Powering up a Country into the Middle-Income Club

The Story of Bangladesh

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Abstract

In this paper, we discuss the stylized facts of Bangladesh's energy sector, critically review the different policies of the government for powering up the nation in the last 50 years, identify existing controversies and finally indicate potential pathways to ensure future energy security. The novelty of the papers is twofold: First, prior literature did not study the in-depth policy analysis of the Bangladesh energy sector. Second, this paper contributes to the existing literature by providing strategic policy suggestions to the Bangladesh government for formulating its own set of energy policies to achieve its vision for 2041 of becoming a high-income country, after having cleared the interim goal

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of becoming a middle-income country at its 50th anniversary of independence. The paper also provides insights for other developing countries aspiring to become middle-income countries.

Keywords

Bangladesh · Energy Security Pathways · Energy Policy · Policy Analysis

1 Introduction

The supply of reliable and affordable energy has become imperative in most production and household activities in modern society. In their seminal work, Goldenberg et al. (1985) discuss that the role of energy in the development process is undeniable as access to energy is a precondition for meeting basic human needs. Amin et al. (2020) argue that no country has accomplished significant progress beyond a subsistence level without guaranteeing a certain energy level. Furthermore, energy influences economic activities, workers' productivity and is a major constituent for improving the quality of life, especially in developing and emerging countries (Rehman et al., 2019). Existing empirical and theoretical literature also finds support for the "growth hypothesis" across the globe.[1] Therefore, having a good strategic framework and security for energy resource management is considered a compulsory element for planning long-run sustainable development.

Located in the northeastern region of South Asia, Bangladesh earned its independence in 1971. The country's origins lay in a deprived and undiversified economy with a pre-existing agricultural economy with low productivity, a weak industrial sector, and poor infrastructure. However, despite the adversities and resource constraints, Bangladesh's economy has experienced landmark successes over the past five decades, as reflected in different socio-economic indicators in Table 1. On average, the GDP growth of Bangladesh has increased from approximately three percent in the 1970s to seven percent in the 2010s and has traversed eight percent prior to the Covid-19 pandemic disruption. According to the Bangladesh Bureau of Statistics (BBS, 2018), extreme poverty was reduced to 10.50% in 2019 from approximately 80% in the early 1970s. Importantly, the Government's goals of a "Sonar Bangla" (Golden Bangladesh) includes its commitment to a low-carbon development path (Momen, 2021).

[1] Growth hypothesis implies that energy consumption speeds up economic activities, for more details, see: Amin et al. (2021b).

Table 1 An overview of socio-economic indicators in Bangladesh. (Source: World Development Indicators (2020))

Criteria	1972	1980	1990	2000	2009	2019
GNI/Capita (Constant USD 2010)	329.74	360.46	421.15	542.55	803.30	1348.26
Primary School Enrolment (Percent of Gross) *	64.52	71.61	83.80	101.65	102.93	116.50
Child Mortality (Under 5)	221.10	198.61	143.80	86.50	51.50	30.80
Fertility Rate (Births Per Woman)	6.93	6.36	4.50	3.17	2.38	2.03
Life Expectancy (Years)	46.51	52.90	58.21	65.45	69.49	72.32

Note: *Gross enrolment may surpass 100 because of inclusion of over-aged and under-aged students due to early or late school entrance and grade repetition*

Groh (2014), and Samad and Zhang (2018) argue that the successful implementation of the Solar Home System (SHS) program in Bangladesh has played a crucial part in reducing energy poverty and increasing people's development opportunities. Khatun (2021) states that life expectancy has increased more than 1.5 times compared to 1972 levels, and GNI/capita has quadrupled in the same timeframe.[2] The Covid-19 pandemic has unexpectedly placed the country in a bad economic downfall. Ahmed and Kamal (2020) argue that the Covid-19-triggered loss on the GDP can worsen the unemployment condition largely, with six million new people becoming jobless.[3] Amin et al. (2021a) simulated a dynamic model and revealed that the economic growth rate in Bangladesh would be approximately 4.5% in the long run, faster than many other countries. This growth prediction is consistent with the International Monetary Fund (IMF) forecast and lies between the Bangladesh Government and the World Bank (Fig. 1).[4]

In 2021, the United Nations Committee for Development Policy (CDP) approved the graduation of Bangladesh from the list of Least Developed Countries (LDC) as it satisfied the eligibility standards with regard to per capita income, human resources, and economic and environmental vulnerability for the second time in a row since 2018.[5] With an aspiration to become a high-income country

[2] For more details, see: https://cpd.org.bd/bangladeshs-achievements-in-50-years-and-making-it-meaningful/

[3] https://cri.org.bd/files/Bangladesh_at_work_in_the_era_of_COVID-19.pdf.

[4] For more details, see: https://www.tbsnews.net/economy/world-bank-keeps-bangladeshs-growth-forecast-unchanged-16-181846.

[5] For more details, see: https://www.thedailystar.net/business/news/bangladesh-gets-un-recommendation-graduating-ldc-status-2051857.

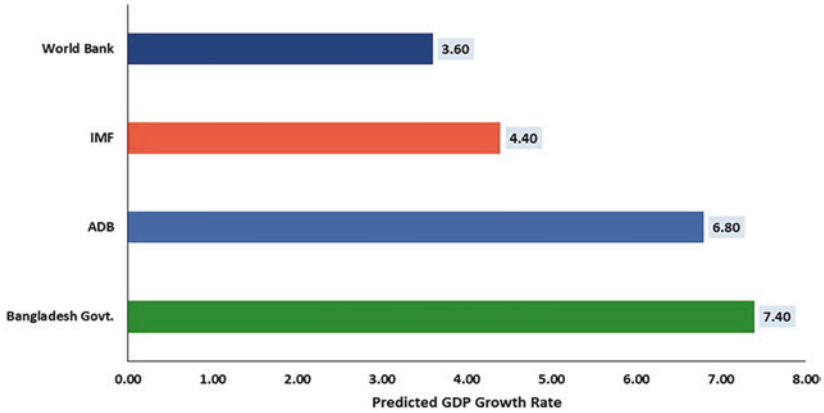

Fig. 1 Economic growth projection in Bangladesh in 2021. (Source: The business standard (2021))

by 2041 and reduce extreme poverty by 2030, Bangladesh currently focuses on achieving sustained economic growth by generating more employment, enhancing the standard of health and education, energy and transport infrastructure, and governance, together with reinforcing anti-corruption procedures (GED, 2020). Accordingly, the energy industry is recognized and prioritized as an important element of sustainable development for the future of the Bangladesh economy.

However, during the liberation war of 1971, the country's infrastructure was largely destroyed. Bangabandhu Sheikh Mujibur Rahman, also coined as the father of the nation, had to take on the Sisyphean task of statecraft and building a nation from scratch.[6] Sobhan (2021) argues that it was challenging for the then Awami League government to address reconstruction problems while dealing with the political bottlenecks associated with institutions, constructing economic policies, and managing their implementation. However, Bangabandhu's resolute leadership placed Bangladesh on the right track of development with a top priority placed on a reconstruction and large-scale recovery program between 1972–1975.

