# Policy Brief

## The Renewable Rise: Shaping Bangladesh's Energy Future in the Context of COP30

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*Selim Raihan, Afia Mubasshira Tiasha and Barun Deb Pal*

Globally, climate change disrupts energy systems through extreme weather events, rising sea levels, and shifting resource availability. Increasing temperatures, unpredictable rainfall, and frequent cyclones pose a threat to energy infrastructure in Bangladesh, a low-lying and climate-vulnerable region. These climatic hazards also influence energy consumption patterns and degrade the efficiency of generation systems. As Bangladesh elevates its energy sector to meet development goals, incorporating climate resilience is critical to ensuring long-term sustainability and security. This policy brief outlines the current challenges, reviews government actions, proposes alternative solutions, and assesses their potential economic impacts in the context of Bangladesh's preparation for the 30th COP in November 2025 and the development of the third Nationally Determined Contribution (NDC).

## Impact of Climate Change

Climate change affects the energy sector by altering supply, demand, and infrastructure stability. Hotter summers increase the demand for cooling, resulting in higher power consumption, while milder winters reduce the need for heating (Bazazzadeh et al., 2021). Increased rainfall may boost hydropower output, but droughts can diminish it (Wasti et al., 2022). Extreme weather events like storms and floods can damage energy infrastructure, causing power outages and escalating maintenance costs (Bianchi & Malki-Epshtein, 2021; Nyangon, 2024). Water scarcity might limit power plant operations, reducing overall energy production. Bangladesh's energy sector is vulnerable to climate hazards like sea level rise, which threatens coastal power plants. If these plants are disrupted, they could have serious effects on electricity generation and economic growth (Rahman et al., 2020). Additionally, rising sea levels and heatwaves weaken energy grids and coastal power plants, impacting energy reliability (Mitra et al., 2023). Notable impacts of climate change on the energy sector are listed in Figure 1.

## At a Glance

- ***$CO_2$ Emissions:*** *Bangladesh shows a rising trend in $CO_2$ emissions from fossil fuels, sharply increasing since 2020.*
- ***Policy Alignment:*** *The 2021 NDC targets significant emission reductions via renewables and efficiency. However, national clean energy plans lack aligned targets and timelines.*
- ***Economywide Impacts:*** *CGE modeling indicates that rising fossil fuel prices severely undermine Bangladesh's GDP and employment, and exacerbate poverty. Solar electricity offers crucial mitigation.*
- ***Opportunities:*** *Bangladesh must unify targets, boost renewable capacity, enhance efficiency, and build climate-resilient energy systems to strengthen its global climate leadership.*

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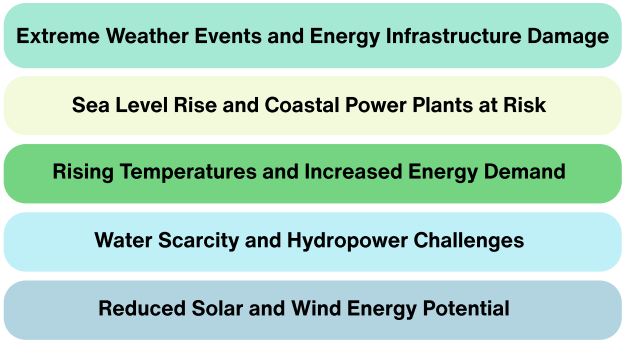
**Figure 1: Impact of Climate Change on the Energy Sector**




*Source: Compiled by the Authors from various sources*

## Energy Sector's Contribution to GHG Emissions in Bangladesh

The sectoral contribution to $CO_2$ emissions from 2000 to 2022 reveals that electricity and heat producers are the leading contributors, with emissions increasing significantly since 2010 due to a greater reliance on fossil fuels (Figure 2). In 2022, electricity and heat producers were Bangladesh's primary sources of $CO_2$ emissions, accounting for 60.4 Mt $CO_2$, the highest percentage among all sectors. The industrial sector followed, with 17.94 Mt $CO_2$ emissions from manufacturing and production operations. The transportation sector emitted 13.46 Mt $CO_2$ due to increased vehicle usage and reliance on fossil fuels. Residential emissions totalled 7.41 Mt $CO_2$, primarily from household energy consumption. Agriculture and forestry contributed 4.17 Mt $CO_2$, mainly from land-use activities and farming. Commercial and governmental services (0.34 Mt $CO_2$) and other energy industries (0.14 Mt $CO_2$) made minor contributions, while non-specified sources contributed only 0.02 Mt $CO_2$ (Table 1).

