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RENEWABLE ENERGY POLICY IN BANGLADESH: RECOMMENDATIONS FOR ACHIEVING VISION 2041

BANGLADESH ADVANCING DEVELOPMENT AND GROWTH THROUGH ENERGY (BADGE)

February 2023

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This white paper is a deliverable under the United States Agency for International Development (USAID) Bangladesh Advancing Development and Growth Through Energy (BADGE) project. The BADGE project plays a critical role in supporting the Government of Bangladesh's management and transformation of the energy sector, creating an efficient and transparent energy market for long-term investment stability and helping mobilize clean energy finance.

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ACRONYMS

ASEAN	The Association of Southeast Asian Nations
COP26	Conference of the Parties 2021
CO2	Carbon Dioxide
CAPEX	Capital Expenditures
COD	Commercial Operation Date
EPC	Engineering, Procurement and Construction
EU	European Union
ESCO	Energy Service Company
FIT	Feed-in Tariff
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoB	Government of Bangladesh
LNG	Liquefied natural gas
NREL	National Renewable Energy Laboratory
NBR	National Board of Revenue
NDC	Nationally Determined Contribution
NEM	Net Energy Meter
NLDC	National Load Dispatch Center
NDRC	National Development and Reform Commission
OPEX	Operating Expenditure
PV	Photovoltaic
PwC	PricewaterhouseCoopers
PSMP	Power System Master Plan
PGCB	Power Grid Company Bangladesh
RE	Renewable Energy
RPO	Renewable Purchase Obligation
RPS	Renewable portfolio standard
REC	Renewable Energy certificate
RESCO	Renewable Energy Service Company
SE	Sustainable Energy
SPPD	Solar Power Park Developers
SREDA	Sustainable and Renewable Energy Development Authority
TGC	Tradable Green Certificate
UN	United Nations
UK	United Kingdom
WFC	World Future Council

UNIT MEASUREMENTS

BDT	Bangladeshi Taka
GW	Gigawatt
GWh	Gigawatt-hour
Km	Kilometer
kWh	Kilowatt-hour
kWh/m2	Kilowatt-hour per Square Meter
m	Meter
m2	Square Meter
MW	Megawatt
MWh	Megawatt-hour
MWp	Megawatts peak
s	Second
TWh	Terrawatt-hour

EXECUTIVE SUMMARY

This white paper reviews the targets and other facilities specified in various policies to promote utility-scale renewable energy. It also provides recommendations based on sector stakeholder suggestions and best practices.The recommendations will enable the country to satisfy its Nationally Determined Contribution (NDC) goals to reduce greenhouse gas (GHG) emissions and make progress toward reducing its significant reliance on conventional fuels. In the renewable energy policy of 2008, targets for renewable energy generation capacity were set at 10 percent of total demand by 2020. In comparison, the country achieved only 1.01 percent of total demand by 2021.

Global energy demand fell by 4.5 percent in 2020 because of the COVID pandemic. However, the growth of the world's capacity to generate electricity from renewable energy sources increased to 29 percent in 2020 from 27 percent in 2019. Wind and solar capacity expanded by 238 gigawatts (GW), more than doubling any prior expansion in 2021. By 2026, worldwide renewable energy generation capacity is expected to increase by more than 60 percent compared to 2020 levels, reaching over 4,800 GW—equivalent to the current total global power capacity of fossil fuels and nuclear combined.[1] It is well recognized that renewable energy (RE) policies significantly helped to scale up the deployment of RE technologies globally. In addition to these policies, various instruments such as feed-in tariffs (FIT), auctions, and Renewable Energy Portfolio and Renewable Energy Certificate (REC) markets have been widely adopted to boost renewable energy markets globally, as shown in Figure 0 1.

[1] IEA press release: Renewable electricity growth is accelerating faster than ever worldwide. https://www.iea.org/news/renewable-electricity-growth-is-accelerating-faster-than-ever-worldwide-supporting-the-emergence-of-the-new-global-energy-economy

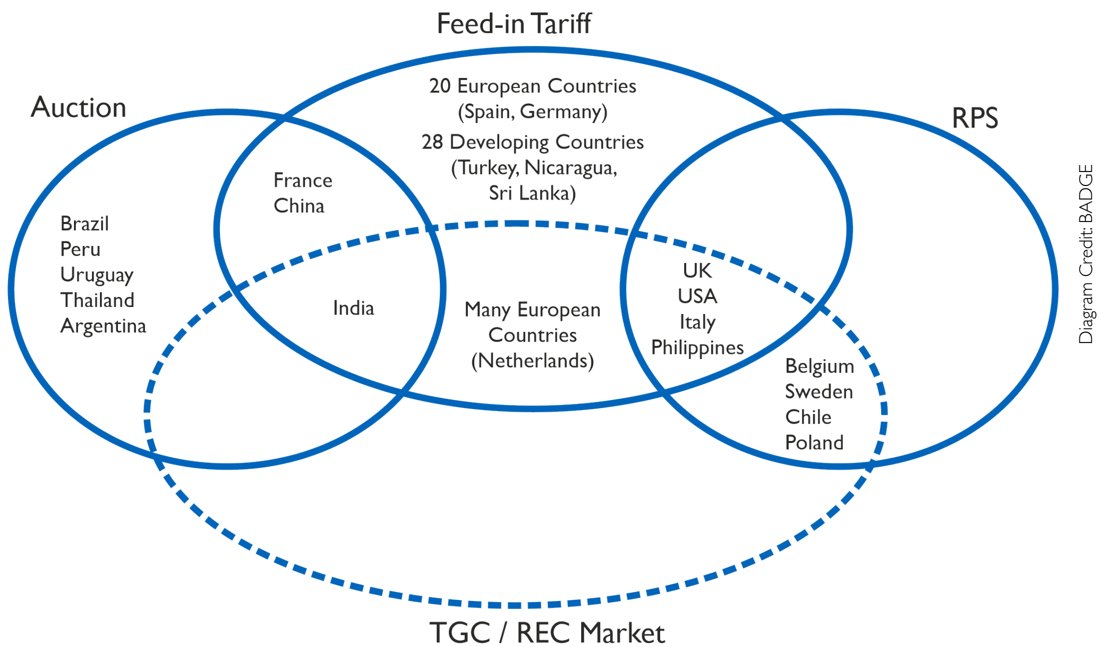

Figure 0 1: Use of RE policy instruments[2]

Bangladesh's power sector still relies on fossil fuels for electricity generation, with only 3.57 percent of total installed capacity coming from renewables, including large hydro, in 2022. Although, hydropower is not even considered a renewable energy in most countries. Natural gas is currently the main fuel used for electricity generation. A British Petroleum (BP) report confirmed that the indigenous gas reserve in Bangladesh will likely last until 2026, considering the remaining reserves and yearly production and growth rate. Therefore, the government is importing liquified natural gas (LNG) to make up the difference. According to the Power Sector Master Plan (PSMP) of 2016, the government plans to increase the number of coal-fired power plants to meet growing electricity demand. Because of the extremely negative environmental impact of expanding coal consumption, the unwillingness of donors and financial institutions to support coal-fired plants, and the rising cost of coal on the international market, the Government of Bangladesh (GoB) is rethinking its plans to build additional coal-fired power plants.[3]

Bangladesh has significant solar energy potential throughout the country due to its geographical location and wind potential along the coastal zone. Several studies depicted below indicate Bangladesh's grid-connected solar PV and wind energy potential.