Among other sectors, the power and energy sector of the country was also systematically destroyed. Therefore, 'powering up the nation' has been among the

[6] For more details, see: https://cri.org.bd/publication/Mujib/A-Nation-Rises.pdf.

top priorities of the Bangladesh government since its independence. Having realized the significance of the energy and power sector as the lifeblood for industrial and economic development in 1971, Bangladesh took multiple strides towards the development of the energy sector by restoring transmission and distribution lines, repairing the power stations and bridges, harnessing the country's mineral resources and beginning the extraction, distillation, and marketing of mineral oil and natural gas.[7] Bangabandhu established the Bangladesh Petroleum Exploration and Production Company Limited (BAPEX) and Bangladesh Power Development Board (BPDB) for the country's future energy security. He bought five gas fields from Shell Oil Company at a low rate of USD 13–14 million to obtain Bakhrabad, Titas, Rashidpur, Kailashtila, and Habiganj gas fields as state-owned gas fields. Today, approximately 31.44% of the country's total gas is produced from these fields.

Since 2009, the present Awami League government has been working to develop multiple sectors in the country, including the energy sector. When the Awami League government came into power in 2009, the country went through two significant problems: Firstly, the electricity demand exceeded its supply between 2000 to 2009. Secondly, the nation relied too much on natural gas, which was the source for more than 90% of the electricity (Amin et al., 2021a). The energy crisis in the early 2000s had become severe due to the immense gap between energy demand and supply. The gap emerged primarily due to Bangladesh's transformation from an agrarian to an industry-based economy in the late 1990s. Such change in the concentration of economic activities required more energy use, but unfortunately, the supply of energy commodities was staggering, resulting in a chronic energy crisis. World Bank (2018) argues that energy and infrastructure bottlenecks remained the main impediments to economic growth for an extended period, and hence the then government put topmost priority on reforming the energy sector.

Amin (2015) and Amin et al. (2021b) argue that the main reform programs during the last 50 years include: i) restructuring of the core utilities, ii) establishing the independent regularity authorities, iii) encouraging the private firms (Independent Power Producers, IPPs; Captive Power Producers, CPPs) to enter

[7] For more details, see: https://www.thedailystar.net/country/news/national-energy-security-day-bangabandhu-the-pathfinder-national-prosperity-1942153.

the energy market,[8], [9] iv) allowing the privately owned rental and Quick Rental Power Plants (QRPP) as a quick and short term solution to reduce the then persistent electricity crisis, v) strengthening the fuel diversification in the electricity generation mix, vi) revising the energy prices to ensure cost-reflective pricing, vii) promoting the uses of renewable energy and viii) improving energy efficiency.

Moreover, the Bangladesh government formulated extensive energy and power development plans, the Power System Master Plan (PSMP) in 2005, 2010, and 2016, the National Energy Policy (NEP) of 2008 to achieve the sustainable development goals in harmony with economical optimization. These master plans focused on short, medium, and long-term power generation plans to develop a sound power generation environment that maximizes the advantages of different power generation methods, including the broad outlook of stable power supply, energy reliability and efficiency, environmental sustainability, and economic stability.[10]

These initiatives resulted in remarkable success in the Bangladesh energy sector in the last few years, especially in raising the electricity generation capacity.[11] However, despite this success, there are a few controversies regarding the skewness towards fossil fuels in the energy mix which still remains very high[12], quality of power issues, nonchalance in harnessing the potentials of renewable energies, lack of private investment in power transmission and distribution, high energy subsidies, an absence of a competitive market environment, as well as 'collusive contracting in an on-going state of emergency' (Khan et al., 2020) etc. Moreover, while the sector incurs massive financial losses on the government side, the share of idle generation capacity has been exceedingly high over the last

[8] For more details, see: https://www.bpdb.gov.bd/bpdb_new/d3pbs_uploads/files/11%20March%2019/1.%20PSEPGPB.pdf.

[9] For more details, see: https://berc.portal.gov.bd/sites/default/files/files/berc.portal.gov.bd/policies/37a75205_8c94_434e_b8e8_0dd643b2a00d/Policy%20Guidelines%20for%20Power%20Purchase%20from%20Captive%20Power%20Plant,%202007.pdf.

[10] The polices incorporated in the perspective plan 2021 and 2041 are also aligned and consistent with the mainstream energy policies and lay the foundations for the considerable success.

[11] For Instance, power generation grows at an average annual pace of 13.4% per year between 2010 and 2019, when generation capacity quadrupled from about 5000 MW to over 22,000 MW.

[12] According to the recent statistics from SREDA (2020b), only 633.31 MW of electricity is produced from renewable sources, where solar energy plays a significant contributor (63.06%).

couple of years and further worsened due to the impact of Covid-19 (> 60%). Experts argue that the dependency on the imported fuel will further expose the country to many macroeconomic issues such as oil price shocks, LNG price fluctuations, and welfare loss (Maheu et al., 2020).

Furthermore, in Bangladesh, the per capita energy consumption remained low at 320 kilowatt-hours (kWh) in 2014 compared to the South Asian average (705 kWh), as found in the latest available data from the World Bank.[13] However, Steckel et al. (2013) shed light on the requirement of reaching a threshold level of per capita energy consumption that corresponds to a high development priority as defined by the United Nations Human Development Program, and to avoid the threat of being trapped in an energy poverty penalty that inhibits economic development (Groh, 2015). Once this threshold is crossed, the historically observed strong positive correlation between energy use and economic growth might break, making way for a low-carbon development path.

The rest of the paper is organized in the following way: Section 2 provides a survey of the last five decades of energy sector development. Section 3 highlights the stylized facts of the Bangladesh energy sector, followed by a brief discussion on market reforms in Bangladesh's energy sector in Sect. 4. Section 5 provides an overview of the existing controversies surrounding the energy sector. Finally, Sect. 6 concludes the paper.

2 Stylized facts on the Bangladesh Energy Sector during Last 50 Years

This section discusses a few of the stylized facts of the Bangladesh energy sector associated with the series of reform initiatives implemented by the Bangladesh government to ensure a sound energy base for sustainable development over the last 50 years.

2.1 Generation Capacity

The generation capacity was minimal in Bangladesh during the 1970s where the average generation capacity stood at 685 Mega-watt (MW). This poor trend in the

[13] For more details, see: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?locations=BD.

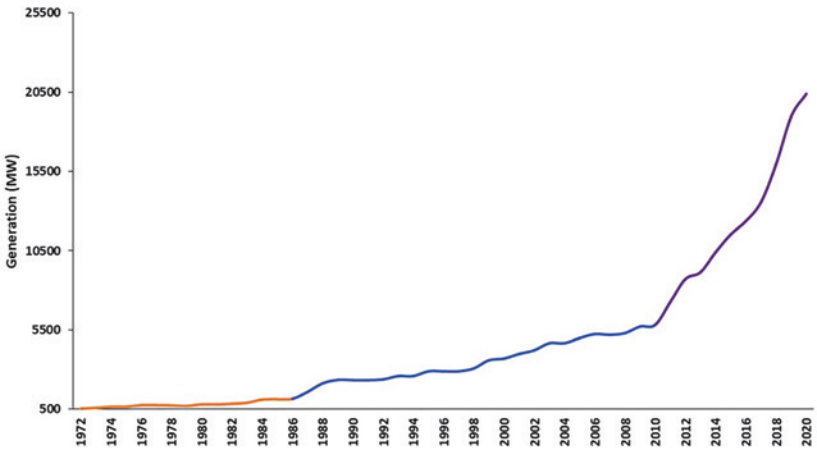

Fig. 2 Electricity generation capacity between 1972–2020. (Source: BPDB annual report (2020))

generation capacity continued until 2009. Mujeri et al. (2013) and Tamim et al. (2013) constitute the poor conditions of generation equipment, a low number of power plants, technical limitations, and inadequate operational, organizational, and maintenance routine as the reasons behind the trend. However, Bangladesh has successfully overcome the shortfall between demand and supply of electricity by increasing its generation capacity significantly since 2009, as reflected in Fig. 2.

