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# Renewable Energy Resources: An Over View in Bangladesh

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**Abstract:** Bangladesh is a developing country in South-Asia. Most of the people live in the villages and that's why around 40% of total people live under poverty line. Both renewable and non-renewable energy resources are being used here. This study is conducted to review the potentials and possibilities of renewable energy sources in Bangladesh based on the previous study and reports. Natural gas is the main source of non-renewable energy and use for electricity production. Besides coal based power plant are also producing electricity. The annual energy demand is increasing here with the world energy demand incensement. The energy crisis is higher with the higher population growth rate. Only natural gas is not enough to meet the annual demand whereas using coal and oil has bad impact on climate change. To mitigate the problem and achieve the energy goal, green energy like renewable energy is a must for Bangladesh. There is a good and effective possibility to produce energy, power and electricity from renewable energy sources like Biomass, Hydro energy, Solar energy, Biogas and Wind energy in the country. Some government and non government organizations are working with renewable energy in Bangladesh. Along with people have to be more conscious and proper man power needs to be appointed for this purpose.

**Keywords:** Renewable Energy, Biomass Energy, Biogas, Solar Energy, Hydro Energy, Wind Energy

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## 1. Introduction

Bangladesh is a densely populated country among the world which occupies an area of 147570 sq kilometers. Almost 158.9 million people live in the country [1]. Recently Bangladesh has overcome its standards from low developing country to developing country where per capita economic income is 1751 US Dollar and the GDP is 7.86% in FY 2018 [2]. Bangladesh is enriched of natural gas, coal, peat, hard rock, heavy minerals in the coastal area. Natural gas is the main resource of production electric energy. Besides, coal is also used for electricity production. More recently a nuclear based power plant at Rup-pur, Pabna is under construction. From the plant, Bangladesh will get approximate 2000MW electricity to the national grid and the government hopes to get at least 10% of total electricity up to the year 2021 in from the power plant [3]. The energy demand of Bangladesh

is increasing with the population growth rate. About 10% of energy demands increase yearly. The total natural gas reserve in the country is almost 26 Tcf. If the power generation only depends on natural gas or bituminous coal, there will be shortage of electricity. Moreover using natural coal to produce electricity has a bad impact on environment. So the government and some organizations are taking several steps to produce energy and electricity using the renewable resources. Bangladesh has a green opportunity to produce energy utilizing its solar energy, hydro energy, biomass and biogas energy. Bangladesh government has set up a plan to generate 5% of the country's total electricity from renewable sources within 2015 and 10% within 2020. Within the year 2015, Bangladesh generated only 3.5% of the total electricity from renewable sources [4]. In mid-1990s renowned energy experts predicted that oil, gas and coal will remain the predominant fuel for power generation until 2030 which gives way to natural gas becoming the universal fuel in 2050.

The battle between fossil fuels and renewable for dominance over world energy market will begin in earnest by 2060 and the battle will clearly swing in favor of renewable by 2070[5]. The types of energy used and renewable energy consumption in Bangladesh is shown in figure 1 and figure 2.

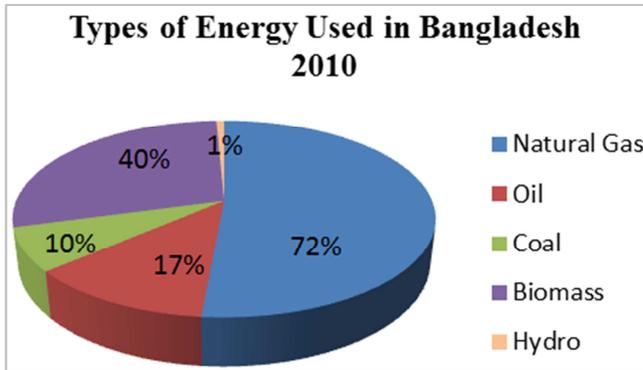


Figure 1. Share of Energy sources used in Bangladesh [33].

