Bangladesh is charting an ambitious course toward a renewable energy future, envisioning a decisive shift away from fossil fuels toward a sustainable energy paradigm. Anchored in this vision are substantial goals, notably aiming for a robust 40% share of renewable energy by 2041, underscoring the nation's steadfast commitment to clean energy initiatives. The roadmap outlines strategic focal points across various renewable sectors. Solar power takes center stage, promoting widespread adoption in homes and businesses through expanded rooftop installations and large-scale solar farms on vacant land. Rural areas benefit from solar mini-grids, ensuring off-grid energy accessibility. Leveraging Bangladesh's coastal and offshore wind potential, plans entail

**Figure 1: Energy-mix of Bangladesh**



Source: SREDA.

wind farm development and innovative floating turbine technology to overcome land constraints. Hydropower optimization for efficiency and sustainability, coupled with exploration into small-scale hydropower for rural communities, stands as

another pillar. The agenda extends to bioenergy and biomass, aiming to convert agricultural waste into sustainable biogas and biomass, alongside promoting efficient biomass cookstoves to curtail firewood use.

**Table 1: Status of Renewable Energy-based Power Generation in Bangladesh**

Technology	Off-grid (MW)	On-grid (MW)	Total (MW)
Solar	366.07	594.98	961.05
Wind	2.00	0.90	2.90
Hydro	0.00	230.00	230.00
Biogas to Electricity	0.69	0.00	0.69
Biomass to Electricity	0.40	0.00	0.40
<b>Total</b>	<b>369.16</b>	<b>825.88</b>	<b>1195</b>

Source: CPD-RE Database, 2023.



**Table 2: Renewable energy projects, their status, and capacity**

RE Projects	No. of Systems	Project Status						Capacity (MWp)
		Completed & Running	Implementation Ongoing	Under Planning	Rejected from the Planning Phase	Under Maintenance	Obsolete	
Solar Park	50	10	8	24	8	0	0	2470.7
Rooftop Solar Except Net Metering	234	225	3	1	2	2	1	76.0
Net Metering Rooftop Solar	1993	1993	0	0	0	0	0	85.2
Solar Irrigation	2973	2877	96	0	0	0	0	55.1
Solar Minigrid	28	28	0	0	0	0	0	5.8
Solar Nanogrid	2	2	0	0	0	0	0	0.001
Solar Charging Station	14	14	0	0	0	0	0	0.3
Solar Drinking Water System	116	82	0	0	0	0	34	0.1
Wind Projects	12	3	2	7	0	0	0	359.9
Hydro Projects	1	1	0	0	0	0	0	230.0
Biogas to Electricity	12	8	1	3	0	0	0	50.9
Biomass Projects	2	1	0	0	1	0	0	0.4

Source: SREDA.

### 3. Overseas Investment in Bangladesh’s Renewable Energy Sector: Case of China’s Overseas Investment

#### 3.1 Overseas Investment in Bangladesh’s Renewable Energy Sector

Bangladesh’s power and energy sector has attracted significant overseas investment over the last few decades. According to the International Energy Agency (IEA), the cumulative investment in Bangladesh’s energy sector from 2010 to 2022 totaled about USD 39 billion, of which about USD 1 billion was invested in renewable energy projects between 2016 and 2021 i.e. investment in the renewable energy sector is gaining attraction since last few years (National Database on Renewable Energy, NDRE). For Bangladesh’s power and energy sector, 2022 Foreign Direct Investment (FDI) in the top five countries and regions are in order are - UK, UAE, the Netherlands, the United

States and China (Table 3). The US ranked the top five countries in terms of investment with USD 2.9 billion, mainly in the natural gas and oil sub-sectors. However, their investment in the power sector is quite low compared to the other countries on the list. China follows with investments totaling USD 667 million, mainly in the power sector which is highest in the power sector. The UAE is also in the Bangladesh’s power sector, where the UAE also invested USD 233 million (which is the 2nd highest in the power sector), further contributing to the sector’s growth and development.

At present, a total of 172 MW worth of FDI-led renewable energy projects is in operation. These projects are either fully foreign-owned or joint-venture with local private power producers. A number of these power plants are set up based on Chinese overseas investment. Table 4 presents the list of power plants.

With an ambitious target of achieving 40 per cent renewable energy-based power generation by

**Table 3: Country-wise FDI Stock in the Power and Energy Sector of Bangladesh, 2022**

Country	FDI Stock (million USD)		
	Gas & Petroleum	Power	Total
USA	2910.50	166.50	3076.90
China	0.00	666.90	666.90
Netherlands	43.10	200.30	243.40
UAE	5.90	232.70	238.70
UK	36.70	184.30	220.90
Hong Kong	0.00	175.10	175.10
Malaysia	0.01	168.40	168.40
India	0.20	117.70	117.90

Source: Foreign Direct Investment and External Debt, January-June 2023, Bangladesh Bank.

**Table 4: Ongoing Overseas Investment in the Renewable Energy Sector in Bangladesh**

Projects	Capacity	Amount	Funding Type
60 MW Wind Power Project at Cox's Bazar by US-DK Green Energy (BD) Ltd	60MW	Around USD 116.51 million	Foreign Investment
Sonagazi 50 MW Solar Power Plant	50MW	Around USD 89.17 million (WB): USD 74.15 million-assistance)	World Bank Loan
Tetulia, Panchagarh 30 MW Solar Park	30MW	Around USD 48.14 million (Sukuk) - USD 36.14 million Sukuk and USD 12.04 million Equity – USD 9.63 million (20 per cent)	Joint - Beximco & Jiangsu Zhongtian Technology Co. Limited
Dharampasha, Sunamganj 32 MW Solar Power Plant	32 MW	USD 100 million	Foreign Investment - HKGE Consortium Ltd.

Source: BPDB Monthly Reports and SREDA.

2041, Bangladesh has much to gain from Chinese expertise and investment. Since China has been investing significantly in renewable energy projects in other countries, particularly in Southeast Asia and Africa, Bangladesh could take lessons from those overseas investment projects. As of June 2023, it is estimated that China's cumulative overseas investment in renewables is USD 86.8 billion across 780 projects. Africa, Southeast Asia, and Latin America are the major recipients due to their availability of resources and their national commitments towards renewables. Bangladesh is a miniscule recipient of Chinese overseas investment in the renewable energy sector.

Between 2000 and 2022, Chinese companies invested in more than 1,400 overseas power-generating units, with 31 per cent of those plants

located in Southeast Asia. China's overseas investment in power generation projects includes greenfield investments and mergers & acquisitions. Under the Belt and Road Initiative (BRI), Chinese investment in Bangladesh reached USD 7.07 billion. While not all of this goes to renewables, it indicates the scale of China's involvement in the country's infrastructure development.

### 3.2 Fiscal and Financial Incentives for Overseas Investment

The Government of Bangladesh (GoB), although encountering several obstacles, has effectively sustained a favourable atmosphere for foreign investors by providing a variety of amenities and incentives to promote investment in the nation. Included in these provisions are other significant

offerings that have been specifically tailored to attract and provide support for foreign investment enterprises.

In order to attract potential investors, GoB has implemented a corporation tax exemption period ranging from 5 to 7 years for specific sectors. This initiative serves as an attractive incentive for engaging in diverse industries inside the country. In addition, private power businesses are provided with a significant corporate income tax exemption that spans 15 years, so augmenting the attractiveness of investing in the energy industry.

In addition to the implementation of tax holidays, other tax exemptions have been introduced to facilitate the seamless operations of international investors. The exemptions encompass the alleviation of tax obligations on royalties, technical know-how, and technical assistance fees, as well as the establishment of conditions for their repatriation. The implementation of tax exemptions on interest from foreign loans serves as an additional incentive for attracting foreign capital, hence fostering financial feasibility for international investments.

The GoB provides assistance to investors by granting exemptions on capital gains arising from the transfer of shares by investing businesses, thus creating a conducive financial environment that promotes prospective profits. Furthermore, it is worth noting that Bangladesh allows for remittances of up to 50 per cent of salary for foreign workers, in addition to providing provisions for the repatriation of their savings and retirement benefits when they leave the country.

In order to streamline operational procedures, Bangladesh adheres to an inclusive approach by implementing a policy that allows for the issuing of work permits to foreign nationals and employees involved in project-related activities. This policy aims to ease the seamless transfer of knowledge and skills, hence promoting the influx of expertise and talent. Furthermore, the government offers comprehensive infrastructure for the repatriation of invested capital, profits, and dividends, thereby facilitating the procedure for investors.

In addition, the GoB promotes reinvestment by considering the reinvestment of remittance

dividends as fresh investment, thus facilitating a perpetual cycle of investment and economic expansion. Investors are additionally allowed to exercise flexibility in concluding their investment through a resolution passed at the Annual General Meeting (AGM), thereby enabling the implementation of a methodical exit strategy.

After fulfilling the requisite procedures for departure from the nation, foreign investors receive approval from the Central Bank to repatriate the revenues from their sales. This facilitates a streamlined and secure mechanism for implementing their exit strategy. The extensive range of facilities and incentives provided by the GoB demonstrates its dedication to cultivating a favourable atmosphere for international investors within the rapidly developing economic context of Bangladesh.

## **4. Challenges Confronted by Chinese Investors in the Case of Investing in the Renewable Energy Sector of Bangladesh**

Overseas investment in the renewable energy sector of Bangladesh grapples with a myriad of challenges, which can be broadly categorised into four distinct areas, each presenting its unique hurdles and obstacles. The challenges were mostly obtained from the KIIs and the webinar. According to the Chinese investors who invested in Bangladesh and participated in the KIIs, broadly six types of challenges are observed in the case of investing in the renewable energy sector of Bangladesh. These include – (a) infrastructure deficits, (b) financing challenges, (c) administrative difficulties; (d) legal intricacies, (e) human resource deficiencies, and (f) technological weaknesses and quality assurance concerns.