2.2 Per Capita Energy Consumption (PCEC)

Existing literature highlights that sustained economic growth results in industrialization, urbanization, increased use of technology and innovative appliances by the households, leading to increasing PCEC (Amin & Khan, 2020; Pachauri, 2012).[14] Murshid (2020) further argues that growing urbanization and

[14] Amin and Rahman (2019) argue that, "*Bangladesh has experienced development mainly through industrialization, and to walk side by side with the rapid urbanization, the energy demand is expected to increase. Buildings are responsible for approximately 40% of total energy demand in urban regions. Most of this energy is for the provision of lighting, heating, cooling, and water supply*".

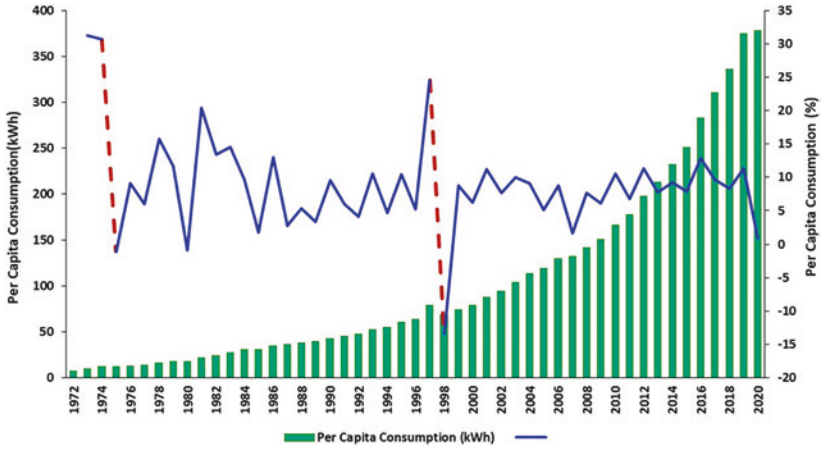

Fig. 3 Per capita energy consumption between 1972–2020. (Source: BPDB annual report (2020))

industrialization encourage rural non-farm activities, especially in areas well connected to major urban centers, leading the PCEC to increase.[15] Figure 3 shows that PCEC has increased gradually between 1972 to 2020 with a growth rate of 8.9%. The average PCEC was only 12.60 kWh in the 1970s, 30 kWh in the 1980s and 378 kWh in 2020. The PCEC increased drastically from the 1990s due to the sectoral shift in the Bangladesh economy.

2.3 Access to Electricity and System Loss

Bangladesh has achieved landmark progress in ensuring access to energy to its citizens. Prior to the 1990s, the average rate of access to electricity was less than 15%, and during the 1990s, only 20% of the population had access to electricity.[16] Between 2000 and 2010, the average share of the population with access to electricity doubled, reaching 45%. Access to electricity became a reality for the

[15] For more details, see: https://whiteboardmagazine.com/1962/insights-into-the-rural-non-farm-sector-of-bangladesh/

[16] Only 3% of the population had access to electricity in 1971.

broader population due to the strategic time-variant policies of the present government which was initiated since 2009.[17] Bangladesh has now achieved nearly 100% electrification by providing electricity access under grid-covered areas.[18]

While this is a remarkable achievement, an integrated electrification pathway where a more inclusive planning approach is pursued to avoid that multiple electrification infrastructures sit on top of each other, might have resulted in a more cost-effective and inclusive universal electrification process (SE4ALL, 2019; Groh, 2015). Bangladesh is referred to as having developed the world's largest decentralized electrification program, mainly through the deployment of up to six million SHS throughout the country (Khan, 2021). The country might have avoided an energy poverty penalty due to the successful SHS program, enabling a more inclusive growth (Groh, 2014; Samad & Zhang, 2018). Moreover, Groh et al. (2016) have shown that those SHS, on average, have performed better in terms of electricity service quality than the national grid if measured against the multi-tier framework to measuring energy access quality as introduced by the World Bank's Energy Management Assistance Program (Bhatia & Angelou, 2015). Even though the number of SHS' has been declining in recent years with the rapid extension of the national grid across Bangladesh, the SHS have served an important interim socio-economic purpose by providing electricity to households in limited quantity. It is still open in how far these assets can be further leveraged as a decentralized asset to the people who own them and the regional grids they could be collectively integrated with.

Bangladesh has also been successful in reducing the system loss to a large extent. Due to heavy system loss, economic and household activities suffered from prolonged load shedding in the 1990s and early 2000s. However, the situation started to improve gradually due to technological improvement and timely policy interventions since 2009. According to the 2020 annual report of BPDB, the system loss was more than 35% in 1992, which was reduced down to 8.73% in 2020.

[17] To know more about the Bangladesh power sector, see: https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/710d7745_8a49_4466_8d4f_22e0a9232a73/PD%20REMARKABLE%20ACHIEVEMENT%20OF%202019-2020%20%281%29.pdf.

[18] As of May 2021, 99% of the Bangladeshi people have access to electricity. For more details, see: https://powerdivision.gov.bd/site/page/6cd25d49-3150-482a-8bd0-701d18136af7/%e0%a6%8f%e0%a6%95-%e0%a6%a8%e0%a6%9c%e0%a6%b0%e0%a7%87.

2.4 Fuel Mix Options in Electricity Generation

Historically, Bangladesh's fuel mix has been dominated by natural gas. Local availability in line with domestic requirements made the country over-dependent on this single source. The share of natural gas in electricity generation accordingly reached more than 80% by 2009. Even though this share gradually declined due to low gas reserves and implementation of smaller quick-rental power plants, Bangladesh is still heavily reliant on natural gas today. Figure 4 also shows fuel mix share from 2005 to 2020 for a grid-based generation. In 2020, the share of natural gas was the highest among all (56%), followed by Furnace Oil (FO) (27%) and High-Speed Diesel (HSD) (6%). Coal accounted for 3% of the electricity generation mix in 2020. However, the relative share of renewables shows a declining trend for the last 15 years as it stood only at 1.36% in 2020 in the electricity generation mix.

2.5 Move towards Competitive Market Environment and Investment Trend

Despite landmark achievements gained in the electricity generation capacity, Bangladesh still has a long path ahead to create a competitive market

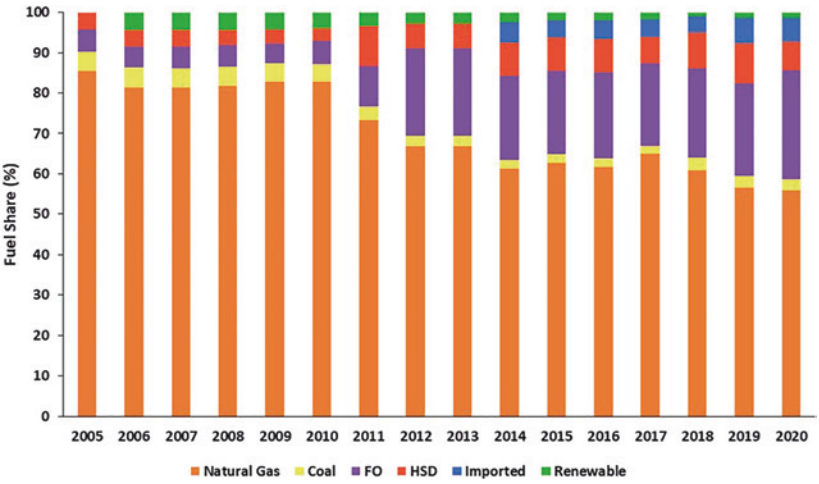

Fig. 4 Electricity generation fuel mix in Bangladesh from 2005 to 2020. (Source: Bangladesh Economic Review (BER) (2020))

environment as many energy utilities are still under the control of the state and have little operational or financial independence. On many occasions, the government influences the regulatory commission to fix the energy prices, which are not formulated following economic principles but based on vested interests and political motives. Due to imperfect or politically influenced pricing without any regard to cost, and operational inefficiencies in the absence of a competitive market, the state-owned power companies face losses, limiting investment in the energy sector. For instance, the Bangladesh Petroleum Corporation (BPC) net loss due to the fuel subsidies was USD 209 million in 2020.[19]

