

Assessment of Renewable Energies to Alleviate Power Crisis in Bangladesh: A Review

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Abstract:- The environmental consequences of energy production has become a great threat to developing countries like Bangladesh. The country has faced a boom in energy capacity; 4 times larger in a decade; the majority of them are based on fossil fuels such as natural gas, oils, and coal. The existing reserve of conventional energy sources, environmentally harmful, are insufficient to meet the present and near future power demand. Besides, it is predicted that these reserves will be depleted very soon. All these presages that Bangladesh will face a catastrophic power crisis in the future. In contrary, Bangladesh is blessed with renewable energies like solar, wind, tidal, wave, and biomass energy. Research carried out by various researchers found that the country has great potential in renewable energies. This paper elucidates the opportunities and reliability of renewable energies in Bangladesh to ameliorate the power crisis.

Keywords:- Power crisis, conventional energy sources, Renewable energy, Solar Home System, Wind energy, Tidal & Wave Energy, Nuclear Energy.

I. INTRODUCTION

Bangladesh has achieved the position to be considered as a role model to other developing countries. The country should give more emphasis to its power generation in order to continue its development. It has one of the lowest per capita power consumption in the world which was 310.4 KWh [1]. Bangladesh's total installed electricity generation capacity (including captive power) was 17,340 megawatts (MW) as of October 2018. It is assumed that Bangladesh will need an estimated 34,000 MW of power by 2030 to sustain its economic growth of over 7 percent. In order to achieve the destination, the country should not rely only on conventional fossil fuels for power generation. It must utilize the enormous natural resources of solar energy, wind, Ocean, tidal and biomass energy; more reliable, continuous, and cost-efficient. Renewable energy can be an additional and vital source of energy to meet the power crisis.

II. POWER SCENARIO

There are five major public power generation companies which include BPDB, APSCL, EGCB, NWPGLC, and RPCL, contributes 52% of the total capacity. The rest 48% power comes from the private sector including power import from neighbor countries. The following graph illustrates the overall power contribution from different energies based on fuel type:

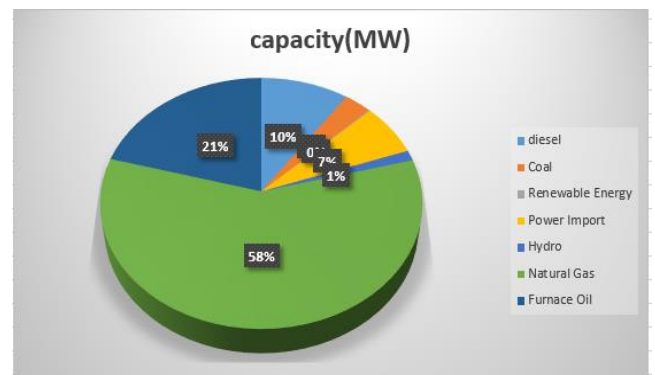


Fig 1:- Total power generation from various sources [2]

The total Electricity generation and installed capacity have faced a boom in the recent previous decade. The country has increased its capacity 4 times within this short period which is remarkable. The Peak Demand has also risen tremendously and it has shown below:

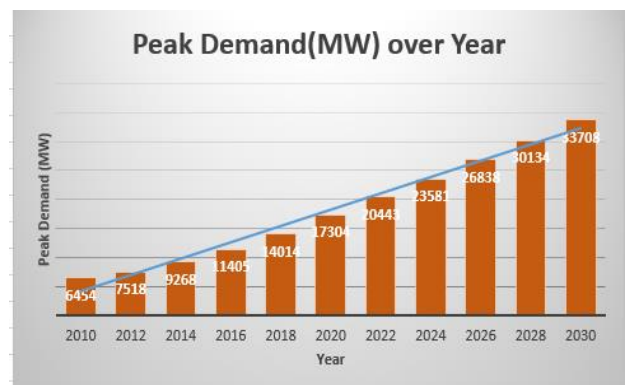


Fig 2:- Peak Demand for Electricity in Bangladesh [2].

The above line graph provides information about the Peak Demand for electricity in Bangladesh for 20 years from 2010 to 2030. Overall, it can be seen that the demand always rises linearly. The power demand in Bangladesh has become 5 fold in 20 years. This trend will continue in the future. So, it will be unwise to depend on one type of fuel rather than using the potential of other renewable energies.

