Chapter 4
Role of Renewable Energy Policy in Ensuring Net-Zero Carbon Emissions and Energy Sustainability: A Bangladesh Perspective

Emadul Islam, Asheer Shah, and Tariq A. Karim

Abstract The current global energy crisis along with the climate impacts of non-green energy sources has necessitated the shift toward renewable and sustainable energy. Limited fossil fuel reserves and high climate change vulnerability index of Bangladesh necessitate the country's need to achieve sustainable renewable energy governance and policy development to guarantee net-zero carbon emissions and energy sustainability. This study illustrates the implementation of national and regional policies in addressing the challenges of Bangladesh's transition to green energy from fossil fuels. The study contributes in the domain of national and intergovernmental green energy policy by developing recommendations along the Bay of Bengal region to increase the scalability of technologies and innovations, highlighting the opportunities and strengths of Bangladesh being the founding member of BIMSTEC integration.

Keywords Renewable energy policy · Net-zero carbon · Energy sustainability · Bangladesh · BIMSTEC

4.1 Introduction

The shift from conventional to clean or renewable energy for energy sustainability has been highlighted in international policy papers such as the United Nations Sustainable Development Goals (7) and the recent Conference of the Parties (COP 26) (Bouyghrissi et al. 2022; Madurai Elavarasan 2021; Murshed et al. 2021; Zeraibi et al. 2021). Rapid and fair transition to clean energy is required to maintain global warming to 1.5 °C and accomplish the goals of the Paris Agreement (Ahmed et al. 2022; Jahid 2018; Murshed and Tanha 2021; Xue et al. 2021). The transition is

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already underway—renewables accounted for more than 70% of new global power capacity additions in 2019—but they must be expedited to ensure its success. Approximately one-quarter of global greenhouse gas emissions are attributed to the electricity industry. We must accelerate the speed of the global transition to sustainable energy by at least fourfold over the next decade if we are to reach the country's Paris Agreement targets (COP26 Energy Transition Council 2021).

The current global energy crisis, as well as the climate impacts of non-green energy sources, has necessitated the shift toward renewable and sustainable energy. Furthermore, states are entitled to limited natural resources, consumption, and production units. Thus, in the current global village, the importance of renewable and sustainable energy is pivotal to countering climate change and productivity limitations. Cherry (1973) discussed the prospects and potential of solar energy in three major areas: the heating and cooling of buildings, production of clean renewable fuels, and electrical power generation. In 1974, Norman (1974) demonstrated how the thermodynamically reversible mixing of freshwater and seawater at static temperature generates free energy and how an osmotic salination converter could harness renewable energy. Similarly, Witwer (1977) analyzed solar energy and its contribution to the United States (US) energy system and how the energy is more cost-effective when compared to depletable fuels. Chisti (2007) illustrated microalgae as a source (more efficient than crop plants) of renewable biodiesel, which can potentially serve the demand for global transport fuel. Goldemberg (2007) portrayed Brazilian sugarcane ethanol as a substitute for motor gasoline and how it is suitable for implementation worldwide.

Asia and the Pacific have made considerable headway in connecting their people to power. The area has three-quarters of the 570 million people who acquired access to electricity between 2011 and 2017, although an estimated 350 million people did not gain access. Approximately two billion people in Asia and the Pacific rely on biomass, coal, and kerosene for cooking and warmth. The People's Republic of China (PRC) and India, the world's two most populated countries, account for 28% of the global primary energy supply. The Asia–Pacific has created a significant renewable energy capacity in solar photovoltaic (PV), wind power, hydropower, biofuel, and geothermal technologies (REN21 2019).

Bangladesh's economy is accelerating, and in 2019, the gross domestic product (GDP) growth rate was at an all-time high of 8.1%. Bangladesh's GDP has expanded by 188% since 2009 (Hasina 2019), per capita income has topped $2554, and it is estimated that by 2030, Bangladesh would be the world's 26th largest economy. Bangladesh has the fifth-largest internet user population in Asia–Pacific, and more than 120 enterprises export information and communications technology (ICT) products worth approximately $1 billion to 35 countries as part of its transformation into a "Digital Bangladesh" (Palak 2019). Bangladesh made remarkable progress by introducing the Climate Change Trust Fund in 2009 to foster climate change adaptation. The Honorable Prime Minister, Sheikh Hasina, is called the world's climate champion. Despite contributing less than 0.47% of the global carbon emissions, Bangladesh is one of the most climate-vulnerable countries. The country shows a continuous commitment to achieve the Paris Agreement and Sustainable Development Goals (SDGs); therefore, it canceled 10 coal-based power facilities worth 12

billion dollars in foreign investment. In terms of the transition to renewable energy, Bangladesh has set a target of 40% of its energy from renewable sources by 2041 (The Daily Star 2021).