Moreover, since the per-unit cost of electricity generation increased after 2009 due to moving away from highly subsidized natural gas and the heavy use of imported liquid fuels, the Bangladesh Energy Regulatory Commission (BERC) has made several adjustments to balance both wholesale and retail electricity markets.[20] Recently, BERC has implemented a benchmark pricing system to attract private participation in electricity generation, making Bangladesh the first South Asian country to introduce this pricing system. Since the administered prices of locally available natural gas are set at levels significantly below that of the international market and remain very low in regard to the opportunity cost in respect of imported-fuel equivalence, the gas prices have also increased five times between 2009 and 2020 after moving towards a more competitive market environment.

It is also argued that the effort from the government in ensuring competition can be reflected in the overall performances of the energy sector in terms of system losses, generator availability, non-technical energy losses, accessibility of service, investment, price levels and structures, and service quality. The 6th, 7th, and 8th Five Year Plans (FYP) of Bangladesh report an increasing trend in private investment due to the price reform initiatives in the last 10 years.[21] However, the investment has increased mainly in the generation sector, backed by generously negotiated Power Purchase Agreements through collusive contracting virtually eliminating all market related risks and costing the Bangladeshi taxpayers approx.

[19] http://www.bpc.gov.bd/

[20] For more details, see: http://www.berc.org.bd/

[21] On the 6th FYP see: http://socialprotection.gov.bd/wp-content/uploads/2017/06/SFYP-Final-Part-1-17-08-111.pdf. On the 7th FYP, see: https://www.unicef.org/bangladesh/sites/unicef.org.bangladesh/files/2018-10/7th_FYP_18_02_2016.pdf. On the 8th FYP, see: https://bnnrc.net/bangladesh-eighth-five-year-plan-july-2020-june-2025-has-published-eversion/. The share of public investment in the energy sector in the Annual Development Program (ADP) allocation also increases since 2010.

USD 1bn yearly in subsidies for fossil-fuel based electricity generation (Khan et al., 2020). Given the present situation, the viable option is to open up the transmission and distribution sectors for private investment.[22]

Jamasb (2002) argues that privatization at the distribution and transmission utilities may be introduced at a later stage of the reform initiatives and will enhance further efficiency improvement for any country that has already significantly ensured private participation in the generation sector. With the significant progress in private power generation over the last one decade, it is time to deliver effective competition through private sector participation in the distribution and transmission sector. It is estimated that USD 216 billion would be needed for the generation, transmission, and distribution sector by 2041 (Power Cell, 2016).[23] Given the fact that the PGCB stands alone for confronting all emerging challenges in transmission sector, the Bangladesh government should plan for opening up the sector for private investment.[24]

3 Energy Market Reforms in Bangladesh

Having realized the importance of the energy sector, most developing and emerging countries started considering energy market reform as part of broader strategies towards a market economy since 1990 (Erdogdu, 2010; Newbery, 2004; Jamasb, 2006). Bangladesh also underwent a range of institutional reforms in the energy sector in the last 50 years. The government restructured the energy market with the unbundling of the sector by creating different publicly owned utilities for generation, transmission, and distribution firms; inviting the IPPs to stabilize the generation shortage faced by the state-owned companies; corporatizing of the core power utility; establishing an independent regulatory authority; and implementing large-scale power generation plants.

[22] Amin et al., (2021b) report that private investment shows a better performance than government investment in increasing energy consumption in South Asia.

[23] For more details about investment potentials in the Bangladesh power sector (as of 13th June 2019), see: http://www.powercell.gov.bd/site/page/8bf3f2bf-cdc8-4235-b2ca-1e8e39e3e7df/-.

[24] For more details, see: https://ep-bd.com/view/details/article/NjAyMA%3D%3D/title?q=open+up+power+transmission+to+private+investment.

3.1 Policies to Facilitate Reform Initiatives

The energy market reform programs in Bangladesh were claimed to be successful, as the reforms had been experiencing a process of remarkable institutional shift since the country's independence. During the 1970s and 1980s, the responsibility of the BPDB had been shared with the Rural Electrification Board (REB) for electrifying rural Bangladesh. In 1994, the Power Sector Reform in Bangladesh (PSRB) was formed, which outlined a reform process focusing on institutional issues. The National Energy Policy (NEP) was the first formal energy policy in Bangladesh, adopted in 1996 (followed by a revised version in 2004) to develop the overall structure for improving the sector. It also advocated for developing energy infrastructures, sectoral unbundling to achieve efficiency, increase in indigenous energy supply, institutional and policy reforms, energy conservation and efficient use, and implementation strategies.[25]

In 1996, the Private Sector Power Generation Policy[26] of Bangladesh was adopted which attracted national and foreign private investment for electricity generation. Following this policy, the IPPs entered the energy market after October 1996. In 1998, the policy guidelines for SPPs[27] were taken into consideration for further mobilization of the private resources. Besides, Private Sector Infrastructure Guidelines[28] were adopted in 2004 to enable procurement and implementation of private infrastructure projects by documenting a set of guidelines, and monitoring and expediting the implementation through institutional arrangements. Bangladesh also adopted policies for purchasing electricity from the CPPs in 2007.[29]

[25] For more details about NEP, see: Amin (2015).

[26] For more details, see: https://www.bpdb.gov.bd/bpdb_new/d3pbs_uploads/files/11%20March%2019/1.%20PSEPGPB.pdf.

[27] For more details, see: https://berc.portal.gov.bd/sites/default/files/files/berc.portal.gov.bd/policies/9ddbabab_e084_464d_9511_46c0364d0ac4/Policy%20Guidelines%20for%20SPP.pdf.

[28] For more details, see: https://berc.portal.gov.bd/sites/default/files/files/berc.portal.gov.bd/policies/bf23784c_4f48_4520_ace0_59667f00838f/Private%20Sector%20Infrastructure%20Guidelines.pdf.

[29] For more details, see: https://www.adb.org/sites/default/files/publication/692451/adbi-wp1238.pdf.

Bangladesh undertook three major PSMPs in 2005, 2010, and 2016 to achieve its energy sustenance goals and meet the energy demands.[30] The main objectives of adopting these PSMPs were to shift to a more comprehensive and mid-long-term planning for meeting the future energy generation by augmenting the challenged in the immediate and interim period (Tamim et al., 2013). Initially, the PSMP 2005[31] mainly focused on increasing the generation capacity by utilizing domestically produced natural gas. However, due to the depleting stock of natural gas, the PSMP 2010[32] shifted the focus on strengthening the energy diversification process for electricity generation by tapping all the possible fossil and non-fossil fuel sources. Finally, PSMP, 2016[33] dedicated on developing the infrastructural development for energy import and human capital development and increasing renewable energy share in the electricity generation mix for stable energy supply. Paltsev (2020) argues that energy and industrial firms, governments, think tanks and other stakeholders must position their strategies with science-based goals while perusing economic growth together with reliable and affordable energy.

