

ENERGY CONSUMPTION AND CO₂ EMISSION IN BANGLADESH: TRENDS AND POLICY IMPLICATIONS

Research Article



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Md. Sujahangir Kabir Sarkar^{1*}, Sumaiya Sadeka², Md. Mehedi Hasan Sikdar³, Badiuzzaman⁴

¹Associate Professor, Department of Economics, Patuakhali Science and Technology University, Dumki 8602, Patuakhali, **BANGLADESH**

²Ph.D. Candidate, Faculty of Social Science and Humanities, Universiti Kebangsaan Malaysia, Bangi 43600, Selangor, **MALAYSIA**

³Associate Professor, Department of Statistics, Patuakhali Science & Technology University, Dumki 8602, Patuakhali, **BANGLADESH**

⁴Professor, Department of Economics, Patuakhali Science and Technology University, Dumki 8602, Patuakhali, **BANGLADESH**

*Email for Correspondence: skabirbau2000@gmail.com

Abstract

Energy consumption is increasing due to the expansion of economic activity and population size which results higher GHG emission worldwide. The study has examined the trends of energy consumption and CO₂ emission in Bangladesh using the secondary data extracted from the World Development Indicators of the World Bank database. The results found that there is an increasing trend of total energy consumption and per capita energy consumption in Bangladesh from 1991 to 2012 where the total energy consumption has been increased nearly three times from 12.55 mtoe (million tonne oil equivalent) in 1991 to 33.17 mtoe in 2012. The total CO₂ emission was estimated by 57.07 mtoe in 2011 which was increased by 140.67% compared to the 1991 emission of 15.94 mtoe. Thus, the CO₂ emission and per capita emission has also provided increasing trend over the period of 1991 to 2011. It has revealed that the growth of CO₂ emission found to be higher than the growth of GDP and energy consumption in Bangladesh. The yearly average growth of CO₂ emission has estimated by 6.7% which is higher than the annual average growth of GDP and energy consumption as of 5.25% and 4.77% respectively. This situation calls for serious attention of the country for reducing CO₂ emission. Therefore, government needs to develop a national mitigation plan/policy and promote the use and development of green technology, renewable energy and green growth for sustainable energy and environment in Bangladesh.

Key words

Trend, energy consumption, CO₂ emission, growth, Bangladesh

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INTRODUCTION

There is an increasing trend of greenhouse gas (GHG) emissions worldwide due to human activities which indicates a substantial increase in atmospheric concentrations of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (EPA, 2014). Carbon dioxide is the most dominant GHGs (greenhouse gases) which accounted 77% of the total global GHG emission where CH₄, N₂O and other gases contributed 14%, 8% and 1% respectively (IPCC, 2007). More or less all of the countries of the world emit GHGs into the atmosphere that causes climate change and global warming. The majority of emissions come from three regions such as Asia, Europe, and the United States, which together accounted for 82 percent of total global emissions in 2011 (EPA, 2014). CO₂ emissions in emerging Asian economies such as India, Indonesia is increasing over time compared to the past years (Olivier, et al. 2014). Bangladesh is a growing South Asian economy that is maintaining macroeconomic stability despite the political turmoil, structural constraints, and global volatility (World Bank, 2015a). Though the country is small in size, it has ranked by 9th position in the world according to the total population size that was estimated by 168.95 million in 2015 (CIA World Factbook, 2015). The economy of Bangladesh is also growing over time and the GDP of the country expanded by 6.12% in 2014 compared to 2013 (World Bank, 2015b). Bangladesh has observed an average GDP growth more than 5% from 1991 to 2012 (World Bank, 2015c). With the impressive economic growth and large population size, the use of energy is increasing over the year for the expansion of the economy and population demand. Thus, GHG emission is also increasing as the

larger of GHG emission is the outcome of higher the energy consumption. However, it can be mentioned that the country produces only 0.19% of the global GHG emission (IEA, 2014) and comparatively low level of per capita emission but the country is most affected due to global warming. However, the GHG especially CO₂ emission is increasing in Bangladesh as the increasing demand of energy due to their larger population and growth of economic activity. Therefore, this study attempts to examine the energy consumption and CO₂ emission trends of Bangladesh and provides some policy implications.