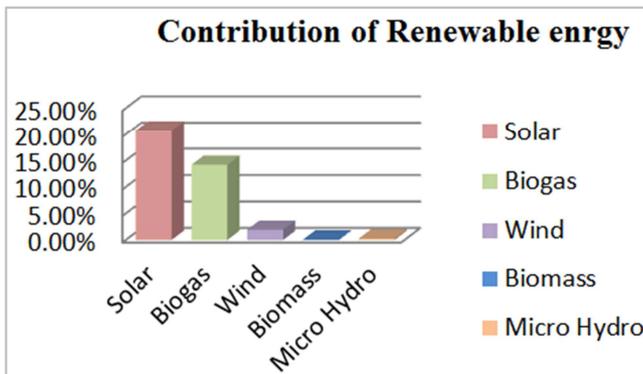


Figure 2. Contribution of Implemented Renewable energy sources in Bangladesh[11].

## 2. Renewable Energy Resources of Bangladesh

Energy is the property which enables a person or a machine to do any job. The law of conservation of energy states that energy can not be created nor be destroyed. It only transforms from one form to another form. Energy resources can be classified into two groups. They are-

- (1) Renewable energy
- (2) Non-renewable energy

Both energy sources are being used in Bangladesh.

### 2.1. Renewable Energy

Renewable energy means the energy which stocks is undefined and which can be renew from natural sources like sun shine, water wave, waste materials and some other sources. This energy used in Bangladesh can be classified into three major types [6].

- i Traditional Biomass Fuel
- ii Conventional Hydro-power
- iii New Renewable Resources (solar, wind, biogas)

### 2.2. Non-Renewable Energy

Non renewable energy refers the energy which reserves are limited and which source can not run life time. After some years, the reserve of non-renewable energy becomes empty. These energy used in Bangladesh include the followings:

- i Natural gas
- ii Coal
- iii Peat
- iv LPG
- v LNG

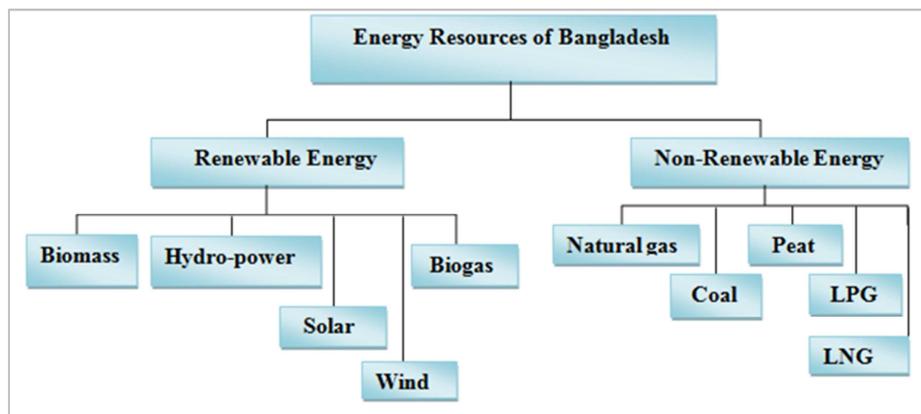


Figure 3. Energy Resources of Bangladesh.

### 2.3. Biomass Energy

Biomass is the first energy source which human being used earlier. It is a good source of renewable energy. It refers the energy which produces from the agricultural waste, plants, cattle dung, etc. This energy is derived from living organisms or recently living organisms. It can be used directly for cooking and warming or by converting it to

electric energy. Biomass is the fourth largest source of energy around the world which is being used for cooking and heating in rural area of developing countries [7]. Nothing has its own energy but the sun. The sunlight energy is preserved in biomass sources by chemical bonds between carbon, hydrogen and oxygen which breaks down by digestion, decomposition or combustion and release energy[8]. In poor country, up to 90% energy is supplied from biomass and

today at least 2 billion people are using biomass for their cooking. Almost 45 Exajule (EJ) of world energy which covers around 10-15% of total energy is provided by biomass energy [9].