The Renewable Energy Policy (REP)[34] was adopted in 2008 to recognize the importance of renewable energy to remove the disparity between urban and rural areas, increase the contribution of renewable energy by setting targets, and developing the local authority. In 2011, the Power and Energy Sector Road Map[35] was implemented that outlined the updated strategies for revamping the power and energy sector. More recent policies included the Energy Efficiency and Conservation Master Plan up to 2030 in 2015,[36] the Gas Sector Master Plan in 2017,

[30] However, according to the PP 2021–2041, there were 2 earlier versions of the PSMP adopted in 1985 and 1995.

[31] For more details, see: https://policy.asiapacificenergy.org/sites/default/files/Power%20System%20Master%20Plan-2005.pdf.

[32] For more details, see: https://policy.asiapacificenergy.org/node/249.

[33] For more details, see; https://powerdivision.gov.bd/site/page/f68eb32d-cc0b-483e-b047-13eb81da6820/Power-System-Master-Plan-2016.

[34] For more details, see; http://policy.thinkbluedata.com/sites/default/files/REP_English.pdf.

[35] For more details, see; https://policy.asiapacificenergy.org/sites/default/files/Roadmap_power_energy_2010.pdf.

[36] For more details, see: https://policy.asiapacificenergy.org/sites/default/files/EEC_Master_Plan_SREDA_2.pdf.

the Electricity Act[37] in 2018, the Quick Enhancement of Electricity and Energy Supply (Special Provisions) Act[38] in 2018, and the 8th Five Year Plan in 2020 for the next five years' energy sector development targets. Guidelines for further improvement of the energy sector as well as for ensuring energy security level are also discussed in the 2nd Perspective Plan of Bangladesh 2021–2041 (GED, 2020)[39] and Bangladesh Delta Plan (BDP) 2021 (GED, 2018). BDP 2021[40] targets to develop long-term renewable energy policies and construct a master plan for at least 50 years and is expected to play a crucial role in attaining future energy security of Bangladesh by harnessing the potentials of the renewable energy resources through public and private investments.

3.2 Energy Sector Reforms in Bangladesh

The main reform initiatives in Bangladesh include restructuring the core utilities, the undergoing institutional reform, ensuring privatization, and establishing independent regulatory bodies (Fig. 5).

3.2.1 Institutional Reforms

In 1998, the Ministry of Power, Energy, and Mineral Resources (MPEMR) was divided into two divisions, the Energy and Mineral Resources (EMR) Division and the Power Division (PD), to improve institutional efficiency. Moreover, Power Cell was formed in 1995 to support PD of MPEMR in monitoring and implementing reform projects, helping different stakeholders for future sectoral activities, and attracting private investment. For facilitating renewable energy

[37] For more details, see: https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/18d2690b_f02f_4c35_8f90_79b70d333242/ELECTRICITY%20ACT,%202018.pdf.

[38] For more details, see: https://www.dpp.gov.bd/upload_file/gazettes/18893_67482.pdf.

[39] More details can be found at: http://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/1/1049/vision%202021-2041.pdf.

[40] To know more about BDP 2100, see: https://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/1/756/BDP%202100%20Abridged%20Version%20English.pdf. BDP 2100 is a long-term holistic and integrated plan approved by Bangladesh in 2018. The key objectives of the BDP are aligned with SDG Goal 2, 6, 13, and 14 and complemented by the policies in the 8th Five Year Plan and the 2nd Perspective Plan (2021–41) in achieving Bangladesh's Vision for 2041. See: https://thefinancialexpress.com.bd/views/bangladesh-delta-plan-2100-implementation-challenges-and-way-forward-1553354695.

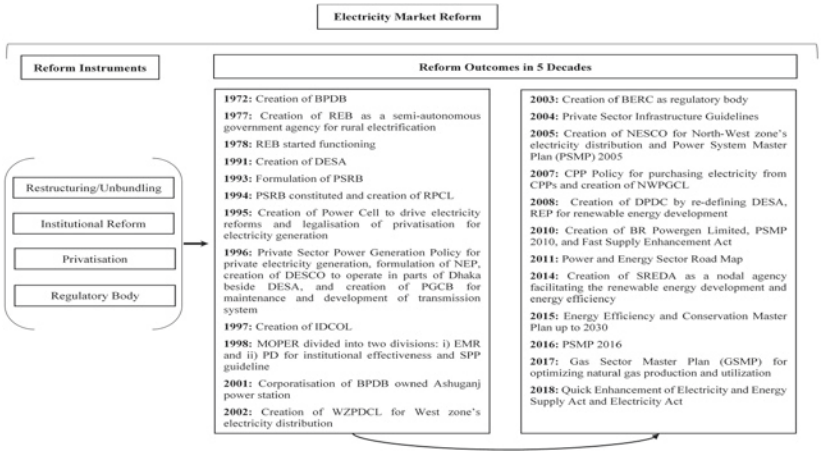

Fig. 5 Reform outcomes in Bangladesh. (Source: Authors own elaboration)

development, the government created the Sustainable and Renewable Energy Development Authority (SREDA) in 2014 as a nodal agency but to date has not decided to provide the same with a ministerial status, which is the case with other countries (e.g. India's Ministry of New and Renewable Energy).

3.2.2 Restructuring of the Core Utilities

The restructuring of the core power and energy utilities has played a crucial role for the Bangladesh energy sector, briefly discussed below.

Generation Utilities

In 1972, the Bangladesh Power Development Board (BPDB) was established as a public sector organization for power generation and transmission and electricity distribution across the country. Before 1995, electricity was generated only by the public utilities under BPDB; however, the share of private companies in electricity generation became significant from 1995. According to the 2020 annual report of the BPDB, 44.47% of the total electricity was generated by the private sector in 2019. For adequate electricity generation and to improve administrative efficiency, BPDB has been continuously unbundling throughout the last 50 years. For example, currently, Ashuganj Power Station Company Limited (APSCL), North-West Power Generation Company Limited (NWPGCL), BR Powergen Limited,

and Rural Power Company Limited (RPCL) work as a subsidiary of BPDB in power generation.[41]

Distribution Utilities

The establishment of the Rural Electrification Board (REB) in 1978 was the first restructuring initiative in the distribution sector to provide electricity in rural areas. Recently, around 80 collaborative organizations [Palli Bidyuit Samity (PBS)] in rural areas have contributed to additional connections and forming distribution lines for increasing rural electricity accessibility. BPDP further underwent unbundling in 1991 to create the public company Dhaka Electric Supply Authority (DESA) with an intention to provide better services to Dhaka and surrounding areas. However, a new entity DESCO (Dhaka Electric Supply Company), emerged after 5 years in 1996, and started distributing electricity besides DESA. Such further unbundling was done to achieve better management of resources and to enhance consumer satisfaction. In 2008, DESA was redefined as the Dhaka Power Distribution Company (DPDC) with new objectives to attain the increasing energy demand. West Zone Power Distribution Company Limited (WZPDCL) was established in 2002 for distributing electricity to Khulna and Barisal divisions. Furthermore, NESCO (Northern Electricity Supply Company Limited) was established in 2005 for the divisions of Rangpur and Rajshahi.

Transmission Utilities

The Power Grid Company of Bangladesh (PGCB) was created (unbundling from BPDB) in 1996 (under the Companies Act 1994) to act as a separate transmission utility in the energy sector. The main reason for such separation was to bring efficiency in operational activities, maintenance, and the development of transmission infrastructure all over the country.