METHODOLOGY

The study assessed the trends of energy consumption and CO₂ emission in Bangladesh. The study has based on the secondary data sources where the most of the data have been extracted from the World Development Indicators of the World Bank database (World Bank, 2015c). The time series trend has been developed based on the data of 1991-2012 to explore the changes of energy consumption and CO₂ emission. The study has also calculated the annual growth (%) of CO₂ emission of Bangladesh using the equation 1. The CO₂ emission growth has been compared with growth of annual GDP and energy consumption of the country. Thus, the study examines the time series pattern of energy consumption and CO₂ emission. Finally, this study has made a synthesis of the ongoing effort of the country for the reduction of CO₂ emission and sustainable energy consumption and provided some policy recommendations.

$$\text{Annual growth (\%)} = \left(\frac{\text{Current year} - \text{previous year}}{\text{Previous year}} \right) \times 100 \quad \dots\dots (1)$$

RESULT AND DISCUSSION

Trend of Energy Consumption

Energy is crucial for development as it run the industry wheel and facilitates basic needs for improving health and education, and reduces the human labor required to cook and so on. Meeting the essential energy needs requires a balanced energy portfolio that is suited to the economic, social, and resource conditions of individual countries and regions (World watch Institute, 2013). Thus, energy is considered as a key factor of production in addition to capital, labor and materials and is seen to play a vital role in the economic and social development of countries, being a key factor in increasing economic growth and living standards (Kabir, 2011). Energy consumption in Bangladesh is gradually increasing over time. Figure 1 shows that there is an increasing trend of total energy consumption and per capita energy consumption in Bangladesh from 1991 to 2012. The total energy consumption has been increased nearly three times within 22 years from 12.55 mtoe (million tonne oil equivalent) in 1991 to 33.17 mtoe in 2012. Consequently, per capita energy consumption has become double between this time period which was 115.68 Kgoe (kilogram oil equivalent) in 1991 and reached at 213.66 kgoe in 2012. Therefore, it clearly indicates that Bangladesh is a growing economy in terms of energy consumption.

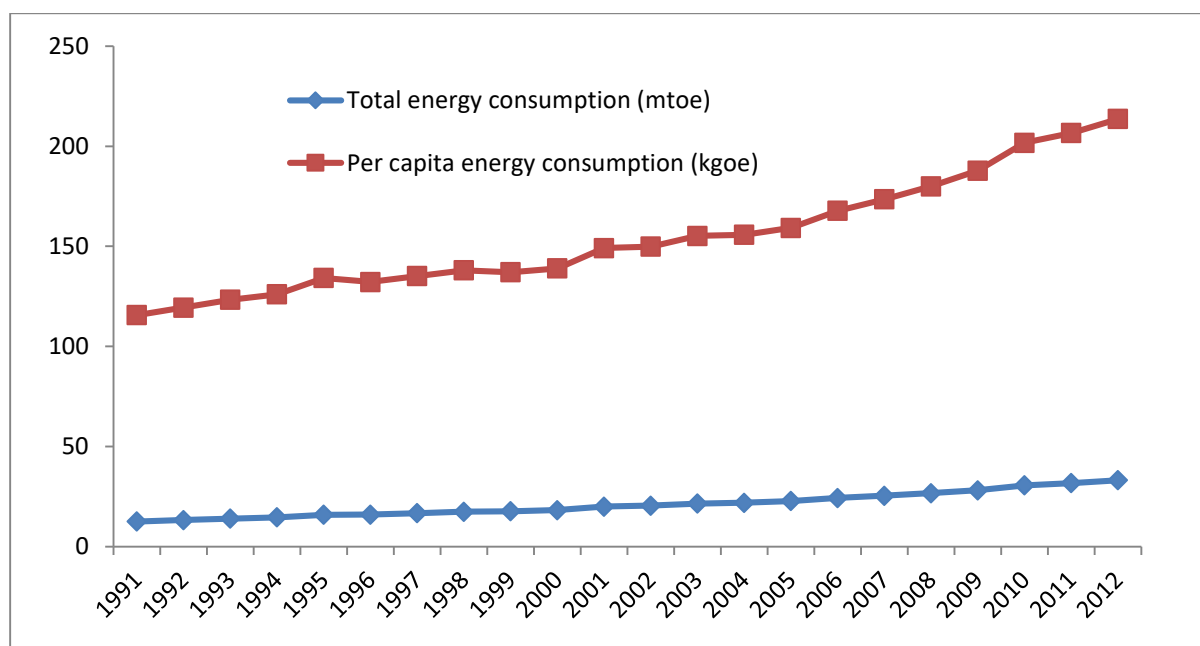


Figure 1: Trend of total and per capita energy consumption in Bangladesh from 1991 to 2012

Bangladesh is the country where natural gas is a major supplier of fulfilling the energy demand. The other sources of energy in Bangladesh are oil/petroleum, coal, hydro and renewable energy. According to Planning Commission (2010), gas has contributed 87% of the total energy in 2010 where oil, coal, hydro and renewable has provided 6%, 3.7%, 2.7% and 0.5% respectively which is shown in Table 1.