III. FUTURE FUELS CRISIS

Bangladesh mostly depends on its fossil fuels for electricity generation which includes natural gas, coal, and oil. All these are precious resources of the world; limited in quantity; will exhaust very soon. Bangladesh stands nineteenth in natural gas production in Asia and it meets 56% of its domestic energy demand. However, Bangladesh faces a genuine energy crisis to meet its vast and growing population [3]. Bangladesh has a total number of 26 gas fields. Unfortunately, these will be depleted in 10-12 years in case no new discovery is made. The following graph shows the reserve status of the country which is evident that our reserves are decreasing rapidly [4].

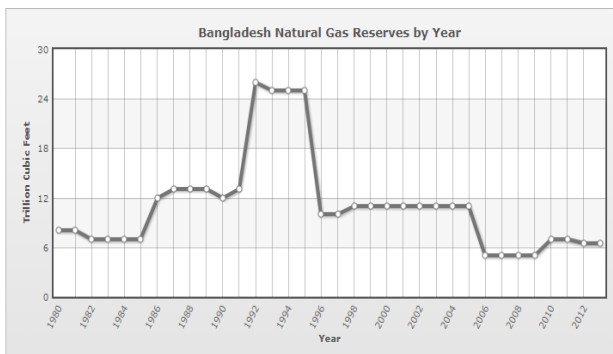


Fig 3:- Natural gas reserve in Bangladesh

Despite, the coal and oil productions are minimum, but the consumption rates are higher. The country imports a large quantity of oil which increases the production cost, and unreliable as well. So, oils and coals are not sufficient to assuage the future power crises in Bangladesh.

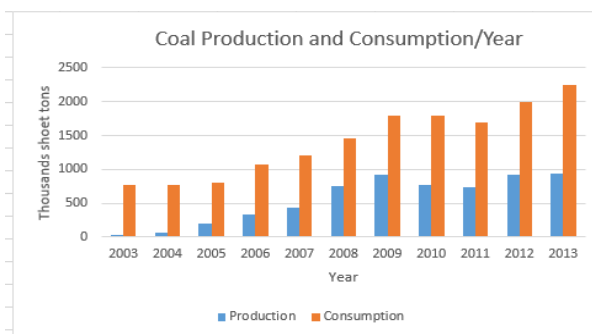


Fig 4:- Coal production and uses in Bangladesh [4]

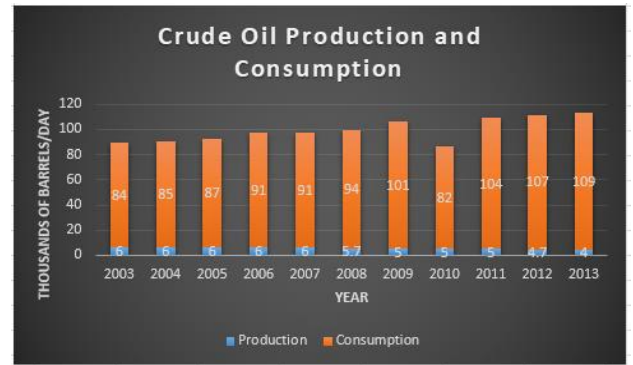


Fig 5:- Crude oil production and consumption in Bangladesh [4].

It is predictable that Bangladesh cannot depend on these conventional fossil fuels for power generation for its numerous insecurity. It is time to look for other option which is pollution less, reliable, less costly, and accepted to all.

IV. ENVIRONMENTAL CONSEQUENCES

Fossil fuels based power plants are largely accountable for various environmental pollution. A big percentage of the world’s electricity (42%) comes from coal-based power plants. Some problematic pollutants in the emission of coal-based generating plants are SO₂, Nitrogen Oxides, CO, CO₂, certain hydrocarbons, particles and many more. Natural gases are responsible for global environmental impact, greenhouse effect, Ozone layer depletion [5]. Bangladesh cannot afford the rise of sea level because it is predicted that if the sea level increase 2-3 meters, major (48%) lower part will go under water. This salty water will make our land unproductive for a couple of years.

