Renewable Energy Financing in Bangladesh: Alignment with the National Policies

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Renewable Energy Financing in Bangladesh: Alignment with the National Policies

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Forewords

As part of the ongoing dissemination of BIBM research outputs, the present research paper contains the findings of the research workshop titled "Renewable Energy Financing in Bangladesh: Alignment with the National Policies."

The research paper was motivated to examine national policies on Renewable Energy and energy security in Bangladesh. The paper discussed the policy framework for renewable energy financing and investment and their enforcement status in Bangladesh. Moreover, the study also addressed on the challenges and gaps of renewable energy financing in the country to align with the national policy targets.

To develop and carry out strategic goals for financing renewable energy in the nation, the Bangladesh Bank, Sustainable and Renewable Energy Development Authority, and other pertinent public, private, and international organizations must effectively coordinate. Identifying a clear goal and maintaining uniformity in the policy document are crucial in this situation. In order to handle seamless financing while reducing risks, it is also important to develop new products and investigate markets for renewable energy.

It gives me immense pleasure to publish and distribute this research output to the practitioners of the banks as well as to the academics and common readers. I hope this research paper will be a useful guide, especially for the bank employees working in the concerned departments.

Dr. Md. Ezazul Islam
Director General
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Executive Summary

Renewable energy is crucial for ensuring energy security around the world. Policymakers are giving priority to renewable energy sources due to their environmental benefits and sustainability. Besides, they are supporting energy transmission technologies due to the growing awareness of energy security and climate risks associated with heavy dependence on fossil fuels. Regardless of the policy initiatives, inadequate investment and financing can impede or delay progress toward a sustainable energy transition.

Developing economies face additional challenges such as inadequate infrastructure and high capital costs. Moreover, the limited availability of commercial financing instruments and doubts about financial viability discourage investment. Therefore, innovative financing solutions and supportive policy frameworks are essential to overcome these barriers and achieve renewable energy goals.

Aligned with the development in several developing economies, Bangladesh has taken several initiatives to promote renewable energy through different policy frameworks. The process started with the National Energy Policy 1996. Subsequently, it was further strengthened through the National Energy Policy 2004 and the Renewable Energy Policy 2008. These policies initially set targets of 5% renewable energy share by 2010 and 10% by 2020. Later, under the Mujib Climate Prosperity Plan, the government aimed to increase renewable energy to 30% by 2030 and 40% by 2041. Additionally, the Sustainable and Renewable Energy Development Authority (SREDA), the Power System Master Plan (PSMP) set an objective for renewable energy production. Bangladesh's Nationally Determined Contribution (NDC) to the Paris Climate Agreement also supports renewable energy expansion.

Despite these initiatives, financing and investment challenges remain major barriers to renewable energy development. The country faces difficulties in mobilising sufficient capital due to high upfront costs, limited financial instruments, and restricted access to international funding. There is also a need to further strengthen policy, regulatory, and incentive frameworks to encourage investment. The Bangladesh Bank has promoted renewable energy financing through banks and non-bank financial institutions under green and sustainable finance initiatives. Bangladesh Bank may think of fixing specific financing targets for banks and

finance companies in the renewable energy financing segment, in line with national targets.
However, significant financing gaps remain to attain the policy targets regarding the renewable energy production and the energy mix. Therefore, stronger policy support and improved incentive mechanisms are essential to accelerate renewable energy financing and help achieve national energy targets.

Effective coordination among the Bangladesh Bank, Sustainable and Renewable Energy Development Authority, and other relevant government, private, and international agencies is essential to formulate and implement strategic goals for renewable energy financing in the country. In this context, it is important to identify a single target and consistency in the policy document. Additionally, it is high time to innovate new products and explore markets for renewable energy to address smooth financing while mitigating risks.

The country needs to invest more resources in outreach, demonstrations, and training to reduce the knowledge gap about renewable energy potential and resources. In addition, supply-side institutions such as banks and finance companies need proper motivation and incentives to enhance their participation and achieve better outcomes.

Renewable Energy Financing in Bangladesh: Alignment with the National Policies

1. Introduction

'Renewable Energy' became crucial in ensuring energy security- a key concern to policymakers in all global economies. Global financing and investments are getting impetus for energy transition technologies, where renewable energy has been one of the key elements. The changing trend demonstrates a growing recognition of the energy security risks and climate risks associated with considerable dependence on fossil fuels. Renewable energy sources such as solar, wind, hydro, and geothermal are increasingly getting policy priority mainly on their attributes of sustainability, stability of supply, resilience, and environmental benefits. Several renewable energy sources can be harnessed locally, reducing dependence on imported fossil fuels and ensuring supply stability. Decentralizing renewable energy systems might enhance resilience by allowing local communities to generate and manage their energy needs. These are inherently sustainable, as they rely on natural processes, and transitioning to renewable energy reduces greenhouse gas emissions and pollution, contributing to climate stability. Aligning with the development, policymakers in developed and developing countries have identified targets for renewable energy production. However, these policy targets for renewable energy production are often delayed or hindered by inadequate investment and financing, which can impede the transition to a sustainable energy future. As a whole, the existing investment and financing trends for energy transition significantly fall short of global associated targets.[1]

In several instances, ambitious targets have been set for renewable energy production by government agencies or the associated organizations. However, achieving these targets requires significant financial resources and investments, which are frequently lacking due to perceived risks with emerging and innovative

[1] The current pace of investment is not sufficient; annual investments need to at least quadruple. Keeping the world on track to achieving the energy transition in line with the 1.5°C Scenario laid out in IRENA's World energy transitions outlook 2022 would require annual investments of USD 5.7 trillion on average between 2021 and 2030, and USD trillion 3.7 between 2031 and 2050 (IRENA, 2022). Achieving an energy transition in line with the 1.5°C Scenario requires the redirection of USD 0.7 trillion per year from fossil fuels to energy-transition-related technologies (IEA, 2022). Over the six years following the Paris Climate Agreement, some large multi-national banks maintained and even increased their investments in fossil fuels at an average of about USD 750 billion dollars per year (Environmental Finance, 2022). The world's 60 largest commercial banks invested around USD 4.6 trillion in fossil fuels between 2015 and 2021, more than one-quarter of which came from US banks (Environmental Finance, 2022).

technologies and a lack of supportive financial mechanisms (IRENA, 2021). Insufficient infrastructure and involvement of high capital costs are particularly challenging for most of the developing economies (World Bank, 2020). Commercial financing instruments are not always available, and in many instances, supply sources are not adequately convinced regarding their financial viability. Additionally, uncertainties surrounding policy frameworks and regulatory environments are not always supportive of the financing challenges (OECD, 2018). Addressing these barriers through innovative financing solutions is essential for unlocking the necessary investments to meet renewable energy targets and combat climate change effectively.

Aligned with the development in several developing economies, Bangladesh has made strides in promoting renewable energy through various policy initiatives starting mainly from 1990s when the first National Energy Policy (1996) was formulated, and then the policy targets on renewable energy production found place in the National Energy Policy 2004, and Renewable Energy Policy 2008 (5% of RE shares by 2010, and 10% shares by 2020). Then, based on the Mujib Climate Prosperity Plan, the Ministry of Environment, Forest, and Climate Change of Bangladesh decided to expand RE targets to reach 30% by 2030, and to 40% by 2041. Policy documents of the Sustainable and Renewable Energy Development Authority (SREDA), the Power System Master Plan (PSMP), and Bangladesh's Nationally Determined Contribution (NDC) to the Paris Climate Agreement set an objective for renewable energy production (WB, 2019). Not different from most of the developing and emerging economies, financing and investment challenges remain among the significant barriers to the progress and development of renewable energy production. The country has been facing difficulties in mobilizing the necessary resources and capital to meet high upfront costs, inadequate financial instruments, and limited access to international funding (Youth Policy Forum, 2024). Moreover, there is an apparent scope for further strengthening of policy, regulatory, and incentive framework for promoting investments and financing of the renewable energy sector. Bangladesh Bank, the central bank of the country, has been active in promoting renewable energy financing as part of green and sustainable financing activities through mainly banks and non-bank financial institutions. The policy-driven approach has come up with positive outcomes in several instances, and there are visible cases of success stories of renewable energy financing in the country. Despite policy and market initiatives for renewable energy financing, there are visible financing and investment gaps on the way to attain the policy targets regarding the renewable energy production and the energy mix. Addressing the challenges and creating the right kind of incentives might be a

remarkable positive force for the expansion of renewable energy financing in the country.

On the above background, the specific objectives of the study are: ***one***, to examine national policies on Renewable Energy and energy security in Bangladesh; ***two***, to discuss the policy framework for renewable energy financing and investment and their enforcement status in Bangladesh; and ***three***, to examine the challenges and gaps of renewable energy financing in the country to align with the national policy targets.

The research workshop paper is based on both primary and secondary information. Renewable energy financing by the banks received the main attention of the data analysis. Published international and national level studies, publications, and reports by the government agencies, and BB information are the key secondary sources.

Primary data were collected through a questionnaire survey, Key Informant Interviews (KII), and Focused Group Discussions (FDGs). A questionnaire survey was conducted for the bank executives, to which officials from the relevant desks of twenty-one banks responded. Five KIIs (SREDA, IDCOL, CPD, PKSF, and SFD, BB) were conducted with the Govt officials and other stakeholders to identify challenges and formulate recommendations for policymakers. An FGD was organized for the bank executives to validate information that was participated by 30 participants from 27 banks. Further, case studies were gathered on renewable energy financing to find challenges and identify replicable cases. The paper identified some issues for discussion in this research workshop, and based on the outcome of the research workshop, the recommendations were finalised.

The paper is organized into five sections. After covering the background, objectives, and methodology in section one, section two attempts to discuss some conceptual aspects and relevant published literature on renewable energy production and financing. National-level policy issues related to renewable energy and associated financing are discussed in section three. Section four focuses on the status and challenges of renewable energy financing (mainly by the banks and finance companies) and their alignment with national policies. Finally, section five put forward recommendations.

2. Renewable Energy Production and Financing- Conceptual Issues and Global Development

2.1 Renewable Energy Sources and the Products

Renewable energy is energy derived from natural sources that are refilled at a higher rate, sunlight and wind for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us. Generating renewable energy creates far lower emissions than burning fossil fuels (un.org).[2] Though sometimes pronounced interchangeably, the concepts and scope of 'renewable energy' is different from the concepts and scope of 'green energy' and 'clean energy'. While there is some overlap, each term has a unique meaning. For instance, while green energy sources are considered renewable, not all renewable energy sources can be considered green. Moreover, clean energy encompasses nuclear energy, which is neither green nor renewable.

In theory, renewable energy is inexhaustible as it is a continuous energy source. However, renewable energy is not always clean, and that cleanliness depends on a given state or nation's laws and parameters for clean power. For example, some renewable sources emit pollutants while staying within the threshold of a legal definition of 'clean.' The cleanest renewable sources are wind energy, geothermal energy, and solar energy. However, while small hydroplants are renewable and clean, large hydroelectric plants emit some pollutants and can harm the environment during construction. Hence, they create renewable but not clean energy. Green energy comes from renewable energy resources that can be renewed naturally and have the least environmental impact.

