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Present Energy Scenario, Necessity and Future Prospect of Renewable Energy in Bangladesh.

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ABSTRACT: *Bangladesh is a developing country with sufficient amount of energy in different form but it is a densely populated country. As a result energy is being consumed at a high rate which will finish the energy resources within a few decades. To mitigate the continuously increasing demand it is necessary to estimate the energy reserved in Bangladesh, usage rate and predict the probable time to be used that non-renewable energy. Bangladesh has different sources of renewable energy such as solar energy, wind energy, biomass, biogas, hydro-electric resources and tidal energy. So huge amount energy can be produced from these resources that will help to reserve the fossil fuel, non-renewable energy for the future and our country will be self-dependent for long time. This research paper will show the present energy scenario, necessity of renewable energy and also the future prospect of that energy.*

KEYWORDS*-Bangladesh, Solar energy, Biomass, Biogas, Hydro power, Hybrid projects.*

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I. INTRODUCTION

Bangladesh is a densely populated country. People needs huge amount of energy for living and production. Most convenient form of energy is electricity. But electricity is generated from conventional sources. Not only the technologies should be developed to produce energy in an environment friendly manner but also enough importance should be given to conserve the energy in most efficient form. Government has issued its Vision and Policy Statement in February 2000, to bring the entire country under electricity service by the year 2020 in phases [1].

In Bangladesh, power generation is mostly dependent on natural gas, around 60 % of electricity is being produced from our gas reserve [2] and this percentage of electricity generation uses 37% of total gas consumption [3], while demand for gas consumption is increasing by about 8% per year [2]. However, our net remaining recoverable reserve of gas was 1.64 TCF at the end of 2018 and would be available up to 2020 at the present consumption rate [2]. The generation of power from the conventional systems will be decreasing in near future because the reservoir of fossil fuel is decreasing day by day. To cope with the high demand with increasing population over the world scientists, engineers and peoples are heading towards the renewable energy sources.

The demand of Bangladesh can't be fulfilled with the limited amount of conventional energy. So it would try to use more amount of renewable energy. Now some questions need to be solved: (i) What are the sources of renewable energy in Bangladesh? (ii)How much is the amount of resources in Bangladesh? (iii) How can we use them effectively? (iv) What is the Government's attitude towards it?

This paper investigates the necessity of renewable energy, resources and availability of that energy for the perspective of Bangladesh to save the conventional energy for future generation.

II. PRESENT ENERGY SCENARIO

Energy refers to the total amount of electricity including captive power from different sources such as from natural gases, wind flow, biogas, biomass, solar system and hydro power. Bangladesh has been producing more power to fill up the demand estimated according to the master plan 2010.

Table **1** shows the progressive power generation scenario, decreasing transmission and distribution loss, accessibility of people to national grid in Bangladesh. It also gives development idea of Bangladesh because the energy defines the development of a country.

Table 1 Bangladesh Power Sector at a Glance [4]

	2009	2018	Addition in 9 Years
Generation Capacity (MW)	4,942*	17,753 MW*	12811
Highest Generation (MW)	3,268 (6 Jan 2009)	10,958 MW (28 May,2018)	7690
Power Plants (No)	27	111 (2017)	84
Expired Plants	0	3 (2017)	3
Total Consumers (Million)	10.8	29.0	18.2
Transmission Line (Ckt. Km)	8000	10,680	2,680
Distribution Line (Km)	260,000 km	446,000 Km	186,000
System Loss (%)	16.9	12.19(June 2017)	-4.71
Distribution Loss (%)	15.2	9.98 (June 2017)	-5.22
Per Capita Generation (KWh)	220	433	213
Access Electricity (%)	47	90	43
Out of Accessibility (%)	53	10	-43

*With Captive

Table **1** exhibits the overall energy scenario. A little portion of renewable energy is used in Bangladesh Fig. 1 shows the percentage share of different sources energy of total amount of energy generated. It also depicts that the renewable is only 2.95 % of total power generation capacity 17,753 MW (including Off-Grid RE) generated in Bangladesh.