- According to the World Future Council (WFC), Bangladesh has the potential for 150 GW of utility-scale solar power plants.[4]
- Around 5,000 megawatts (MW) of electricity can be generated by installing solar panels on the rooftops of ready-made garment, textile and other industry buildings in the country.[5]

[2]Almost all countries apply some type of fiscal or financial incentive in parallel to price or quota-based mechanisms
[3]Jahangir, S. Govt to drop nine coal-fired plants. Daily Sun, February 24, 2021. https://www.daily-sun.com/printversion/ details/537552/Govt-to-drop-nine-coalfired-plants."
[4]https://www.worldfuturecouncil.org/wp-content/uploads/2019/10/Summary-for-the-Policy-Makers-100-RE-for-Bangladesh.pdf
[5]The Business Standard. Solar power achievable from industrial rooftops. https://www.tbsnews.net/bangladesh/energy/5000mw-solar-power-achievable-industrial-rooftops-149302

- According to Energy Tracker Asia, 1,500 square kilometers (km^2) of pond space can accommodate 15 GW, and 2,500 km^2 of shallow water regions can accommodate 25 GW of floating solar power plants.[6]
- The National Renewable Energy Laboratory (NREL) demonstrated that an area of more than 20,000 km2 exhibits wind speeds of between 5.75 and 7.75 meters (m)/second (s) with a gross wind potential of over 30 GW.[7]

Bangladesh contributes less than 0.47 percent of global emissions, despite being one of the most susceptible countries to climate change. To address this vulnerability and provide energy security, the Government of Bangladesh has committed to producing 30 percent of electricity from renewable sources by 2030 and 40 percent by 2041, as stated by the Honorable Prime Minister of Bangladesh at the United Nations Conference of the Parties in 2021 (COP26).[8]

Despite its enormous potential, renewable energy still holds only a small share of the market. The lack of enabling policies and government agency cooperation, land scarcity, and the comparatively high initial cost of setting up renewable energy plants are the key roadblocks to large-scale, on-grid renewable energy projects. To meet the ambitious goals for 2041, all roadblocks should be addressed, and the renewable energy policy must be updated and inclusive. This white paper makes recommendations, based on consultation with stakeholders and global best practices, to assist the GoB in handling the challenges and updating policies to meet its commitments and targets.

RENEWABLE ENERGY DEVELOPMENT TARGET

- The target should be achievable as well as attractive for all stakeholders.
- It should cover the short term (5 years), medium term (10-15 years), and long term (to 2050).
- Renewable energy generation factor is lower than conventional power because it is weather dependent. The target should be expressed in terms of electricity generation capacity in gigawatt-hours (GWh) or as a percentage of total demand.
- To meet the goals, both public and private collaboration and participation must be prioritized. Furthermore, the percentage target for generation might be split between the public and private sectors.
- The level and type of target should be determined based on resource availability, techno-economic assessment, social analysis, and stakeholder participation.

STRATEGIES AND INTEGRATED ACTION PLAN

- The GoB must develop a transparent, inclusive, and publicly accessible renewable energy action plan based on long-term scenarios to provide a clear path to achieving the targets.
- The action plan must identify and solve the primary existing restrictions and problems. All necessary levels of stakeholder participation must be ensured in this regard.

[6]https://energytracker.asia/solar-and-wind-power-potential-in-bangladesh/
[7]National Renewable Energy Laboratory (NREL), Assessing the wind energy potential in Bangladesh. https://www.nrel.gov/news/program/2018/assessing-the-wind-power-potential-in-bangladesh.html
[8]Mujib climate prosperity plan 2030. https://mujibplan.com/

- Strategies and action plans should be integrated with relevant development plans at the national level, such as power generation, transmission, and economics, among others. These plans should be updated and coordinated on a regular basis to keep up with the needs and changes of other important development plans.

RENEWABLE PURCHASE OBLIGATIONS (RPO)

- The renewable purchase obligation (RPO) is a mechanism by which the Electricity Regulatory Commissions oblige entities to purchase a certain percentage of power from renewable energy sources. This framework needs to be introduced in the renewable energy policy.
- Current obligations are applicable only for new consumers. This needs to be updated to include existing consumers with demand over 50 kilowatts (kW) under the mandate.
- Utilities are considering net-metering as a threat to their business model. Therefore, utilities are not showing interest to purchase RE electricity through net-metering. To ensure the quality and continuity of supply of electricity from rooftop solar system, the government should bring the utilities under obligation.
- To fulfill the 2041 RE target, fossil fuel electricity generation companies in both the public and private sectors must now be included in the renewable purchase obligation, as they represent the country's main source of power generation. To achieve the target from renewable obligation, renewable energy certification could be introduced by a national load dispatch center (NLDC) for power generation and distribution companies and by distribution companies for end users.

FEED-IN TARIFF (FIT)

- A feed-in tariff is one of the most extensively utilized incentive programs for promoting renewable energy generation. Its design allows for a lot of flexibility. It can be designed based on the cost of the investment, the location, and the generation technologies. The government can set eligibility, contract duration, purchasing obligation, and capacity on its own. Furthermore, the tariff level can be set based on market conditions, with the option of promoting certain renewable energy technologies, innovations, or regional renewable energy development.
- Investment cost is very high in Bangladesh compared to other countries. The government should design tariff levels that allow a payback period shorter than the length of the agreement.
- Costs to generate electricity differ depending on the renewable energy source (solar, wind, hydropower, among others). Payments should be adjusted accordingly to enable diversity of renewable energy technologies.
- The tariff should be designed to encourage the proliferation of innovative technologies, such as rooftop solar photovoltaic (PV) panels that preserve open spaces.
- A variety of project sizes and locations should be incorporated. For instance, tariffs for smaller projects are usually higher. Feed-in tariffs should vary according to each country's unique energy pricing structure and capacity.

NET METERING

- The 10-megawatt (MW) maximum capacity restriction should be eliminated from the net energy metering (NEM) guidelines.The consumer should be allowed to install 70 percent of the load that has been sanctioned.Through the NEM guidelines, factories in industrial parks, economic zones, and export processing zones would be able to install solar systems.
- The operating expenditure (OPEX) model approach runs the risk of the industry guaranteeing payment. For the OPEX model, a tri-party agreement needs to be signed between the prosumer, utility, and Renewable Energy Service Company (RESCO). The utilities can therefore compel the industry to pay the RESCO, lowering the risks involved in the OPEX model.
- By paying a wheeling charge[9] to the utility, an OPEX operator cannot sell excess electricity to any other user. By paying a wheeling charge to the utility or grid operator, a NEM customer can send excess electricity anywhere in the country.
- For the first 15 years of their commercial operation date (COD), independent power producers who sell power to the national grid receive a tax exemption on their earnings from selling power. To incentivize NEM OPEX operators, a comparable tax exemption should be granted on their earnings.
- Similar incentives should be granted to the NEM engineering, procurement, and construction (EPC) contractor and the NEM OPEX operator who sell power to the national grid and receive import tax or duty waivers on any power plant equipment and spares.
- Because the utilities perceive net-metering as a danger to their business model, they see no motivation to embrace it other than the responsibility to do so. A carbon credit facility should be provided to the utility to incentivize them to accommodate NEM systems.

COST REDUCTION POLICIES

- Renewable energy projects are awarded through a solicitation process rather than an unsolicited proposal, which takes more time and involves additional costs.
- The government can identify and establish competitive renewable energy zones. The government can appoint a single agency to locate, acquire, and develop land and other infrastructure for designated RE zones. The government will either recover the expenditures through a lease agreement with the project developers or alter the costs by purchasing electricity at a reduced rate. In addition, the agency also will be responsible to arrange permission and/or approval from government agencies or departments. The Power Grid Company of Bangladesh (PGCB) and the agency will work together to extend the national grid to the zones.The agency will coordinate with PGCB for extending the national grid to the zones.
- The Sustainable and Renewable Energy Development Authority (SREDA) was founded by the government as a coordination agency for the development of renewable energy in the country. Under SREDA, the government may create an online single-window platform. The project developers will submit all required documentation online, and SREDA will work with the appropriate ministry or agency to obtain approval or clearance.

[9]"Wheeling charge" refers to the fees paid to transport electricity from a power plant to the end consumers.

