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Policy Brief

Building Macroeconomic Resilience to Energy Price Fluctuations: The Case of Bangladesh

Selim Raihan, Md. Tuhin Ahmed, Abdul Zabbar Sakil and Takrem Ferdous Surid

Background

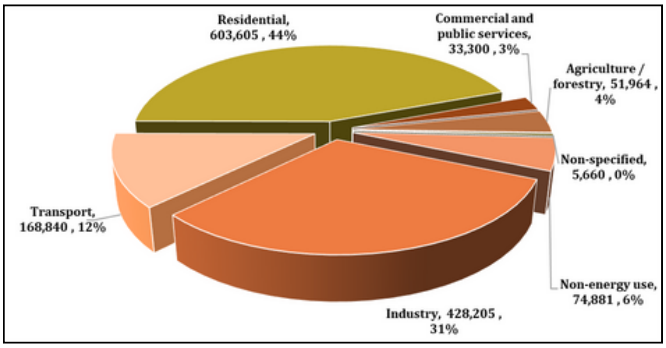
Bangladesh's energy sector is heavily reliant on fossil fuel imports, rendering the economy vulnerable to fluctuations in global energy prices. With natural gas comprising over half of the total energy supply and an increasing reliance on coal, oil, and liquefied natural gas (LNG), the country faces significant macro-economic challenges. Energy price fluctuations directly and indirectly affect macroeconomic variables such as gross domestic product (GDP), inflation, exchange rates, and trade balances, thereby influencing overall economic stability. Against this backdrop, this study seeks to investigate the impact of fossil fuel dependency on macroeconomic stability in Bangladesh. Specifically, it aims to explore the effects of shocks in crude oil prices, coal prices, and LNG prices on six macroeconomic variables such as GDP, inflation rates, exchange rates, net exports, interest rates, and money supply using quarterly time series data from 1990 to 2022.

Exploring the effects of energy price fluctuations on Bangladesh's macroeconomy is crucial for several reasons. Firstly, Bangladesh has faced significant macroeconomic instability in recent years, highlighting the need to understand whether global energy price shocks contribute to this instability. Secondly, as a net energy importer, Bangladesh's economy is particularly susceptible to fluctuations in energy prices. It is crucial to investigate how these variations affect inflation, particularly since the country's monetary authority aims to attain low inflation and price stability through the formulation of effective monetary policies. Thirdly, Bangladesh has undergone rapid economic growth in recent decades, resulting in increased energy consumption. This renders the economy even more sensitive to shifts in energy prices. Fourthly, while previous studies have examined the effects of oil prices on various macroeconomic variables, none have focused exclusively on the relationship between energy prices, such as those of coal and LNG, and macroeconomic indicators. Finally, Bangladesh lacks substantial energy reserves and alternatives to fossil fuels, such as renewable energy sources, rendering the economy highly vulnerable to the adverse effects of rising fossil fuel prices.

An Overview of Energy Consumption in Bangladesh

Bangladesh's energy consumption reflects a growing demand driven by rapid industrialization and population growth. Figure 1 illustrates the breakdown of Bangladesh's total energy consumption in 2021 by source. The data reveals that 44% of the energy consumed was used for residential purposes, making it the largest category. The industrial sector followed, accounting for 31% of total energy consumption, while the transport sector contributed 12%.

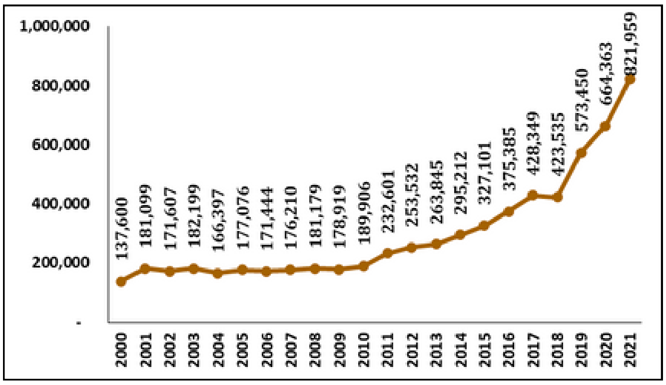
Figure 1: Total Energy Consumption (TJ) in 2021, by Source (%)



Source: International Energy Agency (IEA)

In 2000, Bangladesh's total energy imports were 137,600 terajoules (TJ). Over the following two decades, this figure increased significantly, reaching 821,959 TJ by 2021, reflecting an exponential growth in energy imports. Between 2000 and 2021, the total energy import surged by 497%. In 2021, energy imports constituted 40.4% of the country's total energy supply (Figure 2).