Bangladesh is an agricultural based developing country. Agriculture remains the most important sector of Bangladeshi economy, contributing more than 15% percent to the national GDP and providing employment for 43% percent of the population [10]. So there is a good possibility of biomass energy in here. Around 40% energy is supplied by biomass energy in Bangladesh. The rural people of the country are the consumer of biomass energy. They use this

energy for their cooking and heating purposes as other energy sources like natural gas is unavailable to them. Biomass can be converted to modern energy carriers that are clean, convenient to use, and have little or no associated greenhouse gas (GHG) emissions. Bangladesh is a major country which produces a great deal of rice which is 35,000,000 MT of Paddy per Year on an average [11]. If gasification technique is applied and if 20% can be made useful, by using a generator which efficiency is approximately 50%, total biomass energy can be calculated from the following formula [11]:

$$\text{Biomass energy} = \frac{50\% \text{ of } 7,000,000 \frac{\text{MT}}{\text{year}} \times \text{rise husk} \times 1000 \frac{\text{kgs}}{\text{MT}} \times 1,000}{2 \text{kgs} \frac{\text{husk}}{\text{kwh}} \times 16 \text{hours operation a day} \times \frac{300 \text{days}}{\text{year}}} \text{ watts} \quad (1)$$

This is approximately 364 MW of power generation. Where it is assumed that, 2 Kgs of husk is needed in an hour to produce 1 KW of power. [1 MT = 1,000kgs].

Rise husk can be used for electricity production by gasification system.

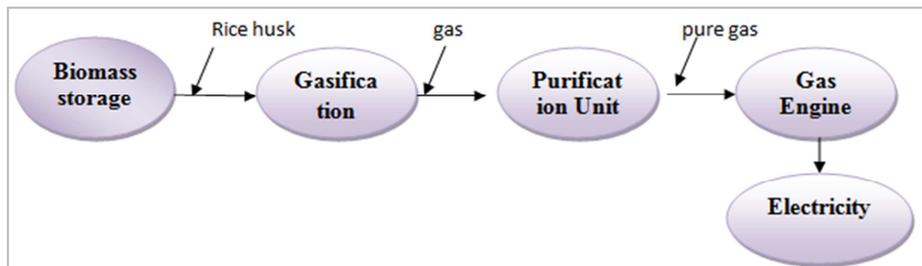


Figure 4. Electricity generation by rice husk gasification [12].

The Biomass potential of Bangladesh is shown in figure 5.

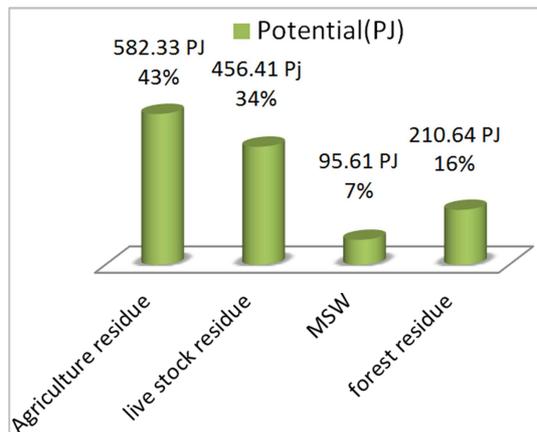


Figure 5. Biomass Potential of Bangladesh (2012 – 2013) [6].

#### 2.4. Hydro Power

Hydro power is a good source of renewable energy. It means the energy which can be got from water wave. Many developed and developing country use hydro power as a good energy source. Some countries like Bhutan, Norway and Paraguay produce all their commercial electricity from hydro power. It has little or no environmental hazard. Comparatively a river based country has greater opportunity

to produce energy like electricity than a country of desert. Generally water wave is used to produce electricity. The more velocity a water source has, the more electricity can be produced using turbine and generator.

Bangladesh is a great delta land which situated beside the Bay of Bengal. This country is river based where about 405 rivers are running through the country and among them 57 are trans-boundary rivers [13]. 54 rivers of 57 are common with India and 3 rivers are common with Myanmar. Hydropower plants can be classified into two categories [14].