Hence, to shift toward renewable energy, Bangladesh needs to achieve suitable energy governance and policy development, along with scientific and technological advancement. This study provides an overview of the energy in Bangladesh emphasizing on renewable energy. Following the renewable energy profile of Bangladesh, the study demonstrates the challenges and barriers to transition toward renewable energy. Post identification of the barriers, the study provides energy policy recommendations in reference to BIMSTEC that will facilitate the transition of Bangladesh toward renewable and sustainable energy, which will eventually ensure net-zero carbon emissions and energy sustainability. The study concludes by illustrating a way forward by addressing renewable energy policy innovations in Bangladesh and the BIMSTEC region. The focal themes of the study are as follows: conceptual analysis of renewable energy and energy sustainability, energy profile in Bangladesh, barriers and prospects of renewable energy in Bangladesh, and pathways to renewable energy for ensuring net-zero carbon. This study is not simply focusing on the renewable energy sources and technologies; it is also aiming to ensure net-zero carbon emissions and energy sustainability by deploying the renewable energy policies. As a result, in this study, renewable energy policy is the independent variable, and carbon emissions and energy sustainability are the dependent variables.

4.2 Conceptual Analysis of Renewable Energy and Energy Sustainability

Energy is an important aspect of modern civilization and a prerequisite for sustainable development (Islam and Khan 2017). Sakalasooriya (2021) illustrated the term sustainability as the equitable, ethical, and efficient use of natural resources for fulfilling the needs of current and future generations and enhancing their well-being. This definition suggests the rational usage of the limited resources available for human consumption. Generally, sustainable development is a course of progress wherein the double-dealing of assets, the heading of speculations, the direction of the mechanical turn of events, and institutional change are all in congruence and upgrade both the current and the future potentials to address human issues and goals (World Commission on Environment and Development 1987). Economics has always studied the scarcity of resources, and presently, the global village is transitioning to sustainability. To address scarcity, the importance of sustainability is substantial. It is noteworthy that, in economics, scarcity of resources leads to opportunity costs. Thus, transitioning toward sustainability to address scarcity incurs numerous opportunity costs. Policymakers, technocrats, negotiators, entrepreneurs, multinational companies (MNCs), civil societies, think-tanks, among others, govern the dynamics of the transition.

Düren (2017) interprets renewable energy as constantly transforming and evolving, depending on time and space dynamics. For instance, renewable energy changes structures and factors based on weather conditions, seasons, and time, among others, making renewable energy and the conditions, the dependent and independent variables, respectively. According to Düren, solar energy can be harnessed maximally in desert geographies, while wind energy can be harnessed efficiently in coastal and mountainous areas. Consequently, the dynamics of renewable energy change based on geographical locations.

Renewable energy sources, including bioenergy, direct solar power, geothermal power (including geothermal heat), hydropower (including hydroelectricity), and wind and ocean energy (including tides and waves), have been demonstrated in literature suggesting that replacing fossil fuel-based energy sources with renewable energy sources will gradually assist the world in achieving sustainability (Owusu and Asumadu-Sarkodie 2016). Tester et al. (2012) defined sustainable energy as "a dynamic harmony between the equitable availability of energy-intensive goods and services to all people and preservation of the earth for future generations". Energy sustainability refers to the utilization of renewable energy sources by ensuring that sufficient energy resources are available for future generations (Ninno Muniz et al. 2020). Notably, energy sustainability does not simply refer to the transition toward renewable energy, but rather to a reduction in the consumption of energy or the further exploration of efficient usage methods of energy by the current global village. This implies that the existing generation requires innovative methods to conduct day-to-day activities using lower amounts of energy components. Thus, it is crucial to explore the interconnectedness of energy and sustainability to formulate and implement policies governing energy sustainability with the assistance of sustainability indicators to discuss issues in the political field, as well as the general public forum (Solarin et al. 2018).

Previous research has emphasized the importance of renewable energy resources in the national energy system to maintain environmental sustainability. Several studies have investigated the relationship between renewable energy consumption and ecological footprint nexus (Xue et al. 2021; Alola et al. 2019; Naqvi et al. 2020; Sharma et al. 2021). For example, Naqvi et al. (2020) discovered statistical proof of increased renewable energy use to minimize the ecological footprint in the context of high- and upper-middle-income nations. Additionally, Destek and Sinha (2020) discovered that the adoption of renewable energy was beneficial for lowering the ecological footprint of selected Organization for Economic Co-operation and Development (OECD) nations. In studies conducted by Alola et al. (2019) for 16 European Union nations and Sharma et al. (2021) for developing countries in Asia, researchers found results similar to those reported here.

In the recent years, academics and researchers have paid close attention to the topic of renewable energy and energy sustainability according to the generated Scopus database. As shown in Fig. 4.1, a total of 10,320 publications on renewable energy and energy sustainability were included in the Scopus database between 2006 and 2021 over the period. This issue has sparked a significant increase in interest among academics and researchers all around the world, and this has been noticed in several