The IEA definition of renewable energy includes electricity and heat derived from solar, wind, ocean, hydropower, biomass, geothermal resources, biofuels, and hydrogen derived from renewable resources (REN 21, 2014). Common renewable energy sources include Solar Energy-energy derived from the sun's rays, captured using solar panels or other solar technologies; Wind Energy- energy generated from the wind using wind turbines; Hydropower – Energy from moving water, typically harnessed in dams; Geothermal Energy-energy from the heat generated and stored in the Earth's crust; Biomass Energy-energy derived from organic materials, such as plants and waste; and Tidal Energy -energy from the rise and fall of tides. The primary product of renewable energy is clean electricity, but it can also be converted into other forms of energy, such as heat or fuel. The key products/output

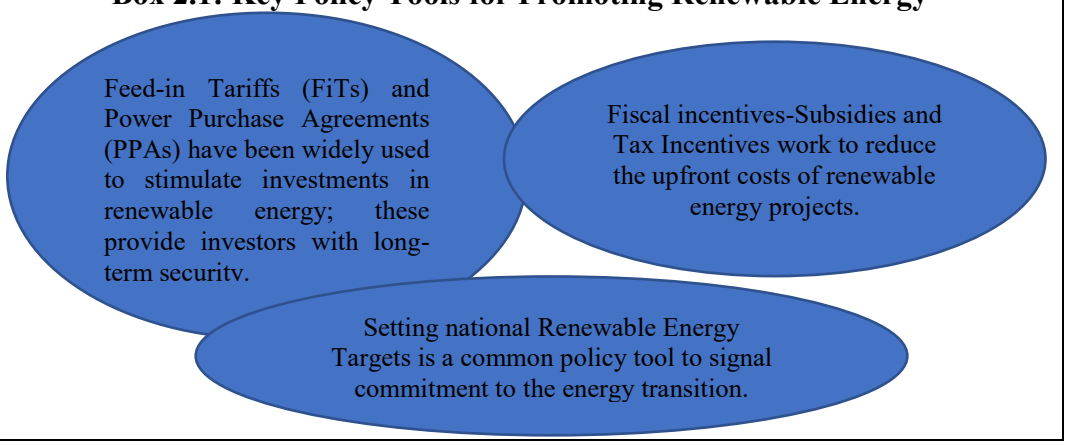
[2] In contrast to that fossil fuels - coal, oil and gas, are non-renewable resources, when burned to produce energy, cause harmful greenhouse gas emissions, such as carbon dioxide.

of renewable energy include: electricity generated from solar panels, wind turbines, hydroelectric dams, and geothermal plants, which can be used to power homes, industries, and transportation systems; Heat produced through biomass, geothermal systems, or solar thermal technologies to heat buildings or water; Biofuels that are renewable fuels derived from biomass (such as ethanol and biodiesel), which can power vehicles or machinery; Hydrogen, when produced using renewable sources (like wind or solar energy in electrolysis) becomes a clean fuel for transportation and industry; and Cooling, like some renewable systems i.e. geothermal heat pumps, can also be used for air conditioning and cooling purposes.[3]

2.2 Renewable Energy Policy Framework and Policy Targets

The global energy landscape is rapidly changing as countries transition from traditional fossil fuels to renewable energy sources, and effective policy frameworks are critical in driving the transition to renewable energy. Three commonly identified mechanisms include market-based mechanisms (such as feed-in tariffs and renewable portfolio standards), fiscal incentives (like tax breaks and subsidies), and regulatory measures (including mandates and renewable energy targets) for the effective progression of renewable energy production and financing (Menanteau et al. 2003).

Box 2.1: Key Policy Tools for Promoting Renewable Energy



Several developing economies identified policy targets to attain renewable energy production, and their level of attainment varies with their key sources (Table 2.1). It is China that surpassed all developing economies by a notable margin both in terms of target attainments and volumes.

[3] https://www.un.org/en/climatechange/what-is-renewable-energy

Table 2.1: Renewable Energy Policy Targets in Selected Developing/Emerging Economies			
Countries	**Renewable Energy Target (GW)**	**Current Capacity (GW)**	**Major Sources**
China	1200 by 2030	1000	Hydropower, solar, wind, biomass
India	500 by 2030	179	Solar, wind, biomass
Sri Lanka	70% of electricity by 2030	1.2	Hydropower, solar
Kenya	10 by 2025	3.0	Geothermal, wind
Vietnam	30 by 2030	21.3	Solar, wind
Nepal	15 by 2030	1.4	Hydropower
Pakistan	30% of total energy by 2030	5.4	Solar, wind
South Africa	25% by 2030	26.3	Wind, solar, biomass
Brazil	45% of the energy matrix by 2030	171	Wind, solar, biomass
Malaysia	31% by 2025	5.2	Solar, biomass
Thailand	20% by 2036	19.2	Solar, biomass, wind
Philippines	35% by 2030	5.0	Geothermal, solar
Source: Based on IRINA, 2023; IRINA, 2022; and IRINA 2021; IEA, 2024; and National Policy Documents of selected economies.			

2.3 Global Patterns of Renewable Energy Investments

It is good to observe that, as a whole, the investment in the renewable energy sector improved over the years (Table 2.2). Published research reports have consistently indicated energy investment flow imbalances, particularly insufficient clean energy investments in the developing world (outside China). There are tentative signs of a pick-up in these investments: in our assessment, clean energy investments are set to approach USD 320 billion in 2024, up by more than 50% since 2020. This is similar to the growth seen in advanced economies (+50%), although trailing China (+75%). The gains primarily come from higher investments in renewable power, now representing half of all power sector investments in these economies. Progress in India, Brazil, parts of Southeast Asia, and Africa reflects new policy initiatives,

well-managed public tenders, and improved grid infrastructure. Africa's clean energy investments in 2024, at over USD 40 billion, are nearly double those in 2020. In 2024, the share of global clean energy investment in the developing world (except China) is expected to remain around 15% of the total. Both in terms of volume and share, this is far below the amounts that are required to ensure full access to modern energy and to meet rising energy demand in a sustainable way (IEA, 2024).

Table 2.2: World Investment in the Energy Sector [2015-2024e]

Year	Total Investment (USD Trillions)	Renewable Energy (%)	Fossil Fuels (%)	Energy Efficiency (%)	Electricity Networks (%)	Nuclear Energy (%)	Other (%)
2015	1.8	35%	54%	7%	3%	1%	0%
2016	1.7	36%	53%	8%	3%	1%	0%
2017	1.8	37%	52%	8%	2%	1%	0%
2018	1.9	39%	50%	7%	3%	1%	0%
2019	2.0	40%	49%	6%	3%	1%	1%
2020	1.9	43%	47%	6%	3%	1%	0%
2021	2.1	44%	45%	6%	4%	1%	0%
2022	2.3	46%	43%	5%	4%	1%	1%
2023	2.5	48%	41%	5%	4%	1%	1%
2024e	2.7	50%	40%	5%	4%	1%	1%

Source: *Based on IEA, 2024.*

2.4 Renewable Energy Financing Models and Instruments

Renewable energy financing models are critical for the successful development and deployment of renewable energy projects, as they help to attract investment, manage risks, and ensure long-term sustainability. These models can vary based on the size of the project, the stakeholders involved, and the local regulatory environment. Menanteau et al. (2023) suggest that the lack of a strong domestic financial market, coupled with high-risk perceptions, limits access to international capital for renewable energy projects. This issue is compounded by the fact that

renewable energy projects often have long payback periods, making them less attractive to traditional investors. ERINA (2022) further argues that financial mechanisms such as concessional financing, blended finance, and guarantees are necessary to de-risk investments in renewable energy in these markets.

Governments in developing countries play a pivotal role in creating an enabling environment for renewable energy financing. Especially, government policies and incentives are essential for attracting private sector investment in renewable energy. Subsidies and tax incentives can reduce the upfront costs of renewable energy projects, making them more attractive to investors. In several instances, governments establish renewable energy funds to channel public and private capital into renewable projects. Central banks have traditionally been responsible for maintaining financial stability and regulating monetary policy; however, in recent years, central banks in some developing countries have begun to play a more active role in promoting green finance, including renewable energy investments. In some instances, central banks have incorporated climate risk into their financial stability frameworks, encouraging banks to consider the long-term sustainability of their investments. Commercial banks are key intermediaries in financing renewable energy projects, but their participation in developing countries has been limited due to several barriers. One of the major challenges commercial banks face is the perception of renewable energy projects as high-risk investments (IEA, 2024).

To mitigate these risks, many renewable energy projects in developing countries rely on blended finance, which combines public and private funds. Some central banks have established special credit facilities/refinancing to support renewable energy projects. In some cases, commercial banks collaborate to finance large-scale renewable energy projects through loan syndication, where multiple banks share the risk of lending (Asedu et.al., 2022). In addition to domestic actors, international financial institutions play a crucial role in supporting renewable energy financing in developing countries to provide capital, technical assistance, and risk mitigation instruments.

Of the different financing instruments, debt financing remains the dominant source, driven by favourable interest rates and investor confidence in renewable projects (Table 2.3). Equity Financing has seen substantial growth, especially in innovative technology start-ups and larger renewable firms. Public Financing continues to support projects, particularly in developing regions where access to private capital is limited. Crowdfunding is emerging as a niche but rapidly growing sector, particularly for smaller-scale projects. Feed-in Tariffs and Power Purchase Agreements are critical for long-term project viability, contributing to a stable

investment climate. Blended Finance is increasingly recognized for its potential to leverage additional private investment. Securitization of Renewable Energy Assets is also drawing attention. Securitization involves pooling renewable energy assets (such as solar projects) and issuing securities backed by the revenue streams of these projects. Brockett et al. (2018) report that securitization can provide renewable energy projects with access to the broader capital markets, allowing them to raise large amounts of financing at lower costs.

Table 2.3: Sustainable Debt Financing in the Asia and Pacific (Billion USD)

Debt Instruments	**2020**	**2021**	**2022**
Green Bond	45	125	115
Social Bond	20	20	55
Sustainable and Sustainability Linked Bond	10	42	46
Total Bonds	**75**	**187**	**206**
Green Loan	8	17	18
Social and Sustainable Loan	-	3	6
Sustainability- Linked Loan	7	36	70
Total Loans	**15**	**56**	**94**

Source: *UN & ESCAP, 2023*

Overall, most investments in the energy sector are made by corporations, with firms accounting for the largest share of investments in both the fossil fuel and clean energy sectors. However, there are significant country-by-country variations: half of all energy investments in developing world are made by governments or SOEs, compared with just 15% in advanced economies. Investments by state-owned enterprises come mainly from national oil companies, notably in the Middle East and Asia where they have risen substantially in recent years, and among some state-owned utilities. The financial sustainability, investment strategies and the ability for SOEs to attract private capital therefore become a central issue for secure and affordable transitions. The share of total energy investments made or decided by private households (if not necessarily financed by them directly) has doubled from 9% in 2015 to 18% today, thanks to the combined growth in rooftop solar installations, investments in buildings efficiency and electric vehicle purchases. For

the moment, these investments are mainly made by wealthier households – and well-designed policies are essential to making clean energy technologies more accessible to all. A comparison shows that households have contributed to more than 40% of the increase in investment in clean energy spending since 2016 – by far the largest share. It was particularly pronounced in advanced economies, where, because of strong policy support, households accounted for nearly 60% of the growth in energy investments. Three-quarters of global energy investments today are funded from private and commercial sources, and around 25% from public finance, and just 1% from national and international development finance institutions (DFIs). Other financing options for energy transition have faced challenges and are focused on advanced economies. In 2023, sustainable debt issuances exceeded USD 1 trillion for the third consecutive year, but were still 25% below their 2021 peak, as rising coupon rates dampened issuers' borrowing appetite. Market sentiment for sustainable finance is wavering, with flows to ESG funds decreasing in 2023, due to potential higher returns elsewhere and credibility concerns. Transition finance is emerging to mobilize capital for high-emitting sectors, but greater harmonization and credible standards are required for these instruments to reach scale.