INSTITUTIONAL ARRANGEMENT AND IMPROVED COORDINATION AMONG STAKEHOLDERS:

- SREDA's institutional capability must be increased as a nodal organization for promoting, facilitating, and disseminating sustainable energy.
- SREDA should also take responsibility for minimizing coordination gaps between entities for renewable energy project development and work to reduce permitting time and accelerate the implementation of projects.
- SREDA should launch a "one-stop service" for the private sector to obtain useful renewable energy project information, requirements, and resource data that enable developers to produce better quality bids in a timely manner.
- SREDA should collaborate with academic institutes and others relevant stakeholders and work together toward improving its policies, institutional arrangements, business models, financing instruments, and incentive programs. SREDA should also address the gender and social inclusion during the policy revision.
- A Renewable Energy Division under the Ministry of Power, Energy and Mineral Resources should be established to help the government achieve its COP26 targets by 2041.
- The government should promote robust community engagement to mitigate the impact of land acquisition on local individuals (men, women, boys, and girls) and socially marginalized groups; compensation schemes may be required, as appropriate.
- The government should also consider creating employment opportunities for the men, women, and individuals from marginal groups who are displaced because of land acquisition.

LAND ACQUISITION GUIDELINE

- The government should consider conducting a land study to identify land use possibilities for utility-scale renewable energy. The benefits of using public land, finding land with lesser agricultural value, and understanding any advantages of designating zones for renewable energy projects should all be included in the study.
- A clear definition and description of the type of land that can be used for RE projects needs to be written into the policy.
- With a coordinating district commissioner office, the government should allocate one agency or institute to deal with assisting developers in obtaining or leasing land.
- The government plans to develop one hundred economic zones that will be designated as renewable energy zones. By utilizing various types of solar PV and wind energy technologies, the government may be able to meet its demand without occupying additional land and with less transmission infrastructure development.
- The government should develop solid guidelines for land acquisition, as many developing countries have done. India's Jawaharlal Nehru National Solar Mission[10] could serve as an example.

[10]Solar Park Guidelines. https://policy.asiapacificenergy.org/sites/default/files/Solar-Park-Guidelines.pdf

RENEWABLE ENERGY RESOURCES, TECHNOLOGY, AND POTENTIAL

- The government should conduct resource potential analyses that identify zones for renewable energy project development while also considering other factors including land availability, road access, and grid expansion plans. At the local level, the indicated zones can be targeted for resource data collection points.
- To strengthen local capacities and competencies, government-led programs should increase collaboration between international agencies, local academic institutions, and research organizations while performing renewable energy resource studies.

INTRODUCTION

BACKGROUND

The GoB has achieved extraordinary gross domestic product (GDP) growth of more than 6 percent yearly over the last decade and has set an ambitious goal of becoming a developed nation by 2041. This has necessitated the development of new power producing capacity. Total power supply increased from 29,247 gigawatt-hours (GWh) in 2010 to 80,243 GWh in 2021, with a projected requirement of 307,000 GWh by 2041. To meet demand, the PSMP 2016 estimates that the country will need to add 60,000 MW of new capacity by 2041. Bangladesh will do this primarily using traditional generation technologies such as domestic natural gas, imported liquefied natural gas (LNG), local and imported coal, nuclear power, renewables, and cross-border electricity imports, as outlined in the PSMP 2016.

Due to a lack of indigenous natural gas, the government has expanded generation by importing LNG, furnace oil, and imported coal, as well as increasing the amount of power imported from a neighboring country. To satisfy future energy demand and assure energy security, reliability, and affordability, which is the GoB's aim, it is necessary to boost the use of indigenous energy resources while lowering import dependence. The Bangladesh Power Development Board (BPDB) has prepared a generation plan that involves the installation of 37,500 MW of new capacity by 2030, after considering the decommissioning of existing plants, in order to fulfill the PSMP 2016's anticipated future generation capacity of 40,000 MW. The BPDB has already made headway on a procurement plan in accordance with the PSMP, albeit there is no provision for RE generation, which is surprising. By 2030, 14,500 MW of coal-fired power plants will be built, according to the BPDB's generating plan. Because of the high environmental effect, the unwillingness of donors and financial institutions to support coal-fired plants, and the rising cost of coal on the international market,[11] the GoB has begun rethinking its plans to build additional coal-fired power plants.

[11]Jahangir, S. Govt to drop nine coal-fired plants. Daily Sun, February 24, 2021. https://www.daily-sun.com/printversion/ details/537552/ Govt-to-drop-nine-coalfired-plants."

Renewable energy technologies are rapidly becoming an important part of the energy system, and they have recently accounted for the world's largest power capacity additions. For power production, heating, cooling, and transportation, policies to assist renewable energy adoption have been widely established. Climate change mitigation, energy security, energy system flexibility, energy system resiliency, and economic development have been the key drivers of these initiatives. Renewable energy support programs had been established in over 146 countries by the end of 2015. However, as renewable energy technologies have become more cost-competitive and widely deployed, policymakers have begun to concentrate their efforts on adapting existing policies to reflect the rapidly changing economics of these technologies and the potential impacts on the energy systems in which they are deployed. Integration of policy mechanisms, linkage between electricity, heating/cooling, and transportation sector policies, and the creation of new mechanisms to integrate growing amounts of renewable energy into energy systems are all recent themes in renewable energy policy.

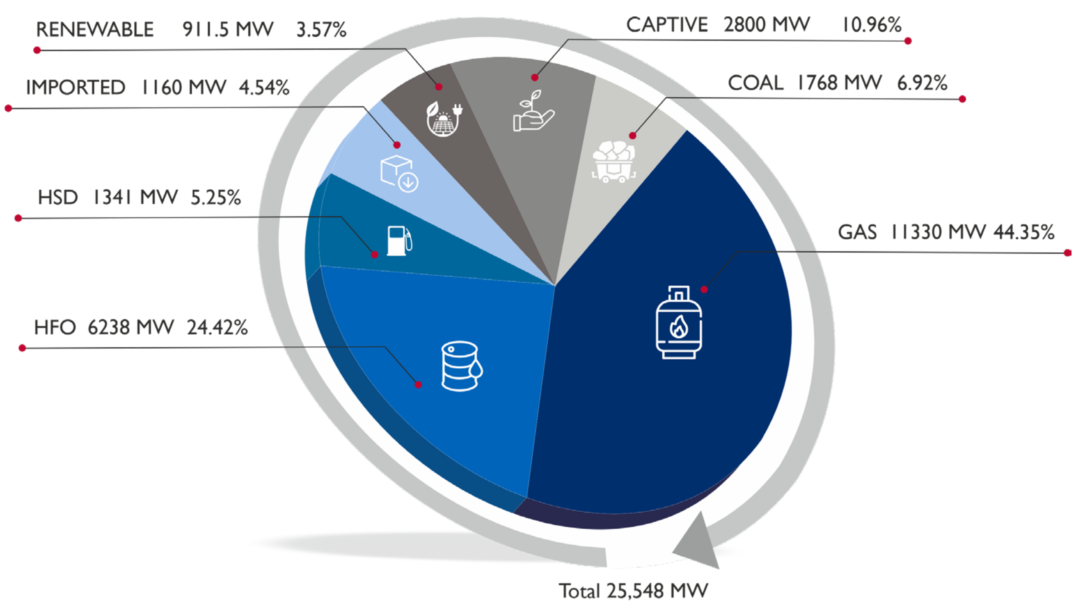

Table 1 1: Fuel-wise electricity generation capacity mix

Renewable energy resources account for only 3.57 percent of total installed capacity as of September 2022, with one huge 230 MW hydropower facility and 321 MW on-grid solar in Bangladesh. The remainder comes from off-grid solar systems, which are essentially obsolete because nearly all places are now connected to the national grid. To expand the amount of utility-scale RE in Bangladesh, the government has implemented several policies that establish goals for increasing RE installed capacity:

- 10 percent share of RE-based power generation capacity by 2021 (PSMP 2016);
- 2470 MW equivalent to 10 percent share of RE based power generation capacity by 2021 (PSMP 2016);
- Bangladesh's NDC to reduce GHG emissions by implementation of renewable energy projects of 911.8 MW (unconditionally) and by 4114.3 MW (with international support) by 2030[12]; and

[12]MOEFCC, Bangladesh National Determined Contributions 2021. http://nda.erd.gov.bd/en/c/publication/nationally-determined-contributions-ndcs-2021-bangladesh-updated

- 30 percent share of VRE-based power generation capacity by 2030, 40 percent by 2041, and 100 percent by 2050 (Mujib Climate Prosperity Plan 2030).