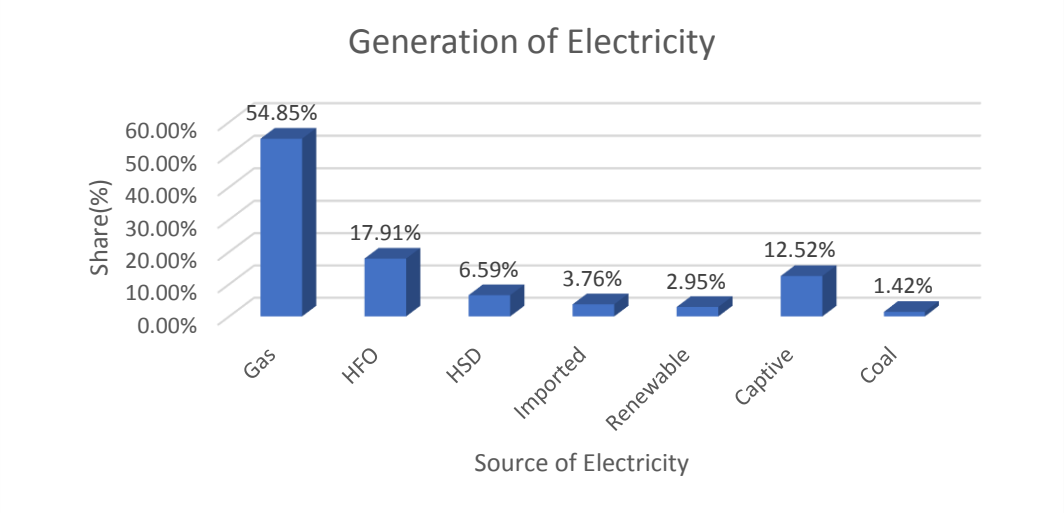

Fig. 1 Electricity generation in Bangladesh from different sources [5]

Table 2 displays the installed power generation capacity of renewable resources. It indicates the that Bangladesh is generating power from solar system, wind energy, hydro energy, biogas and biomass both Off-grid and On-grid.

Table 2 Renewable Energy to Electricity Installed (MW)[5]

Technology	Off-Grid	On-Grid	Total
Solar	267.27	17.35	284.62
Wind	2	0.90	2.90
Hydro	-	230	230
Biogas to Electricity	0.68	-	0.68
Biomass to Electricity	0.40	-	0.40
Total	270.35	248.25	518.60

III. ESTIMATED DEMAND OF ENERGY

In Fig. 2it is shown that power demand is gradually increasing, and this increasing demand is going to be fulfilled by unsustainable energy sources [6]. It is a matter of great concern that the recent power demand is being supplied by quick rental power plants which involve expensive liquid fuels and causes severe harmful effects on environment.

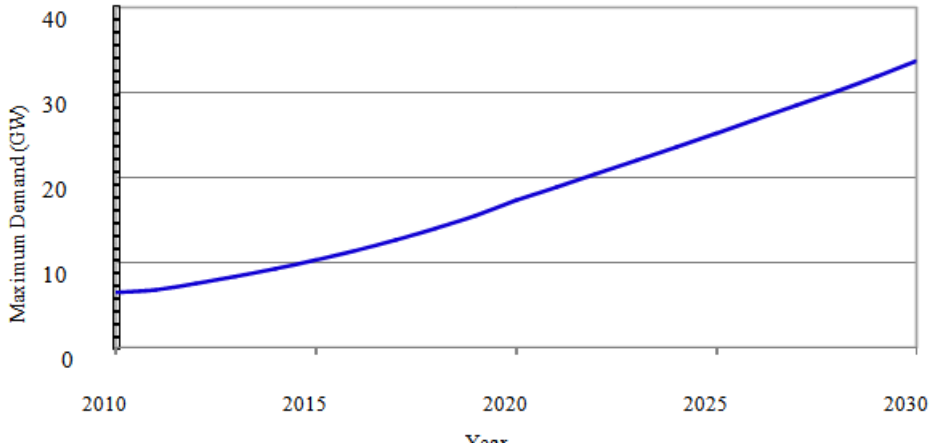

Fig. 2 Projected electricity demand of Bangladesh up to 2030 [7]

To accomplish the next power generation, Power Development Board of Bangladesh proposed a roadmap up to 2030"The Power System Master Plan (2010)" recommending that 30% of power generation would be coal-based. But, in 2012, coal-based power generation contributed only ~2% of total power generated [8], and that was 2.46% in 2011 [9]. Overall coal reserves are 2,527 million tones according toBNEP2004.
So, in such state, it is being expected that the country will face grievous energy dearth in upcoming years. For any country, sustainable energy growth is a compulsory need for the sustainable development. Only shifting to the renewable sources would be the best fit for any country for a sustainable energy expansion while a wonderful merge of different sources of energy in the intermediary period is a crucial requirement to maintain current economic development.

IV. NECESSITY OF RENEWABLE ENERGY

Renewable energy in Bangladesh refers to the use of renewable energy to generate electricity in Bangladesh. The current renewable energy comes from biogas, biomass, hydro power, solar and wind[10][11].Fig. 1 depicts the percentage share of different renewable energy sources where total amount of renewable energy is only 2.95% of installed capacity of Bangladesh.

