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ENERGY OUTLOOK

ACTIVATING BANGLADESH'S WIND ENERGY RESOURCES

By Israt Hossain

Israt Hossain has highlighted the significant untapped potential of wind energy in Bangladesh, exemplified by the Khurushkul project, the country's first major commercial wind power initiative. This article emphasized on strategic advancements in wind energy, supported by favorable policies and technological progress, which could contribute to revolutionize Bangladesh's energy sector, enhancing energy security and fulfilling environmental commitments.

EXISTING SOLAR POWER PLANTS AND FUTURE PROSPECTS

By Ekramul Hasan

Based on his recent site visits, Ekramul Hasan highlights the current state of solar energy adaptation in the country and explores ways for further improvement. He investigates major challenges such as land acquisition and utilization, grid upgradation, and storage integration in installing both utility-scale and rooftop solar power plants.

ENERGY PRICE FLUCTUATIONS AND THEIR IMPLICATIONS FOR BANGLADESH'S MACROECONOMY

By Abdur Zabbar Sakil and Md. Tuhin Ahmed

Abdul Zabbar Sakil and Md. Tuhin Ahmed highlights the effects of energy price fluctuations on Bangladesh's macroeconomy, emphasizing the country's heavy reliance on fossil fuel imports and the resulting vulnerabilities. They advocate for diversifying the energy mix towards renewable sources to mitigate these economic challenges and stabilize the domestic market.

Activating Bangladesh's Wind Energy Resources

Israt Hossain

Wind energy in Bangladesh has been identified as a significant untapped renewable resource, according to a collaborative study conducted by the United States Agency for International Development (USAID) and the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). The study utilized advanced tools to assess the viability and associated risks of harnessing wind power. It revealed a distinct annual cycle in wind patterns, peaking at speeds of 4–6 meters per second (m/s) during spring and summer, and dipping to 2–4 m/s in autumn and winter. This preliminary technical analysis highlighted over 20,000 square kilometers of land demonstrating a gross wind potential exceeding 30,000 megawatts (MW). However, this figure represents a theoretical maximum as it does not account for land already in use, environmental sensitivities, or other unsuitability factors. Despite these considerations, the data suggests a robust potential for wind energy development that could significantly bolster Bangladesh's energy sector.

A notable venture in this domain is the 60 MW wind power plant at Khurushkul, Cox's Bazar, which stands as Bangladesh's first centralized and commercial wind power project. This plant is situated in the southeastern district of Cox's Bazar, distinguished for being the sole operational wind facility in the country. Other smaller projects, like the 0.9 MW plant near Muhuri River dam in Sonagazi and a 1 MW facility in Kutubdia, are currently non-operational due to ongoing repairs.

The Khurushkul project was invested in by Wuling Power Corp., a subsidiary of China's State Power Investment Corp. (SPIC), and constructed by PowerChina Chengdu Engineering Corp. Chinese solutions, Chinese standards and Chinese equipment had been used during the construction of this project to promote the sustainable development of Bangladesh's renewable energy industry according to the investor. They trained the first batch of practical talents in the field of wind power for Bangladesh and providing more than 1,500 local jobs.

The power plant consists of 22 wind turbines having capacity to produce 3 MW per turbine. The daily generation of this plant ranges from 0 Mwh to 400 Mwh. Since the plant started its operation in May 2023 with 10 wind turbines, they do not have a yearly data. However, they have a projection of producing 145 Gwh electricity to transfer to the grid per year. Each wind turbine is basically a wind turbine generator producing 950 V of electricity. This electricity gets stepped up to 35 KV through box transformer to avoid the transmission loss as the more the voltage the less the transmission loss. From each turbine this stepped-up electricity gets connected to BUS in the switch gate room. A BUS is a node, across at which one or many lines, one or many loads, and generators are connected. Then from BUS through the main transformer electricity is again stepped up from 35 KV to 132 KV to give the input to the grid of 132 KV. After that, through the GIS (Gas-insulated substation) switching station electricity reaches to transmission line tower from where it connects with the grid. Commonly, Air Insulated Substations (AIS) are utilized, but this power plant opts for a Gas Insulated Substation (GIS) due to its compact design, which requires less space.