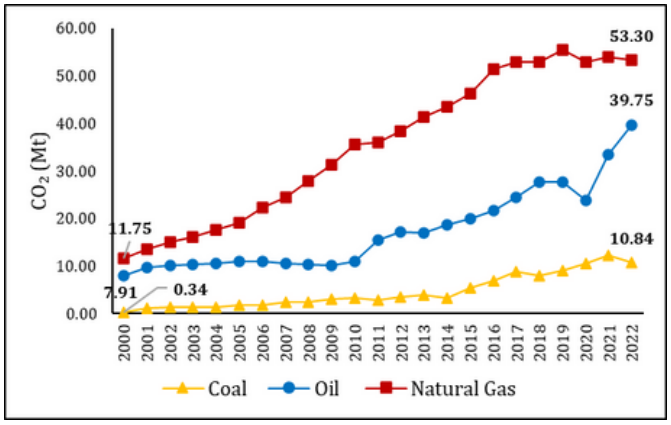
**Table 1: $CO_2$ Emissions by Sector in Bangladesh, 2022**

| Sectors | Value (Mt $CO_2$) |
|---|---|
| Electricity and heat producers | 60.4 |
| Industry Sector | 17.94 |
| Transport Sector | 13.46 |
| Residential | 7.41 |
| Agriculture/Forestry | 4.17 |
| Commercial and Public Services | 0.34 |
| Other energy industries | 0.14 |
| Non-specified (Other) | 0.02 |

*Source: Compiled by the Authors from the International Energy Agency (IEA):*https://www.iea.org/countries/bangladesh/emissions

Currently, fossil fuels provide a large portion of the world's energy (York & Bell, 2019), and this use is unsustainable even if sustainable alternatives are investigated and technology remains unchanged (Mayer, 2022). However, there is a rising trend in carbon dioxide emissions from coal, oil, and natural gas. Oil-related emissions remained generally steady until around 2010, when they began to climb dramatically, with a particularly sharp increase beginning in 2020, most likely due to rising fuel usage in transportation and industry (Figure 2).

**Figure 2: Evolution of $CO_2$ Emissions by Fuel in Bangladesh since 2000**




*Source: Compiled by the Authors from the International Energy Agency (IEA):* https://www.iea.org/countries/bangladesh/emissions

## NDC and Mitigation Actions for the Energy Sector

The mitigation actions of NDC 2021 have highlighted some of the achievable but ambitious planned activities of the government to mitigate the impacts of GHG emissions. The mitigation actions of the energy sector, specifically the power sector, focus on expanding renewable energy, improving efficiency, and upgrading technology to reduce greenhouse gas emissions.

A key priority is the implementation of 911.8 MW of renewable energy projects, including solar (581 MW), wind (149 MW), biomass (20 MW), biogas (5 MW), and hydropower (100 MW).

**In the unconditional scenario**, GHG emissions would be reduced by 27.56 Mt $CO_2e$ (6.73%) BAU in 2030 in the respective sectors. The energy sector will account for 26.3 Mt $CO_2e$ (95.4%) of this emission reduction (MoEFCC, 2021).

- Moreover, a target of achieving 10% energy efficiency in the industry sub-sector through measures according to the Energy Efficiency and Conservation Master Plan (EECMP) has been mentioned in this scenario.
- Specific targets were set related to modernizing power generation, increasing

energy efficiency, and transitioning towards a cleaner energy mix, supporting Bangladesh's commitment to a low-carbon and sustainable energy future.

**Under the conditional scenario,** GHG emissions would be reduced by 61.9 Mt $CO_2e$ (15.12%) below BAU in 2030 in the respective sectors. It is also mentioned in the NDC that the energy sector accounts for 59.7 Mt $CO_2e$ (96.46%) of emission reduction.

- In addition, a target of achieving 20% energy efficiency in the industry subsector through measures according to the Energy Efficiency and Conservation Master Plan (EECMP).
- Specific goals in promoting the green industry and carbon financing have also been mentioned.

## Government Policy Initiatives for the Energy Sector

To move toward a clean and sustainable energy sector, Bangladesh has implemented several policies that emphasize energy security, efficiency, and the growth of renewable energy.