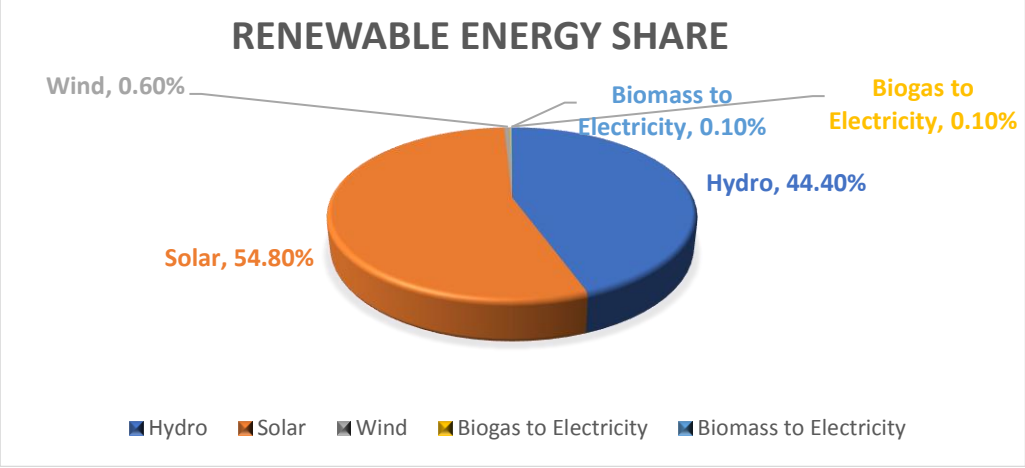

Fig. 3 Renewable energy share in Bangladesh [5]

Table 3indicates the present status and future prediction of gas reserve.

Table 3 Gas consumption and remaining recoverable reserve of natural [12]

Descriptions	2010	2012	2014	2016	2018	2020
Gas Reserve (TFC)	12.21	10.69	8.92	6.86	4.45	1.64
Growth Rate of Consumption	8%	8%	8%	8%	8%	8%
Yearly Consumption (TCF)	0.73	0.85	0.99	1.16	1.35	1.58
Total Reserve remaining (TFC)	11.48	9.84	7.93	5.70	3.10	0.06

If estimated gas reserve is wrong to prove present status and/or gas consumption is increased due to increasing new industry, household, power plant, etc., and new gas field is not uncovered then scarcity of supply may be felt early. Moreover, almost 20% of the fuels running power plants are of 20 years old among the installed capacity [13]; as a result, momentary shutdown and high repairing cost are involved[12].Fig. 3.1 shows the percentage of installed generation (17753 MW) in Bangladesh from various sources.

It can be seen from Fig.3.1 that gas dependent power generation is more than two-third of total electricity production, where only 2.5% of electricity is producing from renewable sources (hydro, solar, Biogas, Biomass and wind). A large portion of generation, 97.5% of total energy, is generating from nonrenewable sources which are polluting air, land, water and organic environment gradually. However, this scenario should be changed very soon otherwise our future generation would probably be in serious power crisis, experience severe harmful environmental effects, and may not stand before other countries. The forecasted power demand is figured out in Fig. 3.2 indicating projected power demand of Bangladesh up to 2030. So to mitigate the estimated energy and to save the conventional energy for the future generation, renewable energy should be used as more as possible to ensure sustainable economic development.

V. FUTURE PROSPECT OF RENEWABLE ENERGY

A. Solar Energy

Present Status of it:

Solar Energy is a great source for solving power crisis in Bangladesh. Bangladesh is situated between 20.30 and 26.38 degrees north latitude and 88.04 and 92.44 degrees east which is an ideal location for solar energy utilization [14]. At this position the amount of hours of sunlight each day throughout a year is shown in the following graph in the Figure-1 [15]. The highest and the lowest intensity of direct radiation in W/m² are also shown in the Figure-3.3 [15].

Fig. 4 The amount of hours of sunlight in Bangladesh[15]

Average solar radiation is shown in Fig. 5 which defines the solar radiation in Bangladesh is varies between 3-5.75 KWh/m^2/day.