Although GIS has a higher initial installation cost, it offers the advantage of lower maintenance expenses compared to AIS.

The project, spearheaded by US-DK Green Energy (BD) at a cost of $116.51 million, benefits from a Power Purchase Agreement (PPA) tariff of $120 per megawatt-hour (MWh) secured by a sovereign guarantee from the Government of Bangladesh. With full commissioning, the total project investment is estimated at $120 million. The debt-equity ratio of this power plant is 77:23 and it has the 15 years tax-exemption activated. As per the company an average wind speed of 5.5 metres per second [m/s] to generate power is needed since modern technology is being used. The highest speed of the wind for the turbines is 9 m/s which will generate at best 3 mw power. Even if the wind speed is more than 9 m/s the turbine will move in such a way that it will still get the 9 m/s wind speed. This plant has an added facility of stopping the turbine movement automatically while the wind speed is more than 20 m/s after 10 minutes of observation to protect the turbines. Each turbine generator can produce 95% of its capacity. To get the wind pressure efficiently, between two turbines there is 0.5 km.

A significant advantage of wind power, as demonstrated by the Khurushkul project, is its efficient use of land. Unlike solar farms that require extensive land coverage, each wind turbine at this facility is surrounded by a boundary of only 25 meters. This configuration allows the land between turbines to be used for other activities, such as salt cultivation, showcasing the multi-functional utility of wind farm sites. Additionally, the Khurushkul project is expected to make a substantial environmental and social impact. According to reports from the State Council of Information Office China, the project will significantly reduce coal consumption by 44,600 tons and decrease carbon dioxide emissions by 109,200 tons annually. Moreover, it will fulfill the electricity needs of approximately 100,000 households, illustrating the broad-reaching benefits of investing in wind energy infrastructure.

While there are challenges such as the need for accurate land assessment and technological adjustments to optimize production, the potential for wind energy in Bangladesh is immense and largely unused. The strategic implementation of projects like the one in Khurushkul, combined with advancements in technology and supportive policies, could catalyze a significant transformation in the country's energy profile. By capitalizing on the inherent advantages of wind energy, such as its low environmental impact and the capacity for local job creation, Bangladesh can move towards a more sustainable and secure energy future. The expansion of wind energy could also contribute significantly to the nation's commitments under international climate change agreements by reducing reliance on fossil fuels and lowering greenhouse gas emissions.

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Existing Solar Power Plants and Future Prospects

Ekramul Hasan

Renewable energy use in Bangladesh has become a focal point in the quest for sustainable development, with solar energy emerging as a key player. Bangladesh's commitment to solar energy is evident from its rapid adoption, starting from off-grid solar home systems (SHS) to on-grid utility scale solar park. Despite the fact that renewable energy in Bangladesh began with hydroelectric power in the 1960s, geographical limitations hindered its growth. In contrast, solar energy initiatives, which started gaining momentum in the early 2000s, have shown promising growth due to their suitability for Bangladesh's flat, sun-drenched terrain. With over 6 million SHS installed, although concerns are there regarding their poor quality, these systems brought electricity to the most remote corners of the country, where the national grid could not reach.

Along with the SHS, the government and private sector have made significant strides in establishing larger-scale solar power plants. The solar energy sector in Bangladesh took a significant leap with the inauguration of the 20 MW Teknaf Solar Power Plant in Cox's Bazar in 2018, the first utility-scale solar project in the country. Teesta Solar Park, the largest in the country, is another prime example. This park alone contributes significantly to the national grid with its substantial capacity of 200 MW. Other notable projects include the Mymensingh Solar Park and the solar plant in Bagherhat, both of which are part of Bangladesh's broader strategy to diversify its energy portfolio.

These power plants also come with new infrastructures benefitting all the people in the locality and creating employment. Despite these successes, the journey is not without its challenges. Land acquisition is a significant hurdle due to Bangladesh's high population density and agricultural priorities. Although the capacity of Teknaf Solar Park seems modest (20 MW), the plant's 116-acre footprint reflects extensive land use. However, over time, advancements in photovoltaic (PV) technology have allowed for more efficient land use. For instance, the Beximco Group's 200 MW Teesta solar power plant was constructed on 600 acres of land, demonstrating the reduced land requirement per MW. Orion Group's 100 MW Energon solar park also demonstrates technological advancements, needing only 2.8 acres per MW due to larger photovoltaic (PV) panels and more efficient layouts.