Figure 2: Total Energy Imports (TJ) in Bangladesh over 2000-2021



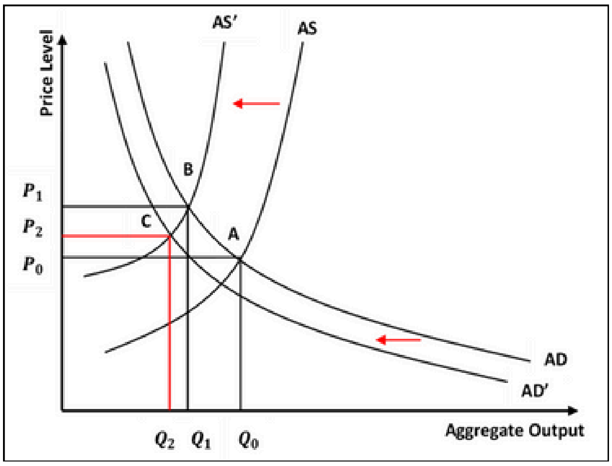
Source: International Energy Agency (IEA)

Figure 3 displays the distribution of primary energy sources used for power generation from 2008 to 2023, expressed as percentages of total energy usage for each year. n the 2008-09 period, natural gas was the predominant source, accounting for 88.4% of energy used in power generation. However, this share has declined steadily, dropping to 52% by 2022-23. In contrast, coal usage has risen significantly, with its share increasing from 6.2% in 2021-22 to 11.4% in 2022-23.

Analytical Framework to Examine the Effects of Energy Price Fluctuations on Macroeconomic Variables

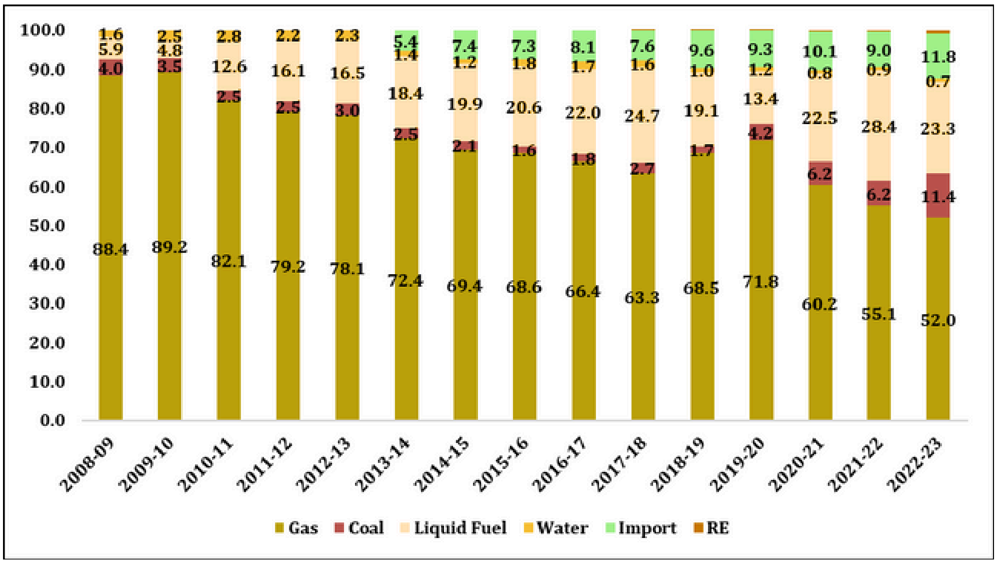
Figure 4 uses aggregate demand (AD) and aggregate supply (AS) frameworks to analyze the effect of higher energy prices on the general price level of an economy.