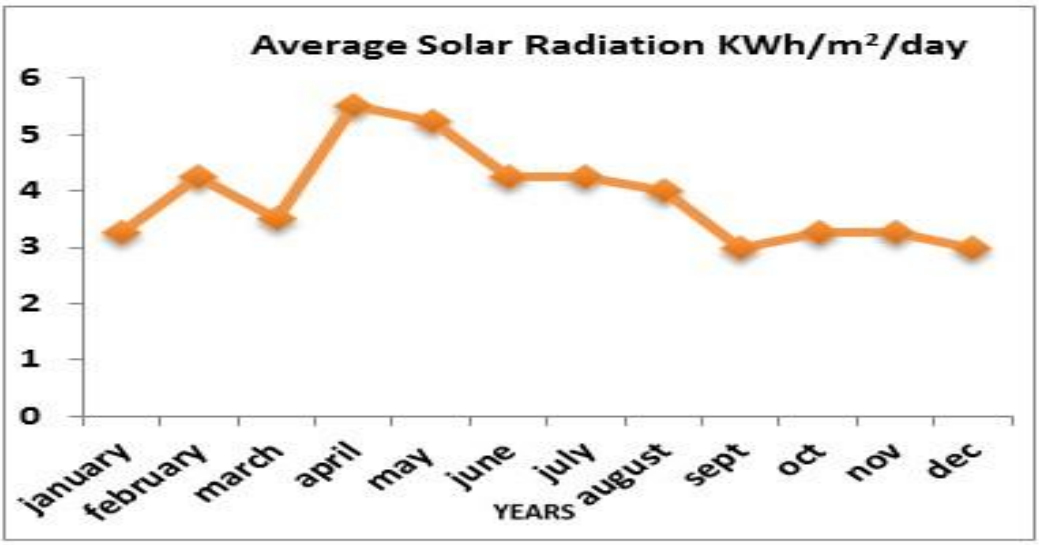

Fig. 5 Monthly average solar radiation profile in Bangladesh [16]

Infrastructure development company limited (IDCOL) has supported NGOs in installation of solar home systems (SHSs). Bangladesh power development board (BPDB) has implemented several Solar PV electrification projects in the remote and hill tracts regions. The Solar PV electrification has emerged as the most appropriate technological option for the electrification of these areas.

On-going Projects

Solar Home System (SHSs), 5187069units having 218.48 MW by IDCOL; Solar Irrigation, 999 units having 18.72 MW by IDCOL; Solar Drinking Water System,152 units having 1.55MW by GIZ; Solar Street Light, units 34194 having 2.32 MW by IDCOL; Solar Telecom Tower ,1933 units having 8.06 MW by Non-govt Organization/Company have been installed [17].

Under Implementation and Planning Projects:

Sustainable and Renewable Energy Development Authority, Power division under the ministry of power, energy and mineral resource government of the people republic of Bangladesh has been taken several mega projects on solar energy. As the part of this projects, 553.19 MW [17] capacity as on grid and off grid solar parks are under implementation and under planning projects having 1402.41MW [17] capacity is being under processed.

B. Biogas

In Bangladesh, the first biogas plant was set up by Dr. M A Karim, a professor of Bangladesh Agricultural University (BAU), Mymensingh, in the University campus in 1972. It was a floating dome type plant of 3m3 gas production capacity. Subsequently, seeing the success of the plant, 4-5 more plants were constructed in the surroundings. These plants did not last long due to leakage in the domes.

A biogas production technology program was undertaken in 1999 and led to the installation of 5,000 biogas digesters in Bangladesh that year. Some 71,396 biogas plants are currently run in Bangladeshi villages, which offsets around 8.52tones of carbon-dioxide annually [18].

The Bangladesh government is providing subsidies to set up 44,000 biogas plants through the Infrastructure Development Company Limited (IDCOL), which provides clean energy to around 200,000 people.

IDCOL has been implementing biogas program in Bangladesh since 2006 with support from KfW Development Bank, the World Bank and SNV Netherlands Development Organization. Till December 2017, IDCOL has financed construction of over 47,200 biogas plants all over the country through its 49 partner organizations [19]. Grameen Shakti [20], one of the leading NGOs in Bangladesh, has been setting up the biogas plants in the village, under its Eco Village Development Project.

IDCOL finances plants with daily gas production capacity ranging from 1.2 m3 to 25.0 m3 thereby meeting demand of both domestic households and mid-sized dairy and poultry farms. IDCOL currently finances two models of plants: brick-cement based plants and fiberglass bio-digester based plants.

The program saves 45,400 tons of firewood ever year worth USD 3.8 million and also reduces the use of 40,200 tons of chemical fertilizer worth USD 9.5 million by producing 280,500 tons of organic fertilizer. The

program also reduces 181,000ton CO_2 consumption per annum. IDCOL has a plan to install 100,000 biogas plants in Bangladesh.