3.2.3 Independent Regulatory Body

One of the key reform initiatives in Bangladesh was to establish the independent regulatory authority (BERC) in 2003 through a legislative Act of the Government of Bangladesh. As a regulatory body, BERC is responsible for fixing the tariff rates of electricity, and other resources such as coal and natural gas. BERC also

[41] For more details, please see: https://www.bpdb.gov.bd/bpdb_new/index.php/site/page/13e9-2cc0-ce41-9c09-088d-94d5-f546-04a6-b4fa-1d18.

guides different policy formulations done by other entities of the energy sector. It is also worth mentioning that the BERC promotes a competitive market environment and protects consumer rights.

4 Existing Controversies

Although Bangladesh initiated different reform initiatives since independence to strengthen the energy sector and quicken the developmental activities' pace, these initiatives became more visible since 2009 as the government targeted 100% electrification by 2021. Although the government successfully resolved the historical energy crisis in terms of its limited generation capacity, this success raised concerns regarding several controversies briefly discussed below.

4.1 Quick Rental (QR) Power Plants and Increase in Liquid Fuel Consumption

The government introduced the QR power plants in 2010 as a quick solution to reduce the then persistent electricity crisis. This policy of introducing the QR power plants has been a success by providing an intermittent electricity supply. However, these QR power plants burn oil to produce electricity, and oil imports have increased by almost 400% over the last ten years (BPDB, 2020). Since the government provides subsidies to the QR power producers for oil, the size of the fuel subsidies soared during this period. The average cost of electricity generation has also increased 2.5 times during the last ten years. Moreover, the increased usage of imported oil exposes the country to oil price shocks in the global market. Amin (2015) reveals that the Bangladesh economy is indeed vulnerable to oil price shocks as increased oil prices have an adverse effect on household welfare which reduces overall consumption and output.

Experts criticize that although the QR power plants were given licenses on a three-to-five-year basis, nine QR power plants with a cumulative generation capacity of almost 1GW continue to supply electricity to the national grid for over a decade now despite the country's vast amounts of excess electricity in recent years. Amin et al. (2019) reveals that shutting down the QR power plants will be welfare-enhancing for Bangladesh's economy and suggest that the Bangladesh government should start shutting down QR power plants and switch to alternative sources.

4.2 Low Reserve of Natural Gas and Issue with LNG

Following the oil price shocks in the 1970s, natural gas became the energy of choice in Bangladesh until 2008. Although the country has faced a diminishing trend in natural gas usage in electricity generation due to the fuel diversification process, the share is still large (55.89%) compared to global standards of 23%, raising the fear of resource depletion. There is a growing concern among the experts that Bangladesh is now at risk of depleting the limited natural gas reserve due to the lack of technical skills, which acts as a hindrance in discovering new gas fields. Therefore, the government aims to continue discovering new gas fields, exploring more natural resources from the offshore blocks, and ensuring natural gas structure in collaboration with foreign companies.

Given this background, the Bangladesh government attached high priority to LNG-based power generation to fill the demand and supply gap. Bangladesh now has two floating storage and regasification units (FSRUs) with a total capacity of 7.5 million tons a year. The country is also developing a land-based terminal that can handle 7.5 million tons per annum (MTPA) of LNG, which is expected to be prepared in 5 years. Bangladesh plans to generate approximately 11% of total electricity from the LNG power plants by 2041.

The existing pipeline, however, is considered too small to accommodate future natural gas delivery. Moreover, the LNG price is still considerably high, which can distort the market environment and result in a vicious subsidy regime in the future. On the other hand, the operating cost of FSRUs is much higher due to the high charter rates of the ships that bring LNG to Bangladesh. Given all these adversities, the higher dependency on LNG as an alternative fuel option remains questionable. The government is likely to observe progress with the LNG expansion scheme and revise the policy as required in the context of the upcoming PSMP before allowing for large-scale investments for electricity generation from LNG.

4.3 Slow Progress in Renewable Energy Development

Despite the huge success in the dissemination of SHS proving solar-powered electricity access to more than 25 million rural Bangladeshis, the increasing global trend of renewable energy generation capacity as a significant part of the energy mix has not yet been observed in Bangladesh. Figure 6 shows a gloomy picture as the share of renewable energy in the electricity generation mix declined

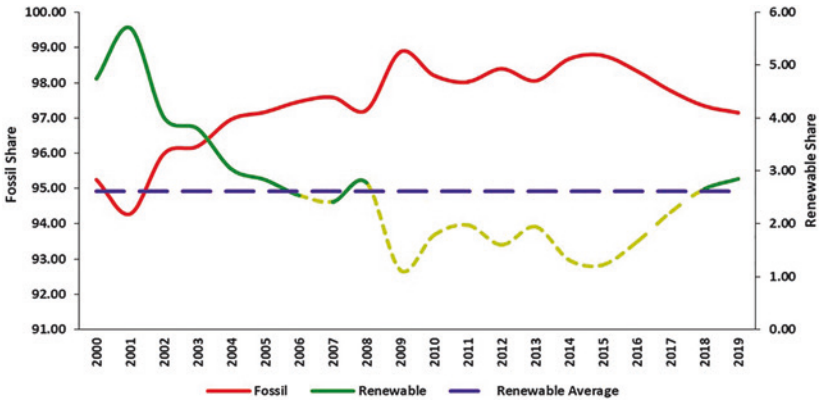

Fig. 6 Fossil versus renewable energy use for electricity generation. (Source: World Development Indicators (2020) and SREDA (2020a))

sharply after 2001. From 2009 to 2016, the average share of renewable energy in the electricity generation mix remained 1.58% (yellow dotted line), which is lower than the average share (2.61%) of renewable energy from 2000 to 2019.

Although renewable energy has been given priority in the different power sector master plans, the renewable energy share is yet to increase beyond the mere three percent. It is worth noting that the share of renewable energy in the total generation was above the average share of renewable energy. One of the main reasons was that Bangladesh generates approximately 200 MW of electricity with the hydro plant from the Kaptai lake due to the flat terrain. However, the increased electricity generation capacity over the years pushed down the renewable share. A closer look at other literature and case studies find that many existing socio-economic and institutional barriers limit the growth of the renewable energy market in Bangladesh from both the demand and supply sides. Market barriers remain another key impediment behind the development of renewable energy in Bangladesh. For example, institutional reforms should come from regulatory legitimacy.[42] Too many institutional segmentations within a centralized set-up are a common feature observed in Bangladesh, like most Asian countries.

[42] Amin et al. (2021a) argues that "Regulatory legitimacy refers to formal rules, compliances, and bureaucratic effectiveness." It is considered as one of the fundamental aspects that determines government dynamics in an economy.

Institutional ambiguity in the energy sector have also led to the slow progress of renewable promotion, generation, and dissemination. Among others, institutional collaborations, infrastructure facilities, monitoring capacity, credit access, after-sales services, quality assurance, pricing issues, and technical issues must be adequately addressed for a sustainable renewable energy market in Bangladesh.

Another important reason behind the inaction in renewable energy development is the poor allocation in the ADP of Bangladesh while formulating energy policies. The 2020 statistics data from the Ministry of Finance[43] shows that between 2015 to 2020, the average share of renewable energy in ADP allocation was only 5.80%, whereas the average allocation of fossil energy in the same period was astonishingly 94.20%. Furthermore, expenditure allocation for Sustainable and Renewable Energy Authority (SREDA) has remained marginal. On average, SREDA received only USD 0.73 million from 2015 to 2020 (SREDA, 2020a), which was approximately 0.03% of the total allocated budget. These points raised above beckon the question of whether the often-cited scarcity of land as the main hindrance to a larger uptake of solar PV (Shiraishi et al., 2017; SREDA, 2020b) really tells the whole story or whether strong elements of stakeholders with vested interests in retaining the status quo are at play.[44] However, according to the PP2041, the government plans to considerably amend and strengthen the renewable policies by learning lessons from experience, encouraging private investors to generate and households to consume renewable energies through different incentives. Several options have been planned to explore the increase in renewable energy, such as offshore wind, tidal energy, waste to energy, etc.