It is evident that green and renewable energy projects lack bankability, and investments are far from the required levels. Renewable energy projects commonly suffer from high investment costs, missing financial incentives, uncertain returns on investment, lack of skilled workforce, political and technological risks, lack of data and metrics, and limited access to the required findings. In developing economies, access to funding is even more challenging, and political risks tend to be greater, putting even more upward pressure on the cost of capital. Delloite (2023) identifies and details the financial instruments to improve the bankability of green and renewable energy projects, grouping them into three key action levers: de-risking green projects, bridging the cost gap between green and fossil technologies, and cutting fossil fuels (Table 2.4).

Table 2.4: Financial Tools to Foster Investments in Renewable Projects				
	Tools and Instruments		How Does it Work	Parameter Influenced
De-risking Sustainable and Green Projects	Implement Policy Frameworks	Set Climate Strategies	Provide Market Transparency & Regulatory Clarity	Reduce Political Risks
	Guarantee Mechanisms & Loss Reserves		Protect the Investors Against Losses	Reduce the Risk of Default
	Offtake Contracts (PPA, CfD, FiT)		Guarantee a Sale Price for the Producer	Reduce Revenue Risk
	Develop a Domestic Financial Market		Increase Confidence, Transparency	Lower Borrowing Costs
	Bonds (Green, Blue, Sustainability-Linked)		Categorize the End-Use of Bond	Lower Borrowing Costs and Transparency
	Portfolio Approach		Diversify Investment	Reduce Portfolio Risk
Bridging the Cost Gap	Upfront Cost Reduction	R&D Support	Financial Support	Reduce Investment & Financing Costs
	Carbon Pricing		Put a Price on GHG Emissions	Make Fossil Alternative More Expensive
	Operational Premiums (CfD, Tax Reduction)		Increase the Revenue Linked to the Sale of the Product	Make Clean Energy Technologies More Profitable
Reducing the Use of Fossil Fuel	Ending Public Support for Fossil Assets Do Climate Stress Test		Stop Direct Socially Untargeted Support to Fossil Fuels	Make Fossil Alternative More Expensive
	Support Job Transformation		Implement Training Programs & Job Reallocation	Provide Skill Labour for the Transition & Social Benefit
Source: *Based on Deloitte, 2023.*				

Foreign investment has been an important source of financing and investment in developing countries. Developing countries, particularly in regions like Asia, Africa, and Latin America, have been major recipients of foreign investments in renewable energy. Several developing countries are big recipients of Chinese FDI. As of the year 2020, some key recipients of the Chinese FDI include Argentina

(USD 3018 million), Lao (USD 5568 million), Guinea (USD 2318 million), Nigeria (USD 7025 million), Pakistan (USD 4204 million), etc (Moazzem and Musfiq, 2024).

2.5 Potentials of Renewable Energy and Opportunities for Improved Alignment with Policies

In connection with drawing investment (as noted in IEA, 2024), solar is the star performer, and more than USD 1 billion per day is expected to go into solar investments in 2023 (USD 380 billion for the year as a whole), edging this spending above that in upstream oil for the first time. Consumers are investing in more electrified end uses. Demand for electric cars is booming, with sales expected to leap by more than one-third this year after a record-breaking 2022. Investment in coal supply is expected to rise by 10% in 2023 and is already well above pre-pandemic levels. Investment in new coal-fired power plants remains on a declining trend, but a warning sign came in 2022 with 40 GW of new coal plants being approved – the highest figure since 2016 (mainly in China).

The positive momentum behind clean energy investment is not distributed evenly across countries or sectors, highlighting issues that policymakers will need to address to ensure a broad-based and secure transition. More than 90% of the increase in clean energy investment since 2021 has taken place in advanced economies and China. There are bright spots elsewhere: for example, solar investment remains dynamic in India; deployment in Brazil is on a steady upward curve; and investor activity is picking up in parts of the Middle East, notably in Saudi Arabia, the United Arab Emirates, and Oman. However, higher interest rates, unclear policy frameworks and market designs, financially-strained utilities, and a high cost of capital are holding back investment in many other countries. Remarkably, the increases in clean energy investment in advanced economies and China since 2021 exceed total clean energy investment in the rest of the world (IEA,2024).

About the broad group of investors, most investments in the energy sector are made by corporates, with firms accounting for the largest share of investments in both the fossil fuel and clean energy sectors. However, there are significant country-by-country variations: half of all energy investments in the developing world are made by governments or SOEs, compared with just 15% in advanced economies. A comparison shows that households have contributed to more than 40% of the increase in investment in clean energy spending since 2016, by far the largest share. Three-quarters of global energy investments today are funded from private and commercial sources, around 25% from public finance, and just 1% from national

and international development finance institutions (DFIs). In 2023, sustainable debt issuances exceeded USD 1 trillion for the third consecutive year but were still 25% below their 2021 peak. Market sentiment for sustainable finance is wavering, with flows to ESG funds decreasing in 2023, due to potential higher returns elsewhere and credibility concerns (IEA World Energy Investment, 2024).

Despite the challenges, several opportunities exist for better aligning renewable energy financing with policy frameworks in developing countries. There are scopes to strengthen the policy framework. Establishing long-term, stable policies that offer clear incentives for renewable energy projects can reduce investor uncertainty and attract more private sector participation. To overcome the financing gap, developing countries should expand the range of green financial instruments available to investors. There is growing evidence that instruments such as green bonds, concessional loans, and blended finance can help attract private investment by lowering the perceived risks of renewable energy projects (World Bank, 2020). It is crucial to ensure enhanced coordination between government agencies and financial institutions to ensure that financing mechanisms effectively support policy goals. Public-private partnerships (PPPs) may offer an effective way to align renewable energy financing with policy by leveraging private investment to meet public sector goals (Asiedu et.al, 2022).

3. Policy Instruments for Renewable Energy and Associated Challenges and Opportunities-Bangladesh Context

3.1 Policy Framework and Targets for Renewable Energy in Bangladesh

In Bangladesh, 'Renewable Energy' came into focus mainly in the mid-1990s. Renewable Energy found its place in the National Energy Policy 1996, and targets for RE were first set up in the National Energy Policy 2004 (5% of RE shares by 2010, and 10% of shares by 2020). Renewable Energy Policy was formulated in 2008. The Renewable Energy Policy of 2008 provides a framework that includes incentives for both public and private sector investments in renewable energy. The policy also outlines the establishment of the Sustainable and Renewable Energy Development Authority (SREDA), which is responsible for promoting renewable energy projects and coordinating national efforts. The Sustainable and Renewable Energy Development Authority Act, 2012 established the Sustainable and Renewable Energy Development Authority (SREDA) to promote, develop, and coordinate renewable energy and energy efficiency programs in Bangladesh.

In 2022, the Sustainable and Renewable Energy Development Authority (SREDA) initiated a revision of the Renewable Energy Policy of 2008. The newly drafted policy is more detailed and comprehensive, addressing various aspects of the energy system to achieve the 40 percent renewable energy target by 2041.

However, the draft was not presented or passed in the previous parliament. Despite some shortcomings, the new draft is significantly better than the existing policy. The draft policy of 2022 shifts its vision from energy security to environmental friendliness and prioritizes climate goals. It expands the focus of renewable energy resources beyond solar, wind, and biogas to include other resources as well (Table 3.1).

Table 3.1: Key Changes in Renewable Energy Policy (Draft) 2022 as compared to Renewable Energy Policy 2008

Issues	Renewable Energy Policy of 2008	Renewable Energy Policy (Draft) 2022
Vision	Energy security	Environment friendliness
Objectives	Prioritizes investments	Prioritizes climate goals
Renewable Energy Resources	Solar, wind, and biogas	Focused on other resources as well
Policy Period	None	10 years
Institutional Frameworks	No role for other organizations	Mentioned roles of IDCOL, PGCB, BERC, etc.
Allotment of Projects	None	Pre-conditional requirements
Investment Facilitations	Micro-credit support systems	Micro-credit support systems
Fiscal Incentives	Exemption from charging 15% VAT	Waived VAT and import duties
Regulatory Policy	None	RPO and REC

Source: *Renewable Energy Policy (Draft) 2022: A Comprehensive Assessment; Moazzem and Hridoy (2023).*

Based on the Mujib Climate Prosperity Plan, the Ministry of Environment, Forest, and Climate Change of Bangladesh decided to expand RE targets to reach 30% by 2030, and to 40% by 2041. Besides, different national plans have outlined long-term plans for improving the share of renewable energy. For example, the Integrated Power and Energy Master Plan (IEPMP) prepared by the Ministry of Power Energy, and Mineral Resources (MoPEMR) mentions 40 percent of 'clean energy' where the share of renewable energy is considered 8.8 percent. On the other side, the Mujib Climate Prosperity Plan (MCPP), prepared by the Ministry of Environment and Climate Change, mentions 40 percent of renewable energy for power generation.

Mujib Climate Prosperity Plan (MCPP) emphasizes achieving domestic energy security through investments in solar power, including rooftop, ground-mounted, and floating installations on reclaimed land as part of the Bangladesh Delta Plan 2100. Solar power is expected to generate 2000MW for government buildings, supplemented by offshore wind and domestic storage capacity. Additionally, the plan includes utilizing alternative power generation in the Bay of Bengal, such as tidal power and ocean thermal energy conversion, and proposes a 4000MW wind generation array network linked to a mangrove green belt along the coastline.

The MCPP aims to achieve a 40 percent RE target by 2041, whereas the IEPMP sets a lower target of 8.8 percent RE by the same year. A notable distinction exists in the IEPMP's inclusion of 'clean energy', often referred to as renewable energy, which considers expensive sources like LNG, ammonia, and CCS. Despite being the directive guidelines, the target of the IEPMP and MCPP differs. However, the IEPMP was developed without taking into consideration the energy-mix suggested in the MCPP. Considering the estimates made by the CPD (2024), 40 percent of power generation through renewable energy, which is equivalent to 13672 MW is a feasible target. This study, therefore, considers 40 percent of renewable energy, or 13,672 or 14000MW, as the share of the energy mix from renewable energy.

To fulfill the 40 percent renewable energy-based electricity generation, the government needs to install new solar and wind-based power plants in different locations, subject to the potential of energy generation. In this regard, several studies have been conducted to assess the availability and potential of renewable energy from various sources, in accordance with the targets outlined in the MCPP and the IEPMP (SREDA, n.d.). The MCPP mentions specific targets, such as generating 4,000 MW of wind-based electricity from the mangrove green belt and 2,000 MW of solar power from government buildings. Additionally, the government aims to explore offshore wind energy and enhance domestic storage

capacity, capitalizing on the Bay of Bengal for tidal power-based energy generation (CPD, 2023).

The National Solar Energy Roadmap 2021-2041 seeks to enhance the role of solar energy in Bangladesh's energy mix. The roadmap is designed to scale up solar energy generation, with a focus on expanding grid-connected and off-grid solar solutions.

Some other policy documents promote the use of renewable energy. For example, the Bangladesh National Building Code (2020) provides for the regulation that requires buildings to supply a portion of their electric load from renewable sources. According to the regulation, residential buildings should supply three percent of the total electric load of the building from solar or other renewable sources, and for non-residential buildings, it is five percent. If we consider the total energy composition, which consists of renewable energy, efficient resources, and alternative resources. However, from a reporting perspective, there is no specific format for how much renewable energy financing is in total energy consumption. Specific and formatted reporting in this regard is a major concern to accommodate the national policy.