***National Adaptation Plan of Bangladesh (2023-2050)*** emphasizes the integration of renewable energy into climate-resilient development strategies. Key initiatives include expanding solar-based irrigation systems to reduce dependence on fossil fuels and promoting rooftop gardening, solar installations, and biodiversity conservation through fiscal incentives. The plan also supports the development of climate-smart solar utilities, the installation of lightning arresters in buildings, and encourages private sector participation in renewable energy-based power supply. Additionally, it advocates for research into farm mechanization powered by renewable sources such as solar and wind energy (Ministry of Environment, Forest, and Climate Change, 2022).

***Integrated Energy and Power Master Plan (IEPMP) 2023*** focuses on establishing a clean, efficient, and sustainable energy system to support Bangladesh's long-term development goals under Vision 2041. It emphasizes the "S plus 3E" approach, ensuring Safety in energy supply, strengthening Energy Security through local resource utilization and import infrastructure, achieving Economic Efficiency with affordable energy access, and protecting the Environment by minimizing greenhouse gas emissions—all aimed at creating a low-carbon economy by 2050 (Ministry of Power, Energy and Mineral Resources, 2023).

***The Power System Master Plan (PSMP) 2016*** sets Bangladesh's energy strategy to support Vision 2041, aiming for energy security and sustainable growth. It emphasizes diversifying energy imports, maximizing domestic resources, enhancing power system quality, promoting renewable energy, and strengthening institutional capacity. The plan aligns with key Sustainable Development Goals, including clean energy, infrastructure development, and climate action (Power Division, 2016).

***Mujib Climate Prosperity Plan (2022–2041)*** emphasizes on important projects like the Bongoposagor Independence Giga Array, a 4-gigawatt wind power project, are intended to update the energy grid, boost resilience, and raise renewable energy to 30% by 2030 and 40% by 2041 with grid resilience and modernization. The major priority areas include ensuring energy systems resilience, maximizing renewable energy wealth, energy efficiency and energy storage infrastructure and modernization of the grid and the ancillary market to support resilience (Ministry of Environment, Forest and Climate Change, 2022).

***National Energy Policy (NEP) 2004*** aims to ensure sustainable economic growth by providing reliable, affordable, and environmentally sound energy across all regions and socio-economic groups. It focuses on the optimal use and development of indigenous resources, promotes both public and private sector involvement, and targets nationwide electrification while fostering regional energy cooperation for long-term energy security (Ministry of Power, Energy and Mineral Resources, 2004).

***Perspective Plan of Bangladesh 2021-2041*** focuses on the development of a sustained power sector, which includes: adopting a least-cost power generation expansion path, promoting the supply of low-cost primary energy, developing the required infrastructure for primary fuel, ensuring investment balance between generation, transmission and distribution, promoting efficient use of installed capacity and private investment in energy and expanding power trade, ensuring proper energy pricing policy and strengthening power and energy institutions (General Economics Division, 2020).

***Bangladesh Delta Plan 2100*** places a high priority on solar energy integration in flood-prone areas, solar-driven water pumping systems, and floating solar systems. Moreover, developing long-term renewable energy policy as well as strategies and formulating a master plan for 50-100 years to harness the potential of renewable energy resources in the country, involving public and private sector investments, are also some key concerns (General Economics Division, 2018).

***8th Five-Year Plan (8FYP)*** prioritizes the adoption of sustainable energy, energy efficiency, and regulatory changes away from coal-fired power plants. It emphasizes mobilizing private and joint-venture investments, diversifying primary fuel sources with a strong focus on renewable energy, and maintaining some highly efficient, low-emission coal plants for cost-effective power generation. The plan also targets improved efficiency by reducing transmission and distribution losses, promoting the use of alternative energy sources, including nuclear energy, and exploring cross-border electricity trade with neighbouring countries such as India, Nepal, Bhutan, and Myanmar. Additionally, it advocates for innovative financing mechanisms, such as leveraging support from Export Credit Agencies, to fund energy sector development (General Economics Division, 2020).

However, the current state of the regulatory framework in the energy industry is not satisfactory. The framework's main flaw is its lack of cohesion (Table 2).