Table 1: Energy sources and their share of total energy in 2010 of Bangladesh

Sources of energy	Percentage (%) of total energy supply
Gas	87.1
Oil	6.0
Coal	3.7
Hydro	2.7
Renewables	0.5

Source: Planning Commission, 2010

Most of the sources of energy are used for power generation in Bangladesh. According to the World Bank (2015d), 85.1% of the total electricity has been produced by the natural gas in 2012. Electricity (power) consumption in Bangladesh is increasing from the past few years with high rate. The electricity consumption was estimated at 13.493 billion kWh (kilowatt-hour) in 2000 and it was increased by three times in 2011 at 39.53 billion kWh. Similarly per capita electricity consumption in Bangladesh has been raised from 102 kWh in 2000 to 279 kWh in 2012 (World Bank, 2014). Nearly 60% of the people of Bangladesh have access to electricity meaning that still a large portion of the people need to provide electricity. The country has also faced a large amount of power shortage from a long time. Thus, Bangladesh needs to produce more electricity that requires more energy in the coming years.

Trend of CO₂Emission

The concentration of greenhouse gases (GHGs) in the earth's atmosphere has been increased markedly due to human activities since 1750. While the concentration of all types of GHGs has increased in the atmosphere, the focus is always on the CO₂ emission, as it constitutes large share of GHG emission. In the Climate Change Synthesis Report 2007, the Intergovernmental Panel on Climate Change (IPCC) has mentioned that the energy sector contributed 25.9% towards global anthropogenic CO₂ emissions (IPCC, 2007). Bangladesh produces a very small share of global CO₂ emission. But, the country's emission scenario has marked a rapid increase of CO₂ emission over time. Figure 2 reveals that CO₂ emission and per capita CO₂ emission in Bangladesh have escalated with increasing trend. The total CO₂ emission was estimated by 57.07 mtoe in 2011 which was increased by 140.67% compared to the 1991 emission of 15.94 mtoe. This indicates an average yearly increase of CO₂ emission by 6.70% over the period of 1991-2011. The per capita emission has also increased by more than two times which was 0.15 metric tonne in 1991 and 0.37 metric tonne in 2011.