Bangladesh Bank (BB) introduced green refinancing lines in 2009. BB strengthened this policy in different phases in 2013, 2017, and 2023. Currently, PFIs are financing @5% and claiming to refinance from the central bank @1%, where this facility is open for 15 subsectors of renewable energy and 3% for priority facilitation in the case of Solar Irrigation Pumping Machines. The tenor under the BDT 10 billion refinancing scheme is within 3 to 10 years, where the debt-equity ratio is 70:30, with the required debt limit from the PFI open for the project that it demands. BB has introduced the Green Transformation Fund of USD 200 million, Euro 200 million, and BDT 500 crore for all the export-oriented industries for importing green machinery, where there is a considerable share of renewable energy in the textile sector and green appliances in green buildings.

To ensure policy support to the banks and financial institutions, starting with the 'Green Banking Policy framework' in 2011, Bangladesh Bank introduced the 'Sustainable Finance Policy' that broadened the scope of sustainable financing, including renewable energy financing. In line with that, in 2022, Guidelines on Environmental & Social Risk Management (ESRM) were issued for Banks and Financial Institutions in Bangladesh. Policy on Green Bond Financing for banks and financial institutions has also been issued. Currently, the central bank of the country is working on the 'Green Credit Guarantee Scheme' which is expected to be publicly disclosed in November 2024. This is said to be tested initially for 4

products on a pilot basis: Environment-Friendly Bricks, Improved Cook Stoves, Solar, and Solid Waste Management. This is expected to ensure supportive incentives for renewable energy entrepreneurs and financing banks. Though the central bank has a specific category of renewable energy product list, some identified products include a certain portion of renewable energy financing (Appendix A1).

3.2 Challenges and Opportunities of Renewable Energy Development in Bangladesh

Bangladesh enjoys moderate levels of solar radiation daily (Global Horizontal Irradiance ≈ 4.5 kWh/m2). It boasts the world's largest off-grid solar home initiative, which has provided electricity to 20 million people, primarily living in remote and rural Bangladesh (Cabraal, et.al, 2021). The country's solar energy-based project typologies are primarily dominated by off-grid Solar Home Systems (SHS), with 6.02 million installations generating 263 MW of electricity. Other solar-based renewable energy generation comes from solar parks (130 MW), rooftop solar (64 MW), solar irrigation pumps (44 MW), solar streetlights (17 MW), and solar mini-grids (5 MW) (Taskin et al., 2021).

Policy inconsistency remains a challenge for the renewable energy sector. According to the draft IEPMP shared with the stakeholders, Bangladesh's expected renewable energy-based power generation capacity by 2050 would be around 12%, though the MCPP has proposed to increase the share of renewables in the fuel mix for power generation to 40% by 2041. Meanwhile, the Perspective Plan 2041 claimed that around 1% of electricity will be generated from renewables by 2041. The different targets set by different ministries suggest that incoherence in policy formulation still exists as a challenge.

Competing policies have been identified as the most prominent reasons behind the decrease in solar home systems (SHS) installation after 2015. Because of the rapid expansion of the national grid in the areas selected for SHS, disregarding the ongoing project, the once successful SHS project of IDCOL could not reach its goal. The apparent downfall of the SHS showed how incoherent policies and measures, along with coordination gaps between different stakeholders, can disrupt renewable energy deployment.

Several Studies (Hellqvist and Heubaum, 2023; SREDA, 2015) have highlighted land constraints as a challenge in installing large renewable energy plants in the country. The country's complex land administration and ownership structure make

it difficult to acquire large amounts of land for large energy projects like solar parks. The country's complicated land administration leads to litigation and harassment of resource-poor households, particularly in rural areas. This results in increased costs and a prolonged project implementation period. Besides, the National Agriculture Policy 2018 discourages the use of agricultural land for non-agricultural purposes and aims to recover agricultural land used for non-agricultural purposes to maintain self-sufficiency in food production and reduce import burdens.

Bangladesh has the main constraints for renewable and sustainable energy expansion because of its land availability and meteorological conditions. There are many shortcomings, such as the institutional platform, technical knowledge among stakeholders, and involvement of the financial side for the promotional activity to utilize these energy sources. Higher costs because of high import duty for quality imported plants, and local products can't be recognized or accepted as import substitution. The size of solar panels varies for power generation depending on the geographical location. The initial costs are high for materials and installation. Require lots of space for this purpose. It cannot produce massive power. The efficiency is not high yet.

Land and connecting infrastructure are the basic requirements for scaling renewables. At present 1 MW ground-mounted solar PV system needs around 2.5 acres of land. It is challenging for densely populated countries like Bangladesh to get large stretches of land for large-scale ground-mounted solar PV project development. One solution to the land shortage is investing in research and development for high-efficiency panels that can generate more power within the same land. The other solution is enhancing the multi-purpose use of spaces. As large-scale renewable energy projects are usually far away from grid lines as well as localities, building transmission lines and transportation facilities is essential to connect the RE plants.

However, opportunities and advantages must be considered very seriously. Bangladesh's first renewable energy-based power generation started in the 1960s with the Karnaphuli Hydropower Plant. Later, in the 1990s, solar home systems (SHS) were introduced in the rural areas of Bangladesh. In 2005, the first wind power plant was installed in Feni. Meanwhile, smaller domestic biogas plants and solar irrigation projects started taking root in Bangladesh, backed by global donors, mostly development financial institutions (DFI). Recently, the Infrastructure Development Company Limited (IDCOL) has installed biomass power plants as well. Several waste-to-energy projects around the capital Dhaka are on the cards. It means Bangladesh has explored at least six renewable energy sources so far: solar,

wind, biogas, biomass, waste-to-energy, and hydropower. According to the Youth Policy Forum brief (2024), Bangladesh's installable potential for solar is around 50,000 MW, hydropower is around 750 MW, on-shore wind power is around 30,000 MW,10 biomass from rice husk is around 1000 MW11 and biogas is around 300 MW. Besides, there is immense offshore potential, according to the Institute for Sustainable Futures, which put it at 134,000 MW.

Solar energy, the key source of renewable energy in Bangladesh, is a pollution-free energy source that causes no emission of greenhouse gases. Developing energy can be connected to a national grid line to overcome the power crisis. It has no dependence on oil and fossil fuels to develop clean electrical energy. It can be utilized to heat water, power for homes and buildings, even for cars. With minimum maintenance, the solar panels last around twenty years. To utilize at night, it can store extra power in batteries. It can help the rural economic infrastructure.

Fiscal support is offering increasing opportunities to the investors. To ensure private participation in the power sector, the GoB allowed private investors to build commercial power plants that comply with the existing environmental laws and regulations, and technical standards of grid interconnection and operation, covering tax exemptions and relaxation of duties. REP 2008 offered several fiscal incentives to the renewable energy sector, including 15 percent value-added tax (VAT) exemption on all renewable energy equipment and related raw materials in producing renewable energy, corporate tax waiver for the first five years of operation, an incentive tariff, etc., which are expected to be improved in the new version (REP 2022).

The net energy metering guideline was introduced in Bangladesh in 2018 to encourage the consumption of renewable energy. In the policy, consumers were recognized as prosumers; this refers to a policy mechanism that allows consumers to connect their renewable energy systems to the national grid, and thus, consumers act as producers. Since the consumption of renewable energy like solar energy is not widely popularised in Bangladesh, the GoB introduced net metering policy to stimulate a wider group of users, including organisations and individuals, to install more solar plants. From 2019 to June 2022, a nearly 42.9 MWp install capacity has been added to the national grid through net metering arrangements (SREDA, 2022).

4. Trends, Patterns, Successes, and Challenges of Renewable Energy Financing in Bangladesh- Alignment with the National Policies

4.1 Trends and Patterns of Renewable Energy Financing in Bangladesh

Renewable energy financing expanded in the country as part of the expansion of green financing that has been actively supported by the central bank of the country. Several policy initiatives have helped some banks to surpass and meet the target of green finance (5%) and yearly target (20%) of sustainable finance. Hence, both green and sustainable finance have increased tremendously. Despite improvement, the volume of green finance/renewable energy financing remained insignificant in proportion to the total volume of lending operations by banks/finance companies. It is not the banks, but rather finance companies that play remarkable roles in supporting the renewable energy sector of the country; a few (IDCOL, BIFFL, etc.) dominate the renewable energy finance market in the country (Table 4.1). The renewable energy financing market was dominated by banks that changed sharply following 2022 and onwards (Table 4.2). This is explained by the opportunity of drawing low-cost funds in the renewable energy sector, which is giving an edge to a few finance companies like IDCOL.

Table 4.1: Renewable Energy Financing by Different Banks and Finance Companies

Type of Bank/FI	**Jan-Mar, 24**		**Apr-Jun, 24**	
	RE Financing (Million BDT)	%	RE Financing (Million BDT)	%
SOCBs	10.63	0.49	254.38	12.45
SCBs	5.48	0.25	2.04	0.10
PCBs	2028.85	93.44	550.05	26.93
FCBs	10	0.46	1115.64	54.62
ISBs	116.42	5.36	120.44	5.90
Total	**2171.38**	**100**	**2042.55**	**100**
Banks	2171.38	18.89	2042.55	28.17
FIs	9326.28	81.11	5207.57	71.83
Total	**11497.66**	**100**	**7250.12**	**100**

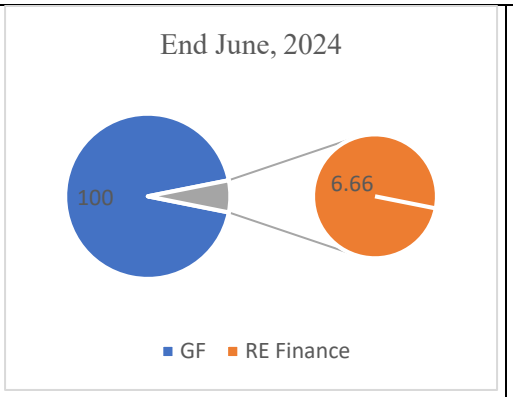
Source: *BB Quarterly, 2024.*

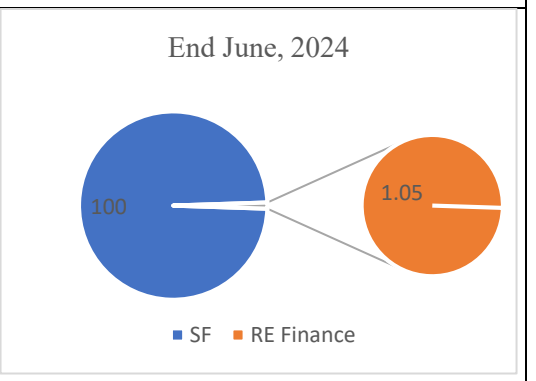
Table 4.2: Changing Trends in the Renewable Energy Financing						
Type of Bank/FI	**2021**		**2022**		**2023**	
	RE Financing (Million BDT)	%	RE Financing (Million BDT)	%	RE Financing (Million BDT)	%
Bank	3911.86	85.26	4434.93	69.10	2431.01	32.76
FIs	676.53	14.74	1982.74	30.90	4990.77	67.24
Total	**4588.39**	**100**	**6417.67**	**100**	**7421.78**	**100**
Source: *BB Reports (various issues).*						

As the data indicate, renewable energy finance as a percent of green finance and sustainable finance remained insignificant. During 2021-2023, renewable energy finance was in the range of 3-7% of the total green finance by banks and finance companies and was less than 0.50% of the total sustainable finance (Table 4.3). According to the BB's published information, as of the end of June 2024, the renewable energy outstanding loan volumes were 6.66% and 1.05% of the total green and sustainable finance by the banks and financial institutions.