**Table 2: Conflicting renewable energy targets among the policies and plans**

| Document | Renewable Energy Targets |
|---|---|
| Perspective Plan 2041 | - Initial target of 3% renewable energy by 2021<br>-Future target projection is absent. |
| National Solar Energy Roadmap 2021-2041 | - 40,000 MW of installed solar capacity by 2041 |
| Mujib Climate Prosperity Plan 2022-2041 | - Transition to renewable energy:<br>30% by 2030; 40% by 2041; 100% by 2050 |
| Renewable Energy Policy (2008) | - 5% of total power demand by 2015<br>- 10% by 2020 |
| Bangladesh Delta Plan 2100 | - 10% renewable energy by 2020<br>- 30% by 2041 |
| Integrated Energy and Power Master Plan (IEPMP) 2023 | - 40% of energy from clean and renewable sources by 2041<br>- 26.2 GW of renewable energy capacity by 2050 |
| Power System Master Plan 2010 | - 5% of total electricity demand with renewables by 2015<br>-10% by 2020 (510 MW by 2015, 1,760 MW by 2020) |
| Power System Master Plan 2016 | - -20 % renewable ratio (RE20) by 2041 |

*Source: Adapted from Raihan et al. (2025)*

For example, by 2041, 20% of total power generation must come from renewable energy (RE), according to the Power System Master Plan (PSMP) 2016 (Power Division, 2016). Whereas the Mujib Climate Prosperity plan and the Integrated Energy and Power Master Plan (IEPMP) 2023 set the goal of 40% renewable energy by 2041 (GED, 2020; Ministry of Power, Energy and Mineral Resources, 2023). This also brings up the policy myopia issue.

## Bangladesh's Energy Future: Economy-wide Effects

We have applied a computable general equilibrium (CGE) model, developed by the International Food Policy Research Institute (IFPRI), to explore the economy-wide effects of climate change impacts on agriculture. IFPRI's standard recursive-dynamic CGE model is an economy-wide simulation tool. Its static and dynamic modules incorporate flexible behavioral features, such as nested production functions, imperfect substitution of imported commodities, and linear expenditure systems of consumer demand. Consumers and producers maximize utility and profits based on factor and product prices, which adjust endogenously to establish market equilibrium. In the dynamic module, population growth and urbanization are set exogenously, affecting labor supplies, while sectoral capital accumulation is endogenously determined based on past investments. The CGE model is calibrated using a Social Accounting Matrix (SAM) of Bangladesh, which is an economy-wide database. Using the dynamic CGE model, we have run simulations as depicted in Table 3. These simulations are related to routine scenario of energy (ROT), world price of energy (WPE), and solar energy promotion (SOL). We have considered a time until 2035 and an annual average of 6% of business-as-usual (BaU) GDP growth rate between 2025 and 2035.

Table 3 outlines the assumptions underpinning each scenario. The ROT scenario assumes a continuation of current domestic energy policies. The WPE scenario simulates global conditions where fossil fuel prices (coal, petroleum, natural gas) increase by 3% annually. The SOL scenario models an energy transition where solar contributes 10% of total electricity generation by 2035. The combined WPE-ROT and WPE-SOL scenarios are critical for understanding the contrast between inaction and proactive solar investment under global price pressures. These scenarios help unpack the potential risks of global energy price shocks and the benefits of solar adoption in mitigating those shocks.

**Table 3: Energy scenarios in the dynamic CGE model**

| Simulations | Descriptions | Assumptions |
|---|---|---|
| **ROT** | Routine scenario | No changes in domestic policy |
| **WPE** | Rise in the world price of energy | 3% annual increase in the prices of fuels - Coal, petroleum and natural gas |
| **SOL** | Solar energy promotion | 10% share of solar electricity in total power generation by 2035 |

*Source: Authors*

The simulation outcomes are reported in Figures 3-7. Figure 3 shows that global energy price increases have significant macroeconomic consequences. Under the WPE-ROT scenario, GDP declines by 1.09% compared to the BaU trajectory, underscoring the drag of higher fossil fuel prices in the absence of domestic energy diversification. However, in the WPE-SOL scenario, the GDP decline is much smaller at just 0.25%, indicating that solar energy promotion can effectively buffer the negative economic impacts of rising global energy prices. This finding points to the importance of proactive domestic energy reforms in maintaining macroeconomic stability amid external shocks.