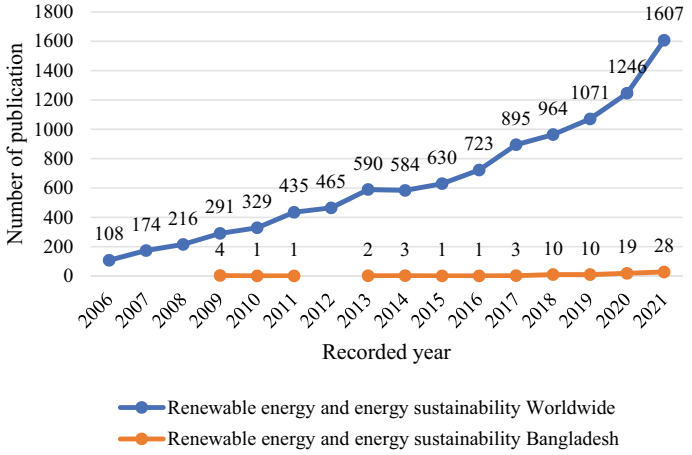

Fig. 4.1 Publication of renewable energy and energy listed in Scopus database during 2006–2021. *Source* Compiled by authors

countries. According to the Scopus database, a total of 83 papers have been published in the context of Bangladesh. Figure 4.2, on the other hand, depicts the overall trend of the mentioned literature on renewable energy and net-zero carbon emissions. A total of 406 titles were listed globally between 2006 and 2021, with just nine titles listed from Bangladesh throughout that time period. Previously, authors have mostly focused on the technological aspects and resource aspects in facilitating the transition toward renewable energy. However, the domain of policy has remained unmurmured in encouraging the transition and addressing the issues of technological advancement and resource availability. Hence, the authors of this study argue that in the development of renewable energy, net-zero carbon, and energy sustainability, innovative policies can act as the mediator of the energy transition. The paper argues that national policies lead to national energy developments; however, an integrated renewable energy policy among the neighbors can lead to a higher scale of national energy development.

4.3 Methodology

The panel data used in this research study has been collected from the International Energy Agency (IEA) database. The IEA was created to ensure and secure the supply of oil in 1974 and currently focuses on a variety of issues. There are 31 member countries in the IEA and further 8 association countries. As a result, it is a viable and noteworthy database in the domain of energy. The figures generated in this paper include and portray the statistical data present at the IEA. The data collected from the IEA was within the time frame of 1990 till 2019. The initial dimensions based

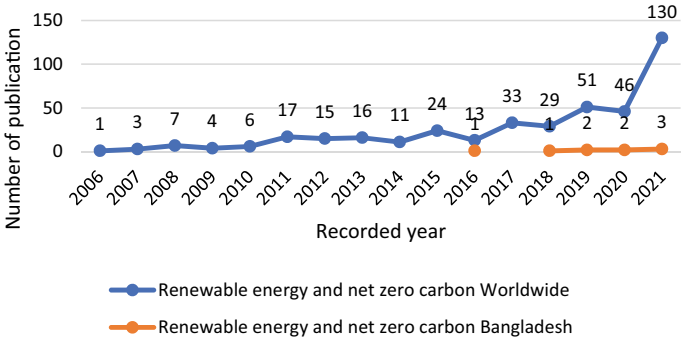

Fig. 4.2 Publication of renewable energy and net-zero listed in Scopus database during 2006–2021. Compiled by authors

upon which the data has been collected are energy supply and energy consumption in Bangladesh. Following the initial phase, the dimension shifted toward renewable energy, as well as modern renewable energy status in Bangladesh and further, segmented the dimension into solar, wind, and hydro sources.

This research utilized another secondary source of data which is the Scopus database for the purpose of literature review. A systematic approach has been followed, noted as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The time frame of the data extraction was from the year 2006 till the year 2021. The initial dimensions of the search engine were "renewable energy and energy sustainability worldwide" and "renewable energy and energy sustainability Bangladesh". The later dimensions of the search engine were "renewable energy and net-zero carbon worldwide" and "renewable energy and net-zero carbon Bangladesh".

This study uses carbon emissions and energy sustainability as dependent variables and renewable energy policy as the predictor. Carbon emission and energy sustainability take into account the important dynamics related to the transition toward green energy sources; since in order to reduce carbon emission and ensure energy sustainability, transition toward renewable energy sources is mandatory. The argument this study aimed to develop is that renewable energy policy can function as a vital variable in enhancing sustainable energy. The study further encourages the idea of common regional renewable energy policy as one of the dimensions of the renewable energy policy domain. Henceforth, this paper addresses the role of BIMSTEC in facilitating the formulation and implementation process of a common BIMSTEC renewable energy policy, integrating the seven Member States tackling a common threat of the region which is limited energy.

4.4 Energy Profile of Bangladesh

Bangladesh is among the top six global economies based on the GDP growth rate of the global village according to World Bank data of 2019 (Tachev 2021). The transition of Bangladesh from the so-called basket case to the top global economies is fascinating, as well as expensive. The transition is being referred to as expensive since development follows through a number of opportunity costs and expenses. In this discussion, energy is being referred to as the expense for the development and growth of Bangladesh. In the energy sector, Bangladesh heavily relies on natural gas in the domain of electricity production. As a result, it is highly important for Bangladesh to shift toward green energy. Figure 4.3 is developed in order to provide a descriptive overview of the energy supply in Bangladesh.

Figure 4.3 illustrates the total energy supply in Bangladesh based on sources and data accumulated from 1990 to 2019. According to the figure, the energy supply in Bangladesh is divided into six segments. On one hand, the hydro, wind, solar, and similar energy sources are harnessed, which are renewable sources of energy, leading to zero carbon emissions. On the other hand, there are fossil fuels such as oil, natural gas, and coal. Fossil fuels are limited, scarce, and have negative environmental impacts with high carbon emission rates. Biofuels and waste energy are complex domains, and their environmental impacts are still under study; hence, they fall in between. The types of biofuel and waste energy are important when referring to renewable energy with positive environmental impacts (Zah et al. 2007).