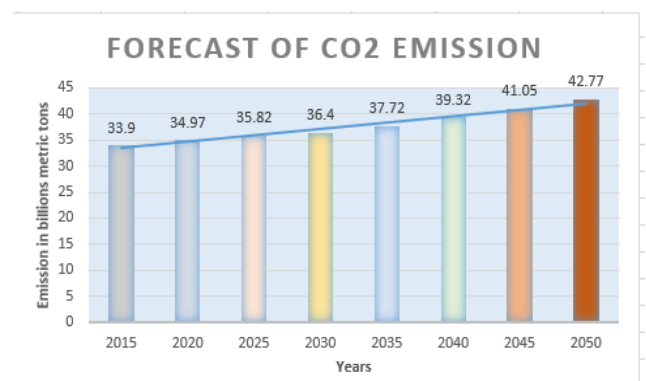


Fig 6:- Forecast of carbon dioxide emissions worldwide from 2015 to 2050 [6].

The above graph predicts that the CO₂ emission will keep increasing in the future. This scenario can be the opposite if the conventional power plant is substituted by renewable energies since the renewable energy emits 5-20

times less CO₂ in the air. The below graph compares the maximum and minimum CO₂ emission by various types of energy sources.

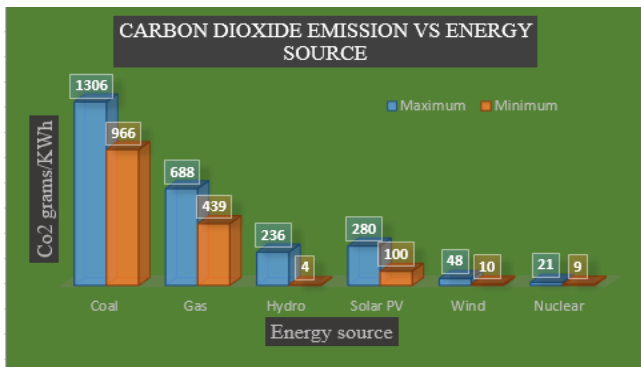


Fig 7:- Comparison of emitted CO₂ in various energy sources [7].

This has become one of our prime duty to increase electricity generation keeping an eye to the impact on the environment. It is crystal clear that renewable energies are exempt from these pollutants. So, emphasis should be given to these clean energy sources in order to ensure proper sustainability in the power sector.

V. RENEWABLE ENERGIES

Energies that are reproduced continuously by natural manners, and also can be reused due to their environment-friendly and sustainable properties known as renewable energy. Renewable energies specifically refer to solar, biomass, hydropower, wind, and geothermal energy exclusion of exhaustible resources like fossil fuels and uranium [8]. Renewable energy shares only 1.0% of the country's total energy, in the world, it accounts for almost 19% of total energy consumption [9]. However, the country has decided to increase the renewable energy utilization for electricity generation up to 10% by the year 2020 [10].

VI. PROSPECT OF SOLAR ENERGY

Solar insolation is the most abundant renewable energy source in Bangladesh. This is because of the geographical location of the country. An average of 5 kWh/m² solar radiation falls on this land for over 300 days per annum. A maximum amount of radiation falls on March-April and minimum on December-January [11].

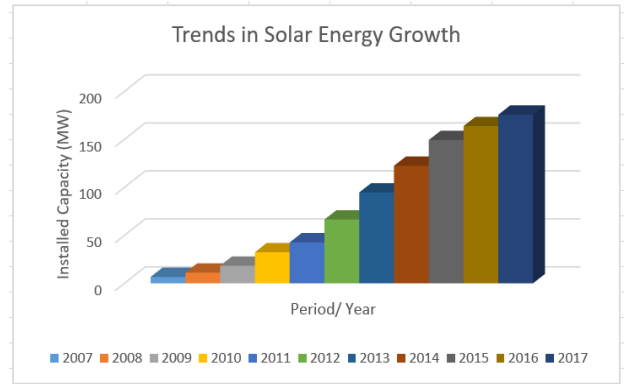


Fig 8:- Solar Energy increment over a decade [12].