Regarding the layouts, being located in the north pole, most of the existing solar power plants have installed their solar PVs facing the south with higher tilt angle, around 30 degrees, so that the PVs get solar irradiation to the fullest and for the maximum time of the days. The Energon Solar Park, however, introduced alternative approach, setting up all their PVs facing both east and west, with a lower tilt angle of five degrees. The lower tilt angles allowed the PVs for both sides to have signification irradiation, east-part PVs having the most irradiation in the earlier part of the days and west-part PVs having the most irradiation in the later part of the days.

This alternative arrangement ensures no consequential loss in power generation compared to the former technology (south facing), while saving significant amount of land at the same time. Along with the lower tilt angles, use of larger PVs also notably reduce land footprint and the good news is as large as 700 W of PV panels are now available in the market, where the existing power plants using PVs not more than 550 W of size.

In the face of severe land scarcity, we observed plenty of underutilized or poorly compensated lands during our site visit. Khulna division alone accommodates thousands of acres of underutilized lands. Some of these lands were intentionally salinized seeing the high export potential of shrimp industry in 1990s, which diminished drastically in later years. Moreover, there is a presence of noteworthy char lands with high degree of solar irradiation in the country, which could be viable for future solar projects. However, establishing plants is not just about the land; the presence and proximity of the grid are crucial. The Teesta plant required a costly 35 km transmission line to connect it to the national grid, highlighting the infrastructural challenges. Potential sites for new solar initiatives are largely hindered by their distances from the national grid. Furthermore, the national grid hardly has the adequate capacity to absorb increased supplies from larger solar installations. For instance, if the Teknaf plant's capacity were increased to 50 MW, the 33 KV grid infrastructure would struggle to distribute this power effectively.

In this context, rooftop solar presents a significant window of opportunity, especially in urban and industrial areas where land is scarce but roofs are abundant and the proximity of the national grid is also close. Studies suggest that Bangladesh has a rooftop solar potential of over 2,000 MW, with industrial and commercial buildings offering the most significant opportunities. Industries and institutions that have already adopted rooftop solar report substantial reductions in their electricity bills. For instance, one particular industry reported that, with a 350 kW rooftop system, it was able to cut its annual electricity expenses to a quarter of what they paid previously. BRAC University has installed a one MW rooftop system, which covers a substantial portion of its daily energy use, underscoring the viability and benefits of rooftop solar in diverse settings. Introduction of Net Metering Policies in rooftop technology, which allow individuals and businesses to sell excess electricity back to the grid, has ensured more efficiency, as there is no possibility of power waste.

Financial constraints also pose a major challenge. While the cost of solar technology has decreased globally, the initial investment is still substantial. The existing large-scale solar power plants have one characteristics in common, with none of them having storage facilities. The capital expenditure for integrating battery storage with solar power plants is still high. Despite declining costs for lithium-ion batteries, the initial investment required remains a significant barrier for large-scale adoption.

Moreover, high import duties on solar equipment, including solar panels, inverters, and batteries, have made them more expensive in Bangladesh compared to other countries with lower tariffs.

Looking ahead, the future of solar energy in Bangladesh is bright but requires strategic planning and continued investment. Investment in research and development can lead to more efficient solar technologies suited to Bangladesh's climate and geographical conditions. As an illustration, floating solar park on the country's abundant water bodies, following the success of Indonesia in installing 145 MW floating solar power plant recently, located in Cirata Reservoir, West Java, can address the land scarcity issue. The reservoirs in Bangladesh, particularly Kaptai Lake and Teesta Barrage Reservoir also have high potential in this regard, with adequate solar irradiation rates to ensure expected power generation.

As stated in the Mujib Climate Prosperity Plan (MCPP), we need to increase our existing renewable capacity at the overarching rate of 24.78 percent annually to achieve the 40,000 MW renewable capacity target by 2041. Focusing on even smaller target of 11 percent of total capacity (8,173 MW), as stated in the IEPMP-2023, the country still needs to thrive at 13.65 percent annually, where solar energy will have the major role to play.