Figure 4: Impact of Higher Energy Prices on the Price Level



Source: Authors' Illustration

Figure 3: Share of Primary eEergy Usage in Power Generation by Source



Source: Bangladesh Power Development Board, 2023

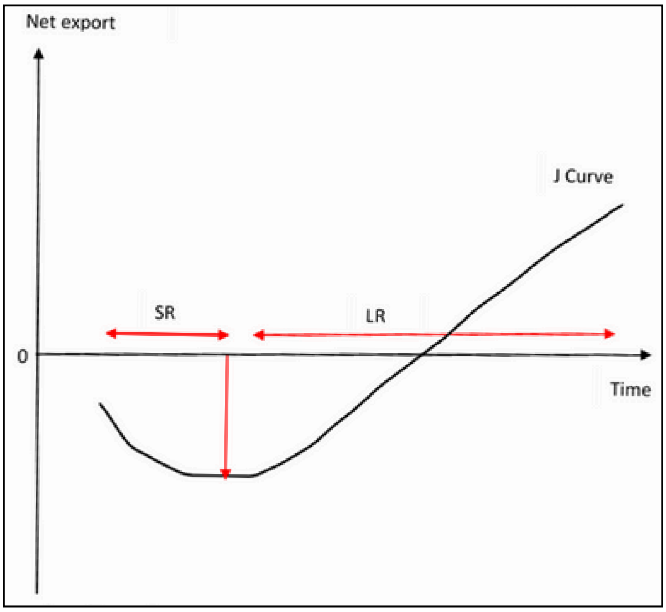
As shown in Figure 4, the economy is initially at point A, representing an equilibrium state characterized by the intersecting aggregate demand and aggregate supply curve. An upward-slopping aggregate supply curve indicates that a higher price level is related to a higher supply of goods, whereas a downward-slopping aggregate demand curve signifies that a higher price level is associated with a lower demand for goods and services. At the initial equilibrium denoted by point A, the economy operates at its full employment capacity, with price level P_0 and output level Q_0.

When the energy price rises, the initial shock is faced by the supply-side of an economy. Higher energy price reduces energy consumption in the production process, which in response reduces output. This shock is depicted by the shift in the aggregate supply curve from AS to AS'. The resultant equilibrium is now situated at point B with a price level of P_1 and an output level of Q_1. From point A to point B, the output level has decreased and the price level has increased. The economy behaves this way because with higher energy prices, the production cost increases. Given the short-run inflexibility of labour wages, employment levels must be reduced to mitigate the rise in production costs.

Point B does not represent a stable equilibrium, as the energy price shock has ramifications on the demand side as well. The elevated price level of goods and services precipitates an overall reduction in demand. This development is illustrated in Figure 4 by the shift in the aggregate demand curve from AD to AD'. After this shift, the economy achieves a new equilibrium denoted by point C. At this equilibrium, the output reduced from Q_1 to Q_2, and the price level decreased from P_1 to P_2. Therefore, the impact of an energy price hike results in a higher price level and lower output level.

According to the absolute purchasing power parity (PPP) theory, the nominal exchange rate is proportional to the domestic price level. That is, when the domestic price level rises due to the increase in energy price, the exchange rate also increases, which means the currency depreciates.

Figure 5: J-Curve Demonstration



Source: Authors' Illustration based on J-Curve Theory

To understand the relationship between the exchange rate and net export, we can illustrate the J-curve (commonly used in international trade), as shown in Figure 5. The J-Curve effect describes the short-term and long-term impact of currency depreciation on the net export. Initially, after depreciation, the net exports may worsen because the prices of imports rise immediately, while the volume of exports takes time to increase. Over time, as the volume of exports grows and import demand falls, the trade balance improves, creating a J-shaped curve when plotted over time.