The above figure shows that the utilization of solar energy has increased tremendously over time. This was possible because of some appropriate decision which includes compulsory of solar installation in a new building, electrification of rural area by IDCOL, and introducing solar power system in prime location. According to a report, Grameen Shakti has installed over 51,000 units Solar Home System at different parts of the country by 2010. Bangladesh has almost 234MW electricity generation potential from SHSs. Solar concentrating power is another efficient technology for harnessing solar energy and found to be suitable in Rajshahi district [13]. A new dimension in the sector of solar energy utilization is possible by bringing Grid-connected solar PV or mini-grid concept. Bangladesh has the capability of generating 50,174 MW through grid-connected solar PV. However, the country is producing only 3 MW from rooftop solar plants connected to the grid [14]. The potential of solar power in Bangladesh has been studied by numerous researcher, and the possibility is shown as below:

Technology	Potential Power (MW)
Concentrating Solar Power (CSP)	100
Solar Home System (SHS)	234
Grid-tied Solar PV	50174

Table 1:- Possible electricity generation from multiple solar technologies [14-15].

VII. WIND POWER IN BANGLADESH

In Bangladesh, the possibility of wind power is confined to off-shore islands, coastal areas, and rivers sides with strong wind regime. Wind power generation depends on multiple factors which include wind speed, size of turbine blades, number of blades, and orientation of blades. In the process, the kinetic energy of air is converted into the mechanical power of the turbine shaft and afterward into

electrical power with the help of a generator. The theoretical amount of generated electricity can be found using the following equation:

$$P = \frac{1}{2} * \rho * A * V^3$$

Where,

- P= power generated (W),
- ρ = density of air (kg/m^3),
- A= area of turbine blades (m^2),
- V=wind speed (m/s).

The following graph shows the wind speed at different heights in some selected areas in Bangladesh [16].

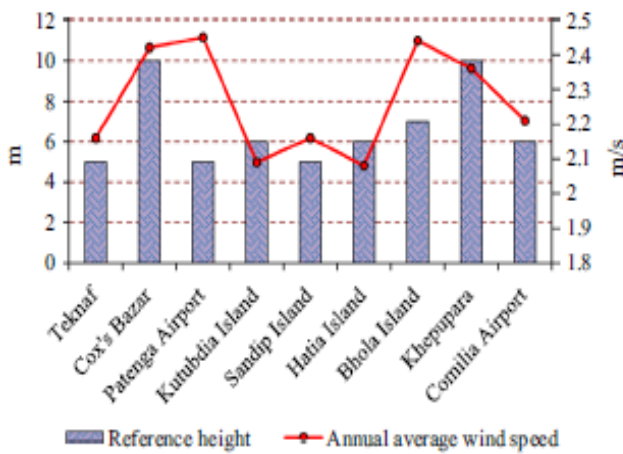


Fig 9:- Wind speed at different heights at different locations.

Bangladesh has realized the scope in wind energy and has undertaken some project to utilize this form of energy. Some projects are listed there:

Location	Capacity (KW)
Muhuri Dam, Feni	900
Kutubdia Island	1000
Multiple sites in Feni	15000

Table 2:- Wind power plant with power capacity [17]

Bangladesh Power Development Board (BPDB) has undertaken a 50-200 MW Wind Power Project at Parky Beach area, Anawara in Chittagong on IPP basis. BPDB along Power Division have primarily selected 22 potential sites for Wind Resource Mapping in Bangladesh. Wind monitoring stations will be introduced at selected sites for comprehensive Wind Resource Assessment (WRA). Furthermore, BPDB has shown genuine interest to expand On-shore Wind Power Plants along the coastline of coastal regions of Bangladesh.

VIII. PROSPECT OF HYDROPOWER

In hydropower plants, kinetic energy from flowing or flow of water is exploited in order to generate electricity. Hydropower plants can be classified into six types such as large hydro, medium hydro, small hydro, mini-hydro, micro-hydro, and pico hydro [18]. Bangladesh has numerous canals and branches of the rivers, which provides a good scope of hydropower extraction. However, the rivers and Chittagong hill tracts are considered more suitable for micro-hydro power plant due to low cost and low current speed. An inspection conducted by BPDB and BWDB on the potential of micro-hydropower sites in Bangladesh had found 19 positions near rivers/chara/ stream with a potential of generating 1197 KW of electricity [19]. This electricity can be used to enlighten rural areas or agricultural firms. It has an enormous impact on socio-economic importance, and this was investigated by SRE and LGED [19].