The intermittency of solar power requires robust solutions for energy storage and the country needs major investment in grid expansion and upgradation to ensure a stable and reliable supply. Grid upgradation rate and developing battery storage systems should be commensurate with the capacity expansion rate. A BloomBerg report states that solar with battery storage will achieve a cheaper LCOE than new thermal power plants by 2030 in the country. Hence, the upcoming solar power plants, unlike to the existing solar power plants, needs to have the adoptability mechanism of introducing battery storage.

Thus, the experiences from existing plants like Teknaf and Teesta, combined with the potential in rooftop and underutilized lands, form a blueprint for future expansion. The potential for solar energy, especially in underutilized and saline lands, combined with advancements in technology and grid management, can pave the way for a brighter, more sustainable energy future for Bangladesh. By addressing infrastructural and policy challenges, Bangladesh can harness solar power to meet its energy needs sustainably, reduce environmental impact, and foster economic growth in the renewable sector.

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Energy Price Fluctuations and their Implications for Bangladesh's Macroeconomy

Abdur Zabbar Sakil and Md. Tuhin Ahmed

There is no denying that maintaining Bangladesh's macroeconomic stability and achieving its development goals requires a consistent and uninterrupted energy supply. Bangladesh's energy landscape is predominantly shaped by fossil fuels, with natural gas including Liquefied Natural Gas (LNG), coal, and oil accounting for over 98% of the nation's electricity generation. Despite efforts to diversify the energy mix, renewable sources such as hydro, solar, and wind contribute only marginally to the overall power generation. However, the high dependency on imported fossil fuels leaves Bangladesh vulnerable to fluctuations in global energy prices, which can have far-reaching implications for the country's macroeconomic stability and developmental aspirations.

In the fiscal year (FY) 2020-21, Bangladesh consumed 45,080 kilotonnes of oil equivalent (ktoe) of energy, primarily in the residential (51%), industrial (33.4%), and transport (10.7%) sectors. A significant portion of residential energy consumption is met by biofuel, accounting for 66.1% of its total usage. The industrial sector relies heavily on natural gas and coal, with 43% of its energy needs met by natural gas and 30.3% by coal. Notably, the industry sector is the sole consumer of coal, predominantly used by the brick industry. In the transport sector, energy demand is entirely fulfilled by oil and natural gas, with oil making up 77.9% and natural gas 22.1% of its total energy use (SREDA, 2021).

To meet its overall energy demand, Bangladesh relies on both domestic production and imports. Specifically, the country depends on imports of coal, oil, and petroleum products, with over 90% of the coal and oil supply and 100% of the petroleum product supply being imported. However, Bangladesh can find some relief in the natural gas sector, as 78.6% of natural gas is produced domestically, while only 21.4% is imported. Despite the relatively low volume of natural gas imports, the amount has rapidly increased since its introduction in FY 2018-19 (SREDA, 2021).

On the other hand, fossil fuel energy prices on the international market are highly volatile. According to the IMF's primary commodity price data, the average price of crude oil surged from USD 44.20 per barrel in Q4 2020 to USD 85.20 per barrel in Q4 2022. Similarly, the average price of natural gas skyrocketed from USD 5.36 per thousand cubic feet (tcf) in Q4 2020 to USD 20.99 per tcf in Q4 2022. Average coal prices increased significantly, from USD 70.10 per metric ton in Q4 2020 to USD 310.01 in Q4 2022. LNG prices jumped from USD 8.18 per million metric British thermal units (mmbtu) in Q4 2020 to USD 28.56 per mmbtu in Q4 2022. This rapid increase in energy prices can be largely attributed to the COVID-19 pandemic and the Russia-Ukraine war.

The question is now how energy price fluctuations affect the macroeconomy. Energy, along with labour and capital, is a critical factor of production.