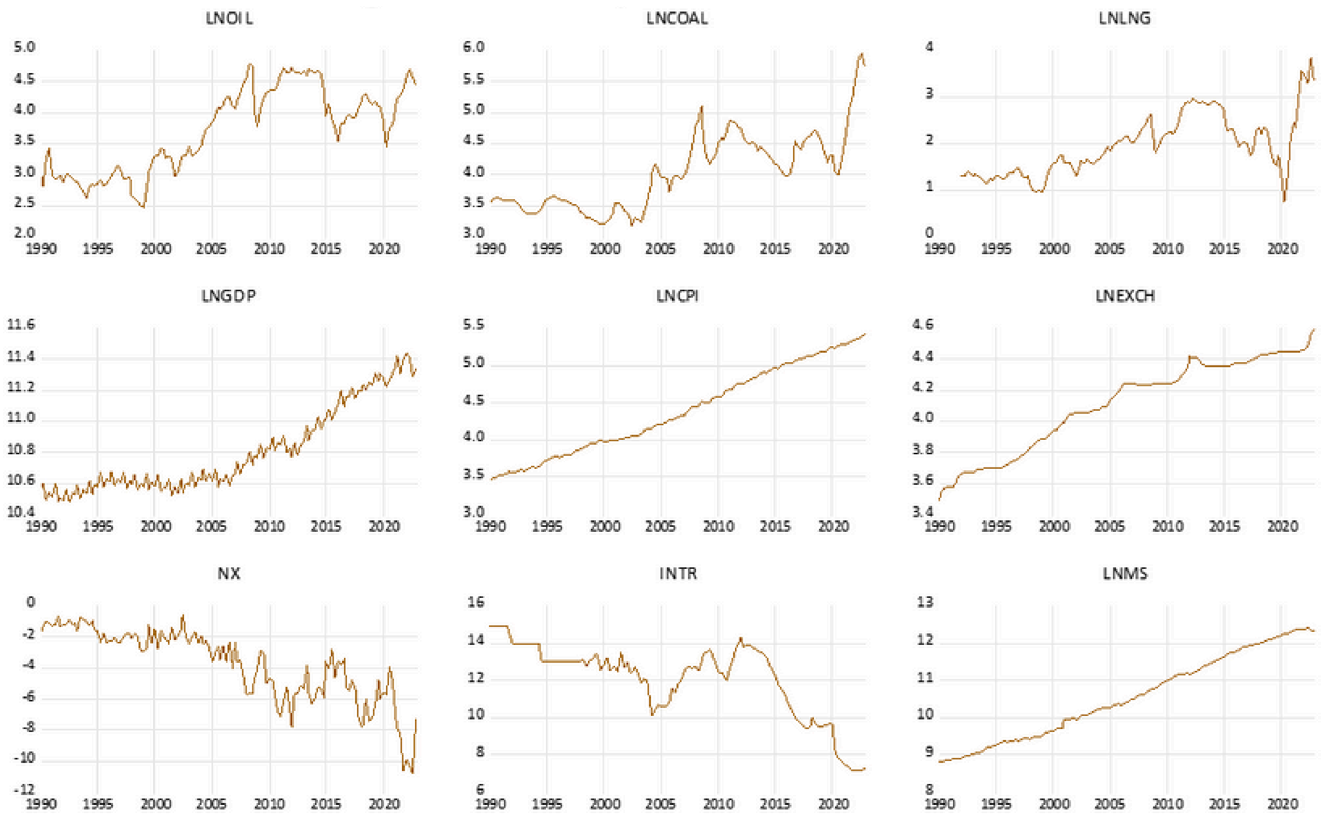
The interest rate, monetary policy instrument of an economy's central bank, also respond to changes in the energy price. According to the Fisher equation, the nominal interest rate is equal to the sum of the real interest rate and the inflation rate. Therefore, energy price indirectly affects the nominal interest rate of an economy by affecting the inflation rate. For instance, if the price level of an economy increases, followed by a higher energy price, the central bank of the economy raises the interest rate. An increase in the interest rate helps to reduce the money supply of an economy.

Trends Analysis of the Energy Prices and Macroeconomic Variables

During the financial crisis of 2008, energy prices (such as crude oil prices, coal prices and LNG prices) experienced a notable surge, which later declined before the onset of the COVID-19 pandemic. During the COVID-19 pandemic, energy prices once again witnessed a significant increase.

Over the years, Bangladesh's money supply, CPI and GDP have experienced a consistent rise. The exchange rate (Taka per USD) has depreciated over the years, and the lending interest rate and net export have followed a decreasing trend (Figure 6).

Figure 6: Time Series Plot of the Studied Variables



Source: Authors' Visualization using EViews 12 Software

Econometric Exercise to Examine the Relationship Between Energy Prices and Macroeconomic Variables

This study employs a Structural Vector Autoregressive (SVAR) model to analyze the impact of crude oil, coal, and LNG price fluctuations on key macroeconomic variables in Bangladesh, including GDP, inflation (CPI), exchange rate, net exports, interest rate, and money supply. The dataset comprises quarterly time series data from 1990 to 2022, obtained from various sources, including the International Energy Agency (IEA), Bangladesh Bureau of Statistics (BBS), and International Monetary Fund (IMF). The Johansen cointegration test was used to assess the long-term relationship between energy prices and macroeconomic indicators, ensuring that the selected variables exhibit a meaningful equilibrium connection over time.