Figure 4 demonstrates the differential effects of energy price changes across sectors. Under the WPE-ROT scenario, all major sectors, i.e. industry, services, and agriculture, experience significant contractions. However, in the WPE-SOL scenario, sectors show either reduced contraction or positive gains. Notably, government services see a remarkable rise of around 20% under both WPE-SOL and WPE-ROT, suggesting a large rise in government spending to absorb the negative effectsfrom the fuel price shocks.

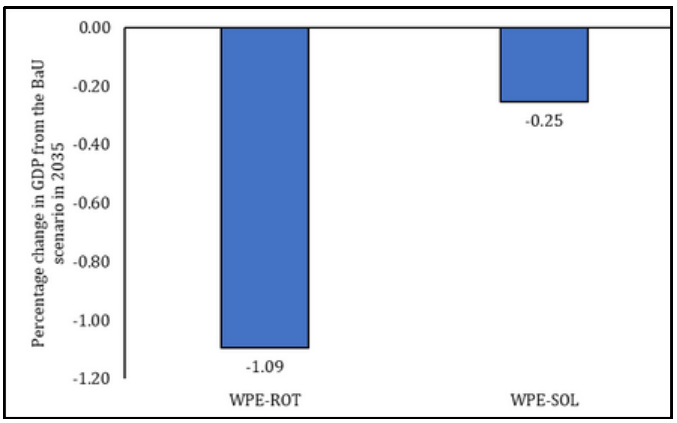
Figure 5 illustrates that employment is highly sensitive to energy shocks. Under the WPE-ROT scenario, employment declines by 1.83 million, with workers who have not completed primary education most affected. In contrast, the WPE-SOL scenario shows a reduced job loss of about 9,000, indicating that solar energy promotion helps retain jobs, particularly among low-skilled labor. This contrast reveals that energy transition policies not only impact aggregate output but also help protect vulnerable segments of the labor market from external energy price shocks.

Figure 6 reveals that global energy price increases without domestic action significantly hinder poverty reduction. Under the WPE-ROT scenario, 353,000 fewer people are lifted out of poverty nationally. Rural areas bear the brunt, with 283,000 additional people remaining in poverty. However, the WPE-SOL scenario limits this setback, with the number of people not escaping poverty reduced to 172,000 nationally and 135,000 in rural areas. These figures suggest that promoting solar energy enhances the resilience of poverty alleviation efforts, particularly in rural Bangladesh, where energy access and affordability are crucial for inclusive growth.

Figure 7 presents strong evidence that solar energy promotion has substantial environmental benefits. GHG emission intensity in 2035 is highest under the base scenario. Under the WPE-ROT scenario, GHG emission intensity declines due to the contraction of the economy. The further decline under WPE-SOL reflects the decarbonizing effects of increasing solar energy's share in electricity production. This demonstrates that transitioning to renewable energy not only helps mitigate economic and social risks but also aligns with Bangladesh's long-term climate commitments.

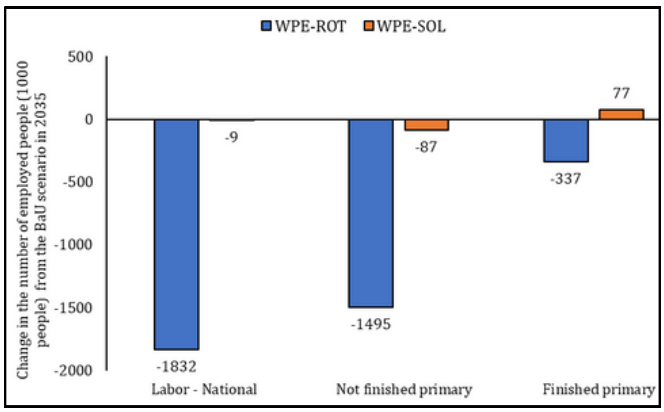
The CGE model simulations collectively underscore the high vulnerability of Bangladesh's economy to global energy price shocks. Without domestic policy reform, such shocks lead to GDP losses, contraction of key sectors, large-scale job losses, and setbacks in poverty reduction. However, promoting solar energy as a strategic response substantially offsets these adverse outcomes. It helps maintain GDP growth, revives sectoral output, especially in industry and power generation, safeguards employment,