On the demand side, when energy prices increase, consumption of these resources tends to decrease. This reduction in consumption leads to a decline in the aggregate demand or output. The magnitude of this impact depends on the economy's ability to substitute energy with other factors such as labour or capital, including substitution among various energy sources (coal, gas, or crude oil). The short-term impact of rising energy prices is typically stronger than the long-term impact. While the economy can adjust its production process in response to factor prices, its ability to substitute input factors is limited.

An increase in energy prices has a more pronounced impact on the supply side than on the demand side. Higher energy prices compel producers to reduce energy usage in production, lowering output levels. Consequently, the productivity of other input factors decreases due to the reduced availability of energy sources. At this stage, nominal wages/interest rates may remain unchanged due to rigidity, resulting in a higher overall price level and lower real wages/interest rates. The higher overall price level prompts consumers to curtail their consumption, thereby affecting overall demand. The impact of energy prices on the supply side is greater because energy prices directly influence the production system. As a result, the economy experiences lower output and a higher overall price level.

For instance, an increase in energy prices deteriorates the balance of payment, especially for a country like Bangladesh which depends fully on oil importation. First, the direct increases in oil price increase the cost of oil importation, as a result, reduced imported raw materials cause production crunch. Second, an increase in oil prices in the international market reduces demand in developed countries that are major export destinations for Bangladesh, which results in reduced export income. So, an increase in oil prices eats up national income since the rise in the cost of importing oil is greater than the rise in national income.

Bangladesh has been experiencing consistently high inflation since August 2022, with rates mostly exceeding 9%. Despite efforts, the central bank has been unable to contain it. The root cause of this inflation surge can be traced back to a combination of post-COVID-19 supply shortages and the Russia-Ukraine war. The COVID-19 pandemic had a twofold impact on the global economy that significantly contributed to the inflation scenario. Firstly, during the pandemic, trade restrictions, factory closures, and the China-USA trade war caused disruptions in the global supply chain, leading to supply shortages. Secondly, as economies began recovering from COVID-19 and businesses reopened, there was a surge in global demand. To meet this increased demand, factories required more energy, which in turn drove up energy prices. Compounding this situation, the Russia-Ukraine war introduced another significant shock. Following Russia's invasion of Ukraine in late February 2022, prices of oil, natural gas, and coal surged, peaking around June and July of that year. Given that Russia is a major exporter of oil and gas, and that 45% of the EU's gas supply was sourced from Russia, the sanctions imposed by the USA and its allies on Russia led to a rapid increase in energy prices.

Consequently, the production and transportation costs of goods escalated sharply, directly impacting Bangladesh's inflation. Higher energy prices significantly impact a country's foreign currency reserves, particularly for a net energy-importing country like Bangladesh. The effect is predominantly negative. Since the lifting of COVID-19 restrictions and the reopening of businesses, Bangladesh's reserves of US dollars have been steadily decreasing. As of April 2024, Bangladesh's foreign reserves stand at 19.98 billion dollars.

In addition to policy failures by the central bank, the lack of remittance inflows through formal channels, and low foreign direct investment (FDI), the rise in energy prices contributes to the depletion of foreign reserves. Since mid-2022, Bangladesh has been meeting its energy demands by purchasing oil, coal, and natural gas at elevated prices. However, the country's productivity has remained relatively unchanged. As a result, Bangladesh is producing the same amount of export goods but at higher import costs, which deteriorates its balance of payments. In other words, Bangladesh is purchasing more dollars from the international market, increasing the supply of taka and the demand for dollars. This phenomenon also causes the taka to depreciate against the dollar. A depreciating domestic currency influences trade balances with other countries, as the dollar is the standard currency for international trade. Depleting foreign reserves and a depreciating domestic currency further exacerbate inflation by raising the cost of intermediate goods and raw materials. This, in turn, increases overall production costs, leading to higher prices for consumers and additional economic challenges for the country.

The constant threat of a volatile energy market and its impact on the domestic economy can be mitigated by diversifying the domestic energy mix towards renewable energy. While renewable energy has high installation costs, these costs are offset by the absence of ongoing fuel purchases, leaving only operational and maintenance expenses. Additionally, the high installation cost positively impacts the domestic economy by creating more jobs. Permanent employment opportunities will also arise for maintaining the facilities and providing jobs for thousands of unemployed graduates. This shift towards renewable energy can yield benefits in two significant ways. First, the country will need to import fewer fossil fuels, thereby spending fewer dollars. This will reduce the pressure on foreign reserves and potentially increase them significantly. Second, Bangladesh will no longer face uncertainty regarding its essential energy supplies, leading to a more stable domestic market with stable prices. Although these changes will not entirely eliminate inflationary pressure, they will certainly lessen a portion of it.