To capture the dynamic responses of macroeconomic variables to energy price shocks, impulse response functions were employed. These functions measure how a sudden change in energy prices impacts the economy over time. Additionally, variance decomposition was applied to quantify the relative importance of energy price shocks in explaining fluctuations in macroeconomic variables. The historical decomposition analysis further validated these findings by tracing the impact of past energy price shocks on Bangladesh's macroeconomic trends. By integrating multiple econometric techniques, this study provides a robust understanding of the transmission mechanisms linking global energy price fluctuations to Bangladesh's economic stability.

Major Findings

Energy price fluctuations have no contemporaneous significant effect on GDP. The insignificant elasticity could stem from factors like time lags in passing increased costs to consumers and businesses, the country and businesses' use of fixed-price contracts, government subsidies shielding from immediate impacts, and the government's allocated expenditure on infrastructure and development projects contributing to short-term economic growth and masking or offsetting the negative impact on GDP.

The coal and LNG price shocks have a contemporaneous significant positive impact on CPI. That is, they both lead to an increase in the CPI inflation. For instance, the elasticity of CPI to coal price movement is 0.03. Meaning, if the coal price increases by 10%, the CPI inflation will increase by 0.3%. Again, the elasticity of CPI to LNG price movement is 0.02, meaning if the LNG price goes up by 10%, the CPI inflation will go up by 0.2%.

The crude oil and coal price fluctuations have a contemporaneous significant positive influence on the exchange rate. The elasticity of the exchange rate to crude oil and LNG price shocks are 0.016 and 0.015, respectively. For example, if the price of crude oil rises by 10%, the exchange rate will rise by 0.16%. On the other hand, if the price of LNG upsurges by 10%, the exchange rate will move in the same direction by 0.15%.

The price shocks of crude oil, LNG, and coal deteriorate the net export. To illustrate, when the price of coal increases by 10%, the net export (as % of GDP) decreases by 0.25 percentage points. Furthermore, if the price of LNG rises by 10%, the net export will go down by 0.17 percentage points. Lastly, if the price of crude oil moves up by 10%, the net export slumps down by 0.16 percentage points.

The outcome of the impulse response function reveals that one standard deviation positive shocks to energy prices significantly affect the macroeconomic variables and can influence policy decisions. Due to one standard deviation positive shocks to energy prices, the GDP responds negatively in most of the quarters over the entire 12 quarters. For one standard deviation positive shocks to energy prices, the CPI and the exchange rate initially increase and then gradually decrease. The net export initially deteriorates and then gradually improves to stabilise after the energy price shocks. The interest rate responds positively in the initial phase and gradually decreases in the later phase, whereas the money supply responds negatively initially and then gradually increases to stabilise after the energy price shocks. This result implies that the central bank can decide to go with contractionary monetary policy initially, when the CPI and the exchange rate increase, but the net export decreases. However, the central bank will choose expansionary monetary policy, in the later phase, when the CPI and exchange rate deteriorate, and net export improves.

The result of variance decomposition shows that there are considerable variances among macroeconomic indicators in response to all energy price shocks. The crude oil price shocks induce around 3.23% of the variation in the GDP. It also explains 1.07% of the variation in the inflation rate, 3.28% of the variation in the exchange rate, 4.64% of the variation in the net export, 2.65% of the variation in the interest rate, and 1.32% of the fluctuations in the coal price shocks can explain around 3.75%, 1.43%, 4.45%, 10.20%, 5.91% and 0.29% of the fluctuations in GDP, CPI, the exchange rate, net export, interest rate, and the money supply, respectively. Around 2.84%, 1.70%, 4.05%, 1.77%, 2.28%, and 1.97% of the variation in the GDP, CPI, exchange rate, net export, interest rate, and money supply, respectively can be explained by the LNG price shocks throughout the entire 12 quarters time horizon.

The historical decomposition of the endogenous macroeconomic variables from energy price shocks validates the results of variance decomposition over time. Over time, energy price shocks were responsible for some of the fluctuations in the GDP, exchange rate, net export, interest rate, inflation rate and money supply. Energy price fluctuations were the greater source of variation in the macroeconomic variables during the crisis period such as the 2008 financial crisis, the 2020 outbreak of the COVID-19 pandemic, the Russia-Ukraine War in 2022, etc.