There is no genuine connection between policies and pledges, and it is unclear what RE strategy and target the GoB will pursue in the end. To meet demand, an additional 15,000 MW of installed generation capacity in the public, private, joint venture, and import sectors will be required by 2030. While 12,967 MW are now under construction, 3,404 MW are in the planning stage, and 333 MW are in the tendering stage, all of which will be operational by 2026. Any extra fossil fuel capacity will lock Bangladesh into a carbon-intensive future, leaving it unable to reach its renewable energy objective and international commitments.

Bangladesh is one of the countries most affected by climate change because of high global greenhouse gas emissions. Despite being the world's lowest emitter, Bangladesh has pledged in its updated NDCs to cut GHG emissions by 6.73 percent, or 27.56 million tons, without conditions, and by 15.12 percent, or 61.9 million tons, with international technical/financial assistance, by 2030. Bangladesh reported total GHG emissions of 169.06 million tons in 2012, with the energy sector accounting for 55.07 percent of total emissions, or 93.09 million tons. Bangladesh's NDC is expected to rise to roughly 409.41 million tons by 2030, with the energy sector contributing 312.54 million tons, or 76.34 percent. To meet the target, Bangladesh will cut 96.4 percent of emissions from the energy sector, which includes power, transportation, industry, residential, commercial, agricultural, brick kilns, and fugitive emissions, and the remaining 3.6 percent from cement and fertilizer, agriculture and livestock, forestry, municipal solid waste, and wastewater.[13]

Bangladeshi policy framework for the energy sector is gender-blind and not socially inclusive. While some instruments—such as the Power System Master Plan of 2016, the Renewable Energy Policy, and the Country Action Plan for Clean Cookstoves—recognize the importance of working with rural communities and mostly women. The documents do not address the impact of complex gendered dimensions or other intersecting identities on access to affordable energy and the goal of inclusive development.

Renewable energy development is one of the most effective ways to advance energy security, long-term sustainability, and lower GHG emissions from the energy industry. At COP26, Bangladesh's prime minister announced a renewable energy target of 40 percent by 2041, which is included in the Mujib Climate Perspective Plan 2041. In 2008, the government announced a renewable energy policy with the goal of meeting 10 percent of total demand by 2020. Although the period ended with only a 1.24 percent achievement (including hydro), Bangladesh has faced numerous issues that need to be addressed and incorporated into policy. This report includes recommendations on how to proceed based on stakeholder engagements and worldwide best practices.

RE POLICY 2008

The Renewable Energy Policy, issued by the Government of the People's Republic of Bangladesh, defines the necessity for the country to develop renewable energy technology. Indeed, in Bangladesh efficient utilization of renewable energy resources is yet to assume commercial dimensions and hence rational policy dissemination on renewable energy usage is essential. The renewable energy includes solar, wind, biomass, hydro, geothermal, and tidal wave. The following content is explored in the policy: objectives, institutional arrangements, resource technology and program development, investments

[13] Ibid.

and fiscal incentives, and regulatory policy.

Intended policy actions from the RE Policy 2008 are listed below:

- Promote appropriate, efficient and environment friendly use of renewable energy through harness the potential of renewable energy potential.
- Create enabling environment and legal support to encourage the use of renewable energy.
- Develop financing mechanisms and facilities by using grant, subsidy, and/or carbon/clean development mechanism (CDM) fund for public and private sector investments in all forms of sustainable energy.
- Renewable energy project investors in both the public and private sectors should be exempt from corporate income tax for a period of five years.
- An incentivized tariff may be considered for electricity generated from renewable energy sources; the tariff may be 10 percent higher than the highest purchase price of electricity by the utility from private generators.
- All renewable energy equipment and related raw materials used in manufacturing renewable energy equipment will be exempt from the applicable 15 percent VAT rate.

Due to the lack of experience when the policy was formed and more than a decade of delay before implementation, renewable energy's contribution to power generation is very low. The challenges encountered should be addressed in the revised policy, and the policy should be enacted promptly to scale up renewable energy on a broad scale.

The white paper of challenges in the development of variable renewable energy in Bangladesh under USAID-SURE project. The report is available via a link https://pdf.usaid.gov/pdf_docs/PA00WPXQ.pdf on the USAID website. This white paper identifies the most critical challenges hindering the development of grid-connected variable renewable energy in Bangladesh and outlines specific solutions that sector stakeholders can act on in order to spur growth in grid-connected renewables. The following recommendation in the next chapter will assist to update the renewable energy policy.

RECOMMENDATIONS

RENEWABLE ENERGY DEVELOPMENT TARGET

Renewable energy targets serve as key drivers for accelerating renewable energy projects. The Government of Bangladesh has declared a short-term and mid-term renewable energy target for developing renewable energy in the country: 5 percent of the total demand by 2015 and 10 percent by 2020 per the renewable energy policy of 2008. Before that, in 2000, the GoB declared a vision of electricity for all by 2021.[14] Due to the high cost and low efficiency of PV modules, which led to huge land requirements per MW, the GoB focused on solar rooftop and mini-grid technology to advance universal electricity access. In just a few years, the government has successfully installed more than 5 million solar home systems and 27 mini-grid projects.

The government set a renewable energy development target of 2,470 MW, or 10 percent of installed capacity, by 2021 and 3,864 MW by 2041 in the Power System Master Plan, which was released in 2016. Because of land availability and weather circumstances, the maximum renewable energy indicated by the PSMP 2016 is up to 3,700 MW, which would generate 4,200 GWh of electricity. When compared to the overall energy generated by the grid, this is a little quantity (estimated 307,000 GWh in 2041).[15] A recent analysis found that Bangladesh has a large amount of renewable energy potential (both solar and wind). At COP26, Bangladesh's Prime Minister expressed his intention to develop renewable energy sources for up to 40 percent of power generation by 2041.[16] Despite

[14]RE policy 2008
[15]PSMP 2016 revised
[16]The Business Standard News. Momen seeks IRENA's support for mapping renewable energy potentials (tbsnews.net). https://www.tbsnews.net/bangladesh/energy/momen-seeks-irenas-support-mapping-renewable-energy-potentials-369955

this, neither of the policies includes gender equality and social inclusion into consideration.

Renewable energy targets, however, are not sufficient on their own. They are an important indicator of the direction of travel, and especially when enshrined in legislation, they can provide some degree of policy certainty for investors. Renewable energy targets should be attractive for all types of stakeholders and achievable. Targets should be distributed for both the public and private sector. The renewable energy generation factor is lower than conventional power because it is weather dependent, so the target should be expressed in terms of generation capacity in megawatt-hours (MWh) or as a percentage of total demand. Setting renewable energy targets is not always a scientific, sequential process. But the process of setting targets has been very comprehensive, beginning with an assessment of resource availability and costs, balancing costs with benefits and overall objectives, relying on sound data and analysis, and involving a wide range of stakeholders before deciding the level and type of target. In some countries, renewable energy targets have been set based on less rigorous processes and/or specific stakeholder interests. Because every country is shaped by different dynamics and conditions, there is no generic methodology for setting renewable energy targets.