Natural gas is the highest energy supply source in Bangladesh. In 2019, the supply of natural gas in Bangladesh was 1,068,016 terajoule (TJ), of which the imports amounted to 127,731 TJ. In 1990, the supply of natural gas was 156,049 TJ. The supply of natural gas increased by 911,967 TJ between 1990 and 2019. In contrast, the lowest energy supply sources in Bangladesh are wind and solar energy. In 2019, there was a supply of 1353 TJ of wind and solar energy in the country. In 2013, the

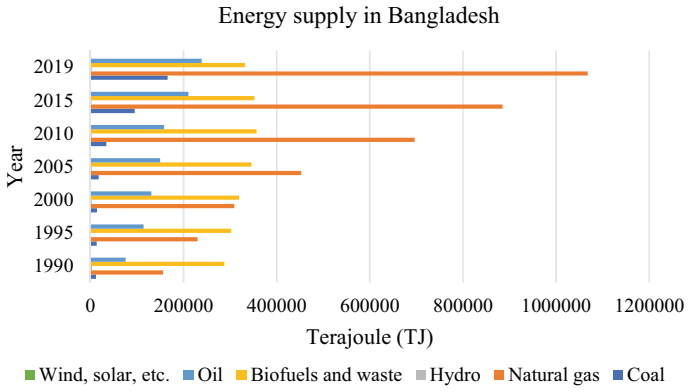

Fig. 4.3 Total energy supply (TES) by source, Bangladesh, 1990–2019. *Source* IEA World Energy Balances

country generated 504 TJ of wind and solar energy and experienced an increase of 849 TJ in 2019. The position of hydroenergy is also similar and replicates the pattern of wind and solar energy generation, which is hardly noteworthy. The generation of hydroenergy was reduced from 3182 to 2767 TJ over 29 years. Hydroenergy generation in Bangladesh appears to have a negative growth rate.

The second-highest source of energy supply in Bangladesh is biofuel and waste. In 2019, the country generated 331,716 TJ of energy from biofuel and waste. However, the generation of energy has not resulted in any notable growth. In 1990, the energy generation from biofuels and waste was 287,395 TJ, which increased by only 44,321 TJ after 29 years.

Oil is the third-highest source of energy in Bangladesh. In 1990 and 2019, the supply of oil was 75,533 TJ and 238,913 TJ, respectively. The supply of oil increased by 163,370 TJ between 1990 and 2019. The supply of coal started to increase significantly in Bangladesh from 2014, where the supply of coal increased from 38,755 TJ to 165,740 TJ in 2019. The use of fossil fuels in Bangladesh is on the rise. Following the energy supply statistics for Bangladesh, Fig. 4.4 illustrates an overview of energy consumption.

Figure 4.4 provides a complete overview of the energy consumption in Bangladesh from 1990 to 2019. According to the figure, natural gas is the most consumed energy in Bangladesh, where in 2019, the country consumed 428,979 TJ of natural gas. The consumption of natural gas has increased since 1990. Coal was among the least consumed energy at 150,000 TJ of coal energy being utilized in 2019. Coal consumption increased drastically in 2015 and again in 2019. Biofuels and waste energy are the second-most consumed energy sources in the country. In 2019, almost 300,000 TJ of biofuel and waste energy was consumed. However, its consumption started to decline from 2010 onward. Contrastingly, the consumption of electricity has risen significantly from approximately 17,000 TJ in 1990 to 284,033 TJ in 2019. The electricity demand has been increasing in the country. In the recent years, the

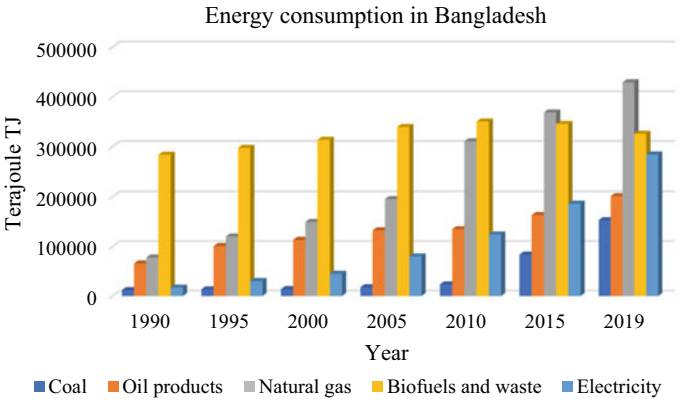

Fig. 4.4 Total final consumption (TFC) by source, Bangladesh, 1990–2019. *Source* IEA World Energy Balances (IEA 2022)

domestic sector has become the major consumer of electricity in Bangladesh (Islam and Khan 2017). Finally, the consumption of oil/oil products has also increased over the years.

The energy profile of Bangladesh has provided an overview of its energy supply and consumption. This particular heading aims to provide an analysis of the patterns and trends of energy supply and energy consumption data. The next section specifically focuses on renewable energy, highlighting the current status, prospects, and barriers to renewable energy.