**Figure 3: Percentage change in GDP from the BaU scenario in 2035**



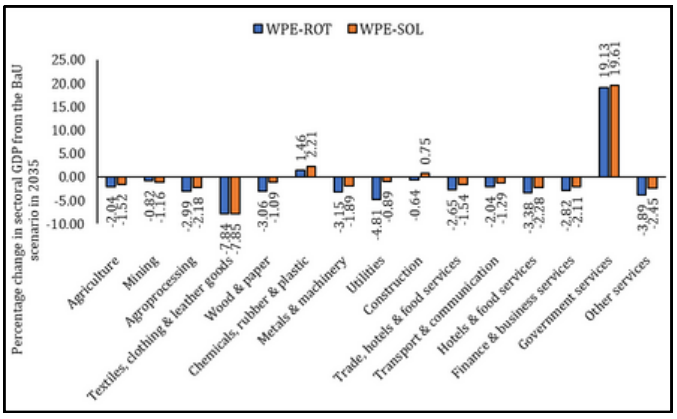

*Source: Dynamic CGE model simulation*

**Figure 5: Change in the number of employed people (1000 people) from the BaU scenario in 2035**



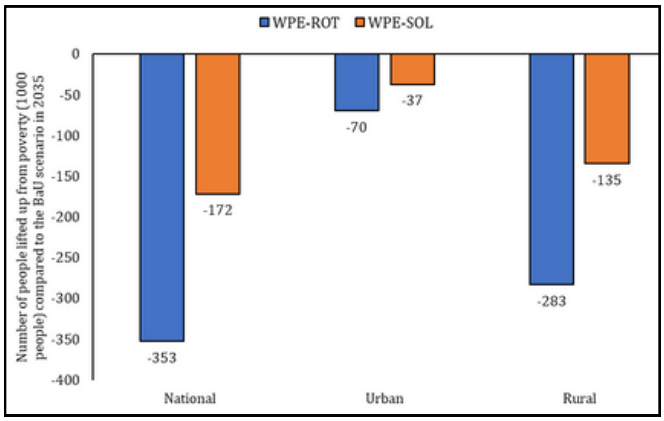

*Source: Dynamic CGE model simulation*

**Figure 4: Percentage change in sectoral GDP from the BaU scenario in 2035**



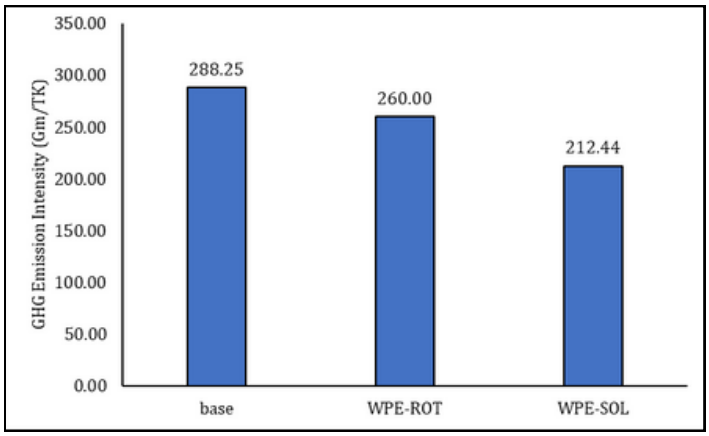

*Source: Dynamic CGE model simulation*

**Figure 6: Number of people lifted up from poverty (1000 people) compared to the BaU scenario in 2035**




*Source: Dynamic CGE model simulation*

**Figure 7: GHG Emission Intensity (Gm/TK) in 2035**




*Source: Dynamic CGE model simulation*

supports poverty reduction, and significantly reduces emission intensity. These findings make a strong case for Bangladesh to pursue a proactive green energy transition to enhance resilience, equity, and sustainability in the face of an uncertain global energy landscape.

## Pathways for a Resilient and Low-Carbon Energy Future

The energy sector has the greatest potential for both mitigation and sustainable development, as it is responsible for the majority of Bangladesh's greenhouse gas emissions. There are still strategic possibilities to increase resilience, coherence, and innovation, even if the government has made some progress. The following are some potential future directions:

**Bangladesh needs to overcome the disparities that presently impede strategic planning and investment by establishing an integrated renewable energy objective for all national plans**. A coherent energy roadmap requires coordinating goals, such as the 20% RE ratio by 2041 objective in PSMP 2016 and the 40% RE ratio in the Mujib Climate Prosperity Plan and IEPMP 2023 (Power Division, 2016; GED, 2020; Ministry of Power, Energy and Mineral Resources, 2023). A clear alignment will facilitate easier implementation and send a powerful message to both domestic and foreign investors.