The results of the Johansen cointegration test reveal that there might exist a long-term relationship between macroeconomic varia-bles and energy prices. Theory postulates that a higher energy price is associated with a higher general price level and lower output level. Thus, energy price fluctuations may create macro-economic instability in the long term, making it difficult to achieve overarching development goals such as the 8th Five Year Plan by 2025, the Second Perspective Plan 2021-2041, SDGs by 2030, middle-income country by 2031, and upper middle-income country by 2041.

Policy Recommendations

Based on the findings, this study provides several policy recommendations aimed at reducing the country's heavy reliance on fossil fuel imports and promoting a shift towards renewable and clean energy sources. These recommendations are designed to improve macroeconomic stability, achieve better environmental outcomes, and support sustainable development.

Diversification of Energy Sources

- Setting a target of using renewable energy in the national energy mix.
- Establishing government-backed incentives for solar and wind power development.
- Developing public-private partnerships (PPPs) to attract investment in renewable energy infrastructure.
- Encouraging the exploration and develop-ment of domestic energy resources, such as natural gas, will further reduce import reliance and strengthen energy security.

Monetary Policy Adjustment

- Bangladesh Bank should undertake contractionary monetary policies (e.g., raising interest rates) when energy price shocks cause inflation, and expansionary monetary policies when energy prices stabilise.
- The central bank should also allow more flexibility in the exchange rate to absorb external shocks, reducing the burden on reserves and mitigating negative impacts on trade and economic growth.

Dynamic Price Adjustment Mechanism

- A dynamic pricing mechanism should be implemented to align domestic energy prices with fluctuations in the international market.
- Bangladesh Energy Regulatory Commission (BERC) should reinclude the public hearing while setting the energy price to ensure fair and market-driven energy prices.

Revising Energy Planning

- Macroeconomic factors should be integrated into the energy planning process.
- Including cost-benefit analysis of energy projects, considering both economic and environmental impacts.
- Gradually phase out fossil fuel subsidies and redirect funds to renewable energy projects.

Strategic Energy Reserves

- Setting up a national strategic energy reserve of key energy commodities, such as crude oil, coal, and LNG.
- Developing regional storage hubs for quick distribution during supply disruptions.
- Implementing a stockpiling policy during periods of low global energy prices.

Enhancing Energy Infrastructure

- Upgrading the national power grid with smart grid technology to improve efficiency.
- Expanding off-grid renewable energy systems in rural and remote areas.
- Investing in energy-efficient transmission and distribution networks to reduce system losses.

Adoption of Efficient Technology

- Providing tax credits for businesses adopting energy-efficient machinery.
- Enforcing mandatory energy efficiency audits in industries and commercial sectors.
- Launching low-interest loans and grants for businesses investing in green technology.

Attracting Foreign Direct Investment in Renewable Energy Projects

- Offering tax holidays for foreign companies investing in renewable energy.
- Establishing a one-stop investment center to facilitate foreign renewable energy projects.
- Setting up a national strategic energy reserve of key energy commodities, such as crude oil, coal, and LNG.
- Developing regional storage hubs for quick distribution during supply disruptions.
- Implementing a stockpiling policy during periods of low global energy prices.

Enhancing Environmental Standards

- Introducing strict emissions caps for fossil fuel-based industries.
- Implementing mandatory carbon footprint reporting for large corporations.

Carbon Pricing

- Implementing a progressive carbon tax system based on emissions levels.
- Developing a national carbon trading system to incentivize emissions reduction.
- Using carbon tax revenue to fund renewable energy projects and R&D.

Fiscal Reserve

- Creating an energy stabilization fund from surplus earnings during low-price periods.
- Allocating a fixed percentage of energy tax revenue to the reserve.

Hedging

- Signing long-term fixed-price contracts with energy suppliers to minimize price volatility.
- Partnering with international financial institutions to hedge against fuel price fluctuations.

Research and Development (R&D)

- Allocating significant percentage of the national budget to clean energy R&D.
- Establishing a national renewable energy innovation hub for technological development.
- Providing R&D tax incentives for companies working on energy efficiency innovations.

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

Md. Tuhin Ahmed *is a Lecturer of Economics at Mawlana Bhashani Science and Technology University and a Honorary Deputy Director at SANEM*

Abdul Zabbar Sakil *is a Research Analyst at International Food Policy Research Institute (IFPRI)*

Takrem Ferdous Surid *is a Programme Analyst at SANEM*