### **4.1 Geographical Challenges**

Chinese investors often face challenges related to land acquisition, quality, and management. To address these issues, the Department of Land aims to refine land use policies and offer incentives to reduce land costs for renewable energy projects. Implementing soil conservation strategies like riparian buffers, conservation tillage, and cover crops is crucial for preserving

soil quality and curbing erosion. Focusing on the efficient use of arid land in the southeastern region is a priority, while managing riverbanks through strategic vegetation and rock bed arrangements stands as a key initiative in sustainable land management practices.

## 4.2 Financing Challenges

The decline in foreign reserves coupled with currency depreciation poses challenges. The bank guarantee structure following the Letter of Intent (LOI) complicates matters for international banks, deterring their investment. Additionally, the inflexibility surrounding key clauses in Power Purchase Agreements (PPA) and Implementation Agreements (IA) hampers project financing closure, creating hurdles in attracting consistent investments as projects progress. The irregularity in investment, particularly in the latter stages of projects, emerges as a concern. Moreover, delayed bill payments by the Bangladesh Power Development Board (BPDB) exacerbate these issues, contributing to a complex investment environment. Adjusting the bank guarantee framework post LOI to ease international banks' concerns may enhance investment prospects. Flexibility in negotiating certain clauses within PPAs and IAs while maintaining essential terms can streamline project financing. Instituting measures for timely bill payments by BPDB is crucial to instill investor confidence and ensure smoother project operations. Collaboration between stakeholders, regulatory adjustments, and improved financial practices can collectively mitigate these challenges.

## 4.3 Administrative Challenges

Navigating the bureaucratic maze to secure registrations and permissions for prospective investors is akin to navigating a complex labyrinth. This convoluted process often becomes an overwhelming ordeal, hindering the initial stages of investment. The absence of a dedicated investment promotion agency further compounds the issue, leaving international investors without specialised support. Critical government agencies like the Board of Investment, Police, National Board of Revenue, and Department of Environment sometimes fail to co-operate, adding significant challenges.

The already intricate process is aggravated by political unrest and blockades, creating an even more uncertain investment environment. Changes in government often result in different treatment, intensifying uncertainties and highlighting the necessity for consistent policies and administrative coordination among governmental bodies.

The delays in obtaining essential services from supporting organisations, notably the Department of Land, serve as additional stumbling blocks in this bureaucratic landscape, amplifying administrative hurdles for investors.

## 4.4 Legal Challenges

Navigating legal intricacies presents a multifaceted challenge for foreign investment. Inadequate enforcement of Intellectual Property Law significantly erodes trust in safeguarding proprietary innovations and technologies, raising concerns among investors about the security of their intellectual assets. The prevalence of corruption within the system further compounds these apprehensions, acting as a substantial deterrent for potential investors. Additionally, the frequent policy fluctuations surrounding import duties on essential components like raw materials, machinery, and equipment contribute to an environment of uncertainty, significantly impacting long-term investment strategies and planning for businesses.

## 4.5 Quality Assurance Challenges

Quality assurance and skilled manpower is pivotal for sustainable investment attraction. The scarcity of professionals and specialised, sector-specific training hampers the country's capacity to align with international standards. Furthermore, the lack of standardised quality infrastructure in areas like home and household domains adds to the challenges, affecting overall quality assurance measures.

Effectively tackling these multifaceted challenges requires a collaborative approach from governmental bodies and the private sector. This involves streamlining administrative procedures, enhancing infrastructure, fostering investment-friendly legal frameworks, and prioritizing investment in skill development. These concerted

efforts are essential to augment Bangladesh's appeal for foreign finance and investment by bolstering its capabilities to meet global standards and requirements.

#### 4.6 Manpower Challenges

The challenge of insufficient professional talent and an underdeveloped industrial chain can be addressed through strategic recommendations. Collaborative efforts between academia and industry are essential to bridge the gap. Establishing partnerships that integrate academic programmes with industry needs will cultivate the skills and expertise required for the energy sector. Simultaneously, tackling the issue of inadequate local employment opportunities involves providing targeted training initiatives. These programmes should encompass a broad spectrum, including manufacturing technologies, engineering construction, and project operations, empowering local individuals to actively engage in and contribute to energy projects while enhancing their employability within the sector.

#### 4.7 Technological Challenges

The lack of sufficient infrastructure presents substantial obstacles to Foreign Direct Investment (FDI). Inadequate capacity to supply electricity and gas to industries severely limits operational capabilities. Moreover, the absence of efficient physical and technological infrastructure exacerbates these challenges, hampering smooth business operations and dissuading potential investors who require strong technical support.

### 5. Lessons from China's Success in the Renewable Energy Sector

#### 5.1 China's Renewable Energy Sector

China, being the global champion in the renewable energy sector is far ahead compared to Bangladesh which ranks 38 in the global ranking for renewable energy. China is ranked globally number one in hydroelectricity, solar, and wind energy. Despite the rapid growth of renewable energy in recent years, coal still accounted for 62 per cent of China's total energy consumption in 2021, although this represents a decline from over 70 per cent in the mid-2000s. The absolute level of coal

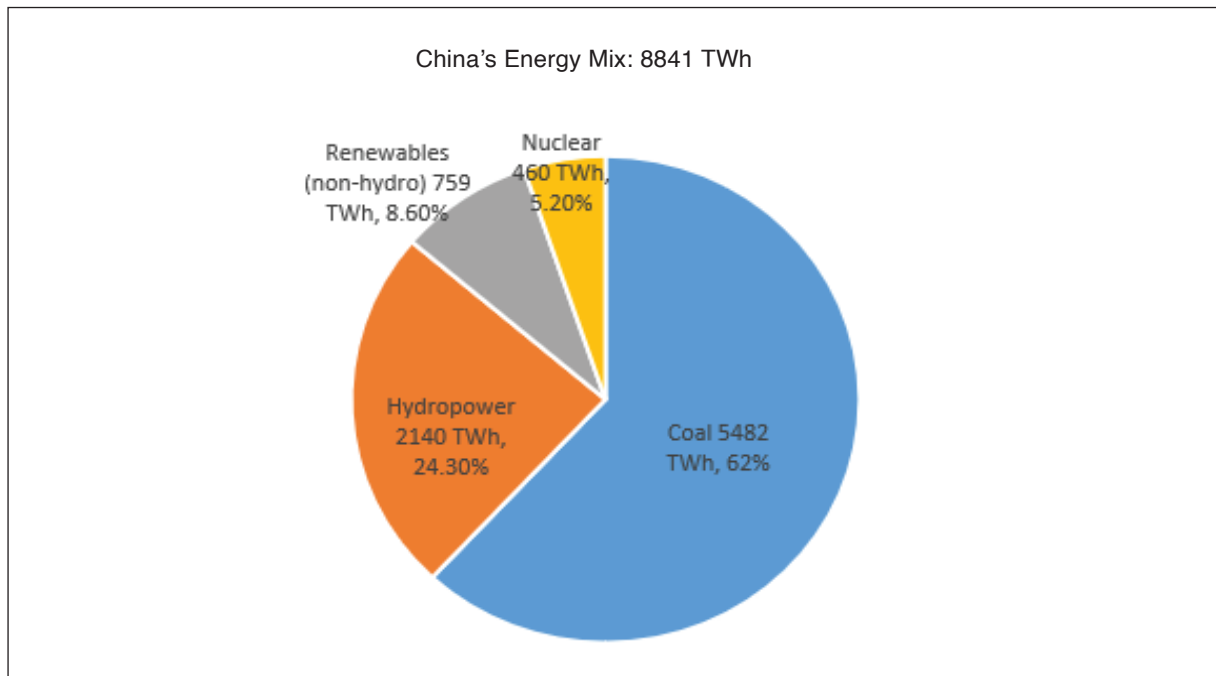
use has continued to rise, and China is home to the world's largest fleet of coal-fired power plants, comprising around 50 per cent of the operating capacity globally. The country's 14th Five-Year Plan (FYP) (CSET, 2021) indicates a commitment to not building new coal power projects whose sole purpose is electricity generation.<sup>2</sup> Other than coal, renewables—including nuclear power—accounted for about 39 per cent. Hydroelectric sources accounted for 24.3 per cent of China's energy mix. Non-hydro renewables, including wind and solar power, accounted for 8.6 per cent of China's energy mix (ITA, 2023). The China Energy Transition Status Report 2021 highlights that in 2020, 57.7 per cent of China's total primary energy consumption came from coal, while 14.3 per cent was from renewables<sup>3</sup> (Figure 2).

China is leading the global market in renewable energy, with projections to achieve a record 230 gigawatts (GW) of wind and solar installations in 2023, as reported by the Reuters. This figure significantly surpasses the combined installations of the US and Europe, emphasising China's dominant position in the renewables sector. The country's investment in wind and solar projects is anticipated to hit USD 140 billion for the year. Despite other markets scaling back on renewable energy targets, China has increased its wind and solar outlook for 2025 by 43 per cent or 380 GW within just a few years. This growth in renewables is part of China's broader energy transition, with coal's share in power generation declining significantly. Approximately 80 per cent of this reduction has been substituted by renewable sources, with the remainder mostly covered by nuclear power. Additionally, China's installed solar power capacity reached 536 GW in October 2023,

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<sup>2</sup>China submitted its First NDC in February 2016, which aimed to peak CO<sub>2</sub> emissions around 2030 and increase the share of non-fossil fuels in primary energy consumption to around 20 per cent by 2030. In 2020, China announced an updated NDC, which targets to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060. According to a report by the National Center for Climate Change Strategy and International Cooperation, China's NDC is consistent with global emissions pathways that meet the 2°C goal.