**It is necessary to enhance energy efficiency for both mitigation and cost-effectiveness.** Bangladesh's current efficiency targets such as 10% under the unconditional NDC scenario and 20% under the conditional one, can be achieved through strong regulatory enforcement, fiscal incentives, and technological upgradation. Sector-specific initiatives, particularly in industry and urban infrastructure, can significantly reduce energy demand while supporting competitiveness and environmental performance.

**Climate-resilient energy infrastructure is vital in disaster-prone regions.** Rooftop solar, floating solar systems, and battery storage solutions can offer reliable alternatives in areas frequently affected by floods and cyclones. Integrating these technologies into off-grid and coastal areas will improve energy access and strengthen adaptation to climate risks.

**Bangladesh must improve access to international climate finance to achieve its conditional energy targets.** The energy sector contributes over 95% of potential GHG reductions outlined in NDC 2021's conditional scenario (Ministry of Environment, Forest and Climate Change, 2021). Mobilizing support through carbon markets, the Green Climate Fund, green bonds, and blended finance mechanisms will be critical. Capacity-building for project developers and public institutions will also enhance the bankability of clean energy projects.

**A robust institutional coordination framework is necessary to integrate energy with climate, finance, and development goals.** Currently, fragmented policymaking across ministries slows implementation. A central coordination platform backed by strong political leadership and data-driven planning can align policies, facilitate knowledge sharing, and ensure timely execution of key initiatives.

**Bangladesh should accelerate innovation and private sector involvement to scale up clean energy adoption.** Incentivizing domestic manufacturing of solar panels, wind components, and battery systems can create green jobs and reduce import dependency. Public-private partnerships in smart grid development and decentralized energy solutions can drive the transition toward a more modern and efficient energy system.

**At COP30 and other global forums, Bangladesh must ask for support for a just and inclusive energy transition.** Bangladesh needs strong research to show its needs and the impact of climate change on its energy sector to do this. It should clearly present its renewable energy potential, climate risks, and how clean energy can improve both the economy and people's lives. Simple, evidence-based messages will help convince global partners to provide funding and technical support. This will also strengthen Bangladesh's voice as a climate-vulnerable country pushing for real solutions.

## Conclusion

The energy sector is at the intersection of sustainable development and climate change. There is a pressing need for resilient and low-carbon energy systems as the effects of climate change worsen, from extreme weather that damages infrastructure to rising energy use. Bangladesh is extremely vulnerable to climate change, despite having a negligible global GHG emissions footprint. Nationally Determined Contributions (NDC) 2021 of Bangladesh contain considerable mitigation pledges, including boosting renewable energy sources and energy efficiency. However, aligning these targets across national plans and ensuring policy coherence is essential. Renewable energy efforts must go hand-in-hand with reducing dependence on fossil fuels and imported LNG, while also integrating energy efficiency, climate resilience, and inclusive development. Strengthened coordination, data-driven planning, and international support will be key to transforming the energy sector into a pillar of Bangladesh's climate-resilient future.

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*The SANEM-IFPRI project focuses on integrating agrifood systems into climate and development policies ahead of COP30 in Brazil (2025). Furthermore, the study aims to provide model-based analysis to support Bangladesh's government in areas such as low-carbon agricultural technologies, sustainable energy transition, and transport sector mitigation strategies. It will also assess the macroeconomic impact of climate policies, financing options for low-carbon development, and socioeconomic risks of transition. Key activities include workshops with policymakers, sectoral diagnostics, economy-wide modeling, and a final report to be completed by December 2025. Finally, the study seeks to enhance Bangladesh's food security, resilience, and environmental sustainability.*


***Dr. Selim Raihan** is a Professor in the Department of Economics at the University of Dhaka and the Executive Director of the South Asian Network on Economic Modeling (SANEM).*

***Afia Mubasshira Tiasha** is a Senior Research Associate at the South Asian Network on Economic Modeling (SANEM).*

***Dr. Barun Deb Pal** is a Research Coordinator at the Foresight and Policy Modeling Unit of the International Food Policy Research Institute (IFPRI) in New Delhi.*



Flat K-5, House 1/B, Road 35, Gulshan-2
Dhaka-1212, Bangladesh
Phone: +88-02-58813075
E-mail: sanemnet@yahoo.com
Website: www.sanemnet.org

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