C. Biomass

Biomass Gasification:

Biomass gasification is the process of converting solid fuels (wood/ wood-waste, agricultural residues etc.) into a combustible gas mixture. This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas or producer gas and is itself a fuel. The power derived from gasification of biomass and combustion of the resultant gas is considered to be a source of renewable energy. The calorific value of this gas varies between 4.0 and 6.0 MJ/Nm3 or about 10 to 15percent of the heating value of natural gas [21].

Resources of Biomass

Bangladesh is an agriculture-based country and the available biomass is mainly of agricultural residues like rice husk & rice straw from rice plants, Biogases from sugarcane, Jute stick, residues from Wheat, potato, oilseeds, spices etc. In addition to the agricultural wastes the other sources are dry materials such as dry wood, dried leaf, charcoal, coconut shells etc. The percentages of different traditional energy were as follows: cow-dung 20.4%, jute stick 7.5%, rice straw 11.6%, rice husk 23.3%, bagasse 3.2%, fire wood 10.4%, twigs and leaves 12.5% and other wastes 11.1% [22].

D. Wind Energy

Wind power is the use of air flow through wind turbines to mechanically power generators for electricity. Wind power, as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, consumes no water, and uses little land [18]. Bangladesh is situated between 20O34'-26038 North Latitude and 88001'-92041' East Longitude. The country has a 724 km long coast line and many small islands in the Bay of Bengal, where strong south-westerly trade wind and sea-breeze blow in the summer months and there is gentle north-easterly trade wind and land breeze in winter months. The government has taken several initiatives to introduce wind generated power to the national power grid since 2013, but none of them has made any tangible progress.

Implemented Projects

The potential of wind energy is limited to coastal areas, off-shore islands, rivers sides and other inland open areas with strong wind regime. In order to generate electricity from Wind Energy, BPDB installed 4x225 KW = 900 KW capacity grid connected Wind Plant at Muhuri Dam area of Sonagazi in Feni and 1000 KW Wind Battery Hybrid Power Plant at Kutubdia Island was completed in 2008 which consists of 50 Wind Turbines of 20 kW capacity each [23].

Ongoing Projects

Steps have been taken to install 15 MW Wind Power Plant across the coastal regions of Bangladesh after 1-year Wind Resources Assessment in Muhuri Dam Area of Feni, Mognamaghat of Cox's bazar, Parky Beach of Anwara in Chittagong, Kepupara of Borguna and Kuakata of Patuakhali. Wind Mapping is going on at Muhuri Dam area of Feni and at Mognamaghat of Cox's bazar by Regen Powertech Ltd. of India [24]. Installation of Wind Monitoring Stations at Inani Beach of Cox's

E. Hydro Power

Electricity produced from the potential energy of water is known as hydro power. Its running cost is very low.

Running Project:

Today, hydropower makes up the largest share of electricity generated from renewable sources as the global capacity reaches 1,000 GW. The only hydroelectric power plant was established at Kaptai with present installed capacity of 230 MW [25].

Future Plan:

Bangladesh Power Development Board (BPDB) identified two other sites at Sangu (140 MW) and Matamuhuri (75 MW) for large hydropower plants. Further exploitation of hydropower appears to be limited due to flat terrain of Bangladesh. Several studies have identified a few sites having potential ranging from 10 kW to 5 MW [25].

F. Hybrid Projects

Hybrid projects mean combination of two or more different types plants such Biogas, Wind and Diesel power plants together all.

Ongoing Projects

7.5 MW off Grid Wind-Solar Hybrid System with HFO/Diesel Based Engine Driven Generator in Hatiya Island, Noakhali [25].

Projects under Planning

BPDB has planned to install 1 MW off grid solar- diesel based hybrid power plant in kutubdia Island [25].

G. Micro/Mini Hydro Projects

Implemented Projects

Micro/ mini-hydro have limited potential in Bangladesh with exception of Chittagong Hill Tracts region. A 50 kW micro-hydro plant was installed at Barkal Upazila of Rangamati district in 2005 [25].

Ongoing Projects

50-70 kW Mohamaya Irrigation-cum-Hydro Power Project at Mirersorai, Chittagong. Rehabilation of 50 kW Micro-Hydro Power Plant at Barkal Upazila of Rangamati district [25].

Projects under Planning

Micro-hydro power projects on the potential streams/charas/rivers of CHT regions will be implemented after detail Feasibility Study.

VI. CONCLUSION

In this paper present energy scenario and the resources of the renewable energy have been represented based on data. Conventional energy is insufficient for the increasing demand. To mitigate this huge demand, renewable energy would be used in Bangladesh especially in rural and remote area to ensure the sustainable socio-economic development. Usage of renewable energy helps us to make our society green and long lasting for the whole bio-diversity. Most important thing is to create public awareness about the necessity of saving of energy.

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