Table 4.3: Renewable Energy Financing as % of Green and Sustainable Finance						
Year	Green & RE Finance			Sustainable & RE Finance		
	GF Million BDT	RE Finance	%	SF Million BDT	RE Finance	%
2021	72,328.50	4588.39	6.34	8,25,516.74	4588.39	0.56
2022	1,22,264.65	6417.67	5.25	13,07,622.35	6417.67	0.49
2023	1,93,043.08	7421.78	3.84	19,73,691.40	7421.78	0.38
2024 (Jan-June)	1,52,110.72	18747.77	12.33	20,54,964.93	18747.77	0.91
Source: *BB published data, 2024.*						

Figure 4.1: Outstanding Renewable Energy Financing as Percentage of Green and Sustainable Financing





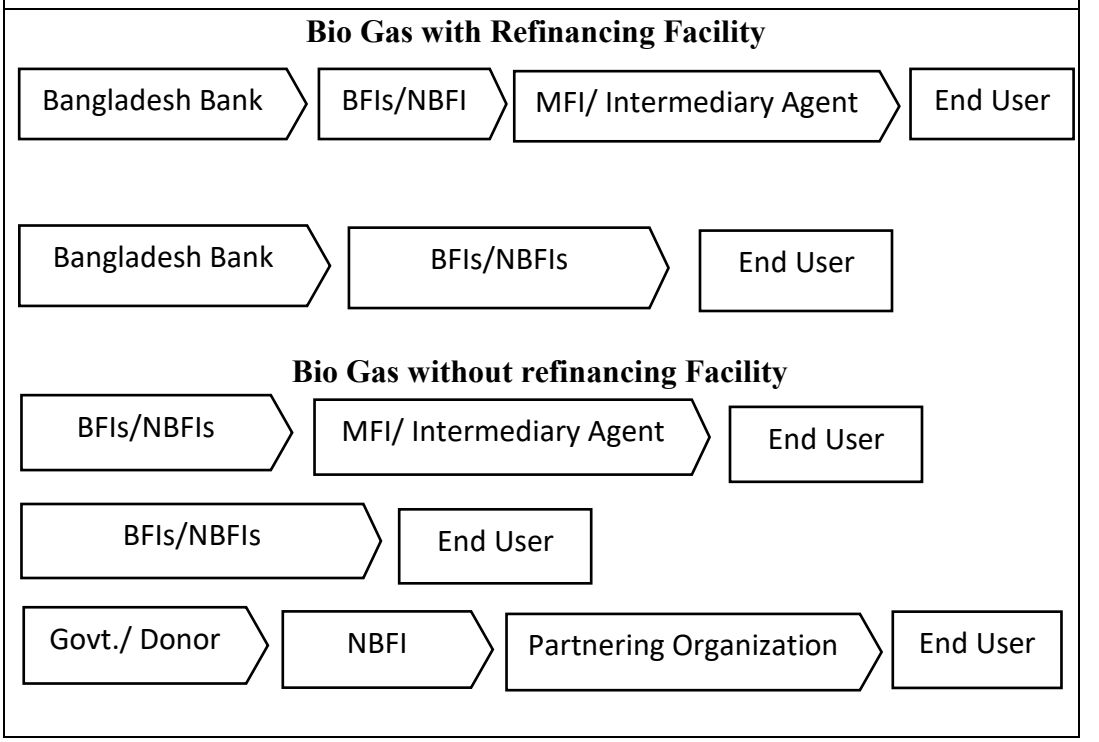
Source: *BB Quarterly, 2024*

As revealed in the survey data, except for solar home systems and net metering rooftop solar system, the percentage share of renewable energy finance to total finance is insignificant. Amount of financing is significantly higher for men in both urban and rural areas than for women from 2021 to 2024. It is noted that Roofs are a great resource for generating highly cost-competitive solar energy. The solar home system has the largest contribution to green finance followed by integrated cow-rearing biogas plant, solar irrigation pumping system and biogas plant, as opined in the FGD.

In the process of financing, several models have been in use by the banks and finance companies using their own funds; Bangladesh Bank's refinance fund; and donor fund. At the implementation stage, banks and finance companies (called participatory financial institutions) use the services of MFI or Intermediary Agents (Suppliers)[4], and/or partnering organizations (MFI/NGOs to perform the financing-related and field-level operations). Households and small business entities are the end users (Figure 4.2).

[4] Enterprise Development Company Limited etc.

Figure 4.2: Bio Gas Models in use



Solar financing includes financing for solar home systems, solar irrigation, and solar panels. In the process of financing, several models are in use. Banks and finance companies use their own fund; Bangladesh Bank's refinance fund; and donor fund. At the implementation stage, BFIs/NBFIs (called participatory financial institutions) use the services of MFI or Intermediary Agents (Suppliers), and/or partnering organizations (MFI/NGOs to perform the financing-related and field-level operations). End users are the households, business entities, and farmers (Figure 4.3).

Figure 4.3: Solar Home System in use

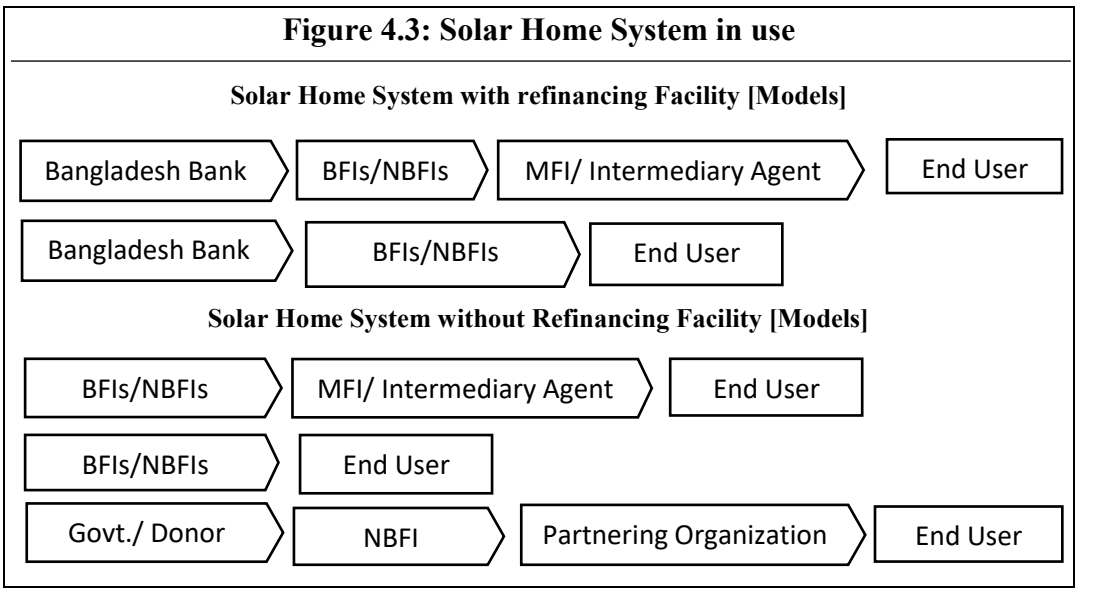
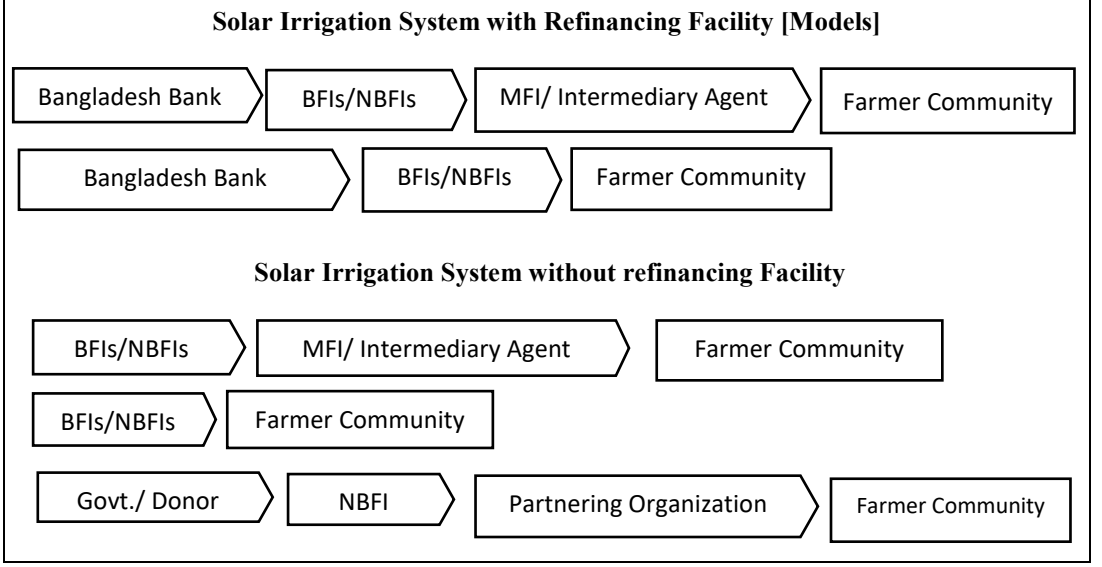


Figure 4.4: Solar Irrigation System in use



Alongside attaining BB's target, on the way to promoting and supporting renewable energy, banks, and finance companies have also been investing in solar-powered branches, sub-branches, and agent banking units (Box 4.1). These are undertaken as part of their in-house environment management.

Box 4.1: Attaining Target, and Installation of Solar Panel on the Roofs of the Branches

Bangladesh has committed to achieving a 100% reduction in emissions by 2050, in alignment with the Paris Agreement of 2015. In support of this national goal, some banks attempted to develop a net zero emission policy. In this context, an old-generation private commercial bank has been working for a big change. From 2021 to September 2024, a total of 5,073.226 million Taka was disbursed to 442 borrowers, with an outstanding amount of 4,862.186 million Taka in the renewable sector. The bank exceeded its target for green finance loan disbursement in three quarters of 2024. Additionally, the bank has initiated the installation of solar panels on the roofs of branches, sub-branches, and ATM booths.

Note: *Based on data from the Bank source.*

Despite notable investment in the energy sector by the donor agencies/international organizations, fund flows to the RE sector remained limited. The cumulative investment in Bangladesh's energy sector from 2010 to 2022 totaled about USD 39 billion. Out of which about USD 1 billion was invested in renewable energy projects between 2016 and 2021. According to data from the American Enterprise Institute (2024), from 2010 to 2023, Bangladesh received USD 12.3 billion in investment from China in its power and energy sector (http://www.changeinitiaitves.bd/). According to CPD research (Moazzem and Musfiq, 2024), currently, only a minuscule amount of overseas investment worth 172 MW renewable energy project (loan and FDI-based) is in operation in the country. The current experience of the Chinese investors in the country is a drawback in this context. Chinese investors identified infrastructure deficits, financing challenges, administrative and legal limitations, and technology and human resource limitations as key challenges for Chinese investors in the country (Moazzem and Musfiq, 2024). Some donor agencies and international financial institutions have been active in supporting the renewable energy financing sector of Bangladesh. Some of these are directly coordinating with local commercial banks and finance companies to support renewable energy financing (Box 4.2 and 4.3).