The government should set ambitious, but realistic, renewable energy targets according to the following principles :[17]

- Targets should cover the short (5 years), medium (10-15 years), and long term (to 2050).
- Targets should be set for all sectors: electricity, heating and cooling, and transport.
- Enshrining renewable energy targets in primary legislation can add certainty.
- Renewables targets should be set with a clear purpose in mind (such as CO2, air pollution reduction, or energy security) and align with other strategic policy goals to avoid perverse outcomes.
- The target should address the energy needs of men, women, children, and people from socially marginal groups.

Targets for renewable energy have become a defining aspect of the global energy environment. As of mid-2015, 164 countries had set at least one form of renewable energy target, up nearly fourfold from 43 countries in 2005.[18]

Table 2 1: Renewable energy share and targets in different regions and countries

COUNTRY	CURRENT SHARE (%)	TARGET (%)	YEAR
USA	23	100	2035
EU	20	35	2030
UK	40	100	2050
ASEAN	17	23.2	2030
China	18	35	2030
India	21.4	40	2030
Philippines	22	35	2030
Thailand	14.5	30	2037

[17]IEA, Renewable Energy policy recommendation
[18]IRENA: Renewable energy Target setting 2015: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Target_Setting_2015.pdf

Because targets were set in a timely manner, India's renewable energy growth has been exceptional. The Government of India (GoI) established lofty renewable energy objectives of 175 MW by 2022, which increased to 227 GW in 2018, and a new goal of 275 GW by 2027. Based on continuous successful installations of RE projects, the Government of India announced a new target of 500 GW of renewable electricity capacity by 2030 at the United Nations' Climate Summit in New York on September 23, 2019.19 Grid-connected renewable electricity capacity at the end of December 2021 was 151.4 GW, with solar PV accounting for 49.34 GW, onshore wind accounting for 40.08 GW, large hydro accounting for 46.51 GW, and small hydro and biofuel accounting for the rest.[20] China continues to dominate the world in new capacity additions, with 1,200 GW of total wind and solar capacity planned in 2026, four years ahead of its current target of 2030. In September 2007, China's National Development and Reform Commission (NDRC) released its Medium- and Long-Term Development Plan for Renewable Energy. China established a goal of increasing renewable energy's share of total primary energy consumption to 10 percent by 2010 and 15 percent by 2020. China has reached renewable energy installation capacity of 680 GW by 2020, which is more than a 15 percent share of total capacity.[21] China has announced intensive target of 85 percent of all energy and more than 90 percent of total electricity consumption from solar, wind, and nuclear energy by 2050 and carbon neutrality by 2060.[22]

The Association of Southeast Asian Nations (ASEAN), established in October 2015, set a regional aspirational target of 23 percent renewable energy in total primary energy supply by 2025, up from slightly under 10 percent in 2014.To meet this goal, ASEAN members have divided the target into four sectors: power, transportation, industry, and construction, each with a different proportion.

STRATEGIES AND INTEGRATED ACTION PLAN

Setting goals is a crucial first step toward further renewable energy production. It aids in attracting key stakeholders to the sector by grabbing their attention. The methods and action plans that will be used to attain the goals must be detailed. These should include a development strategy based on a resource evaluation and an acknowledgement of the current state of technology development and implementation in the country. These should be integrated with other development plans at the national level, such as the electricity generation, transmission, and economic plans, among others. These plans should be revised on a regular basis to reflect changing demands and other relevant development plans.

The social impacts can be addressed both in price-only and multi-criteria auctions. In a price-only auction, policymakers define social impact requirements that projects need to meet to qualify for the auction. Then, for projects that meet these social impact requirements, the award of an electricity supply contract or incentive is decided based on price only. Price-only as an award criterion can be more transparent, while ensuring that awarded bids meet the requirements defined.

Bangladesh's government published a Renewable Energy Policy in 2008. Following that, the GoB released solar park development guidelines in 2013, net-metering guidelines in 2018, and a solar energy roadmap in 2021. Through the Power System

[19]India 2020 Energy policy review by IEA

[20]National investment promotion and facilitation agency. https://www.investindia.gov.in/sector/renewable-energy

[21]China. 13th renewable energy development five-year plan 2016-2020. https://www.iea.org/policies/6277-china-13th-renewable-energy-development-five-year-plan-2016-2020

[22]China energy institute present new net-zero scenarios by 2050. https://energypost.eu/chinese-energy-institutes-present-new-net-zero-scenarios-for-2050/

Master Plan 2016 (PSMP 2016), the Government of Bangladesh has set a new target for 2041 that is quite low in comparison to the country's demand. SREDA established a five-year renewable energy development plan based on the PSMP 2016 target, which did not correspond to the BPDB generation plan or the PGCB transmission line extension plan. So far, overall renewable energy production has reached 787.3 MW, with 434.36 MW on-grid and 230 MW hydro.[23]

The best practice strategies and action plans for renewable energy should:

- Be formulated based on long-term scenarios to provide a clear trajectory towards the achievement of the targets.
- Identify barriers and measures to overcome them.
- Be clearly linked to the entire national energy plan to achieve strategic goals like energy security and CO2 reduction.
- Involve all relevant levels of governance (e.g., national and local authorities).

RENEWABLE PURCHASE OBLIGATIONS

Renewable purchase obligations (RPOs) require power generation companies (both public and private), distribution companies, and other medium and large electricity consumers to purchase or generate a certain percentage of electricity from renewable energy sources to meet their generation, distribution, and consumption targets. Bangladesh had a total generation capacity of roughly 25 GW by the end of February 2022, with only 787.3 MW coming from renewable energy sources. Many organizations are involved in the production of power from fossil fuels, while just a few are interested in the renewable energy sector. Many of the organizations who expressed interest in renewable energy are new to the Bangladesh energy industry. Bangladesh's renewable energy market is still in its infancy, making development extremely difficult. To meet an ambitious renewable energy target, all power producing businesses (public and private) have been required to generate a set percentage of electricity from renewable energy sources to meet demand.

Due to the scarcity of available land, maximum utilization of roof space (including public and private buildings) is required to increase the contribution of renewable energy in terms of electricity generation. The GoB introduced rules in 2010 requiring mandatory rooftop solar power systems for consumers who wish to obtain new domestic, industrial, and commercial electricity connections from the grid system. These rules aim to boost the share of renewable energy in the country's total energy mix. According to the existing guidelines, household consumers need to have at least 3 percent of solar power generation capacity against their total demand, while industries and commercial consumers whose demand exceeds 50 kilowatts need to have at least 10 percent.[24] The guidelines should be modified to include all consumers who already are electrified and to increase the percentage from 3 percent to 10 percent to boost the RE contribution. In most residential, commercial, and industrial consumers, the roof space allows for much more production than the requirement. Utilities could use the space properly once the renewable obligation has been imposed on distribution companies, and a certain percentage of electricity distributed from renewable energy sources to meet the demand.

To meet the target from renewable obligation, renewable energy certification could be introduced by a national load dispatch center for power generation and distribution companies and by distribution companies for end users.

[23]SREDA, National Renewable Energy Data Base

[24]The business standard. Rooftop solar panels are now junk. https://www.tbsnews.net/bangladesh/energy/rooftop-solar-panels-are-now-junks-176203

Under the support of the renewable obligation scheme, the United Kingdom experienced rapid growth in electricity generated from renewable sources. From 2006 to 2020, electricity generated from three main renewable sources (wind, solar, and biofuels) increased from 14.17 terawatt-hours (TWh) to 127.84 TWh, representing 3.56 percent to 40.97 percent of total electricity generation. Wind generation increased from 4.26 TWh in 2006 to 75.37 TWh in 2020, representing 1.07 percent to 24.16 percent of total electricity generation.