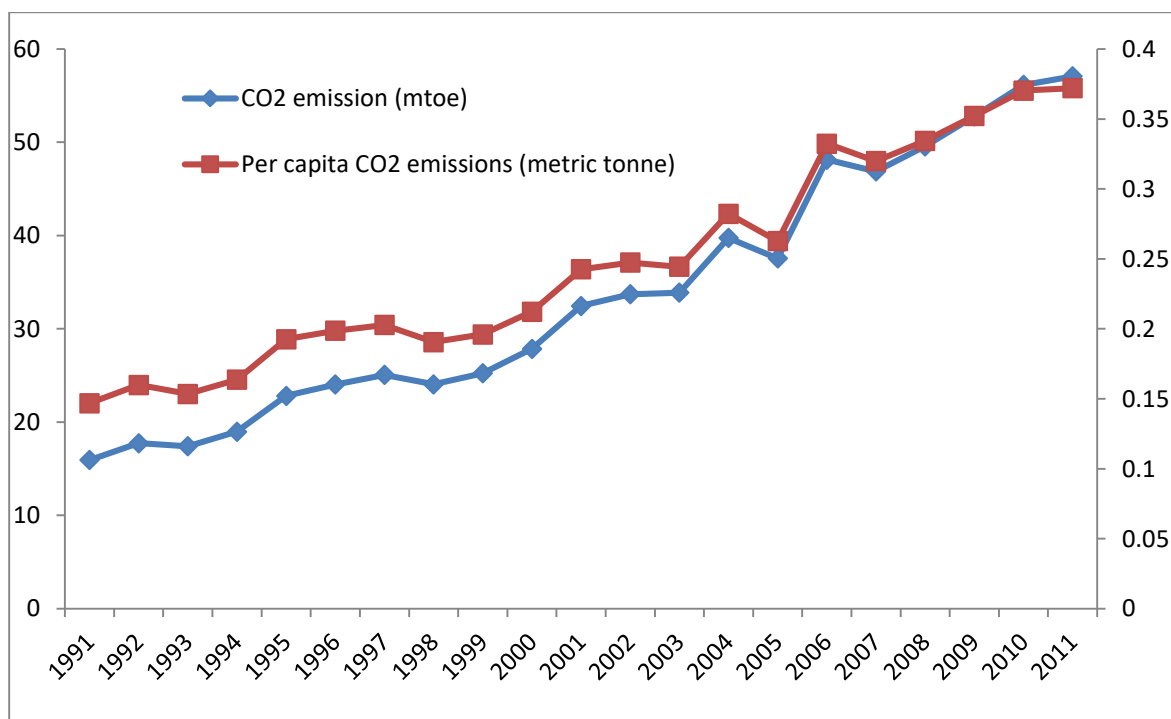


Figure 2: CO₂ emission and per capita CO₂ emission in Bangladesh

CO₂ emission has been evolved from various sources such as electricity, transport, manufacturing and so on. In Bangladesh, highest CO₂ emission has been produced by electricity generation sector followed by manufacturing sector. In 2012, electricity sector contributed 47.72% of the total CO₂ emission in Bangladesh while manufacturing and construction; residential and commercial and public services; transport; and other sectors originated CO₂ emission by 20.87%, 11.13, 14.49, and 5.79% respectively. Figure 3 shows the sectoral share of CO₂ emission and their trend over the period of 1991-2011. The figure indicates that there is an increasing trend of CO₂ emission from the electricity generation sector where a decreasing trend has found in case of manufacturing and construction sector. The other three sectors have shown more or less stable trend of emission over time.