<sup>3</sup>The International Energy Agency (IEA) apprehended that China will continue to add to its coal-fired capacity until around 2030, but it anticipates that the output from coal-fired power plants will peak around 2025 and then start to decline. The IEA also notes that China's energy transition will require a gradual effort, and the country's shift towards sustainable energy is a nationwide movement driven by the need to address environmental concerns and contribute to global sustainability goals.

**Figure 2: China's Energy Mix**

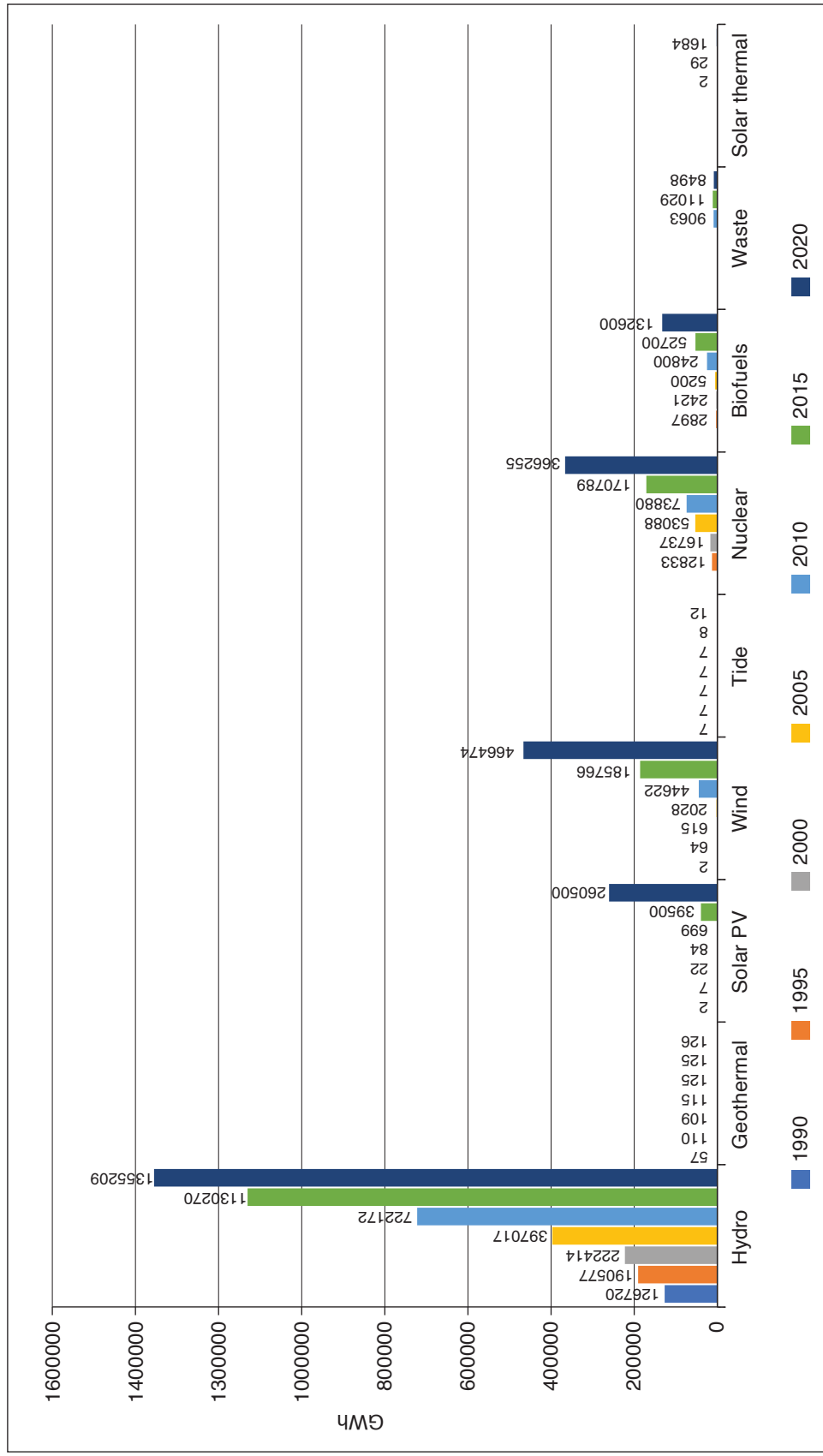
Source: BP Statistical Review of World Energy 2022.

marking a 47 per cent increase from the previous year, and wind capacity rose by 15.6 per cent to 404 GW. China is set to maintain over 80 per cent of the world's solar manufacturing capacity through 2026, positioning it as a key supplier for the global demand for solar products in the coming decade.

China's journey towards a diversified and cleaner energy portfolio has seen remarkable progress in recent years. China's renewable capacity has grown rapidly in recent years partly due to investments in wind and solar megaprojects in the country's sparsely populated west that export power to manufacturing centers in the east. Renewable sources now make up 50.9 per cent of the country's power capacity. The nation's electricity generation has witnessed a rapid surge,

with a notable emphasis on hydropower, reaching a peak of 1,355,209 gigawatt-hours (GWh) in 2020 (Figure 3). In addition, 2020 marked significant milestones for other clean energy sources, with solar, wind, and biofuels reaching their peaks at 260,500 GWh, 466,474 GWh, and 132,600 GWh, respectively (EIA, 2023). In a span of 30 years, generation through hydro increased by 12.5 folds. While these sources have reached impressive heights, China continues to advance in areas such as waste-to-energy and solar thermal, demonstrating a sustained commitment to diversifying its renewable energy portfolio since 2015. This ongoing progress highlights China's dedication to sustainable energy generation across a range of sources, contributing to a more environmentally responsible energy landscape (CNN, 2023).

Figure 3: Electricity Generation of China by Sources over the Years



Source: Authors' calculation from IEA.

## 5.2 Regulatory Success of China

### Major Policies and Laws Dominating China's Renewable Energy Sector

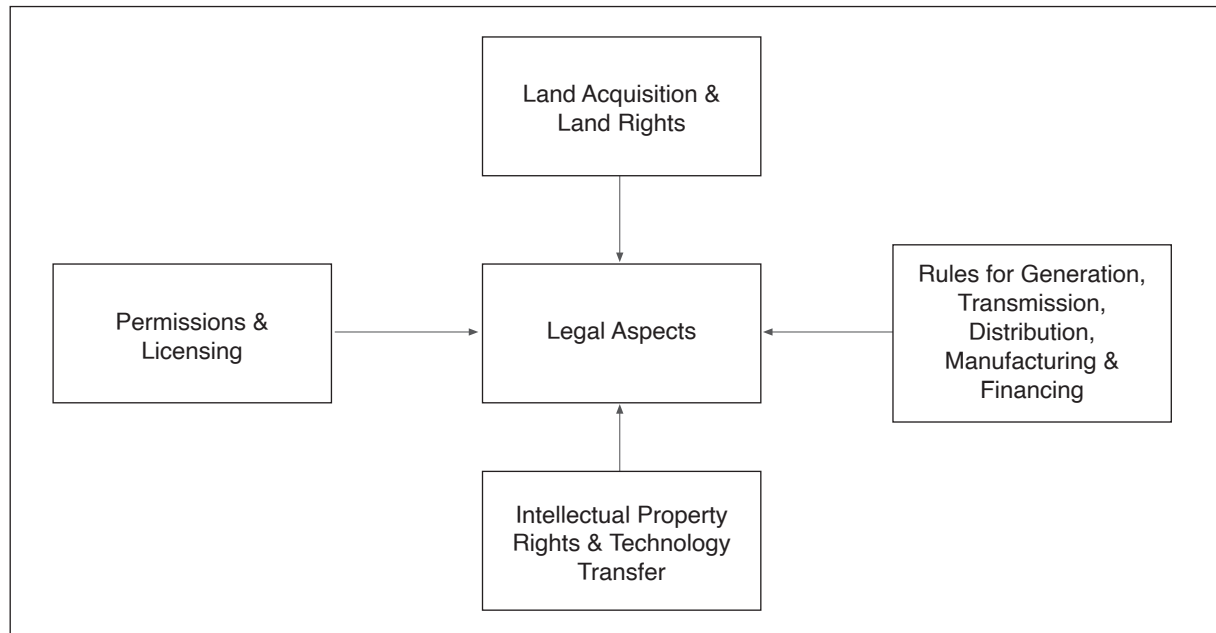
China's renewable energy regulations are comprehensive, with key laws shaping the shift towards cleaner energy sources (Figure 4). Several pivotal legal documents have shaped China's renewable energy sector, starting from the 1990s. These include the Renewable Energy Law, the 14th Five-Year Plan on Renewable Energy Development, China Energy Transition Policies 2020, the National Renewable Energy Development Plan, and the Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality. These policies establish targets, offer

- c) The 14th Renewable Energy Five-Year Plan sets ambitious targets for renewable energy consumption, emphasising China's commitment towards sustainability (CMS, 2020).

### Rules for China's Generation, Transmission, Distribution, Manufacturing, and Financing in Renewable Energy

- d) 'The Electricity Law'<sup>4</sup> governs various aspects of electricity in China, including investment, generation, and supply. It emphasises prior approval for investments and includes provisions that protect the interests of investors, enterprises, and consumers, ensuring a fair and balanced electricity market.

**Figure 4: Legal Aspects of the Renewable Energy in China**



Source: Authors' illustration.

developmental guidance, and highlight renewable energy's crucial role in sustainability goals.

- a) The Renewable Energy Law covers various sources, excluding less efficient practices. It prioritises renewable energy, establishes tech standards, and penalises violations by entities like government bodies and energy suppliers.
- b) Four Supporting policies reinforce the sector, boosting capabilities for large-scale development, especially in hydropower.