FEED-IN TARIFF (FIT)

Feed-in tariffs (FITs) are the most extensively adopted policy for accelerating the deployment of renewable energy, accounting for a larger share of RE development than other policies.[25] FITs have resulted in a large increase in RE deployment, propelling nations that have effectively implemented them to the forefront of the global RE market. Between 2000 and the end of 2009, FIT regulations in the European Union (EU) resulted in the deployment of more than 15 GW of solar photovoltaic (PV) electricity and more than 55 GW of wind power.[26] FITs account for over 75 percent of global PV deployment and 45 percent of global wind deployment. Countries like Germany have shown that FITs may be an effective policy tool for accelerating RE deployment and achieving combined energy security and emissions reduction goals.[27] Many European countries, the United Kingdom, the United States, and more than 26 developing countries have introduced FIT policies in various forms to boost RE development.[28]

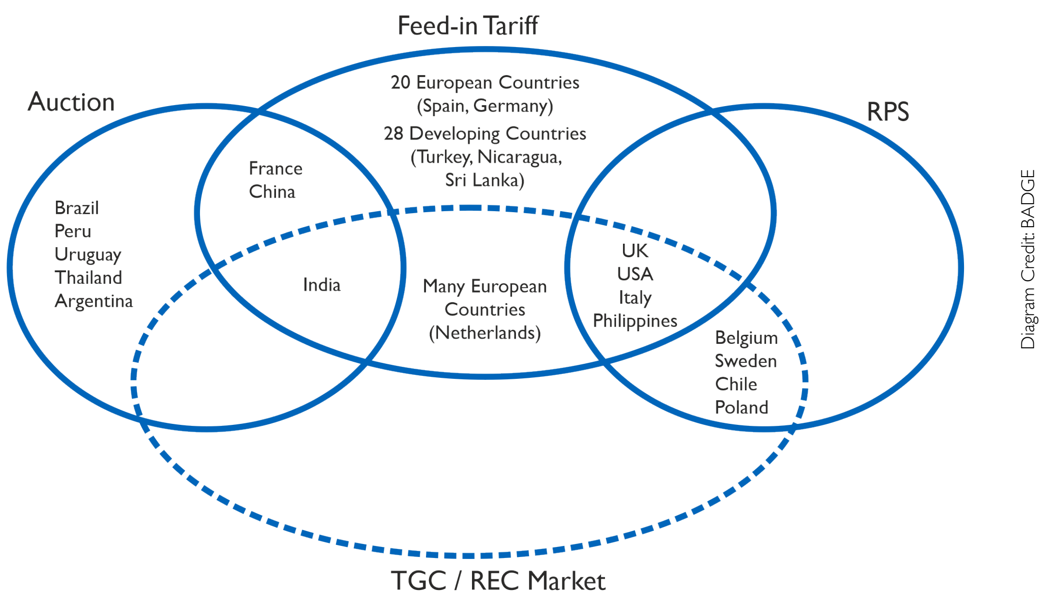

Figure 2 1 Use of RE policy instruments[29]

[25]Renewable Energy Policy Network for the 21st Century (REN21). (2009). Renewables Global Status Report: 2009 Update, Paris: REN21 Secretariat.
[26]This figure for PV refers solely to grid-connected systems
[27]National Renewable Energy Laboratory (NREL). A Policymaker's Guide to Feed-in Tariff Policy Design.
[28]World Bank: Design and Performance of Policy Instruments to Promote the Development of Renewable Energy. https://documents1.worldbank.org/curated/en/727261468182043383/pdf/632140WP0Desig00Box0361508B0PUBLIC0.pdf
[29]Almost all countries apply some type of fiscal or financial incentive in parallel to price or quota-based mechanisms

In the United Kingdom, the FIT scheme is primarily used to assist small-scale generation. Different states in the United States have also implemented FITs in various forms to encourage residential and business rooftop solar projects. In March 2013, the Virginia State Cooperation Commission approved the FIT for residential and commercial solar photovoltaic systems. Participants will earn 15 cents per kilowatt-hour (kWh) for all PV-generated electricity sent to the grid throughout a five-year contract term and will continue to pay the retail rate for all electricity consumed. Residential users paid an average of 10.5 cents per kWh in 2012, while commercial customers paid 7.8 cents per kWh. As part of its post-Fukushima policies, Japan enacted a new FIT in 2012 with especially high PV tariff rates (above 40 cents/kWh). The ASEAN member countries have adopted FIT policies as one of the key instruments for solar power to achieve a 23 percent share of renewable energy in the energy mix by 2025.

A FIT is a performance-based incentive rather than an investment-based incentive. It resembles production tax credits and renewable energy credits in the Renewable Purchase Obligation market more than investment tax credits or other investment subsidies in that regard. FITs are frequently utilized in conjunction with one or more of these additional incentives in the United States.[30]

FIT programs are identical to net-metering programs except for one major difference: the power generated by a utility customer's system is compensated at the FIT's rate rather than the retail electricity rate. This generating is handled separately from the customer's own power consumption, which is invoiced at the utility's standard retail rates. A utility customer is essentially paid the retail rate for any generation that is fed back into the grid in a net-metering program.

Feed-in tariff rates that result in significant incremental renewable energy investment are typically set higher than the retail cost of electricity. The premium amount may be determined by the motivation and aims of the program: FIT schemes with more ambitious goals (for example, an explicit capacity target or a particular number of renewable energy credits to achieve an RPO or to foster a domestic renewable energy industry) may need to set the rate significantly above the current retail price.

NET METERING

By 2017, 55 nations, including Australia, Canada, China, the European Union, Japan, and the United States, had implemented the net energy meter (NEM) policy mechanism to support distributed renewable energy generation. NEM's most popular technology is solar PV. Net-metered solar PV applications are growing in popularity around the world, with global installations expected to more than double from 2019 to 530 GW by 2024.

[30] https://www.eia.gov/todayinenergy/detail.php?id=11471#:~:text=Participants percent20will percent20receive percent2015 percent20cents, all percent20electricity percent20that percent20they percent20consume.

Net Metering Benefits

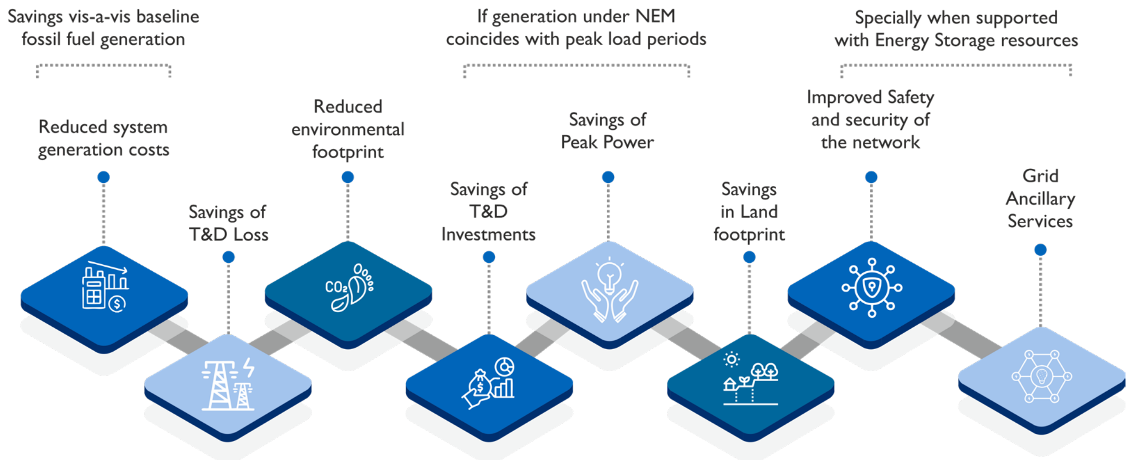

Figure 2 2: Benefits of net-metering guidelines

Bangladesh has a lot of potential to incorporate rooftop solar into industrial hubs, such as economic zones and export processing zones, to meet aggressive renewable energy targets. In 2018, Bangladesh implemented a net-metering policy aimed at the industrial sector. The industrial sector's net-metering policy is not "tailor-made." These principles were developed based on off-grid rooftop PV system experience and research into net-metering legislation in other countries; nevertheless, what works in Bangladesh may differ. The scenario in Bangladesh makes deploying net-metering in the industrial sector particularly difficult. The market is now being held back by a lack of adequate finance schemes, tariff cross-subsidization, component quality, and installation and maintenance capability. Furthermore, this strategy must keep utilities involved in a program that they may see as a danger to their economic model. As a result, only 1,590 rooftop solar projects with a total capacity of 41.57 megawatts peak (MWp) were brought into the net-metering system under six power distribution firms across the country after three years. The policy gap must be addressed and revised suitably to scale up the rooftop PV business. Based on interviews with stakeholders and global best practices, some recommendations are made to address the barriers.