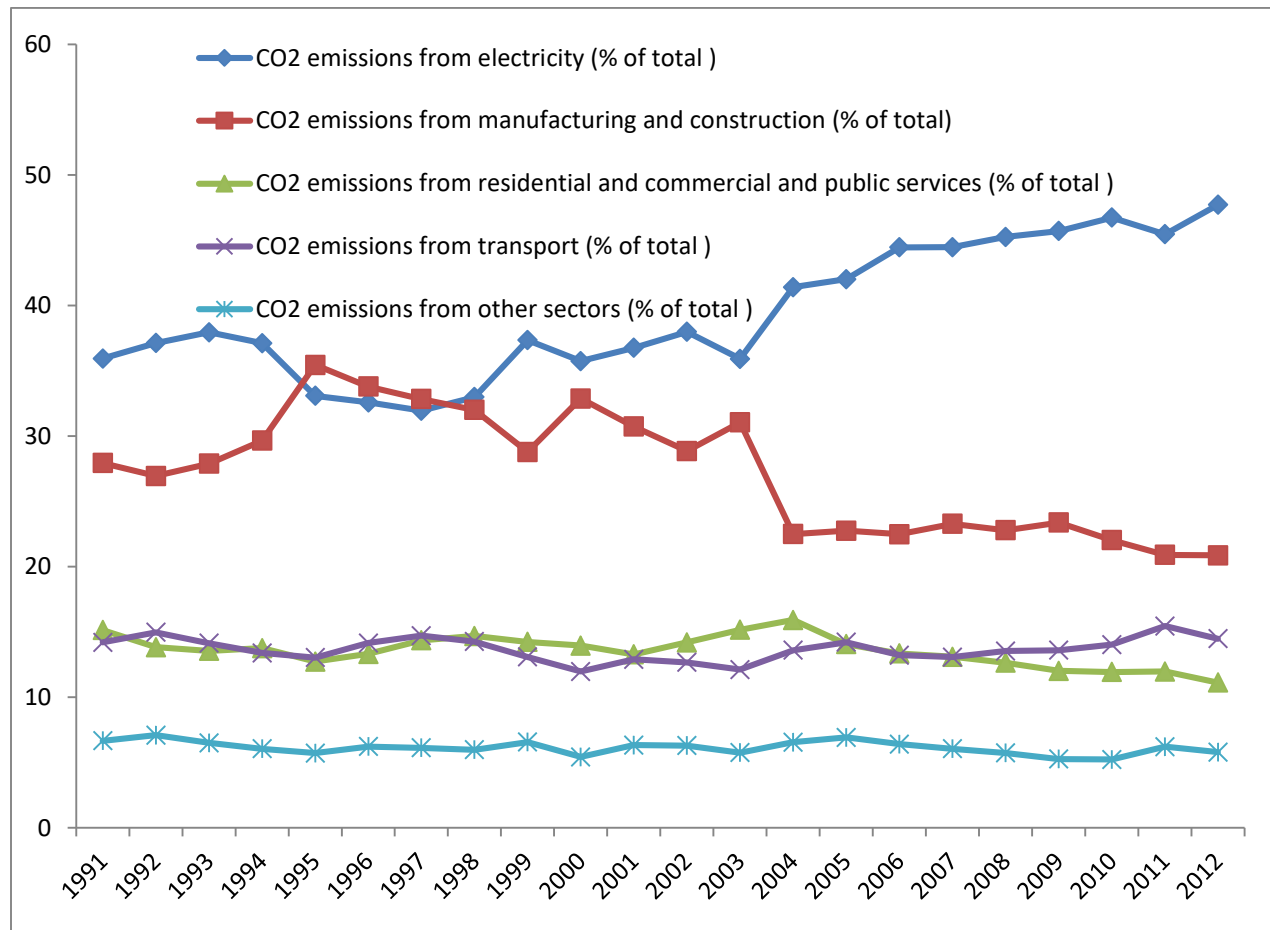


Figure 3: Sources of CO₂ emission in Bangladesh by sectors

Trend of GDP, Energy Consumption and CO₂ Emission Growth

There is an obvious relationship between GDP growth, energy consumption and CO₂ emission. Several studies have conducted to achieve such relationship in different countries. It has found that there is a unidirectional causality running from coal consumption to GDP both in short and long run under supply side analysis in China (Bloch, et al., 2012). Jalil and Mahmud (2009) also found a unidirectional causality running from economic growth to emissions in China. Ghosh et al. (2014) examined the economic growth, CO₂ emissions and energy consumption relationship in Bangladesh and found that energy consumption has a positive and significant impact on economic growth while carbon emission has a negative and insignificant effect on economic growth. Asafu-Adjaye (2010) found a combination of unidirectional and bidirectional causality between economic growth and energy consumption in four Asian developing economies. However, the trend among the growth of GDP, energy consumption and CO₂ emission in Bangladesh is shown in Figure 4. The results indicate that growth of CO₂ emission trend has crossed over the growth of GDP and energy consumption in Bangladesh with larger fluctuation. The yearly average growth of CO₂ emission has calculated by 6.7% while the annual average growth GDP and energy consumption has found as 5.25% and 4.77% respectively. Thus, it is essential to address the CO₂ emission in Bangladesh.