4.5 Status of Renewable Energy in Bangladesh

Bangladesh has made limited and steady progress in the renewable energy sector following the publication of the renewable energy policy guidelines in 2008 by the Ministry of Power, Energy, and Mineral Resources (Tachev 2021). Currently, Bangladesh generates hydroenergy electricity, solar PV, and wind electricity. The following figures illustrate the electricity generation trend from renewable sources in Bangladesh from 1990 to 2019.

Figure 4.5 shows electricity generation in Bangladesh using hydropower. From 1990, the trajectory was on a downward slope until 1995. The electricity generation fell below half the capacity in 1990. In 1995, the figure followed an upward slope and increased electricity generation to almost 800 GWh in 2000 and remained constant from 2000 to 2010. From 2010 onward, the trend again followed a downward slope until 2015 and only reached the static electricity generation capacity by 2019. Since 1990, the hydroelectric electricity generation capacity has not surpassed the previous maximum generation capacity. In 1990, Bangladesh generated approximately 900 GWh of hydroelectric power. However, even after 29 years, the country still produces approximately 800 GWh of hydroelectric electricity, which is below its initial generation level in 1990.

Figure 4.6 shows the solar PV electricity generation trend in Bangladesh from 2013 to 2019. The figure followed an upward slope from 2013 to 2019, indicating that the generation of solar PV electricity in Bangladesh has significantly increased in the recent years. In 2013, the solar PV electricity generation capacity in Bangladesh was approximately 140 GWh. The generation capacity increased to > 350 GWh in 2019. The generation capacity increased by more than 200 GWh over these six years.

Figure 4.7 provides an overview of wind electricity generation in Bangladesh over six years. The wind electricity generation figure exhibited an upward slope from 2013 to 2015. The generation capacity increased from 4 to 6 GWh. The wind electricity generation capacity of Bangladesh has remained constant since 2015 and seems to have reached its maximum generation capacity based on existing infrastructures and technologies.

Figure 4.8 illustrates a comparison of renewable sources that generate electricity in Bangladesh. According to the figure above, hydro sources contributed the highest portion of electricity, solar PV was the second-highest contributor, and wind

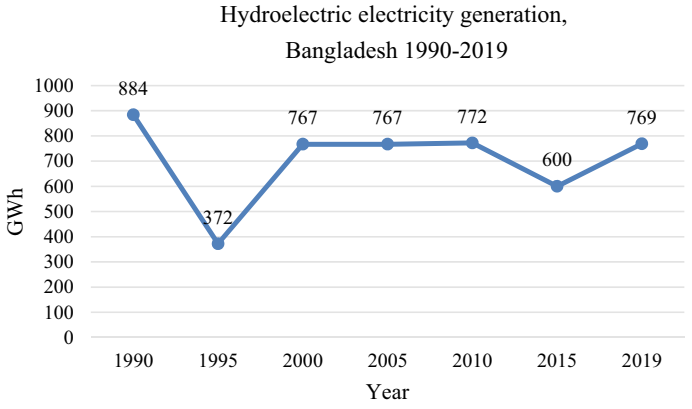

Fig. 4.5 Hydroelectric electricity generation, Bangladesh, 1990–2019. *Source* IEA World Energy Balances (IEA 2022)

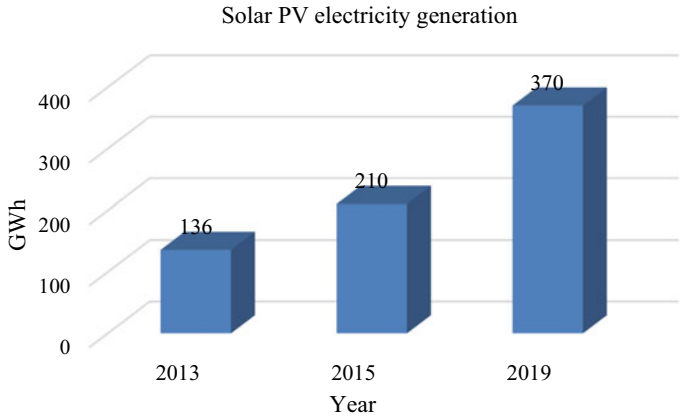

Fig. 4.6 Solar PV electricity generation, Bangladesh, 2013–2019. *Source* IEA World Energy Balances (IEA 2022)

contributed the least. However, among the three renewable sources, only the solar PV figure showed an upward trend. This means that the electricity generation capacity of solar PV sources is increasing compared to that of hydro and wind sources. The generation capacity of hydro sources has reduced over the years, and the generation capacity of wind sources has remained static over the past few years. From Fig. 4.8, it can be concluded that solar PV sources have a greater prospect of dominating the energy supply sector in Bangladesh.