Site	Expected power (KW)	Power Delivery in Houses100	Power Delivery in School/ Clinics/ Bazar	Power to small Industries
Nunchari	3	100	3	1
Chang-co-Para	30	200	5	2
Bangchari	25	600	12	5
Liragaon	20	500	8	3
Kamalchar	20	150	8	9
Thang Khruue	30	300	6	3
Monjaipara	7.5	50	3	-

Table 3:- Possible impact of mini hydropower plant in selected locations

IX. BIOMASS ENERGY

Biomass is the most prominent renewable energy and sustainable energy resource that can be stored and transferred. It is an organic material that comes from living or dead organism such as plant, tree, crops, and its residues. Biomass consumes CO2 and firmly believed that biomass is physically CO2 neutral. This is because it takes in the same or more amount of CO2 in growing that it releases due to the burning of biomass.

Biomass resources are huge in Bangladesh that includes crop residue, rice husk, animal waste, municipal waste, wood, jute stick, sugarcane and many more. Rice is the main agricultural crop; produced almost 34.36 million tons in the year 2013-2014; covered about 96.35% of total food grains, produced tons of waste, husk etc. In addition, Bangladesh had 53.02 million livestock and 293.235 million poultry, a good source of biomass. Besides, forest residues including tree leaves, twigs, roots, bark, and sawdust contribute to the biomass energy sector. The potential for biomass in generating electricity is given below:

Biomass source	Biomass generation (million tons)	Electricity generation (TWh)	Equivalent Coal (million tons)	Equivalent Gas (billion cubic meters)
MSW	13.38	26.57	3.26	2.42
Forest residues	17.44	58.53	7.19	5.33
Livestock residues	88.89	126.81	15.58	11.54
Agricultural residues	94.10	161.80	19.88	14.72

Table 4:- Potentiality of biomass energy [20]

All these presage that Bangladesh has great potential in biomass energy. Biomass has the capability of generating 373.71 TWH electricity that saves around 46 tons of Coal and 34 billion cubic meters of Gas. The opportunities had not exploited properly. However, biomass is getting popular in rural areas in Bangladesh. Some private company like IDCOL has already financed two rice husk gasification power plant. IDCOL also financed eight biogas based electricity power plants.

Bangladesh should also utilize the ocean energy that has the potential of generating 30 MW electricity. Despite, Tidal and wave energy are limited in Bangladesh; has the capability to bring important changes in the rural economy and rural life.

X. TIDAL & WAVE ENERGY

Energy is extracted from the rise and fall of sea levels which is due to the gravitational pull of the moon and sun on earth. Bangladesh has long coastal areas, lots of barrages and sluice gates, low head, medium head tidal in multiple areas. Research carried out by BUET in 2010 in six different regions are shown below:

XI. NUCLEAR POWER PLANT

Power generation from nuclear energy diversifies a country's energy source to get relief of power crisis problem. A country like Bangladesh with limited natural resources should give emphasis on the nuclear power plant to ameliorate the scarcity of power. Bangladesh has undertaken a nuclear power plant at Rooppur with the capacity of 2500MWe power. Nuclear power beats other forms of energy in all aspects such as land requirement, electricity production cost, environmentally friendly and so on. Five steps of safety will be ensured in order to make it hazardless for the inhabitants of Bangladesh. It is predicted that more nuclear power plant will be visible to minimize the power crisis in Bangladesh in near future.

XII. CONCLUSION

Bangladesh should realize that it is not blessed with enormous natural resources which assures the energy security. In contrast, renewable energies have the potential to amend the power scarcity and substitute our dependency on conventional energy sources. Renewable energy should be promoted as an alternative and sustainable energy solution

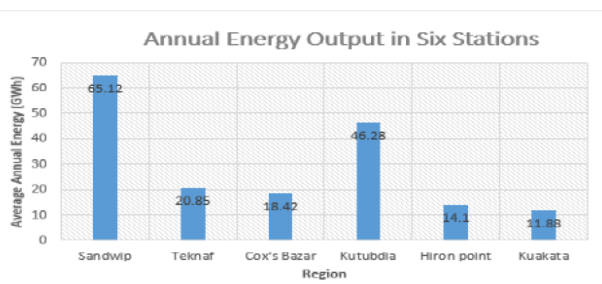


Fig 10:- Potential of tidal energy in Bangladesh in selected areas.

since it is reliable, affordable, and more importantly exempt from environmental issues. A subsidy, as well as emphasis, should be given in new research and implementation of renewable energy. Renewable energy helps to enlighten the rural area; creates rural employment; boost up rural economy and development. The government must work along with private organization to encourage and spread awareness among people for renewable energy.

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