<sup>4</sup>The Electricity Law of the People's Republic of China, also known as the Electric Power Law, is a comprehensive legal framework that governs the electric power industry in China. It was adopted at the 17th Meeting of the Standing Committee of the Eighth National People's Congress on December 28, 1995, and entered into force on April 1, 1996. The law covers various aspects of the electric power industry, including construction, production, supply, utilisation, pricing, rural electric power construction, agricultural use of electricity, protection of electric facilities, supervision, inspection, and legal responsibility.



- e) Established in the 1980s when the state monopoly ended, the 'Fair Dispatch Rule'<sup>5</sup> was designed to promote private investment in electricity generation. Its primary objective is to ensure equitable cost recovery for all investors. Provincial governments assign benchmark feed-in tariffs, varying by generation technology, while also regulating transmission and distribution fees and retail electricity prices.
- f) The 'Feed-in Tariff'<sup>6</sup> system guarantees generators a fixed price for their electricity, while consumers retain the right to purchase electricity at regulated retail prices or negotiate lower contract prices, fostering a balanced energy market.
- g) 'Forward Contracts'<sup>7</sup>, permitted since 2002, facilitate agreements between eligible generators and major consumers within the same province, promoting efficient energy transactions.
- h) 'Energy Conservation Law'<sup>8</sup> regulates the manufacture, import, and sale of energy-using products and equipment in China. It establishes mandatory energy efficiency standards for these products and equipment,

with non-compliance subject to fines and penalties.

- i) The government regulates transmission and distribution prices, with approval authority vested in the 'National Development and Reform Commission (NDRC)', ensuring oversight and management of pricing structures within the energy sector.

#### ***Handling Legal Issues Related to Land Acquisition and Land Rights***

- a) The Renewable Energy Scale-Up Programme (CRESP) includes a resettlement plan to minimise the impact on affected communities and land users. Land access is regulated through leases or allocations, with a focus on optimising space for large-scale solar PV installations in desert areas or non-agricultural land.<sup>9</sup>
- b) To foster social acceptance, the Chinese government established the Renewable Energy Investment Fund, encouraging local community participation in projects (Bhandary et al, 2022). This strategy aims for a sustainable, fair transition to renewable energy while managing land use and social concerns.

<sup>5</sup>Prior to the reform, China employed an equal allocation dispatch system with a fair dispatch rule, which was an equal quota rule that ensured roughly equal allocation of power generation quotas to each generator within a province. Dispatching in China currently follows an administratively predetermined fair dispatch rule, where generators produce an allocated energy volume, rather than an economically optimised merit order dispatch, which is common in most market-based systems.

<sup>6</sup>Starting in 2021, China began phasing out feed-in tariffs nationally for most photovoltaic (PV) and onshore wind projects. Feed-in tariffs remain for specific categories such as offshore wind and concentrating solar power, with the tariffs for these categories set and paid for by provincial authorities.

<sup>7</sup>The Bank of China offers foreign exchange forward contracts, which allow the bank to represent its clients in buying or selling currencies at a predetermined price on a future date. The China Financial Futures Exchange (CFFEX) has been actively involved in the development and launch of new futures contracts, such as the 30-year China government bond (CGB) futures contracts and has adjusted fees for various futures contracts.

<sup>8</sup>It constitutes a long-term strategic policy in the nation's economic development, emphasising the importance of energy conservation in the country's overall economic and environmental goals. It also outlines the responsibilities of the department of energy conservation administration under the State Council, in conjunction with other relevant departments, in formulating and revising national standards and industrial standards for energy conservation.

#### ***Permissions and Licensing for Renewable Energy Installations***

The development and operation of utility-scale renewable energy projects in China involve a series of crucial authorisations and permits to ensure regulatory compliance. These essential approvals include:

- a) **Administrative Permit:** As mandated by the Renewable Energy Law of the People's Republic of China, renewable power generation projects must secure an administrative permit from the National Energy Administration (NEA) to initiate project development.
- b) **Feasibility Study and Planning Approval:** The Project Pre-Approval, issued by the

<sup>9</sup>When land is acquired for renewable projects, the government compensates landowners based on land value and potential income loss, while prohibiting new solar projects on cultivated land or forests to protect food supplies (IDB, 2021). For displacements, comprehensive resettlement plans ensure affected individuals and communities are supported. Grievance mechanisms and involvement of local agencies resolve disputes.

- NEA, plays a pivotal role in the project's development, allowing for comprehensive feasibility assessments and planning approval.
- c) **Land Use Permission:** Renewable energy projects need land use permission from the Ministry of Land and Resources, ensuring that land allocation aligns with the project's objectives.
  - d) **Grid Connection Approval:** Approval for connecting renewable energy projects to the grid is typically granted by key entities like the State Grid Corporation of China (SGCC) and the China Southern Power Grid Corporation (CSG), ensuring efficient integration with the electrical grid.

In addition to stringent regulatory requirements, China's renewable energy sector has implemented expedited processes to streamline the permitting and licensing procedures:

- e) **Online Permitting Systems:** Digital platforms facilitate the submission and processing of necessary permits, improving the efficiency of authorisation processes.
- f) **One Stop Service Centers:** These centers serve as centralised hubs for co-ordinating various permits and approvals, simplifying the process for project developers.
- g) **Fast-Track Approvals:** Projects aligned with government priorities receive expedited approvals, reflecting the nation's commitment to advancing renewable energy initiatives. These measures collectively support China's pursuit of a robust and efficient renewable energy sector.

#### ***Handling Intellectual Property Rights and Technology Transfer***

- a) Since the 1990s, China has enhanced its intellectual property rights (IPR) protection, integrating legal reforms. It acquires advanced renewable energy technologies through technology transfer agreements with foreign entities, commercial and governmental. These agreements involve proprietary tech, know-how, and expertise, often a requirement for market access in China.
- b) Engaging in global R&D collaborations like the International Solar Alliance and Belt and Road Initiative facilitates knowledge exchange and joint technology growth (Wagner, 2023).

- c) China has eased restrictions on foreign ownership and control in certain renewable energy sectors, notably in collaborations with German entities. To protect intellectual property, European companies engaging in tech transfer with Chinese partners are advised to use IP licenses, clearly defining rights and documenting transferred technologies. Contracts should include clauses restricting Chinese parties from reverse engineering, strengthening IP rights protection (Wang, 2020).

#### **5.3 Successful Programmes and Measures**

China has implemented a variety of policies and mechanisms to promote renewable energy and sustainability, including:

- a) **Feed-in Tariffs (FiTs):** China has introduced FiT pricing mechanisms for onshore wind, solar PV plants, distributed solar, and offshore wind sectors, with rates varying by resource area.
- b) **Renewable Energy Quotas:** Local governments are incentivised to procure a certain percentage of their energy from renewables, with China targeting renewables to supply 33 per cent of national power consumption by 2025, with a specific emphasis on non-hydro renewables contributing 18 per cent.
- c) **Renewable Energy Auctions:** China has initiated competitive auctions, such as offshore wind projects in Guangdong, with local content requirements playing a role in participation and winner selection.
- d) **Carbon Trading Pilot Programmes:**<sup>10</sup> These programmes, launched in various regions, cover a significant portion of China's CO<sub>2</sub> emissions and have proven effective in reducing carbon emissions in numerous cities.
- e) **Preferential Electricity Pricing:** China has adjusted its electricity pricing model to support all businesses, offering a 5 per cent reduction in industrial and commercial electricity prices until the end of 2023.

<sup>10</sup>China's pilot carbon-trading programmes, launched in seven regions in 2013–2014, cover roughly 7 per cent of China's CO<sub>2</sub> emissions. These market-based policies offer valuable evidence on whether the national carbon-trading programme, which started in 2021, will effectively curb emissions. The pilot programmes have shown improvements in local air quality, likely as a co-benefit of reduced carbon emissions.

- f) **Tax Breaks:** Substantial tax breaks have been introduced to boost demand for green cars, including exempting new energy vehicles from purchase tax, providing a significant incentive for consumers.
- g) **Subsidies for Solar Power Stations:** The Chinese Finance Ministry has allocated substantial subsidies, including those for solar power stations, collected from renewable energy surcharges by the Renewable Energy Law of China.

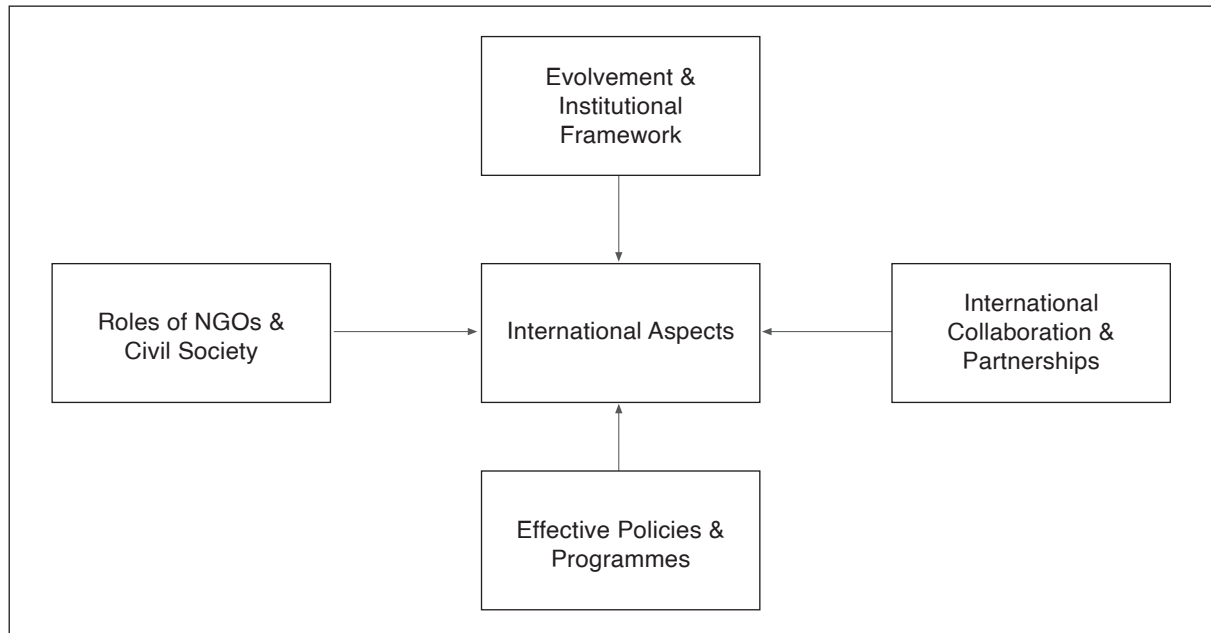
### 5.4 Institutional Success

China's robust renewable energy development is a result of close collaboration among various governmental organisations and institutions, each playing a unique role in shaping the nation's energy landscape (Figure 5). These include:

- a) **National Energy Administration (NEA):** As the central government agency, NEA is responsible for energy planning and policy development, playing a pivotal role in shaping renewable energy strategies.
- b) **State Grid Corporation of China (SGCC):** This state-owned power company is involved in the

- development and transmission of renewable energy, ensuring efficient integration into the national grid.
- c) **China National Renewable Energy Center (CNREC):** The CNREC is a research and development institution specialising in renewable energy technology, policy research, and international cooperation.
- d) **China National Energy Investment Group (CEIC):** A state-owned enterprise, CEIC invests in and operates various energy projects, including renewable energy initiatives.
- e) **China Renewable Energy Engineering Institute (CREEI):** The CREEI conducts research and provides technical support for renewable energy projects, driving innovation and development.
- f) **China Renewable Energy Society (CRES):** CRES is a non-profit academic organisation dedicated to advancing research and development in renewable energy technologies and policies.
- g) **National Development and Reform Commission (NDRC):** The NDRC is responsible for macroeconomic planning and development, co-ordinating major renewable energy projects and investments.

**Figure 5: Institutional Aspects of the Renewable Energy in China**



Source: Authors' illustration.

The Central Bank of China and the Ministry of Science and Technology collaborate closely to ensure strict compliance with these laws, fostering continued growth in China's renewable energy sector. Their joint efforts have significantly contributed to China's leadership in the global renewable energy landscape.

Prominent non-governmental organisations (NGOs) and civil society groups play a vital role in influencing and contributing to China's renewable energy sector. These organisations conduct research and offer insights and recommendations to the government on environmental and energy policies. Their international collaborations, especially with countries like Germany, help them learn and import new renewable energy technologies, boosting China's renewable energy sector. Advocating for sustainable policies and advising the government, these organisations are pivotal in shaping China's renewable energy landscape to align with global sustainability goals. Noteworthy among them are:

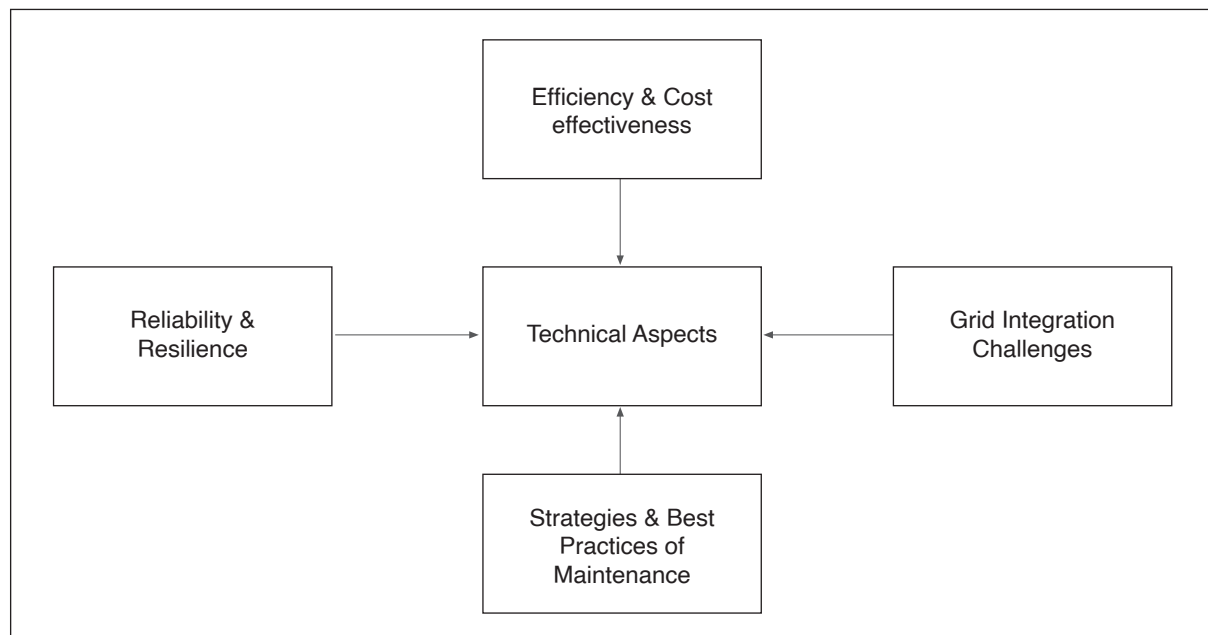
- a) **Friends of Nature:** This organisation actively engages in advocating for legal and policy changes by participating in significant environmental events, thereby promoting sustainable practices in the renewable energy sector.
  - b) **Global Environmental Institute (GEI):** The GEI collaborates with policymakers, businesses, scientists, civil society leaders, and local communities to facilitate dialogue and innovative solutions that protect the environment and enhance economic opportunities in China. Their work contributes to the advancement of sustainable renewable energy practices.
  - c) **Rock Environment and Energy Institute (REEI):** The REEI offers independent policy analysis on various environmental and energy issues in China, including climate change, energy, air pollution, carbon markets, environmental law, and sustainable development. Their research and analysis serve as valuable inputs for shaping renewable energy policies and practices.
- a) **The International Renewable Energy Agency (IRENA)** and China's Ministry of Ecology and Environment (MEE) signed a landmark co-operation agreement in 2021, focusing on accelerating renewable energy development to align with China's climate goals.
  - b) **The International Energy Agency (IEA)** has produced an energy sector roadmap to carbon neutrality in China, emphasising technology challenges and opportunities in the power sector dominated by renewables.
  - c) **China actively participates in the Clean Energy Ministerial (CEM)**, collaborating with other nations to share best practices, technology, and policies for renewable energy development.
  - d) **The Asian Development Bank (ADB)** has made substantial investments in clean energy and renewable energy projects in China, supporting green and inclusive transformations.
  - e) **The World Bank** has played a role in developing renewable energy with battery storage and increasing the supply of renewable energy in China through projects implemented by Hua Xia Bank.
  - f) **The United Nations Environment Programme (UNEP)** has provided policy recommendations to reduce greenhouse gas emissions in China's 14th Five-Year Plan (2021-2025).
  - g) **The International Finance Corporation (IFC)** has invested in solar energy projects, including China's first large-scale, thin-film-based solar project, and supports energy efficiency and renewable energy projects through the China Energy Efficiency Finance Program (CHUEE).

China's commitment to renewable energy has garnered international co-operation and support, exemplified by partnerships and initiatives with key organisations:

## 5.5 Technological Success

The technical aspects of renewable energy in China are crucial for understanding the country's progress in this sector (Figure 6). China could achieve an 80 carbon-free electricity grid by 2035 by tapping into its enormous domestic renewable resources. China's grid was 33 per cent carbon-free in 2020, so hitting 80 per cent clean requires China to build approximately 145 gigawatts (GW) of wind and solar annually this decade. China produces roughly 75 per cent of the global supply of solar panels and batteries and about 60 per cent of key components for wind turbines (Yen, 2022).

**Figure 6: Technical Aspects of the Renewable Energy in China**



Source: Authors' illustration.

**Technological Innovations which Improved the Efficiency and Cost-effectiveness**

Innovative technologies are reshaping the renewable energy landscape in China.

- a) Bifacial solar cells capture sunlight from various angles, boosting energy generation.
- b) Floating solar farms optimise land use, reduce water evaporation, and enhance panel efficiency by utilising water bodies.
- c) Concentrated Solar Power (CSP) systems use mirrors or lenses to generate heat for power production, with high-temperature CSP storing thermal energy for extended power generation.
- d) Low-speed wind turbines placed in China's central region highlight the adaptability of renewable energy solutions to varying wind speeds.

**Facilitating Grid Integration**

Following technologies and strategies drive the evolution of a more resilient and sustainable energy ecosystem.

- a) Smart grid technology is efficiently ending energy supply and demand in real-time, managing energy storage efficiently, and

addressing the intermittency of renewable sources.

- b) Energy storage solutions store surplus energy for peak demand times and combat curtailment issues, where renewables shut down due to low demand or grid capacity.
- c) China's policies focus on improving grid infrastructure, expanding transmission, and utilising energy storage to tackle curtailment.
- d) Emerging solutions like Virtual Power Plants (VPPs) aggregate distributed resources to provide grid services, maintaining equilibrium despite fluctuations.
- e) Market mechanisms, like ancillary services markets, allow grid operators to stabilise the grid amid variable renewable energy generation by purchasing services like frequency regulation.

**Enhancement of the Reliability and Resilience of Renewable Energy Systems**

China employs various strategies and technologies to bolster the reliability of its renewable energy infrastructure in the face of extreme weather and natural disasters. Collectively, these strategies and technologies fortify China's renewable energy infrastructure, ensuring reliability despite challenging conditions.