4.4 Overcapacity in Generation and Issue of Capacity Charge

Bangladesh has maintained a surplus of 40% electricity for the past few years, although the global accepted level of overcapacity is 20% (GED, 2020). One of the main causes for overcapacity is the mismatch between the demand–supply

[43] For more details, see: https://mof.gov.bd/

[44] For more details, see: https://thefinancialexpress.com.bd/trade/land-scarcity-key-barrier-to-dev-of-renewable-energy-1552062684 and https://www.tbsnews.net/feature/panorama/solar-power-not-enough-land-consider-highways233173#:~:text=The%20biggest%20problem%20facing%20Bangladesh,options%20in%20Bangladesh%20are%20negligible.

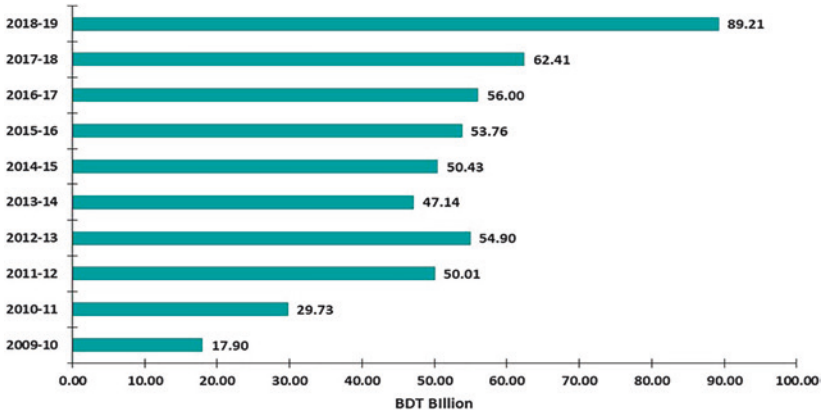

Fig. 7 QR capacity charge over the years. (Source: BPDB (2020))

prediction and the inaccurate forecasting methods used in the PSMP. The economic inaction associated with the Covid-19 pandemic has also reduced the overall energy demand of the country. The overcapacity problem is also linked with capacity charges, as the government has to pay a significant amount of money as a capacity charge to the idle QRs to cover up their losses, leading to upward pressure in electricity prices.[45] Figure 7 further shows that the capacity charge has increased since 2014, and the government paid USD 1.06 billion as a capacity charge, which is the maximum value ever recorded. According to the officials of the BPDB, 35% of overcapacity is needed in Bangladesh for several reasons. For example, 5% electricity is required for the plant's own use, 10% for maintenance, 10% for spinning capacity, and another 10% for system loss.[46] Moreover, overcapacity is needed because of the difference in seasonal consumption (peak summer vs. peak winter). Given that the demand may rise once the Covid-19 pandemic is over, the overcapacity in generation in Bangladesh may be seen as a way to avoid any future supply shortage, albeit a costly strategy.

[45] For more details, see Speedy Supply of Power and Energy Act of 2010. https://www.dpp.gov.bd/upload_file/gazettes/18893_67482.pdf.

[46] See: https://www.thedailystar.net/backpage/news/power-generation-overcapacity-new-headache-2032377.

4.5 Subsidy Issues

Ahmed et al. (2016) highlights that the energy sector in Bangladesh is constrained by the prevalence of high subsidies and distorted energy prices. Many government power companies in Bangladesh are in severe financial need, which causes upward pressure on the national budget. The government has to support these institutions by providing subsidies, which adversely affect the government's potential to finance expenditure on education, health, and social protection. Moreover, when there was a rise in the global oil price, the government could not transfer the higher cost to the consumers. This caused an upward gap between the average cost of oil commodities and the selling price to the consumers. Accordingly, the subsidy bill of the government soared. For instance, BPC had historically suffered losses because of the non-adjustment of oil price in the local market in accordance with oil price increases in the international market. Consequently, the government had to provide large yearly subsidies for importing petroleum products during those periods.[47]

It is also worth noting that the electricity tariff structures in Bangladesh vary across sectors and consumption levels. Amin (2015) argues that industrial and commercial sectors pay higher tariffs while domestic and agriculture sectors pay low subsidized tariffs. According to the 2020 statistics of the Power Division, the total subsidy in 2015–16 was USD 0.56 billion, which increased to USD 0.87 billion in 2020 due to the increased generation cost. The subsidy for imported fossil fuels is still a significant burden for the Bangladesh energy sector. The average amount of subsidy allocated for the energy sector for the last 10 years is approximately USD 0.76 billion (Fig. 8).

The debates are ongoing in how far subsidies actually help the poor due to energy subsidy's inefficient and inequitable nature (IMF, 2013). Most of the benefits of fuel subsidies tend to go to the affluent who can then buy more fuel (Granado et al., 2012). Moltke et al. (2004) discuss that those cross-subsidies may reduce industrial firms' global competitiveness, compelling them to pay higher tariffs and, consequently, hinder economic development. Jamasb and Nepal (2015) also make the point that cross-subsidies from industrial to residential users are not economically desirable. However, any policy revisions regarding subsidy

[47] Nevertheless, the government did not have to provide any subsidy between 2016 and 2018 due to the declining international oil prices. However, during 2019, the prices began to rise again, and the BPC started incurring losses from furnace oil and diesel.

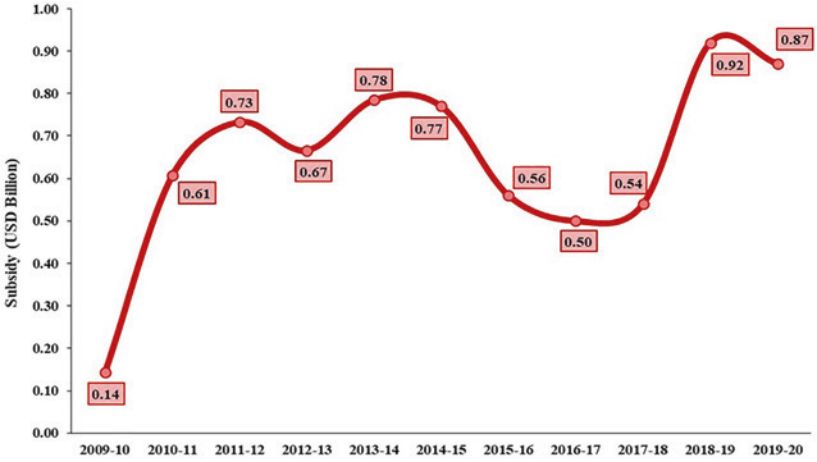

Fig. 8 Electricity subsidy in Bangladesh 2009–2019. (Source: Power division (2020))

removal are not easy and need to be introduced from equity consideration since most developing countries face difficulty in reducing or removing them, often because of the political unrest their withdrawal causes. BERC has made several adjustments during the past few years to maintain financial discipline in the sector and protect consumers' interests. However, the increasing trend of electricity prices will continue unless efficiency and other cost measures are considered. It is argued that adequate pricing of fossil fuels is necessary to foster generation, the use of green energy options, and to meet Bangladesh's environmental objectives, including its commitments to the Paris Accord on Carbon Emission Reduction (GED, 2020).