Under the net-metering program, an electrical customer would be able to generate power from renewable energy resources up to 10 megawatts (MW) or 70 percent of the sanctioned load on their own property and export the excess electricity to the distributed grid. Given the scarcity of land, the renewable energy contribution should not be limited to maximum exploitation of any free space, such as residential, commercial, and industrial roofs, or any other suitable area where a utility meter exists and it is possible to increase RE contribution.

According to the net-metering guideline, exported electricity will be adjusted with imported electricity each billing month, and the utility will pay all prosumers for the surplus electricity at the bulk rate at the end of the settlement period (in June). The electricity pricing structure in Bangladesh differs for residential, commercial, and industrial customers, but the cost of installing a rooftop PV system is the same for everyone. Residential tariffs range from BDT 4 to 10.7 per kWh, while commercial and industrial tariffs are BDT 9.27 per kWh and BDT 7.34 per kWh, respectively. As a result, various prosumers have varied payback periods. A tariff structure should be designed for all customers so that the payback period is the same and the investment is financially beneficial.

On the other hand, utilities perceive net-metering as a danger to their business model. They see no motivation to embrace it other than the responsibility to do so. To make net-metering acceptable to utilities, carbon credit facilities or a new economic model for utilities to shoulder greater burdens must be offered. In the industrial and commercial sector, there are two business models accessible in best practice: CAPEX and OPEX/ESCO. In the CAPEX model, the client is responsible for the entire project's capital costs and engages a solar EPC to design and install the solar PV system. Concessional loans, tax breaks, higher tariffs, and capital subsidies are used in this scheme to ensure that solar net-metering investments are sustainable. The OPEX or Energy Service Company (ESCO) financing model is another promising alternative for overcoming the barrier of the significant upfront cash required for the CAPEX financing strategy. Third-party financing for rooftop solar power has been a major driver of expansion in the rooftop solar business around the world. In India, for example, third-party financing accounts for roughly 13 percent of all roof-top solar installations. The industry predicts that under the OPEX financing model, total installed capacity could reach more than 20 GW by 2022.[31]

Similar benefits should be granted to the OPEX business model in the NEM. Independent power producers receive tax exemptions on their earnings from selling energy, as well as import tax or duty exemptions on the purchase of any power plant equipment and spares.

COST REDUCTION POLICIES

Over the last decade, the cost of investing in renewable energy has dropped dramatically because of continually improved technology, economies of scale, competitive supply chains, improved developer experience, and a combination of targeted government policy support. Between 2010 and 2020, the global weighted-average installation cost of utility-scale solar PV declined by 81 percent, from $4,731/kW to $883/kW.

Several policies are in place around the world to incentivize voluntary investments in renewable energy by lowering the costs of such expenditures. These policies (1) reduce capital costs up front via subsidies and rebates, (2) reduce capital costs after purchase via tax relief, (3) offset costs through a stream of payments based on power production via production tax credits, (4) provide concessionary loan and other financial assistance, and (5) reduce capital and installation costs through economies of scale.

The Government of Bangladesh has implemented a variety of incentive programs from the start of policy creation to facilitate and expedite electricity generation from renewable energy sources. The government has declared investment and fiscal incentives for encouraging local and foreign investors in major policy reports such as the National Energy Policy 2004, Private Sector Power Generation Policy 2004, Renewable Energy Policy 2008, and the Guideline for the Implementation of Solar Power Development Program 2013, among others, although there are some inconsistencies in the policies, particularly in the area of renewable energy. Because renewable energy power plant equipment is not featured in the National Board of Revenue (NBR) duty exemption list, the sponsors are having difficulty obtaining benefits from various government agencies, such as customs duty exemption from NBR. The government should implement all the incentives outlined in the policies, and the lending process should be streamlined and enhanced to facilitate the successful implementation of renewable energy projects.

However, compared to other nations, Bangladesh's investment costs for establishing utility-scale solar power facilities are relatively high. Many factors

[31]Bangladesh's Net-Metering Policy: Jump Starting the Solar Rooftop Market prepared by German Solar Association. https://reeep.sreda.gov.bd/projects/2018-10-31-Bangladesh-Net-Metering-Policy-Jump-Starting-the-Solar-Rooftop-Market-BSW.pdf

contribute to the rising investment costs of utility-scale solar PV plants in Bangladesh, including:

- Lengthy approval process for unsolicited proposals.
- High cost of land due to scarcity and local influence.
- Non-agricultural land that is situated on the floodplains of rivers and in coastal areas requires additional investment for development and erosion protection.
- Approval for development of land and erosion protection required from multiple government agencies, which is added time and cost.
- Additional land required for constructing transmission lines as the land is far from the national grid.
- Multiple approvals and/or permits required from different agencies before and after financial closing.

The following concerns not only raise the project's cost, but also reduce interest from both domestic and international investors in building renewable energy projects. The Bangladeshi government must carefully assess how it might assist project developers, particularly in the early stages of project development. The following suggestions will help to address these challenges while also lowering the initial outlay.

- Renewable energy projects are awarded through a solicitation process rather than an unsolicited proposal, which involves more time and additional costs.
- The government can identify and establish competitive renewable energy zones. The government can assign a single agency to locate, acquire, and develop land and other infrastructure. The government will either recover the expenditures through a lease agreement with the project developers or alter the costs by purchasing electricity at a reduced rate. In addition, the agency will oversee all forms of approval. PGCB and the agency will work together to extend the national grid to the zones. The agency will coordinate with PGCB for extending the national grid to the zones.
- Under SREDA, the government may create an online-based single window platform. The project developers will submit all required documentation online, and SREDA will work with the appropriate ministry or agency to obtain approval or clearance.

INSTITUTIONAL ARRANGEMENT AND IMPROVED COOPERATION AMONG STAKEHOLDERS

According to the government's renewable energy policy institutional arrangement, the Sustainable and Renewable Energy Development Authority was established on December 10, 2012, but it began its journey in 2014 as a nodal agency to promote, facilitate, and disseminate sustainable energy (SE), which includes both renewable energy and energy efficiency, to strengthen the country's energy security. The responsibilities of SREDA as a firm are clearly stated in the policy. With limited manpower, the institution is currently functioning under the Ministry of Power's Power Division, making it difficult to meet all of the obligations outlined in the RE policy. To expand renewable energy industry and meet the ambitious target, which was announced by the Prime Minister at COP26, SREDA institutional capacity should be increased. Many key stakeholders also thought a separate renewable energy ministry could help to scale up RE projects.

Due to a lack of institutional capability within public and private organizations, as well as a lack of coordination among government agencies, progress in Bangladesh's renewable energy sector has stagnated. Bangladeshi institutions also lack experience in the establishment of renewable energy projects. The government (through SREDA) should establish a work plan to strengthen public utility expertise and institutional capacity, particularly for utility-scale renewable energy. The government (through SREDA) should take responsibility for closing coordination gaps between entities and launching a one-stop shop for the private sector to obtain useful renewable energy project information, permits or approvals, and resource data, allowing developers to submit higher-quality bids more quickly.

Bangladesh must endeavor to improve its laws, institutional arrangements, business models, financing instruments, and incentive programs to boost the renewable energy industry and reach the ambitious target set by the Prime Minister at COP26. To establish and implement these policies and financing programs, government authorities, industry actors, finance agencies, and other stakeholders will need to collaborate. Regular meetings of working groups with defined objectives on intertwined technical, regulatory, market, and business model-related topics could bring together representatives from the public, private, and financial sectors to propose the establishment and continuous improvement of relevant frameworks.