Box 4.2: Development Loans and Grants

The International Development Association (IDA) has pledged a total of USD 40 billion, with USD 524 million earmarked for renewable energy projects. A cooperative climate finance initiative amounting to USD 320 million, involving the ADB, World Bank, and other parties, highlights the global backing for Bangladesh's transition to clean energy. The European Investment Bank (EIB) and the European Union have committed Euro 395 million to develop 750 MW of renewable energy capacity, which includes a Euro 350 million framework loan alongside a Euro 45 million grant. Moreover, the International Finance Corporation (IFC) is allocating USD 15 million to the Southeast Asia Clean Energy Fund II, aimed at supporting renewable initiatives in Bangladesh. Germany has also extended Euro 232.5 million in aid as part of the Bangladesh-German Development Cooperation Negotiations 2024.

Source: *CPD, Policy Brief, 2024.*

Box 4.3: Joint Financing by a Reputed Local Commercial Bank and ADB in Solar Power Plant

Muktagacha Solartech Energy Ltd. is a 20MW Grid Tied Solar PV Power Plant 'Build, Own and Operate' basis. The project is located over 80 acres of land at Nimoria, Mankon Union, Muktagacha, Mymensingh. The project entails establishing a 20MW Grid Tied Solar Power Plant along with an approximately 8 km overhead transmission line as an independent power producer. It will supply contracted electricity to the Bangladesh Power Development Board on a Build-Own-Operate (BOO) basis for 22 years. A reputed local commercial bank is providing financing facilities for ULC/Acceptance [machineries/goods/services] for Bill financing and Time loan purposes. ADB is the main financing partner in the project and has done all the due diligence. ADB is providing the Term Loan facility. The project is an important investment in energy infrastructure to deliver affordable renewable energy amid growing electricity demand in Bangladesh.

Source: *Based on Survey*

Budget allocations and financing support remained crucial for attracting private investors and stakeholders to be engaged in renewable energy investments. In recent times, the Power Division has been contemplating setting up many more solar power plants as it received the NBR's notification for reinstating the tax exemption on such private investment. Earlier, the Power Division had planned to set up 10 solar power plants in the private sector and sought the Finance Ministry's concurrence for the NBR to reinstate the tax holiday on private investment. Each of the proposed plants was supposed to be 50 MW with a total capacity of 500 MW,

and the number might be between 30-40. As per the NBR circular, issued on October 27, 2024, private investors in renewable energy will get a 10-year tax exemption on their investments. The circular said that those companies that will start commercial operation of their renewable energy-based power generation project based on Build-Own-Operate basis under the Private Sector Power Generation Policy of Bangladesh within a period between July 1, 2025, to June 30, 2035, will avail a tax holiday for 10 years (based on Financial Express, November 03, 2024).

Prospects and challenges in the promising sectors are to be considered on the way to renewable energy financing in the country (based on the outcomes of KIIs, FGDs, and secondary literature). Certain product challenge also offers valuable sessions for our future planning and directions (Appendix Table A.2, A.3, and A.4). For example, the unusual stoppage of the Solar Home System reveals unplanned initiatives and lack of coordination on the part of the policymakers of the country. As opined in the KIIs and FGDs, while financing renewable energy, focusing on a few products and small-scale interventions is restraining the potential for generating larger energy outputs through large-scale renewable solar and wind projects. Summary opinions on the performance and the challenges (based on KII and FGD) offer insights into the existing and future needs and challenges of renewable energy financing (Box 4.4).

Box 4.4: Challenges in Renewable Energy Financing and Suggestions

Challenges

-High capital investment, complex approval process, limited technological capacity, regulatory hurdles, and lower-than-expected returns impede the banking sector's involvement with other large-scale renewable energy sources i.e., wind, hydro, and biomass (75%).

-Imposing high import duties on essential technology is also limiting the market growth, increasing project costs, and discouraging private investments. Moreover, poor after-sales service due to a lack of local expertise in renewable energy products and the non-availability of spare parts are also the reasons for not thriving in the sector (45%).

-The high population density of our country results in significant land scarcity, complicating the identification of suitable locations for renewable energy projects. Due to geographic constraints, the feasibility of various renewable energy sources like hydropower, wind energy, etc., faces challenges (45%).

-High interest rates coupled with short loan tenors make it hard for renewable projects to be economically viable. Besides, the lack of awareness of businesses

on the favorable terms of green financing initiatives is impacting demand and market acceptance (35%).

-Limited public awareness and demand for renewable energy solutions are still developing, which can lead to limited market uptake (25%).

-The underdeveloped bond market, a potential source for large-scale renewable financing, is also limiting the scope for renewable expansion (25%).

-Govt. Commitment to renewable energy policies shows inconsistent implementation. Besides, insufficient incentives for large-scale investments and a lack of coherent long-term strategies further inhibit the sector's growth (20%).
-Heavy reliance on government or international funding may create uncertainty in the sector (10%).

Suggestions

-Strengthening policies for government incentives, such as tax breaks and subsidies for large-scale projects, incentivizing commercial banks by offering lower capital requirements for green investments, and developing clearer guidelines for project approvals could improve investor confidence and ease project execution, which can stimulate demand and drive the market forward (75%).

-Innovative financing mechanisms, proper capacity assessment, and solving land issues for large-scale solar panel set-up a key to attaining real growth (70%).
-Promoting PPP for land development as well as financing can help to boost the sector (35%).

-Enhancing awareness among all stakeholders, like regulators, developers, businesses, bank employees, investors, and the mass public about renewable energy would help increase adoption rates (35%).

-Establishing an easy regulatory framework would foster a more conducive environment for investment in renewable energy (30%).

-Building a robust green bond market could open new financing avenues, enabling banks to meet the long-term capital needs of renewable energy projects affordably and sustainably (25%).

-More investment is required in R&D. Besides, how local technologies can be adopted should be planned (25%).

-Tailor-made refinancing schemes focusing on various products would be beneficial. Moreover, linking the funding and technological arrangement to Development Finance Institutions (DFIs) could offer greater benefits to the country by reducing the financial burden and developing capacity, enabling them to offer competitive rates and proficient suggestions to borrowers (15%).
-Developing clear guidelines for land acquisition in renewable energy zones and sector-specific mandates is a must (15%).

-Use the COP27-pledged Loss and Damage Fund to promote the transfer and deployment of renewable technologies (10%). -Ensuring after-sales service and availability of spare parts is also required to sustain the growth of the sector (10%).
Note: *Based on FGD and KII outcomes.*

4.2 Financing Gap and Aligning Renewable Energy Financing with the National Targets

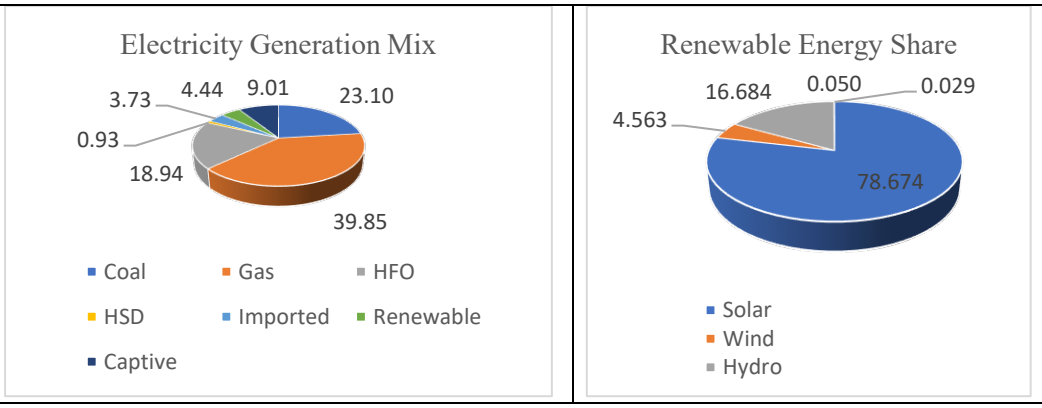
Bangladesh currently incorporates 2.93 percent of renewable energy, amounting to 650.14 MW, within its overall energy mix, while the total installed power capacity stands at 22,215 MW. A substantial portion (48 percent or 10,678 MW) of the total power generation relies on natural gas. The primary renewable resources in Bangladesh, including solar, wind, hydro, and biomass, are determined based on the country's geographical location. As of June 2023, these resources collectively hold an installed capacity of 1,183 MW, constituting 4.5 percent of the total installed capacity. Here, solar power takes the lead, contributing approximately 80 percent, including off-grid and on-grid systems (UN, 2024). Table 4.4 and Figure 4.5 indicate an insignificant contribution (4.4%) of renewable energy to the energy mix and the dominance of solar in the renewable energy segment. Of the different categories, solar home systems, rooftop solar, and solar irrigation remained dominant (Table 4.5).

Table 4.4: Installed Capacity of Energy Sector

Fuel/Resource	Installed Capacity	% Share
Coal	7179	23.10
Gas	12384	39.85
HFO	5885	18.94
HSD	290	0.93
Imported	1160	3.73
Renewable	1378.62	4.44
Captive	2800	9.01
Total	31077	100.00

Note: *Based on SREDA web.*

Figure 4.5: Electricity Generation Mix and Renewable Energy Share



Note: *Based on SREDA web.*

Of Bangladesh's overall power generation based on renewable energy about 39.1 percent of this power is generated by solar-based on-grid power plants, 4.4 percent is generated by wind-based power plants, 14.6 percent by hydropower, and the remaining 41.9 percent is generated by off-grid solar home systems. The private sector generates the highest share of this renewable energy-based power (61.6 percent), followed by the public sector 21.2 percent) and by the joint venture (17.1 percent) (CPD, Policy Brief, 2024).

Table 4.5: Distribution of the Renewable Energy Production

RE Source	Technology	Quantity	Off-grid MWp	On-grid MWp	Total MWp
Solar	Solar Park	11	0	536	536
	Rooftop Solar Except NEM	243	33.14	52.409	85.549
	Net Metering Rooftop Solar	2437	0	110.497	110.497
	Solar Irrigation	3381	54.616	2.742	57.359
	Solar Home System	6037689	263.793	0	263.793
	Solar Minigrid	28	5.805	0	5.805
	Solar Microgrid	0	0	0	0
	Solar Nanogrid	2	0.001	0	0.001
	Solar Charging Station	15	0.275	0.016	0.291
	Solar Street Light	297691	17.104	0	17.104
	Solar Powered Telecom BTS	1933	8.06	0	8.06
	Solar Drinking Water System	82	0.095	0	0.095
Wind	All Wind Projects	4	2	60.9	62.9
Hydro	All Hydro Projects	1	0	230	230
Biogas	Biogas to Electricity	7	0.69	0	0.69
	Biogas Plant	87536	0	0	0
Biomass	Biomass to Electricity	1	0.4	0	0.4
Total		6431061	385.979	992.564	1378.543

Note: *Based on SREDA Web.*

Despite initial targets of generating five percent of its electricity from renewables by 2015 and 10 percent by 2020, as of June 2023, Bangladesh has fallen well short of its goals. In FY2024, 15 renewable energy-based power plants, with a combined capacity of 477 MW, were at various stages of implementation, but none were fully operational on time. Several reasons have fuelled the low priority of renewable energy in Bangladesh. Over-ambitious power demand estimation, absence of smart grid, unjust policy and fiscal incentives for renewable energy, and slow implementation of renewable energy projects are a few of them. Moazzem and Quaiyyum (2024) estimate that 40 percent of the RE by 2041 indicates 14,000 MW of electricity. Considering the current capacity of 1,374MW, an additional 12,626MW worth of renewable energy investment would be required. As per the BPDB, a total of 4,850 MW would be generated from renewable energy-based power generation by 2027. To achieve 40 percent renewable energy by 2041, an additional 7,776 MW worth of renewable energy-based power generation capacity needs to be installed between 2028 and 2041 (CPD, 2023).