Figure 4.9 captures data on the share of renewables in Bangladesh's energy sector. The figure shows data from 1990 to 2018. In 1990, approximately 70% of Bangladesh's energy consumption was from renewable energy sources. However, since 1990, the trend has been declining. In 2018, approximately 30% of the energy

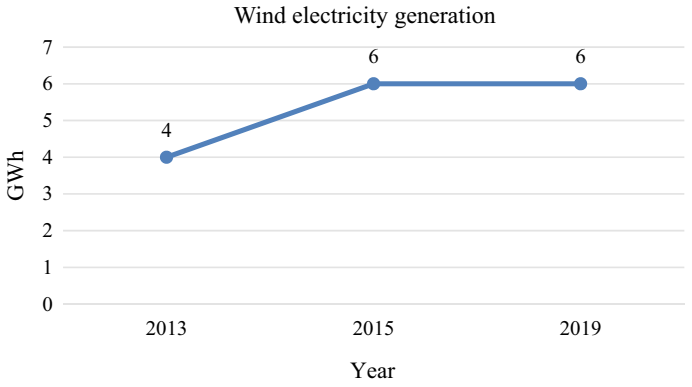

Fig. 4.7 Wind electricity generation, Bangladesh, 2013–2019. *Source* IEA World Energy Balances (IEA 2022)

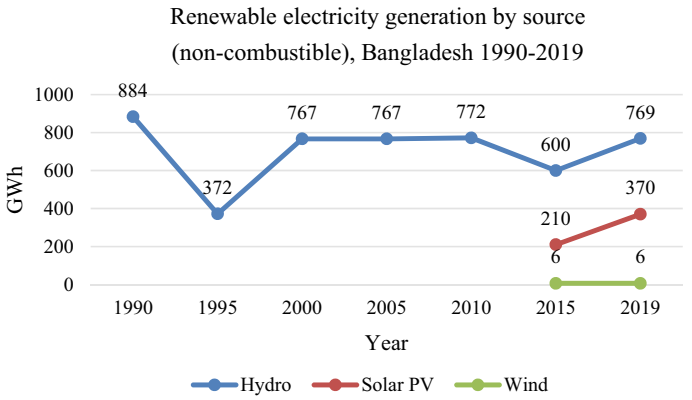

Fig. 4.8 Renewable electricity generation by source (non-combustible), Bangladesh, 1990–2019. *Source* IEA World Energy Balances (IEA 2022)

consumption in Bangladesh was from renewable energy sources. The share of renewable energy in final energy consumption in Bangladesh was reduced by 40% in 2018 compared to the 1990s.

Figure 4.10 comprises data focusing on the share of modern renewable energy in Bangladesh's final energy consumption. In 1990, modern renewable energy contributed to approximately 50% of the energy consumption. However, the contribution started to decline and dropped to approximately 20% in 1995. The share of modern renewable energy increased to 40% in 2000, following a downward slope until 2015, when it reduced to approximately 20% again. The contribution of 2018 was almost 35%, which was below the initial level in the 1990s.

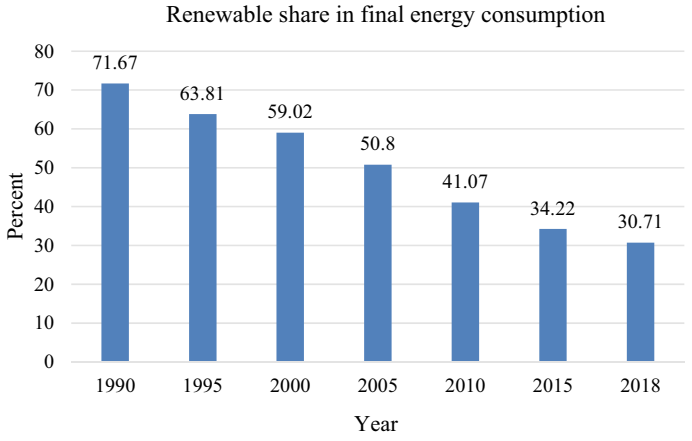

Fig. 4.9 Renewable share in final energy consumption (SDG 7.2), Bangladesh, 1990–2018. *Source* IEA World Energy Balances (IEA 2022)

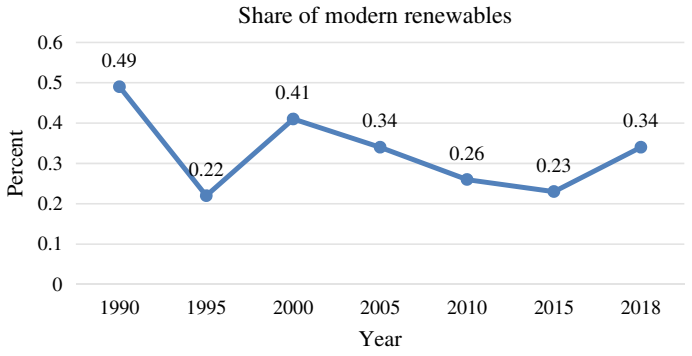

Fig. 4.10 Renewable share (modern renewables) in final energy consumption (SDG 7.2), Bangladesh, 1990–2018. *Source* IEA World Energy Balances (IEA 2022)