- a) Advanced weather forecasting, utilising technologies like supercomputers and remote sensing, enables operators to predict and prepare for extreme events.
- b) Microgrids ensure continuous power to critical infrastructure during emergencies by disconnecting from the main grid.
- c) Grid hardening involves strengthening infrastructure, such as burying power lines underground, to withstand severe conditions.
- d) Hybrid renewable systems, like solar-wind or wind-hydro combinations, enhance reliability and efficiency by utilising multiple energy sources.
- e) Geothermal-biomass systems combine stable geothermal energy with biomass for added support.
- f) Demand response programmes, like SGCC's 'Demand Response for Peak Shaving', incentivise reduced consumption during peak hours.
- g) checking electrical connections, especially crucial in remote or harsh environments.
- b) Predictive maintenance, using techniques like condition monitoring and data analytics, identifies potential failures before they occur (Yen, 2022).
- c) Asset management tracks performance, schedules maintenance, and ensures compliance with safety and environmental regulations.
- d) Regional warehouses for spare parts facilitate swift repairs.
- e) Upgrades and retrofits keep systems current and aid grid stability amid growing renewable capacity. For instance, retrofitting wind farms with remote-controlled turbine pitch systems optimise energy capture and complies with safety and environmental standards (IEA, 2019).
- f) The adoption of digital twin technology creates virtual replicas of assets, offering real-time insights for proactive maintenance.
- g) Artificial intelligence and machine learning analyse these twins, predicting potential failures and enhancing long-term planning.

**Strategies and Best Practices related to the Maintenance and Operation of Renewable Energy Installations**

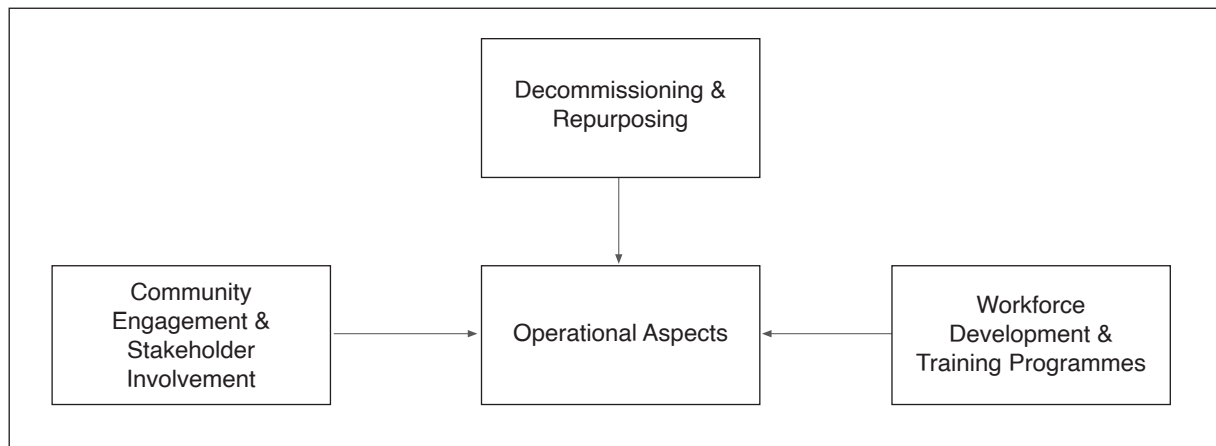
China employs diverse strategies to maintain and operate its renewable energy installations effectively. The following multifaceted approaches collectively bolster China's renewable energy infrastructure maintenance and operations.

- a) Regular maintenance involves cleaning solar panels, lubricating wind turbine parts, and

**5.6 Operational Success**

While operating the renewable energy power plants, China overviews the pre-project and post-project aspects as well (Figure 7). In the pre-project phase, they ensure community engagement and workforce development, and in the post-project phase, decommission the installations.

**Figure 7: Operational Aspects of the Renewable Energy in China**



Source: Authors' illustration.

### ***Decommissioning and Repurposing of Renewable Energy Installations at the End of Their Operational Life***

- a) China has proactively addressed the environmental impact of retiring solar panels and wind turbines by establishing a robust recycling system. Collaborating with five state agencies, the National Development and Reform Commission (NDRC) has issued guidelines to accelerate recycling efforts in these industries.<sup>11</sup>
- b) Technical standards and policies for wind and solar sectors aim to create dedicated industry clusters nationwide by 2030. China aims to achieve a 'basically mature' full-process recycling system for wind turbines and solar panels by the end of the decade, recognising the wear and tear of photovoltaic panels, often retired after around 25 years, in many Chinese projects, prompting active recycling efforts (Xue, 2023).

### ***Workforce Development and Training Programmes***

- a) China's renewable energy sector has become a significant employer, with 5.4 million workers in 2021, accounting for 0.7 of the nation's workforce.
- b) Top academic institutions like Tsinghua University and Shanghai Jiao Tong University offer specialised Bachelor's and Master's programmes in Renewable Engineering to prepare students for industry roles.
- c) The China National Renewable Energy Center (CNREC), State Grid Corporation of China (SGCC), and the National Energy Administration (NEA) conduct training sessions and programmes, emphasising skill development through the Green Energy Talent Program (ILO, 2022).
- d) Industry leaders like Goldwind and LONGi operate training centers in wind turbine maintenance and solar technology.
- e) Certification programs by entities like the China Wind Energy Association (CWEA) and China National Institute of Standardization (CNIS) ensure professionals meet industry standards,

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<sup>11</sup>NDRC encourages equipment producers to offer recycling services or partner with third-party providers and metal recycling companies to mitigate environmental repercussions.

contributing to the sector's professionalism and growth (Meredith, 2023).

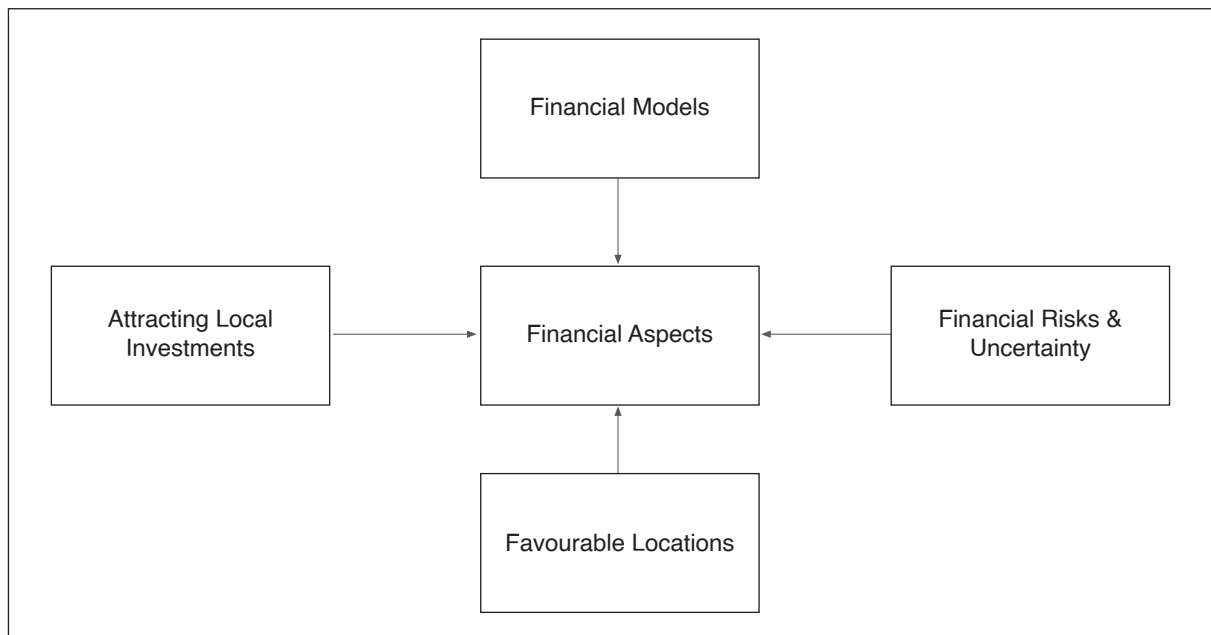
### ***Community Engagement and Stakeholder Involvement in the Planning and Operation***

In China's renewable energy projects, successful engagements have been pivotal in building trust and fostering positive relationships between developers, local communities, and stakeholders.

- a) The Longyuan Rudong Offshore Wind Farm engaged local fishermen, offering compensation and support to address concerns about the project's impact on fishing activities. They involved communities in environmental monitoring, creating a sense of ownership.
- b) The Huaneng Rudong Offshore Wind Farm established a 'Wind Energy University', providing training and jobs for locals while supporting education, healthcare, and infrastructure.
- c) The Pingluo Solar Power Plant formed a management committee with local representatives to oversee operations and address community concerns. Similarly, the China Guangdong Nuclear Power Group engaged communities through consultations, shared benefits, and invested in local development.
- d) The Yuhuan Offshore Wind Farm collaborated with fishing communities to minimise disruptions, addressing safety concerns and offering compensation. These engagements highlight how inclusive practices foster harmonious relationships between renewable projects and affected communities and stakeholders.

## **5.7 Financial Success**

China has become a global leader in renewable energy investment, marked by substantial government resources dedicated to technology advancement and implementation. This commitment involves economic incentives, subsidies, and financial support for research and development (Figure 8). Incentive structures like feed-in tariffs ensure fixed prices for renewable energy producers, attracting investors, especially in wind, solar, and biomass energy (Nakanno & Kennedy, 2021).

**Figure 8: Financial Aspects of the Renewable Energy in China**

Source: Authors' illustration.