- a Large hydropower plants (>10 MW )
- b Micro hydropower plants (<10 MW )

In Bangladesh, most of the river become mighty flows high capacity of water during rainy monsoons. The only running hydropower plants in Bangladesh is Kaptai, Karnaphuli in Rangamati district which capacity to generate electricity is 230 MW with combination of 5 units [15]. This plants is a large hydropower plants operated by Bangladesh Power Development Board (BPDB) which established in 1960s [7, 16]. Besides two large hydropower plants are under consideration. They are -

- i Sangu Power Plant: It will be in Sangu river and its capacity will be 140 MW with annual energy is about 300 GWh per year [17].
- ii Matamuhuri Power Plant: This project will be in Matamuhuri river and its capacity will be 75 MW with

average annual energy 200 GWh per year.

As there are many rivers and canals passing through the country, Bangladesh has opportunity to establish micro

power plants for electricity production. Several site are chosen for construction micro power plant which are listed in table 1.

Table 1. Micro-hydro Power Sites Identified by SRE Study in 2004 [18].

Site	Expected Power Generatin (KW)	Socio-economic Infrastructure within 1 Km		
		House hold	School/Mosque/Bazar/Clinic	Small industry
Nunchari Tholipara, Khagrachari	3	100	3	1
Chang-oo-Para, Bandarban	30	200	5	2
Bangchhari, Bandarban	25	600	12	5
Liragaon, Bandarban	20	500	8	3
Kamalchar, Rangamati	20	100	8	9
ThangKhre, Rangamati	30	300	6	3
Monjaipara, Bandarban	7.5	50	3	-

The power generation can be calculated by the following formula [11].

$$P = H \times Q \times g \text{ (in KW)} \tag{2}$$

Where P = net power generated in KW

H = Gross Water head in meter

Q = water flow rate in  $m^3/sec$

g = gravitational force,  $9.8 ms^{-2}$

Moreover, Bangladesh can use tidal force to produce electricity as tidal rise and fall remain between 2m to 5m in Khulna, Barisal, Bagerhat, Satkhira and Cox's Bazar regions[19].

2.5. Solar Energy

Sunlight is the source of solar energy. Bangladesh has a great possibility of enlarging her power grid by utilizing solar energy. Geologically Bangladesh occupies a good position which latitude is  $20^{\circ}34'$  to  $26^{\circ}39'$  north and longitude is  $80^{\circ}00'$  to  $90^{\circ}41'$  east[20]. So Bangladesh is a subtropical country and hence almost 70% sunlight of a year is plentiful which makes the use of solar panel effective[21]. Daily solar radiation in Bangladesh is 4-6.5 kWh/m<sup>2</sup> and the maximum radiation is generally received in the months of March-April and minimum in December-January[20]. The highest and the lowest intensity of direct radiation in W/m<sup>2</sup> are also shown in the Figure 4.

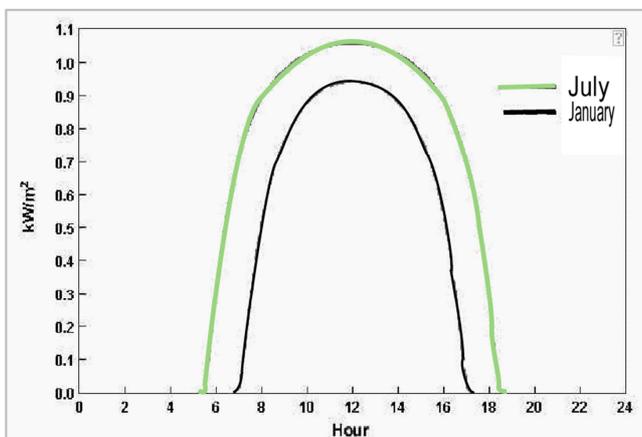


Figure 6. Highest and lowest intensity of direct radiation Wh/m<sup>2</sup>, Bangladesh [22].