There are efforts to estimate the annual investment requirement to attain the nationally determined renewable energy targets. Bangladesh has set ambitious targets to meet 40 percent of its energy needs through renewable sources by 2041. Achieving this will require an estimated investment of $1.5 to $1.71 billion, according to the Center for Policy Dialogue (CPD). According to IEEFA, Bangladesh requires an annual investment of between USD1.53 billion and USD1.71 billion from 2024 to 2041, without considering the cost of grid modernization and storage facilities, to produce 40% of total electricity from renewables. Despite improvement, the financing gap is visible. Small-scale local green entrepreneurs struggle to secure funding due to difficulties in proving creditworthiness, lack of proper documents, and high transaction costs. Banks and finance companies often receive applications without proper documentation, making it difficult to provide loans.

The MCPP aims to achieve a 40 percent RE target by 2041, whereas the IEPMP sets a lower target of 8.8 percent RE by the same year. A notable distinction exists in the IEPMP's inclusion of 'clean energy', often referred to as renewable energy, which considers expensive sources like LNG, ammonia, and CCS. Despite being the directive guidelines, the target of the IEPMP and MCPP differs, and the IEPMP was developed without taking into consideration the energy-mix suggested in the MCPP.

It is to be noted that banks and finance companies need to play a crucial role to ensure adequate investment in the renewable energy sector to attain the nationally determined targets. In the absence of bond market, banks and financial institutions need extensive efforts to attain the targets. The following table is an attempt to estimate the existing financing gap (based on certain assumptions) and indications of future requirements of financing efforts on the part of banks and finance companies of the country.

The estimation considered USD 1.71 billion investment target to attain the goal of 40% RE target by 2041. Table 4.6 reveals a significant yearly financing/investment gap (column 5 and 6) that needs to be covered from other sources or by assigning additional efforts by the banks or finance companies to maintain the required level of investments.

Table 4.6: Estimation of Financing Gap to Attain Nationally Determined Renewable Energy Targets [in Crore BDT]

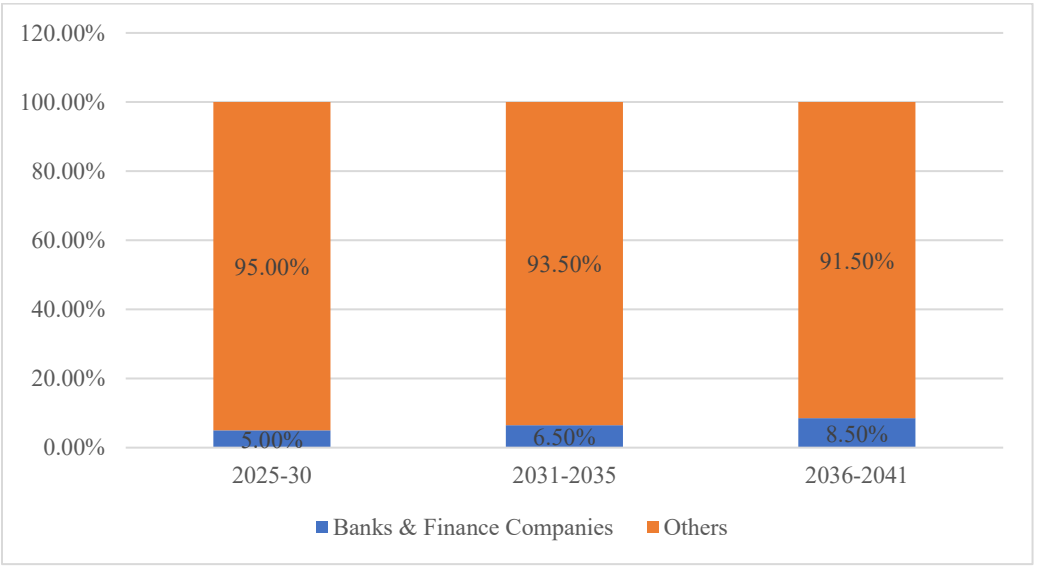
Year	Funding Requirement (Clean/RE-40%)	Funding Requirement (RE-8.8%)	Bank/FI Disbursement to RE	Gap (4-2) RE 40%	Gap (4-3) RE 8.8%
2023	20520	4514.4	742.178	-19777.8	-3772.22
2024	21546	4740.12	816.3958	-20729.6	-3923.72
2025	22623.3	4977.126	898.0354	-21725.3	-4079.09
2026	23754.47	5225.982	987.8389	-22766.6	-4238.14
2027	24942.19	5487.281	1086.623	-23855.6	-4400.66
2028	26189.3	5761.645	1195.285	-24994	-4566.36
2029	27498.76	6049.728	1314.814	-26183.9	-4734.91
2030	28873.7	6352.214	1446.295	-27427.4	-4905.92
2031	30317.39	6669.825	1590.924	-28726.5	-5078.9
2032	31833.25	7003.316	1750.017	-30083.2	-5253.3
2033	33424.92	7353.482	1925.019	-31499.9	-5428.46
2034	35096.16	7721.156	2117.52	-32978.6	-5603.64
2035	36850.97	8107.214	2329.272	-34521.7	-5777.94
2036	38693.52	8512.574	2562.2	-36131.3	-5950.37
2037	40628.2	8938.203	2818.42	-37809.8	-6119.78
2038	42659.61	9385.113	3100.262	-39559.3	-6284.85
2039	44792.59	9854.369	3410.288	-41382.3	-6444.08
2040	47032.22	10347.09	3751.317	-43280.9	-6595.77
2041	49383.83	10864.44	4126.448	-45257.4	-6737.99

Note: *The figures are in crore BDT; exchange rate is adjusted by annual rate of 5% based on the average annual rate of devaluation/deprecitation for last 15 years; RE disbursement data are calculated based on current RE disbursement data of BB considering 10% annual growth; the estimation did not consider debt-equity ratio in the process of RE investment.*

Table 4.7: Estimation of Financing/Investment Coverage by Banks and Finance Companies Align with the National FE Targets [in %]		
Year	40 % of RE/Clean Energy Target	8.8% of RE Energy Target
2023	3.75	19.67
2024	3.94	20.81
2025	4.13	22.02
2026	4.34	23.31
2027	4.56	24.69
2028	4.78	26.18
2029	5.02	27.77
2030	5.27	29.48
2031	5.54	31.32
2032	5.82	33.31
2033	6.11	35.46
2034	6.42	37.79
2035	6.75	40.31
2036	7.09	43.06
2037	7.45	46.05
2038	7.84	49.33
2039	8.24	52.92
2040	8.67	56.87
2041	9.12	61.24
Note: *Authors' Estimation.*		

On the way to attaining 40% RE targets, the existing RE financing by banks and finance companies is lower, even if an annual 10 percent growth rate of RE financing is attained (ranging between 3.75% to 9.12%) between 2023 and 2041. Considering 8.8%, the contribution of the banks and finance companies may surpass 40 percent only after 2035 if the 10 percent growth is maintained (Table 4.6). The estimation clearly reveals significantly higher cumulative investment and financing requirements in the RE sectors by other sources or big push on the part of banks and finance companies.

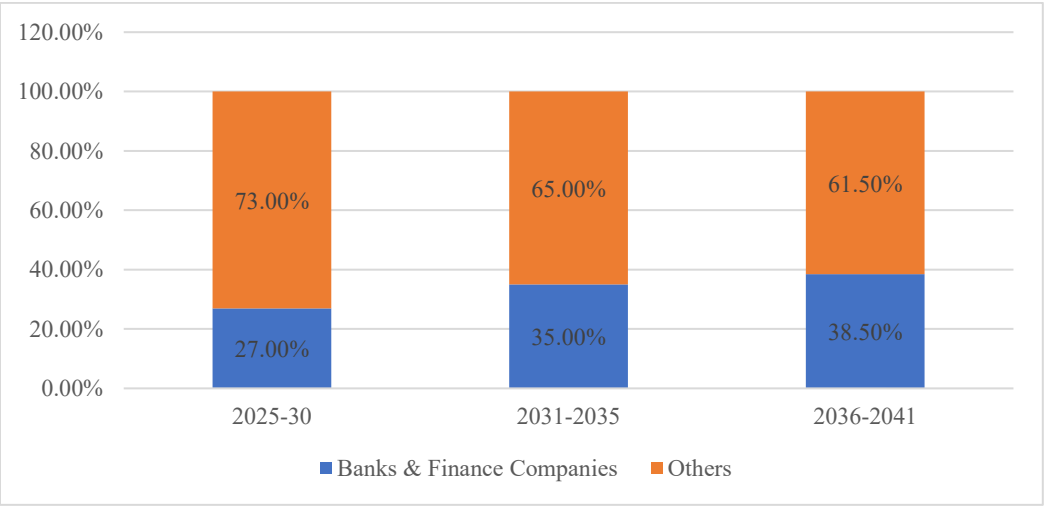
Figure 4.6: Additional Financing Requirements to attain the National RE Goal of 40%



Note: *Authors' Estimation*

The estimated financing requirements indicate huge financing and investment needs from sources other than banks and finance companies, including from the central bank's refinancing. To attain the goal of 40%, 95% of the financing/needs are required to be met during 2025-30 reduced marginally over the following years (if 10 percent renewable energy credit growth is attained (Figure 4.6).

Figure 4.7: Additional Financing Requirements to attain the National RE Goal of 8.8%



Note: *Authors' Estimation*

The financing and investment needs from sources other than banks and finance companies, including from the central bank's refinancing, would be lower if the target is 8.8% (figure 4.7). To attain the goal of 8.8%, over 70% of the financing/needs are required to be met during 2025-30 reduced marginally over the following years (if 10 percent renewable energy credit growth is attained (Figure 4.7). Even drawing 60% of annual investment/financing from the national budget, FDI, and other avenues seems to be a mammoth task.

5. Recommendations and Way Forward

Based on the observations, the paper put forward the following recommendations:

5.1 Aligning the National targets with Clear Strategic Roadmap on Renewable Energy

Both the MCPP and IEPMP are government plans; however, the IEPMP was amended later with an energy plan where the renewable energy-based power generation target is still below 10 percent. It is important to identify a single target and consistency in the policy and planning document. Attaining 40% RE by 2041 may be too ambitious; however, it cannot be below 10 percent if the country targets energy security through sustainable investments. Based on the specific goals, a strategic roadmap is needed covering financing/investment sources and other key issues.

5.2 Coordination among the Key Stakeholders for Efficient Renewable Energy Financing

To formulate strategic goals of renewable energy financing, the country needs further formal coordination arrangements among the Bangladesh Bank, SREDA, and other relevant government agencies. The country's investment and resource planning in the different renewable energy segments need complementary arrangements and cooperation. This is clearly a multi-stakeholder endeavour on both a micro and macro level. International agencies, private stakeholders, and researchers should be part of the formal coordination arrangement.

5.3 Market Competition Structure and Segmentation

A lot to be achieved in renewable energy financing/investment in the country. In the absence of direct mode of financing and a mature bond market, banks and finance companies have a much bigger role to play. Bangladesh Bank may think of fixing specific financing targets for banks and finance companies in the renewable energy financing segment in line with national targets. Considering the differential cost structure of wholesale financing (where applicable), the central bank may think

of market segmentation and responsibility allocation, identifying specific renewable energy products for different groups of banks/finance companies.