LAND ACQUISITION GUIDELINE

The most significant impediment to developing utility-scale renewable energy plants and a grid network to evacuate power into the national grid is land. Bangladesh is a densely populated country, with 70 percent of the people living in rural areas and 87 percent of rural households relying on agriculture for their livelihood. In Bangladesh, land is classified as either agricultural or non-agricultural, with agricultural accounting for 70 percent of total land and non-agricultural land consisting of rural settlements, urban and industrial regions, and accreted land. Renewable energy projects can only be built on non-agricultural land, according to existing policy. Each MW of solar power requires around three acres of land. As a result, developing a 100 MW power plant will necessitate about 300 acres of non-agricultural land in a single site, which will be extremely challenging for any developer to manage. When land becomes available, it is typically located distant from the national grid, in underdeveloped areas with little access and infrastructure. Land is mostly available along riverbanks in Bangladesh's northwestern region, khash[32] (or state-owned) land, and coastal areas, including islands in the country's south. These places are either disconnected from the national grid or have insufficient grid capacity to connect new facilities. This increases the developer's need for extra land as well as their costs.

This problem has arisen in several other places around the world. The government should consider conducting a land study to identify land use possibilities for utility-scale renewable energy. The benefits of using public land, finding land with lesser agricultural value, and understanding any advantages to designating zones for renewable energy projects should all be included in the study.

Another issue is the difficulty in identifying non-agricultural land for RE projects due to the lack of definition for what constitutes agricultural land. Cropland, , mangrove forest, rivers, lakes, beel and haor[33] , aquaculture land, tea estates, and saltpans are all considered agricultural land.[34] It is entirely dependent on the inspector of the land office's

[32]Khas land means government owned fallow land, where nobody has property rights

[33]A beel is a billabong or a lake-like wetland with static water as opposed to moving water in rivers and canals and A haor is a wetland ecosystem in the northeastern part of Bangladesh which physically is a bowl or saucer shaped shallow depression, also known as a backswamp

[34]Hasan, M. N., Hossain, M. S., Bari, M. A., & Islam, M. R. Agricultural Land Availability in Bangladesh. Dhaka, Bangladesh: Soil Resource Development Institute (SRDI), Ministry of Agriculture, 2013. http://srdi.portal.gov.bd/sites/default/files/files/srdi.portal.gov.bd/publications/459e2999_b735_4b81_b8b3_e0272e1d1848/Agricultural%20land%20availability%20in%20Bangladesh-monograph-1.pdf

decision. As a result, the amended policy should include a clear indication of the area that can be used for RE projects.

Land acquisition, whether public or private property, by purchase or lease, is time-consuming, expensive, and complex in Bangladesh and many other nations, and is frequently regarded as a more pressing issue than land availability. Purchasing or leasing land from hundreds of landowners has proven difficult for developers. The landowner's legal documents, which are required to transfer ownership, are frequently missing. In other circumstances, land prices skyrocket when landowners learn of a planned project in their neighborhood.

Most non-agricultural land available for solar PV and wind power projects is in river floodplains and coastal areas, which will need to be backfilled and protected from erosion. Backfilling and erosion control work add to project development expenses and lengthen project construction timetables. Dredging sand from a river and backfilling necessitates many official clearances and approvals.

All infrastructure projects regardless of their energy source affect the local community where they are sited. The most accessible renewable energy resources are often in rural areas due to their lower population density. Communities that can be affected include people living close to the project site or the associated grid infrastructure, which can include women and marginalized groups who are less likely to be consulted and informed on renewable energy projects or to have their voices heard. This puts them more at risk of losing control over the use of land and resources. Therefore, a robust process for engaging with local communities is critical for the social feasibility for RE infrastructure development. The government should protect the social security of displaced people as well as create employment opportunities for the men and women of the affected communities.

Both difficulties can be efficiently addressed by developing a proper guideline, as several countries have already done. India's Jawaharlal Nehru National Solar Mission may serve as an example.

The Government of India's task was to produce guidelines for the development of solar parks with a capacity of 500 MW or more, which were published in October 2015 as part of the Jawaharlal Nehru National Solar Mission. The rules attempted to make information more accessible to local and international solar project developers/investors, as well as to create a single point of contact for the permission and clearing system, as well as any other formalities that slowed the projects' progress. Following are the most important guidelines[35]:

Unless an implementing agency has its own land, the state government is responsible for locating suitable sites for large-scale solar projects. The land should be government waste/non-agricultural to make land purchase easier and less expensive. If a single piece of land is not accessible, various spots in proximity can be chosen. Land acquisition, other land-related clearances, and all infrastructure development, such as approach and internal roads, water and drainage facilities, electricity supply, internal transmission system, and arrangement for power evacuation with grid, land leveling and development, are all solely the responsibility of the state government. According to the guidelines, the state government nominates solar power park developers (SPPD) under the large solar park scheme. The SPPD is responsible for the operation and maintenance of the plant for 25 years after setting up the solar park.

[35] MNRE. Guidelines for Development of Solar Park. https://www.mnre.gov.in/Solar/policy-and-guidelines.

RENEWABLE ENERGY RESOURCES, TECHNOLOGY AND POTENTIAL

The major objectives of the renewable energy policy are to harness the potential of renewable energy resources and disseminate renewable energy technologies. Many resources and technologies are available around the world, including solar PV, wind, and biogas resources and technologies, which are used in Bangladesh. The highest renewable energy potential, according to the PSMP 2016, is 3,700 MW. Some efforts are currently underway to identify Bangladesh's renewable energy resource potential. The efforts have revealed that the country has significant solar and wind potential, albeit several hurdles must be overcome in order to fully realize the potential.

Although the United Nations Development Programme (UNDP) is assisting Bangladesh in developing a solar resource assessment, there is presently no comprehensive assessment of solar PV potential in different locations of the country. The National Renewable Energy Laboratory has performed a wind assessment study that found wind speeds of 5.75–7.75 m/s over a 20,000 km^2 area along the coast, with a gross wind potential of over 30 GW. When considering the obstacles, however, this estimate may be reduced.

The following are some of the most significant issues in assessing renewable energy resources:

- A lack of renewable energy resource data for solar PV in specific regions, including seasonal variation measurements, and a lack of assessment of the true renewable energy potential after land availability is considered;
- The fact that wind resources have the greatest potential in the southern coastal region, which is also prone to cyclones; and
- The lack of mapping or zoning for renewable energy projects where site-specific resource data can be measured.

Initial assessments by NREL and the UNDP of solar and wind potential are useful for taking the initiative to scale up renewable energy projects, but more research is needed to achieve project bankability.

- The government should conduct resource potential analyses that identify zones for renewable energy project development while also considering other factors including land availability, road access, and grid expansion plans. At the local level, the indicated zones can be targeted for resource data collecting.
- To strengthen local capacities and competencies, government-led programs should increase collaboration between international agencies, local academic institutions, and research organizations while performing renewable energy resource studies.

CONCLUSION

There was no other way to fulfill the goal of becoming a middle-income country by 2021 but to industrialize, which was impossible without a rapid expansion of the power industry, which is a top priority of the government. The GoB focused completely on the conventional energy sector to increase the supply of electricity in the national grid due to the high cost and other constraints of renewable energy. Due to a lack of domestic natural gas and an uncertain international fuel market brought on by the conflict between Russia and Ukraine, the nation is currently experiencing significant load shedding. The GoB has taken the initiative to amend its Renewable Energy Policy 2008 to foster an environment that will encourage all interested parties to invest in RE projects and reduce investment risk. Renewable energy progress is very slow because of several constraints not addressed in the existing policy. The proposed recommendations will assist the GoB to address those challenges in the country's upcoming RE policy, fulfill its commitments under the Paris Agreement, and enhance energy security in Bangladesh.

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