4.6 Barriers and Prospects of Renewable Energy in Bangladesh

4.6.1 Solar Energy

Bangladesh has an ample supply of renewable energy sources (Amin et al. 2016). The above discussions demonstrate the availability of hydro, solar, biomass, and wind as renewable sources of energy. It can be stated that the prospects of solar and biomass energy are significantly based on the data and existing trends. The prospect of solar energy is noteworthy because of the geographical location of Bangladesh and the daily amount of solar radiation received. Thus, Bangladesh can be referred to as a

solar-blessed country with great prospects in the solar energy generation segment. However, progress has been limited to the solar energy generation and utilization sector in Bangladesh. Solar energy is mostly used in rural areas, with very limited implications for urban sectors. In the urban sector, buildings and constructions have varying heights. Thus, equal or similar amounts of radiation are not received by all structures, and it becomes a challenge to generate maximum solar energy in urban zones. Furthermore, the solar energy sector has rarely encountered any technological advancements since its introduction in 2013. Hence, even after the existence of great solar energy generation prospects in Bangladesh, the sector is developing within a limited range. Barriers to solar energy generation in Bangladesh include uneven building structures in urban areas and limited technological advancements. Technological advancements, research, and awareness can aid the development of the solar energy sector.

4.6.2 Limited Technology and Knowledge to Install Wind Turbine

Wind energy is one of the fastest-developing renewable energy sectors. Asia has surpassed Europe as a leading investor in renewable energy, particularly in the wind turbine sector, with China and India leading the way (Islam et al. 2014). The potential for wind energy is not promising except in certain coastal regions of Bangladesh. Bangladesh has a 724-km-long coastal strip that includes many islands in the Bay of Bengal. Commercial wind turbine power generation, in contrast, needs a thorough techno-economic analysis, which is not available.

4.6.3 Prospect of Biomass Energy

The second-largest supply of energy in Bangladesh comes from biofuels and waste. Biomass energy can be environmentally sustainable, based on the methods and materials used in the process. Thus, Bangladesh has great potential to generate electricity through biomass technology. Approximately 70% of energy consumption in Bangladesh is from biomass (Rofiqul Islam et al. 2008). If Bangladesh can implement a sustainable biomass-to-electricity conversion procedure, the country will be able to meet its rising domestic electricity demand. Figure 4.11 illustrates a conversion procedure that Bangladesh can adopt for electricity generation using biomass. However, technological advancements are barriers to the transition.

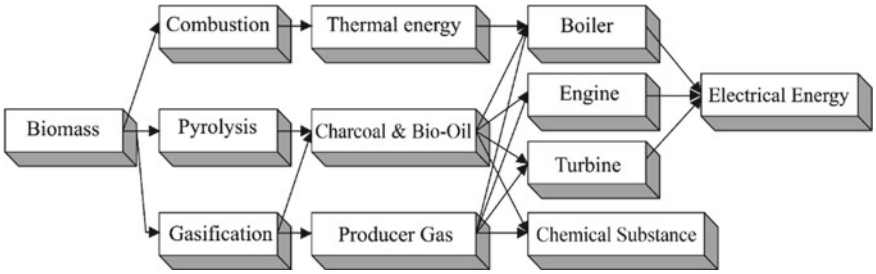

Fig. 4.11 Conversion of biomass into energy. 2007 *Source* Waewsak et al. (2007)

4.7 Pathways to Renewable Energy for Ensuring Net-Zero Carbon Emission

One of the most vital strategies for addressing a particular issue (such as the carbon emission rate) at the national level is public policy. However, the policy mileage depends on the policymaker's skills. Establishing a functional public policy requires expertise in two processes: policy formulation and implementation. The policy formulation (the basis of the specific public policy) process is under the leadership of the policymaker. Therefore, the policy implementation process requires the involvement of numerous stakeholders. In the policy implementation process, the involvement of policymakers, law enforcers, entrepreneurs, non-state actors, and most importantly, the public is crucial in enhancing the functionality of public policy. The skills of the policymaker will ensure reciprocal recognition of the policy from each of stakeholders and will ensure that the policymakers must address the stakeholder demands. These are the fundamentals of public policy and hence must be followed when formulating renewable energy and energy sustainability policies. Thus, the concluding heading will focus on how policymaking can be a pathway to renewable energy and energy sustainability, ensuring net-zero carbon emissions.

4.7.1 Role of National and Regional Renewable Energy Policy

The following analysis was based on the policy descriptions provided in the IEA database: The 1996 Private Sector Power Generation policy of Bangladesh targeted private investments in the energy sector to preserve the limited natural gas resources of the country and, hence, developed policy guidelines for small power plants in the private sector. In 2003, the BERC was established to facilitate competitive ground in the energy sector, governing transparency and accountability in management, operation, and tariff settings; countering the exploitation of consumer interests; and sustaining an environment of ease of doing business for private investors in the energy