4.6 Demand Forecasting Methods

Due to the unplanned urbanization, the rapid industrialization, the existence of a large informal economy and the urban–rural divide, it is very difficult to maintain the generation target as forecasted in the demand estimations. Moreover, since the government introduced rigorous rural development programs, the energy used in the rural area (especially rural non-farm sectors) also increased significantly. Rural energy demands, however, are significantly more difficult to capture through econometric models (Bhattacharyya & Timilsina, 2009).

5 Conclusion and Priority Actions

It is recommended that the Bangladesh government continue adopting coordinated policies to ensure that the further development of the energy sector is aligned with the development momentum pace. Bangladesh should strive to achieve a more efficient, environmentally friendly, and least-cost fuel mix in its electricity generation. It is worth noting that coal power is not a cheap option as the costs of renewables have been undercutting coal for years. The BDP 2021 targets to produce a minimum of 30% energy generation from renewable sources by 2041 and plans to prepare a master plan for at least 50 years to exploit the potential of renewable sources in the country incorporating public and private investments.

Nuclear power production is also included in the Bangladesh government's agendas to increase the generation capacity in meeting the growing electricity demand. The Rooppur nuclear power plant is expected to generate the first 1200 MW nuclear power by 2024. However, there are concerns regarding the safety issues as critics find it to be a massively risky venture for Bangladesh, which could severely affect the safety of millions of people in this densely populated country and strain external payment's sustainability. Therefore, the government should carefully review the action with nuclear power and, if required, revise the PSMP to revolutionize their energy production through renewables by providing the consumers and the private sector with a proper incentive structure to create a sustainable renewable environment. Accordingly, the continued staggering dependency on fossil fuels needs to be decreased to compete with the progress made by global clean energy usage.

Petroleum products and gas also have severe pricing issues in Bangladesh. Despite numerous adjustments, the gap between average cost and price is still sizable. BPC imports crude and refined oil every year according to the country's demand. Given the volatility of the global fossil fuel markets, a high risk of financial debt will continue unless there are regular price adjustments.

Furthermore, adequate pricing of fossil fuel commodities is vital to promote products, clean fuel options, to gain energy efficiency, and financial sustainability. Globally, it is well acknowledged that subsidized fossil fuel has given rise to excessive carbon emission and discouraged the adoption of clean technology and investments in renewable energy (Beyer et al., 2020; Surge et al., 2020). It is worth noting that Indonesia's innovative policy of inclusive fossil fuel subsidy removal, initiating direct social welfare strategies to assist its poorest citizens while following a green energy policy may serve as an example. Therefore, price

reform and the gradual withdrawal of the subsidies will permit Bangladesh to advance to a competitive and environmentally sustainable least-cost power generation, transmission, and distribution system together with greater private involvement, owning resource mobilization to lessen the dependence on finite financial resources and to meet the environmental goals of Bangladesh including its devotion to the Paris Accord on Carbon Emission Reduction.

For further development of renewable energy, the government's emphasis on a low-carbon development path also needs to be reflected in its budget allocation. Moreover, innovative financing schemes for grant funding and low interest financing for interventions targeted to make the country's current grid infrastructure smarter, e.g., innovations in decentralized storage technologies for more grid flexibility, should receive strong support. Furthermore, least cost technology for bridging the gap between on-grid and off-grid renewable energy projects ought to be implemented. Existing support programs through institutions like IDCOL and Investment Financing Facility for Private sector (IFFP) should be further strengthened. The government should focus on the adoption of Electric Vehicles (EV) for road transport, including the 1.5 M+ already existing electric three-wheelers, and reverse the trend of recent bans toward those vehicles to a conducive policy framework facilitating a safe and clean adoption of the same. Moreover, a framework for connecting solar home systems into the grid, integrated electrification planning should receive increased financial and policy support. The existing market barriers surrounding the renewable energy sectors also need to be addressed adequately, creating at least a level playing field. Waste to Energy (WtE) power plants could also be prioritized and implemented thoroughly throughout Bangladesh, as it creates massive potential in renewables in the country. Additionally, mobilization of adequate financial resources should be considered, including the proper mobilization of private finance for investments in indigenous renewable energy and other energy infrastructure development.

Policies such as liberal trade regimes (bilateral or multilateral), customized financial motives for clean technology, and Cross-Border Electricity Trading (CBET) can also bring improvement in the energy security level (Pan et al., 2019; Jamasb et al., 2015). With a harmonized policy framework and creating regional solid energy cooperation, Bangladesh can access the hydropower generated in Nepal and Bhutan channeled through India, and other resources to reduce the country's primary electricity generation fuels and associated resources risks. It is worth noting that such diversification through trading collaboration will help Bangladesh to lessen the possibility of power supply disruption from conflict and accidents. However, the government has to be cautious since the success of the

CBET depends on the political relations of the trading partners and the volatility of energy prices.

According to the 8th FYP, till now, only 27 gas fields have been discovered in Bangladesh. However, about 50 unexplored gas blocks (17 onshore and 22 offshore) from which a good amount of natural gas can be extracted to generate electricity and provide energy to other priority sectors, also exist. The cost of exploration and development of untapped resources is likely to be lower than LNG import. To undertake exploration and development of undiscovered resources, external support may be needed. To address such technical and financial issues, Joint Venture or "Strategic Partnership" between BAPEX and foreign companies may be sought through a Production Sharing Agreement with IOCs to pursue both onshore and offshore oil and gas options.

We also emphasize private and Public–Private Participation (PPP) projects so that the government can focus on developing other energy-related infrastructure. Besides, the government also needs to accelerate the phasing out of the QR power plants immediately and find alternatives for the LNG to solve the overcapacity and capacity charge issues and expected price distortions associated with the LNG.

Bangladesh should implement large-scale power transmission and distribution systems to stabilize the network voltage fluctuations and frequency problems, create uninterrupted quality power distribution, and install more high-power transmission lines in line with the growing demand and massive supplies originating from new power generation hubs (Payera, Roop Pur, Rampal and Matarbari). Attracting foreign and domestic large-scale private investment and introducing newer innovative solutions should be given utmost priority in the upcoming years for developing the transmission and distribution sector. The government may further look for implementing well-articulated demand-side management (DSM) to ensure cost-effective ways to curtail the peak demand and control load shedding while simultaneously reaching out to consumers to adopt energy-efficient appliances and equipment, and introduce improved energy-efficient technologies and new building insulation standards to meet the energy efficiency targets.[48]

Energy efficiency programs need to be strengthened to promote high-efficiency household appliance sales, awareness programs to induce behavioral changes in consumers to save energy, introducing peak and off-peak tariff systems to reduce peak demand, and implement rigid regulations in large buildings to save energy such as nominating energy managers. Additionally, energy storage

[48] For details, please see: https://openjicareport.jica.go.jp/pdf/12231247.pdf.

system development can be focused on through further Research and Development (R&D).

Institutional reform needs to be addressed as the lack of organizational power of the decentralized institutions within a centralized system which impedes and slows down policy implementations and private investments (Cai & Aoyama, 2018; Ghafoor et al., 2016; Vijay et al., 2015). Besides, several bureaucratic issues restrict the acceleration of currently enrolled energy-related programs. Hence, following the argument of Jamasb et al. (2016), substantial priorities should be given to coordinated institutional reforms through regulatory legitimacy in energy technology exploration, investment mechanisms, DSM, cross-border negotiations, and energy dissemination programs. Finally, the government might consider adding policies that can be used to develop different skill sets of the existing workforce and train newly enrolled employees in the energy sector to reduce the administrative inefficiencies and reallocate the prevailing subsidies to the development of renewable energies.

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