### **Financial Models**

- a) China has emerged as a leader in utilising Public-Private Partnerships (PPPs) for infrastructure, led by the China Public Private Partnerships Centre (CPPPC). The country's Renewable Energy Law guides PPPs in the renewable sector, often following the Build-Operate-Own-Transfer (BOOT) framework. Private entities fund and manage projects, transferring ownership to the public sector after a set period, leveraging governmental support, land allocations, and enduring power purchase agreements (PPAs) (Wang & Nisar, 2017).
- b) China's financial landscape involves Policy Banks, providing substantial loans for infrastructure and overseas investments. The National Development Bank of China (NDB) issued green financial bonds in 2016, aligning with the People's Bank of China's green guidelines (Bloomberg, 2022).
- c) Institutions like the New Development Bank (NDB) and Export-Import Bank support power generation capacity projects abroad, focusing on Belt and Road Initiative (BRI) nations. The China Development Bank (CDB) supports BRI countries' renewable energy projects with significant loans, mainly medium- and long-

term foreign exchange project loans. This robust financial ecosystem underpins China's strides in renewable energy and infrastructure development.

### **Addressing the Issues of Financial Risks and Uncertainties**

- a) In China's dynamic renewable energy landscape, key financial mechanisms like Long-Term Power Purchase Agreements (PPAs) ensure stable revenue streams and mitigate market price volatility risks, fostering investment in projects.<sup>12</sup>
- b) Risk insurance and guarantees, requiring successful project track records and self-financing, are vital for loan approval, bolstering sector stability (Gordon, 2008).
- c) China's 2022 reforms aim to establish a national electricity market by 2025, enhancing resource allocation and power generation efficiency.
- d) The creation of spot markets and inter-provincial trade aligns with the Renewable Energy Law's dispatch quotas, furthering

<sup>12</sup>For instance, Air Liquide's PPA with China Three Gorges Renewables demonstrates this success in Jiangsu province (Dent, 2015).



China's national priorities (Chen, 2017). These financial strategies fortify the stability and growth of China's renewable energy sector.

- e) Green finance<sup>13</sup> catalyses renewable energy development, both directly and indirectly, by driving research and development efforts and reinforcing market mechanisms. The China Banking and Insurance Regulatory Commission (CBIRC) has identified key sectors for green credits, including green transportation, emerging industries, renewable energy, and industrial energy savings.
- f) Additionally, the China Green Bond Endorsed Project Catalogue offers guidance on eligible projects for green bond financing, further contributing to the growth and sustainability of China's renewable energy sector (Larsen, 2020).
- g) The Chinese government employs various fiscal incentives to boost local investments in renewable energy. Subsidies, like cash grants and tax credits, totaled 3.87 billion yuan (USD 607.26 million) in 2022, benefiting wind farms, solar power stations, and biomass generators (Wu, 2022).
- h) Tax-related benefits, including Corporate Income Tax Law provisions, offer advantages to enterprises engaged in infrastructure development, such as renewable energy projects. Immediate VAT rebates and 10 per cent tax credits further incentivise investment in specific environmental, energy, and safety equipment (Wang & Ziyang, 2023).
- i) Pricing incentives, like grid-parity rates for hydro, wind, and solar power, encourage investment. Special funds like the China Clean Development Mechanism Fund (CCDMF) and the National Green Development Fund receive government levies and stakeholder contributions, contributing to the sector's growth (Zhao et al, 2022).

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<sup>13</sup>Green finance refers to the financing of investments that provide environmental benefits in the broader context of environmentally sustainable development. It is a set of financial regulations, standards, norms, and products that pursue an environmental objective. Green financing can be promoted through changes in countries' regulatory frameworks, harmonising public financial incentives, increases in green financing from different sectors, alignment of public sector financing decision-making with the environmental dimension of the Sustainable Development Goals, increases in investment in clean and green technologies, financing for sustainable natural resource-based green economies and climate smart blue economy, and increasing the use of green bonds.

## 6. Way Forward

### 6.1 Navigating Challenges Confronted by Chinese Investors

Chinese investors confronted different types of challenges in Bangladesh while implementing their infrastructure projects. The challenges are more complex in the case of investment in the renewable energy sector. According to the Chinese investors invested in Bangladesh, broadly six types of challenges are experienced by Chinese investors in the case of investing in the renewable energy sector. These include – (a) infrastructure deficits, (b) financing challenges, (c) administrative difficulties, (d) legal intricacies, (e) human resource deficiencies, and (f) technological weaknesses and quality assurance concerns.

#### Geographical Challenges

The most common complaints of the Chinese investors are about geographical ones e.g., acquisition of land, land quality, flood from the upstream, etc. Because of the lack of low-cost suitable land, the project cost increased substantially which even made the projects unviable. To optimise land utilisation, the Department of Land aims to refine land use policies, particularly by offering incentives to reduce land costs for renewable energy projects. Implementing soil conservation strategies like riparian buffers, conservation tillage, and cover crops is crucial for preserving soil quality and curbing erosion. Additionally, focusing on the efficient use of arid land in the southeastern region is a priority. Managing riverbanks through strategic vegetation and rock bed arrangements also stands as a key initiative in sustainable land management practices.

#### Financing Challenges

The decline in foreign reserves coupled with currency depreciation poses challenges. The bank guarantee structure following the Letter of Intent (LOI) complicates matters for international banks, deterring their investment. Additionally, the inflexibility surrounding key clauses in Power Purchase Agreements (PPA) and Implementation Agreements (IA) hampers project financing closure, creating hurdles in attracting consistent investments as projects progress. The irregularity

in investment, particularly in the latter stages of projects, emerges as a concern. Moreover, delayed bill payments by the Bangladesh Power Development Board (BPDB) exacerbate these issues, contributing to a complex investment environment. Adjusting the bank guarantee framework post LOI to ease international banks' concerns may enhance investment prospects. Flexibility in negotiating certain clauses within PPAs and IAs while maintaining essential terms can streamline project financing. Instituting measures for timely bill payments by BPDB is crucial to instill investor confidence and ensure smoother project operations. Collaboration between stakeholders, regulatory adjustments, and improved financial practices can collectively mitigate these challenges.

### Administrative Challenges

The prolonged development period stems from the inefficiency in government approvals, significantly impeding progress. The absence of clear policies governing the renewable energy market further exacerbates the situation, hindering its growth and impeding the implementation of sustainable energy solutions. Rectifying these issues necessitates streamlining the approval processes, ensuring they are more efficient and timelier. Simultaneously, establishing comprehensive policies that incentivise and support the renewable energy market will be pivotal in fostering its development and encouraging investment in renewable energy initiatives. Passing the Renewable Energy Policy of 2022 legislatively can enhance the situation.

### Legal Challenges

Addressing the challenges posed by a weak legal system requires a strategic approach. Implementing targeted laws concerning power generation, transmission, distribution, and financial frameworks is essential to strengthen the legal foundation within the energy sector. Simultaneously, the absence of short and medium-term policies necessitates the development of a comprehensive roadmap. This roadmap should outline clear, achievable milestones to progress toward overarching long-term goals, thereby providing a structured approach to accomplish individual objectives within defined timeframes.

### Manpower Challenges

The challenge of insufficient professional talent and an underdeveloped industrial chain can be addressed through strategic recommendations. Collaborative efforts between academia and industry are essential to bridge the gap. Establishing partnerships that integrate academic programmes with industry needs will cultivate the skills and expertise required for the energy sector. Simultaneously, tackling the issue of inadequate local employment opportunities involves providing targeted training initiatives. These programmes should encompass a broad spectrum, including manufacturing technologies, engineering construction, and project operations, empowering local individuals to actively engage in and contribute to energy projects while enhancing their employability within the sector.

### Technological Challenges

The technological challenges encompass several key areas. Firstly, addressing power storage limitations by focusing on technology imports and transfers, particularly for Lithium-ion batteries, could significantly enhance storage capacities. Secondly, the absence of small to medium-sized grids needs attention; their establishment would diversify energy distribution and cater to localised needs more efficiently. Additionally, ensuring grid stability remains crucial, requiring ongoing improvements and investments in infrastructure and technology. Lastly, creating a local grid market could invigorate the energy sector, fostering economic growth and enhancing energy accessibility within the region. Each challenge presents an opportunity for strategic development and advancement in the energy landscape.

## 6.2 Measures to Attract Chinese Overseas Investment in the Renewable Energy Sector of Bangladesh

To foster a more conducive environment for renewable energy development, Bangladesh should consider implementing a series of recommendations modeled after China's successful practices.

- a) Adoption of a variety of financial models, such as Public-Private Partnerships, Build-Operate-

Own-Transfer, and access to loans from Policy Banks or the National Development Bank, can stimulate investment in the sector. Introducing similar models in Bangladesh, like BOOT and Policy Banks, could attract much-needed financing for renewable energy projects.

- b) Establishing comprehensive risk mitigation measures for investors is crucial. Bangladesh should learn from China's approach, which provides assurance to investors through Long-Term Power Purchase Agreements, Risk Insurance, Guarantees, Market Stabilisation Measures, and Green Finance Risk Control Mechanisms. This would instill confidence and attract more investment in the sector.
- c) Addressing the complex structure of Power Purchase Agreements (PPA) and Implementation Agreements (IA) in Bangladesh is essential to encourage investment. Emulating China's flexibility in customising PPAs based on demand and plant capacity can simplify the process and make it more investor-friendly.
- d) Prompt bill payment is imperative to maintain investor confidence. Bangladesh should consider adopting a policy like China's, where delays in bill payment are regarded as punishable offenses, thus ensuring timely payments and financial stability.
- e) To further stimulate investment, Bangladesh should actively disburse green finance, as allocated by Bangladesh Bank, for renewable energy projects. Similarly, introducing renewable energy quotas for power companies, tax breaks for newly built renewable energy plants, and subsidies for electric vehicles can provide additional incentives for renewable energy development.
- f) Implementing competitive renewable energy auctions, like those in China, where consumers can access the cheapest source of renewable energy, can help drive down costs and make renewable energy more accessible to the public. Bangladesh should explore such initiatives to accelerate the growth of the renewable energy sector.