sector. The BERC dictates the wholesale and retail selling prices for electricity, gas, and petroleum. The BERC is mandated to issue licenses and implement codes, regulations, and standards that guarantee the quality of services in the energy sector. Furthermore, it accumulates, maintains, and publishes statistical data on the energy sector of Bangladesh. Thus, it can be concluded that the BERC plays a significant and active role in the policy formulation domain of Bangladesh's energy sector. In 2004, import taxes were eased for wind and solar equipment, with a maximum import duty on solar water heaters with insulated storage tanks at 10%. After five years, Bangladesh developed a renewable energy policy in 2009 carrying several objectives such as utilizing the capability of sustainable power assets and scattering of environmentally friendly power advances in the country, peri-metropolitan, and metropolitan regions; empowering, energizing, and working with both public and private areas interest in sustainable power projects; fostering economic energy supplies to substitute native non-sustainable power supplies; increasing commitments of sustainable power to electricity creation; and increasing commitments of sustainable power both to power and to warm energy. The original goal of the policy was to generate 5% of Bangladesh's total power demand by 2015 and further push it to 10% by 2020. In 2012, the Sustainable and Renewable Energy Development Authority Act led to the creation of the Sustainable and Renewable Energy Development Authority (SREDA). The Act sets up the SREDA to guarantee energy security and alleviate chances related to normal cataclysms originating from global warming. The SREDA began operations in 2014 and is currently practicing as an administration office. SREDA plans to advance sustainable power and energy effectiveness by organizing sustainable power and energy effectiveness endeavors of the public authority, normalizing and naming the sustainable power and energy effectiveness items, directing innovations, and taking drives for their extension, establishing a favorable climate for the financial backers, embedding mindfulness for sustainable power and energy effectiveness, building linkages with local and worldwide associations, among others (Table 4.1).

Post-institutional establishments came to the breakthrough when the "Energy Efficiency and Conservation Master Plan up to 2030" was developed, which aligns with the United Nations (UN) Sustainable Development Goal (SDG) 7. (SDG 7 focuses on access to clean, renewable and affordable modern energy for all.) The master plan is aimed to follow a systematic approach toward energy efficiency and conservation. This portrays how the establishment of institutes such as BERC and SREDA can lead to formulation and implementation of renewable and sustainable energy policies like the 2030 master plan which can facilitate the advancement and development of renewable energy sources ensuring net-zero carbon emission. In order to have a functional energy transition in Bangladesh, advancement in the sector of research is vital. However, Bangladesh lacks in the domain of resources and technologies, and the case is similar in the South Asian region. In order to advance in the sector of renewable energy and technology, the South Asian neighbors must collaborate and integrate. The existence of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) can facilitate the collaboration and integration in the energy sector among the seven Member States. Resource, data, knowledge, and expertise can be inter-exchanged, and new technologies can be easily availed for

Table 4.1 Renewable energy and energy sustainability policy status of Bangladesh

Policy	Year	Status	Jurisdiction
SREDA Standard and Labelling (Appliances & Equipment) Regulation-2018	2018	In Force	National
Energy Efficiency and Conservation Master Plan up to 2030	2015	In Force	Unknown
Scaling Up Renewable Energy Program for Bangladesh (SREP Bangladesh)	2015	In Force	National
BDS 1852:2012	2012	In Force	National
BDS 1853:2012 Performance of close control air conditioners—minimum energy performance standard (MEPS) requirements	2012	In Force	National
The Sustainable and Renewable Energy Development Authority Act 2012 (creation of the Sustainable and Renewable Energy Development Authority [SREDA])	2012	In Force	National
BDS ISO 13253:2011 Ducted air-conditioners and air-to-air heat pumps—Testing and rating for performance	2011	In Force	National
Renewable Energy Policy of Bangladesh	2009	In Force	National
Import Duty Exemptions for Solar and Wind of Bangladesh (Statutory Regulatory Order)	2004	In Force	National
Act 2003 establishing Bangladesh Energy Regulatory Commission (BERC)	2003	In Force	National
Policy Guidelines for Small Power Plants in Private Sector	1996	In Force	National
Private Sector Power Generation Policy of Bangladesh 1996	1996	In Force	National

Source IEA (2022)

testing and later, producing in terms of scalability. For instance, the Bay of Bengal can be utilized for renewable wind and hydroenergy potentials. The South Asian region needs to have an integrated renewable energy policy, in order to best flourish in the domain of green energy with the existing technological resources. Bangladesh must portray the innovative policy frameworks at the upcoming fifth BIMSTEC summit. As a result, a number of policy recommendations are being outlined for Bangladesh to address the issue of renewable energy.

4.7.1.1 Key Policy Recommendations for Bangladesh

- Establishing renewable energy research center in Bangladesh
- Establishing specialized research centers on wind, solar, hydro, and biomass energy in Bangladesh
- Formulating Bay of Bengal renewable energy policy frameworks focusing on wind and hydroenergy

- Utilizing Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) membership to facilitate the formulation and implementation of a granting renewable energy policy among the seven Member States addressing BIMSTEC priority three (Energy) and 14 (Climate Change) **
- Accessing and utilizing technological advancements in the sectors of solar and wind, such as *Smartflower.*

4.8 Conclusion

The paper aimed to illustrate an overview of the energy profile of Bangladesh, addressing the barriers and prospects of renewable energy sources in the country. A common issue of the South Asian countries has been the limited availability of renewable energy technologies. On the other hand, when the technology and data are available, affordability and scalability are absent. Bangladesh as a country can transit toward green energy; however, it requires technology, research, and data. Hence, this paper illustrated the role of national policy innovations in governing the energy climate of Bangladesh and the role of regional policy innovations in solving the energy limitations of South Asia.

In the twenty-first-century global village, only globalization can lead to renewability and sustenance.

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