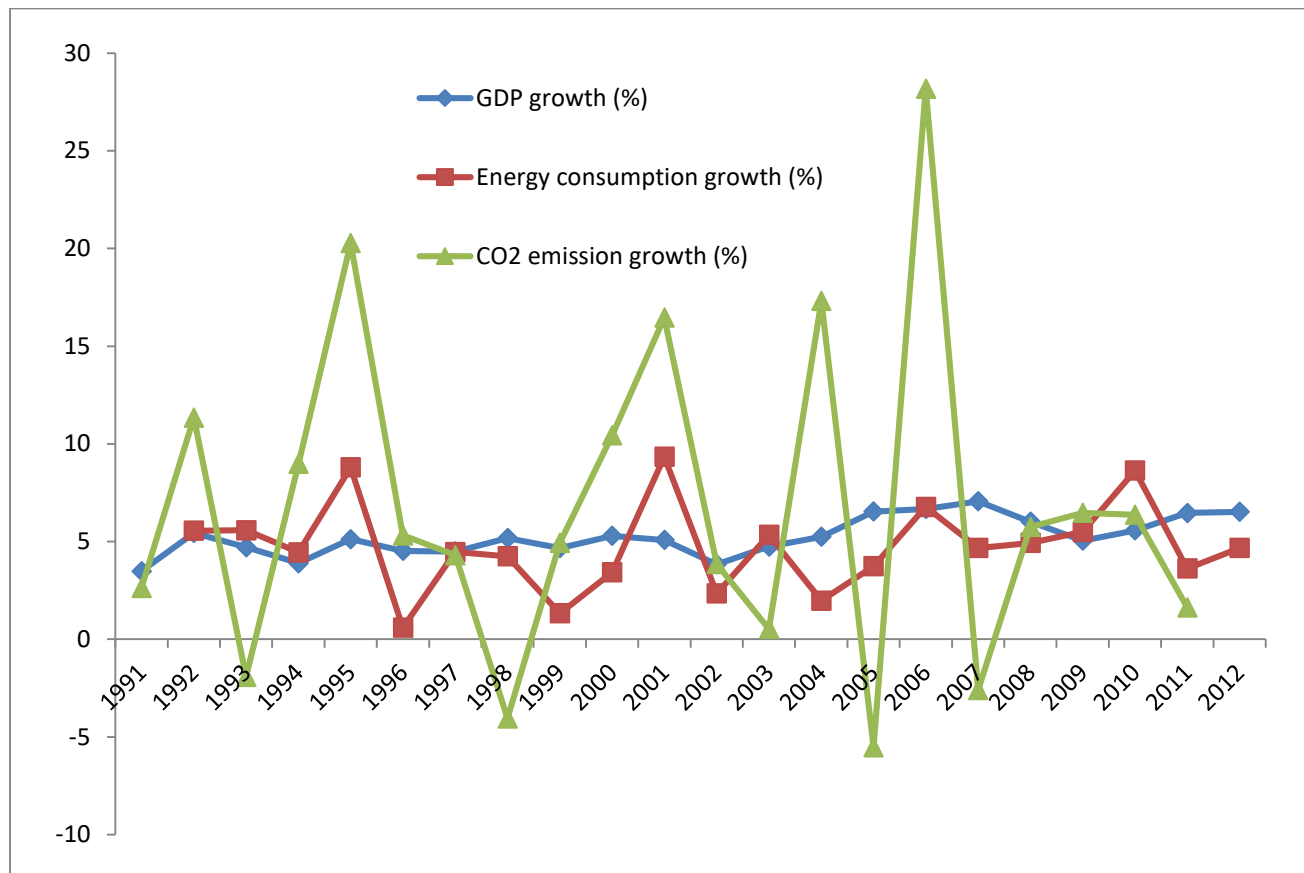


Figure 4: Trend of GDP, energy consumption and CO₂ emission growth in Bangladesh

Initiatives for Reduction of CO₂ Emission

As the global temperature is increasing with the increase of CO₂ emission, most of the world's leaders have recognized the need to limit and ultimately reduce global CO₂ emissions, leading to the 15th United Nations Climate Change Conference (COP15) in Copenhagen, held from December 7-18, 2009. The increasing rate of CO₂ emissions calls for effective mitigation strategies to reduce the CO₂ emission and global warming. Though Bangladesh is a low emission producer, the country is one of the most affected due to climate change. Thus, the country is trying to implement several programs, initiatives and projects to reduce emission and tackling climate change impacts. Bangladesh has developed Climate Change Strategy and Action Plan towards mitigation and low carbon development along with other strategic areas (MoEF, 2009). Ministry of Power, Energy and Mineral Resources (2008) has published the National Renewable Energy Policy aiming for developing renewable energy resources (solar, wind, hydro) to meet 5% of the total power demand by 2015 and 10% by 2020. It promotes the use and development of renewable energy by encouraging and facilitating both public and private sector investment which further promote appropriate, efficient and environment friendly use of renewable energy and clean energy. The National Adaptation Program of Action (NAPA) for Bangladesh has been developed by the Ministry of Environment and Forest (MOEF) to address adverse impacts of climate change and extreme events and to promote sustainable development of the country (MoEF, 2005). National Adaptation Plan (NAP) Global Support Program is another initiative of Bangladesh which would promote common understanding of the UNFCCC (United Nations Framework Convention on Climate Change) NAP guidelines among ministries of Environment, Planning, Finance and key sectoral ministries (USAID, 2012). Bangladesh government has also taken initiative to develop Nationally Appropriate Mitigation Activities (NAMA) for the steel sector (DOE, 2014). The NAMA project would facilitate to identify technological need, capacity building, policy and financial needs to enhance energy efficiency actions and development in the steel sector which would reduce CO₂ emission (DOE, 2014). Some other projects such as enhancing capacity for low emission development strategies (EC-LEDS) and USAID low emissions Asian development (LEAD) Program are also implementing in Bangladesh for reducing emission from climate, energy and land. Table 2 summarizes the initiatives taken in Bangladesh for addressing emission and climate change.