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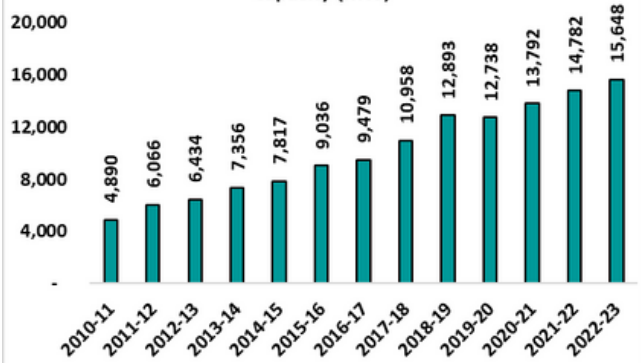
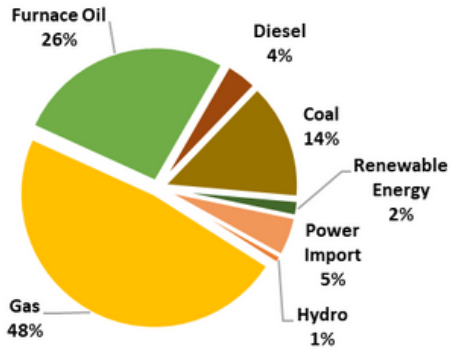
Figure 1: Bangladesh's maximum power generation capacity (MW)



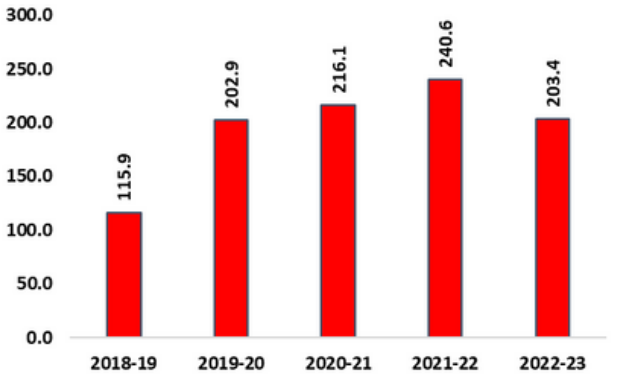
Source: Bangladesh Power Development Board Annual Report, 2022-23

Figure 2: Distribution of Bangladesh's power generation capacity in FY2022-23 by fuel type



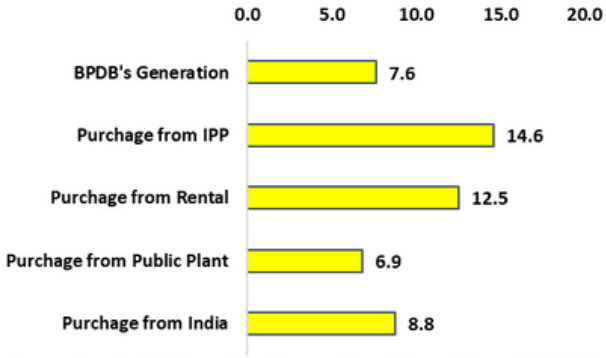
Source: Power Division Annual Report, 2022-23

Figure 3: Bangladesh's LNG import (Bcf)



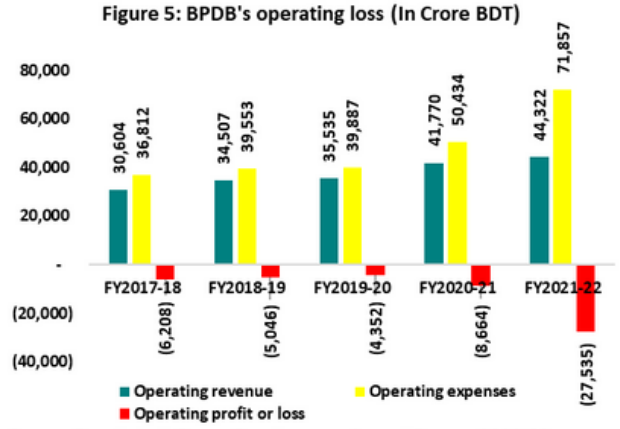
Source:Hydrocarbon Unit,Energy and Mineral Resources Division 2022-23