5.4 Exploration of New Renewable Energy Products and Markets

The Green Credit Guarantee Scheme might be useful to address credit risk and offer greater confidence in renewable energy technology and entrepreneurship. Piloting and country-level customization would be crucial. It is to be remembered that earlier such initiatives and guarantee schemes either failed to deliver or could not bring much. Lessons from the earlier initiatives might be useful. As part of promoting solar irrigation, the green clustering approach might work for sustainable financing arrangements. For that matter, banks and finance companies need to be incentivized to be engaged in green cluster development. Existing RE funding/financing models may be reviewed/revisited to incentivize based on their costs and benefits.

5.5 Drawing Foreign Director Investment in the Renewable Energy Sector

Though Bangladesh attracted a notable volume of FDI in the energy sector, FDI in the renewable energy sector remains very limited. Fiscal and financial incentives for FDI might require review and reconsideration in line with innovative financing models practiced in the renewable energy sector. China may be targeted to draw foreign investment, considering its experiences and exposure in developing countries.

5.6 Awareness and Financial Literacy on Renewable Energy Technology and Financing

Limited knowledge of the renewable energy market potential and resource needs is among the major challenges. Likely, the customer doesn't have previous experience with solar and biogas, and possibly they have not heard of all of these at all. To overcome the challenge, it is important to invest enough resources in outreach, demonstrations, and training. The supply side (banks and finance companies) also needs to be motivated and incentivized for optimum outcomes.

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Appendices

Appendix A1: List of Renewable Energy Products that are Used in the Other Green Product	
• Net Metering Rooftop Solar System • Solar Grid • Solar Park • Solar Irrigation Pumping System • Solar Photovoltaic (PV) Assembly/Manufacturing Plant • Solar Water Heater Assembling/Manufacturing Plant • Solar Home System • Solar Pump for Drinking Water • Solar Cooker Assembly/Manufacturing Plan • Solar Air Heater & Cooling System Assembly/Manufacturing Plant • Solar Powered Cold Storage • Biogas Plants7 • Integrated Cow Rearing and Setting up of Bio-gas Plant • Wind Power Plant • Hydro Power Plant • Portable Solar Charging Station	• Establishment of Green Industry certified by appropriate authority • Establishment of Green Building certified by appropriate authority • Establishment Green Featured Buildings • Coastal Renewable Energy • Coastal Renewable Energy • Coastal Renewable Energy • Coastal Renewable Energy • Establishment of Green Building certified by appropriate authority • Establishment Green Featured Buildings • Financing in Govt. approved Eco-tourism project • Water purification, • To clean water Coastal Renewable Energy • Coastal Renewable Energy • Coastal Renewable Energy • Rooftop Agriculture/Vertical Farming or Gardening • Rooftop Agriculture/Vertical Farming or Gardening • Coastal Renewable Energy • To Clean Air • Coastal Renewable Energy • Coastal Renewable Energy

Note: *based on SFD, Bangladesh Bank, 2023*

Appendix A2: Prospects and Challenges of Solar Home System

The renewable energy landscape in Bangladesh offers promising avenues through solar home systems, solar irrigation, solar mini-grids, and biogas. Each technology addresses distinct needs within the country's energy infrastructure, yet faces challenges.

Solar Home Systems (SHS): Bangladesh has seen success in rural electrification through SHS. As of March 2024, there are around 60 lakh homes in Bangladesh with Solar Home Systems (SHS). The number of SHS in Bangladesh has declined from 2.25% of the population in 2021 to 1.81% in 2023. This is due to more households being connected to the national grid.

Prospects:

Enhanced Rural Electrification: Bangladesh's SHS program, one of the largest in the world, has provided electricity to millions in rural and off-grid areas, improving the quality of life, reducing reliance on kerosene, and supporting local businesses and education.

Scalability and Technological Advancements: With the continued growth in solar technology, SHS can be further scaled to include more remote regions.

Economic Growth and Job Creation: The SHS initiative has contributed to economic opportunities by creating jobs in installation, maintenance, and sales. Additionally, the renewable energy sector has supported small enterprises, allowing them to operate beyond daylight hours and improve productivity.

Challenges:

Substandard panels: The entry of unregulated, substandard panels into the market has led to a lack of trust in the SHS

User satisfaction: Studies found people are not fully satisfied with the SHS due to high costs, low back-up time.

Maintenance and the cost of replacement: While initial funding and grants have propelled adoption, ongoing maintenance and the cost of replacement parts remain hurdles for long-term viability and affordability in rural households, especially as many still face limited economic resources. Remote areas often face difficulties in accessing repair and maintenance services, as technical expertise is limited in rural regions.

Technical Limitations: The systems typically offer limited power, enough for basic lighting and phone charging but inadequate for heavier appliances. This limits the capacity for SHS to support more intensive economic activities, which could further enhance rural development.

Appendix A3: Prospects and Challenges of Solar Irrigation

Solar Irrigation: Solar irrigation pumps (SIPs) are a promising alternative to diesel pumps in agriculture, which is a significant sector in Bangladesh. Diesel pumps contribute notably to carbon emissions, and SIPs offer a cleaner solution by harnessing solar energy for water pumping.

As of August 2023, there are 2,877 solar irrigation pumps (SIPs) in Bangladesh. These pumps generate 52.29 megawatts (MW) of renewable energy. The dominant player in the sector is IDCOL. They has been instrumental in financing SIPs, intending to install 50,000 by 2027. Barind Multipurpose Development Authority (BMDA), Bangladesh Agricultural Development Corporation (BADC), Bangladesh Rural Electricity Board (BREB) are other key players.[i]

Prospects:

Reduction in Diesel Dependence: SIPs offer a sustainable alternative to diesel pumps, significantly reducing carbon emissions. Diesel-based irrigation currently contributes roughly 4.4% of Bangladesh's annual CO_2 emissions, so SIPs align well with the government's commitment to reduce emissions under the Nationally Determined Contributions (NDCs)

Lower Operational Costs for Farmers: SIPs have lower operational costs than diesel pumps. Farmers pay a service fee to access irrigation, which is more economical and predictable compared to the fluctuating costs of diesel.

Potential for Grid Connectivity: Bangladesh's government has approved policies to connect SIPs to the national grid, allowing surplus energy from pumps to be fed back during off-peak seasons. This approach would maximize SIP utility and support rural electrification goals.

Financial Support and International Backing: Organizations like IDCOL, alongside international partners, provide grants and loans to encourage SIP adoption. These financial incentives reduce the initial cost barrier for farmers and project sponsors, accelerating SIP installation and usage across rural Bangladesh.

Challenges:

High Initial Installation Costs: While operational costs are low, SIP installation remains expensive, which can deter investment. Despite subsidies, the cost of solar PV systems and storage for irrigation purposes is high, requiring a robust financing model.

Underutilization During Non-Irrigation Periods: SIPs are typically active only 110–150 days per year, leading to underutilization for much of the year. Some operators are experimenting with alternate uses, such as running cold storage or mills, but maximizing usage remains challenging. Without access to the grid, much of the energy produced by SIPs during non-irrigation periods goes to waste.

Technical and Maintenance Challenges: Rural areas often lack the technical expertise and infrastructure to maintain solar equipment, which can lead to efficiency losses over time. Regular maintenance is essential, but can be difficult to implement consistently in remote locations.

Dependency on Crop Choices: The success of SIPs depends partly on farmers' crop choices. High water-demand crops like Boro rice drive SIP demand, but fluctuations in crop profitability can impact the revenue collected by SIP operators, which may affect loan repayments and financial viability.

Appendix A4: Prospects and Challenges of Solar Mini Grid

Solar Mini-Grids: For off-grid island and char regions, solar mini-grids supply a decentralized energy solution. As of June 2024, Bangladesh has 22 operational solar mini-grids (SMGs).[ii] IDCOL has financed 20 of the 22 SMGs, and plans to finance 200 more over the next seven years. Commercial finance is also becoming a viable alternative. The government of Bangladesh (GoB) considers SMGs to be an important way to electrify remote areas and reduce carbon emissions. Bangladesh has deployed mini-grids in several remote locations, offering electricity for household and small business needs.

Challenges:
Expansion remains costly, with limited options for scaling due to high installation and maintenance costs, as well as challenges in maintaining consistent power due to weather-dependent solar generation.

The current business model for SMGs has been successful in attracting initial investment, but there are limitations to developing the market at scale. Rural areas of Bangladesh are still poorly connected to the grid, despite a rapid increase in electrification overall.

Appendix A5: Prospects and Challenges Bio-Gas

Biogas: Biogas production taps into agricultural and household organic waste, offering a sustainable energy source for cooking and power. It addresses waste management while reducing reliance on traditional biomass, which contributes to indoor pollution.

Bangladesh, which produces around 124.15 million tons of livestock and urban waste each year, is missing out on the vast potential of organic fertilizer and biogas. The country has a potential of 50 lakh biogas plants, but only 1.5 lakh plants have been built.[iii] However, biogas technology faces obstacles in adoption due to high upfront costs and lack of widespread awareness, especially in remote areas. Scaling biogas solutions would require increased financial incentives and educational campaigns to raise awareness among rural communities.

Prospects

Waste management: Biogas can help with waste management in big cities, where more people are migrating

Energy Independence: Biogas production can reduce dependency on imported fuels by providing a locally produced energy source, which is especially beneficial in remote and rural areas lacking reliable grid electricity. This can improve energy security and provide stable energy for rural households.

Feedstock management: Proper management of biogenic residues, such as livestock manure and food waste, is a challenge

Health and Environmental Impact: Replacing traditional biomass (e.g., firewood and cow dung) with biogas reduces indoor air pollution, which is linked to respiratory diseases. Biogas thus offers a cleaner cooking alternative that benefits both health and the environment.

Challenges

High Initial Investment: Despite its long-term benefits, the initial cost of biogas plants remains a barrier for widespread adoption, especially among low-income households. This high upfront investment often requires subsidies or financing, which can be challenging to secure consistently.

Maintenance and Technical Skills: Effective biogas production requires regular maintenance and some technical knowledge, which may not be readily available in rural areas. Poor maintenance can lead to inefficient gas production, reducing the viability of biogas as a sustainable energy source.

Awareness and Social Acceptance: In some communities, awareness of the benefits of biogas remains low. There may also be cultural reservations regarding the use of biogas derived from animal waste, which can hinder adoption.

Seasonal Variability and Resource Availability: Feedstock availability may fluctuate seasonally, impacting biogas output. Crop residue and animal waste vary by season and location, affecting continuous biogas production.

Other issues: Low methane volumes, Difficulty managing post-digestion slurry, High cost of cattle dung, High labour cost, and civil construction costs.

List of Abbreviations

BOO	Build-Own-Operate
BMDA	Barind Multipurpose Development Authority
BADC	Bangladesh Agricultural Development Corporation
BREB	Bangladesh Rural Electricity Board
CPD	Center for Policy Dialogue
DFI	Development Financial Institutions
ESRM	Environmental & Social Risk Management
EIB	European Investment Bank
FDI	Foreign Direct Investment
Fits	Feed-in Tariffs
FDGs	Focused Group Discussions
GHGs	Greenhouse Gases
KII	Informant Interviews
IEPMP	Integrated Power and Energy Master Plan
IDCOL	Infrastructure Development Company Limited
IDA	International Development Association
IFC	International Finance Corporation
MoPEMR	Ministry of Power Energy and Mineral Resources
NGO	Non-Governmental Organizations
MFI	Microfinance Institutions
PSMP	Power System Master Plan
	Power Purchase Agreements
PKSF	Palli Karma-Sahayak Foundation
SREDA	Sustainable and Renewable Energy Development Authority
SIPs	Solar Irrigation Pumps
SMGs	Solar Mini-Grids
SPV	Solar Photovoltaic
SHS	Solar Home Systems
SOEs	State-Owned Enterprises
WB	World Bank

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