### **6.3 Drawing Chinese Lessons for Bangladesh**

The renewable energy sector has a lot of shortcomings compared to China when it comes to attracting FDI. Based on the Chinese

experience, these challenges can be mitigated. The challenges and lessons are classified according to the aspects on which the Chinese lessons were stratified. They are:

#### **Policy-related Lessons**

It is highly recommended that Bangladesh takes a proactive approach to periodically review and update its renewable energy policy, like China's exemplary practices. China's commitment to revising and amending its policy framework as necessary, even at the provincial level, demonstrates a commitment to staying current and addressing evolving needs. Furthermore, engaging in consultations with international organisations, donors, and civil society, as China has done, can help identify and rectify gaps and weaknesses in the existing renewable energy policy, promoting its robust development. A key area for improvement is the establishment of specific policies for various renewable energy technologies, such as solar, wind, and geothermal, akin to China's approach. Bangladesh should consider diversifying its RE policies beyond the Solar Roadmap to fully harness the potential of these technologies, ensuring a more comprehensive and sustainable approach to renewable energy utilisation.

#### **National and International Target on Carbon Emission and Power and Energy Sector-related Lessons**

Considering China's commendable practices, Bangladesh can establish and formalise clear, medium to long-term targets for its environmental initiatives. China has set multiple targets across various guidelines such as the Working Guidance for Carbon Dioxide Peaking and the '1+N' framework, which have proven instrumental in shaping the nation's sustainable development path. Bangladesh should consider adopting similar comprehensive guidelines beyond its existing Nationally Determined Contributions (NDC) and incorporate specific medium-term goals to enhance its environmental commitment. Furthermore, Bangladesh can take inspiration from China's innovative financing approaches, such as its Carbon Trading Market and soft loans, which have proven effective in funding sustainability initiatives. To promote a more robust environmental agenda, Bangladesh

should explore alternative financing mechanisms, moving beyond the limited financing provided by the Clean Development Mechanism (CDM) of the Kyoto Protocol. By diversifying its financing strategies, Bangladesh can unlock new opportunities for achieving its environmental and climate objectives.

### Law and Rules-related Lessons

To advance its energy sector and foster sustainable development, Bangladesh should consider taking valuable lessons from China's proactive approach. China's practice of periodically amending its Electricity Law, alongside the existence of distinct laws for power generation, transmission, and distribution systems, provides a robust framework that Bangladesh could learn from and adapt to its specific needs. It is highly recommended that Bangladesh updates its Electricity Law, which dates to 2008, to align with contemporary requirements and challenges.

Furthermore, Bangladesh can benefit greatly from introducing and enforcing key regulations and laws like the Fair Dispatch Rule, Feed-in Tariff, Forward Contracts, and the Energy Conservation Law, as observed in China. These measures are pivotal in creating a conducive environment for the energy sector's growth and regulation. It is essential to consider the introduction of these guidelines, as they are currently absent in Bangladesh's legal framework.

Additionally, addressing intellectual property rights (IPR) is critical for fostering innovation and technological progress in the energy sector. China's stringent IPR laws, in place since the 1990s, have been instrumental in promoting innovation and protecting intellectual property. Bangladesh should consider implementing relevant IPR laws to encourage research and development in the energy sector, ultimately advancing the country's technological capabilities and energy sustainability.

### Operational Lessons

Bangladesh can greatly benefit from adopting several key recommendations drawn from China's successful practices in the renewable energy sector. Firstly, streamlining and digitalising the licensing and registration processes in

Bangladesh is essential to reduce administrative delays and encourage investment. Simplifying these procedures can attract more investors and expedite project implementation.

Secondly, addressing the high costs of land and bureaucratic obstacles is crucial for maintaining the momentum of renewable energy financing in Bangladesh. Emulating China's methods, including Long-Term Power Purchase Agreements, Risk Insurance, and Guarantees, Market Stabilisation Measures, and Green Finance Risk Control Mechanisms, can help ensure a smoother and more efficient financing process.

Thirdly, Bangladesh should explore opportunities to make use of its alluvial land for renewable energy projects, as China has done with arid land. This will open new avenues for investment and project development.

Moreover, investing in training and education to create a skilled and capable workforce is essential. Bangladesh can learn from China's approach, where universities, renewable energy companies, and agencies offer comprehensive training programmes to enhance human resources in the renewable energy sector. Expanding the training initiatives, like what SREDA has initiated, can boost expertise and efficiency in Bangladesh's RE workforce.

Lastly, considering the introduction of a Full-process Recycling System for decommissioning RE project equipment, as China has done, will contribute to environmentally responsible practices in Bangladesh's renewable energy projects, ensuring a sustainable and eco-friendly approach.

### Technological Lessons

Bangladesh should focus on investing and researching extensively in critical areas such as energy storage, grid stability, grid integration, and the development of small to medium-scale grids, following China's proactive approach. These facets are integral for a well-rounded and sustainable energy system and addressing them is essential for the country's energy future. While commendable efforts by the Sustainable and Renewable Energy Development Authority (SREDA) to import storage technology are

underway, it is imperative to expand these initiatives and foster a holistic approach to energy development, ultimately ensuring reliability and efficiency in Bangladesh's energy landscape.

### **Institutional Lessons**

To enhance the effectiveness and co-ordination of renewable energy development in Bangladesh, several key recommendations can be drawn from China's successful approach. Firstly, Bangladesh should consider establishing multiple agencies with distinct roles, similar to China's NEA for planning and CREI for research. Expanding the capacity beyond SREDA will help ensure more comprehensive coverage and efficient functioning of the renewable energy sector.

Secondly, addressing the issue of decision-making capacity within SREDA is crucial for driving progress. Bangladesh should explore models like those in China, where agencies such as NEA and CNREC collaborate seamlessly without overlaps, ensuring smoother decision-making processes and faster implementation.

Moreover, improving inter-ministry co-ordination is imperative to avoid potential conflicts and bottlenecks in policy implementation. Bangladesh can take cues from China's practice, where relevant ministries offer suggestions when

policies are reformed or amended. Encouraging collaborative efforts among various ministries, such as Land and MoPEMR, will foster a more harmonious and efficient approach to renewable energy development.

### **Manufacturing Lessons**

To create a more attractive investment environment for renewable energy in Bangladesh, it is recommended that the country addresses key challenges and learns from China's successful practices. While Bangladesh's FDI criteria are relatively lenient, the bureaucratic hurdles must be minimised to encourage and facilitate foreign investors. China's digitised approach has proven effective in eliminating bureaucratic obstacles and ensuring a smoother FDI inflow, providing a valuable model for Bangladesh to consider.

Furthermore, Bangladesh should focus on research and technological development to position itself as a potential market for renewable energy investment and manufacturing in the sector. China's relentless efforts in this regard have made it the largest renewable energy market globally. By emulating China's commitment to research and technology advancement, Bangladesh can establish itself as an attractive destination for renewable energy investments and a thriving hub for renewable energy manufacturing industries.

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## ANNEX

**Annex Table 1: Countries with Chinese FDI in renewable energy projects**

Country/Area	Sub-technology	Amount (2020 USD million)
Argentina	Multiple renewables	208.8
	On-grid Solar photovoltaic	339.8
	Renewable hydropower	2470.1
	<b>Total</b>	<b>3018.7</b>
Belarus	Renewable hydropower	206.9
Benin	Renewable hydropower	554.4
Bolivia	Renewable hydropower	1050.8
Brazil	Onshore wind energy	60.2
Bulgaria	On-grid Solar photovoltaic	271.6
Cambodia	Renewable hydropower	410.4
Cameroon	Renewable hydropower	565.3
Central African Republic	Renewable hydropower	32.8
Chile	On-grid Solar photovoltaic	939.7
Congo	Renewable hydropower	114.8
Côte d'Ivoire	Renewable hydropower	773.5
	On-grid Solar photovoltaic	61.5
	Solid biofuels	60.5
<b>Total</b>	<b>121.9</b>	
Congo	Renewable hydropower	1116.8
Ecuador	Onshore wind energy	41.1
	Renewable hydropower	1166.8
	<b>Total</b>	<b>1207.9</b>
Eritrea	Renewable hydropower	98.8
Ethiopia	Onshore wind energy	624.9
	Renewable hydropower	712.8
	<b>Total</b>	<b>1337.7</b>
Guinea	Renewable hydropower	2317.9
Kenya	Geothermal energy	403.2
	On-grid Solar photovoltaic	139.1
	<b>Total</b>	<b>542.3</b>
Lao	Renewable hydropower	5567.9
Lesotho	On-grid Solar photovoltaic	70.8
Mali	Renewable hydropower	511.2
Nepal	Renewable hydropower	289.8
Nigeria	Renewable hydropower	7025.4
Pakistan	Onshore wind energy	481.6
	Renewable hydropower	3722.6
	<b>Total</b>	<b>4204.3</b>

(Annex Table 1 contd.)

*(Annex Table 1 contd.)*

<b>Country/Area</b>	<b>Sub-technology</b>	<b>Amount (2020 USD million)</b>
Peru	Renewable hydropower	374.2
Romania	On-grid Solar photovoltaic	82.7
Rwanda	Renewable hydropower	216.4
South Sudan	Renewable hydropower	26.9
Sri Lanka	Renewable hydropower	366.9
Uganda	Renewable hydropower	1915.8
Uzbekistan	Renewable hydropower	208.7
Zambia	Renewable hydropower	1713.5
Zimbabwe	Renewable hydropower	318.8
<b>Grand Total</b>		<b>37,636.2</b>

Source: IRENA.



The study offers a comprehensive exploration into the dynamics of attracting Chinese investments into Bangladesh's burgeoning renewable energy market. It delves into the existing renewable energy landscape, pinpoints the multifaceted challenges impeding Chinese investments, and extracts actionable insights from China's successful renewable energy initiatives. The authors propose a meticulously crafted set of policy recommendations designed to navigate and surmount these hurdles, ultimately aiming to harness Chinese expertise and financial influx to accelerate Bangladesh's renewable energy growth and fulfill its ambitious energy objectives.



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