Figure 4: Cost of Bangladesh's power generation (BDT per Kwh) in FY2022-23 by sources



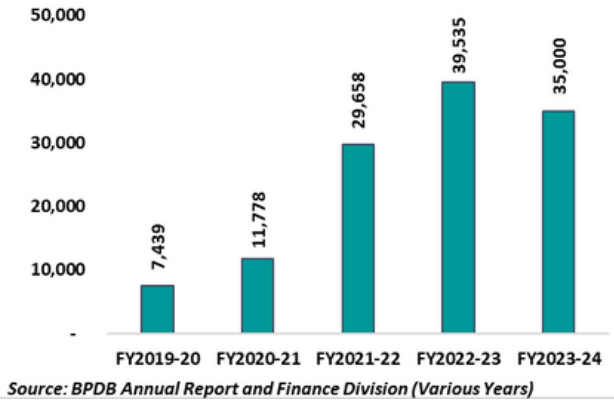
Source: Bangladesh Power Development Board Annual Report, 2022-23

Figure 5: BPDB's operating loss (In Crore BDT)



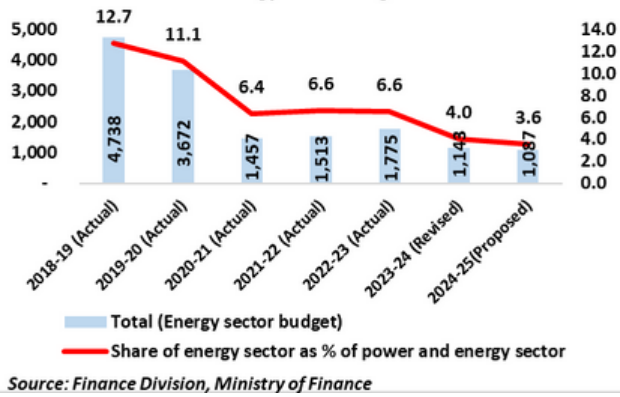
Source: Bangladesh Power Development Annual Report, 2021-22

Figure 6: Subsidy (In Crore BDT) provided to BPDB



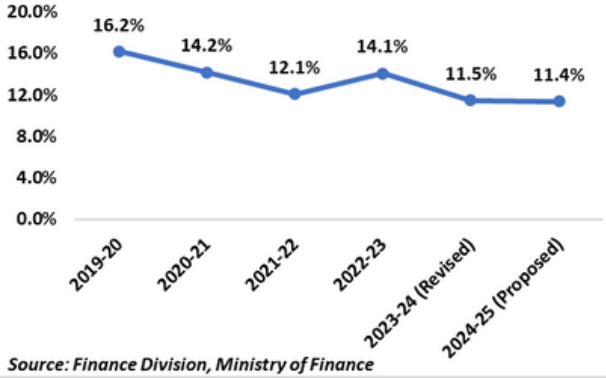
Source: BPDB Annual Report and Finance Division (Various Years)

Figure 7: Energy budget as % of total power and energy sector budget



Source: Finance Division, Ministry of Finance

Figure 8: Power and energy sector ADP as % of total ADP



Source: Finance Division, Ministry of Finance

SANEM ENERGY OUTLOOK

SANEM Energy Outlook is a quarterly newsletter dedicated to disseminating SANEM's research on Bangladesh's transition to green and clean energy. SANEM, a non-profit research organization established in January 2007 in Dhaka and registered with the Registrar of Joint Stock Companies and Firms in Bangladesh, focuses on economic modeling and policy research specific to South Asia. It aims to deliver high-quality, objective research to support policy-making in the region. SANEM collaborates extensively with global, regional, and local think tanks, research organizations, universities, and individual researchers to enhance its research impact.

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