Table 2: Initiatives for reducing CO₂ emission in Bangladesh

Initiatives/Programs	Sectors involved	Implementing Agency/Partner
Bangladesh Climate Change Strategy and Action Plan ¹	Climate	Ministry of Environment and Forest, Government of the People's Republic of Bangladesh
National Renewable Energy Policy ²	Energy	Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh
National Adaptation Plan of Action (NAPA) ³	-	Ministry of Environment and Forest, Government of the People's Republic of Bangladesh
National Adaptation Plan Global Support Program (NAP-GSP) ⁴	Climate	United Nations Development Program (UNDP), United Nations Environment Program (UNEP)
Nationally Appropriate Mitigation Activities (NAMA)	Steel	Department of Environment, Bangladesh
Bangladesh-USAID Low Emissions Asian Development (LEAD) Program ⁵	Climate, Energy, Land	ICF International, United States Agency for International Development (USAID), United States Environmental Protection Agency (US-EPA), United States Department of State
Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) ⁶	Climate, Energy, Land	USAID, US-EPA United States Department of Energy, United States Department of State

Source: ¹MoEF, 2009, ²MoPEMR, 2008, ³MoEF, 2005, ⁴UNDP, 2012, ⁵USAID, 2012, ⁶EC-LEDS, 2014

Policy Implications

It is evident that government of Bangladesh with support of global partners has already initiated some plans, programs and activities to address mitigation and adaptation to climate change. However, there is still need some concrete strategies and actions to reduce CO₂ emissions by the power generation, transport, manufacturing, residential and other sectors. Implementation of actions is very crucial to achieve the goal. It can be mentioned that CO₂ emissions will not spontaneously decrease if the country continues to develop its economy without adopting instruments for mitigating climate change (Xu et al. 2012). Thus, mitigation options are important to reduce the GHG emissions which can promote sustainable energy use, reduction of global warming as well as the environmental sustainability. Some cost effective mitigation options such as afforestation, sustainable forest management, reduction of deforestation, cropland management etc. need to be promoted in Bangladesh. There is also need energy efficient technology, decarbonizing electricity generation, hydrogen and electric vehicles and behavioral changes of the people. Renewable energy resources is one of the most efficient and effective solutions for clean and sustainable energy development in Bangladesh (Ahiduzzaman and Islam, 2011). Biomass conversion to energy in the form of liquid, gaseous and solid pellet or briquette could be a viable option to reduce the pressure on the conventional fossil fuel (Ahiduzzaman and Islam, 2011). Thus, this study proposes the following major policy recommendation towards reducing emission in Bangladesh:

- To formulate an extensive national mitigation plan/policy and nationally appropriate mitigation actions towards establishing a low carbon society
- Strengthen or modify the existing strategies, plans and policies relating to the sustainable energy use
- To stimulate the use of cleaner fuel, renewable energy, solar energy, wind energy and biomass energy
- To introduce eco-labeling technique for the industry towards emissions reduction
- To ensure the proper implementation of projects with transparency and accountability
- To promote research and development (R & D) related to green energy, green technology, renewable energy and energy efficiency
- To ensure regular inspection and monitoring of the industry and power plant for maintaining the level of emission
- To identify key stakeholders, actions and financing sources and promote implementation of actions/plans towards climate-resilient economies and low emission status in key sectors and areas of the economy
- To strengthen institutional capacity and coordination among stakeholder to implement the policy/plans/actions at different sectors and level
- To promote green growth by incorporating environmental sustainability into the economic development plans and policies

CONCLUSION

Energy is vital for economic growth and development, but it is crucial for the country to promote a sustainable energy policy. Increasing energy consumption results higher emission and global warming consequences that would seriously affect every country and regions. Bangladesh is one of the most vulnerable countries to climate change effect due to global warming. It has found that there is an increasing trend of CO₂ emission which is higher than the energy and GDP growth of Bangladesh. This situation demands major attention for reducing CO₂ emission as most of the countries agreed to reduce GHGs emission in the 15th United Nations Climate Change Conference (COP15) in Copenhagen, 2009 towards maintaining global temperature by below 2^oC by 2100. Effective mitigation strategies are essential to reduce the increasing rate of CO₂ emissions in Bangladesh. Therefore, the country needs to develop a national mitigation plan/policy and promote and implement nationally appropriate mitigation strategies as well as negotiations with the global partners and developed countries for funding, technology and technical knowledge building.

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