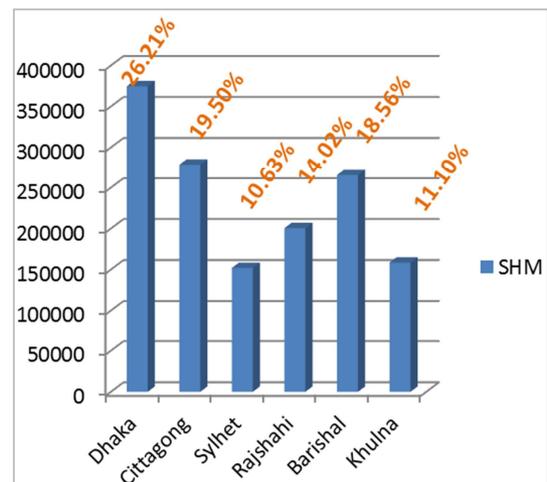


Figure 7. Distribution of Solar Home System(SHM) in six divisions of Bangladesh to January[23].

As Bangladesh is a rural based country solar energy will meet the demand of primary energy by implementation of solar grid. Till now there are several isolated area where electricity can not be provided due to their location. To minimize this problem, Bangladesh government and some private organizations are helping by providing and implementing solar grids.

The distribution of solar home system(SHS) is shown in the figure 5 and from figure, it is clear that solar home installation is highest in Dhaka division and lowest in Sylhet division.

Bangladesh has a good amount of solar energy which is almost 4 to 7 kWh/m<sup>2</sup>/day which is enough to meet the demand[6]. Bangladesh Rural Electrification Board(BREB) and non government organization are involved to supply and install solar panel to meet a good demand of electricity.

Bangladesh government has taken a step to install 5MW to 10MW capacity solar panel. As solar energy is green energy and it has clean, safe and reliable power, it is easy to install solar panel. This energy is two types which are (i) passive solar energy and (ii) active solar energy [8]. The function of solar energy is very easy and that is shown in figure 6.

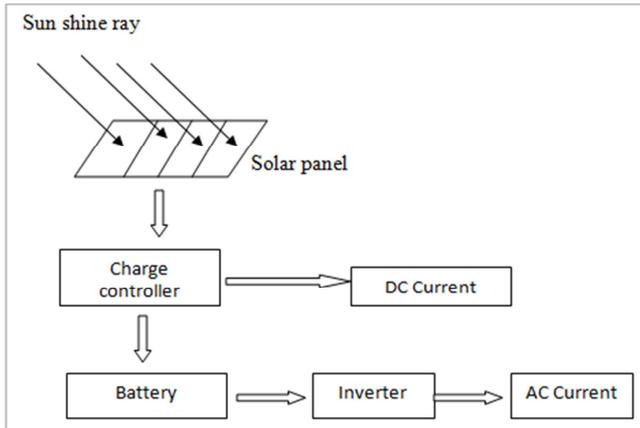


Figure 8. Solar Energy Mechanisms.

### 2.6. Biogas Energy

Biogas is an important source of renewable energy. It is the mixture gases derived from organic materials. Organic materials are decomposed by bacterial activities in the absence of oxygen. Bangladesh has a great chance to produce biogas as it is a rural based country. Most of the people live in villages where organic materials such as cow dung, poultry waste, household organic waste and food waste. The ideal temperature for biogas production is almost 35°C which can vary in Bangladesh from 6°C to 40°C [15]. Biogas is mainly used for cooking in the rural areas of the country which at present used for electricity production as its main element is methane. The composition of biogas is listed in table 2 and the potentials of biogas in Bangladesh is listed in table 3.

Table 2. Biogas composition [24].

Element	Composition (%)
Methane (CH <sub>4</sub> )	50-75
Carbon dioxide (CO <sub>2</sub> )	25-50
Nitrogen (N <sub>2</sub> )	0-10
Hydrogen (H <sub>2</sub> )	0-1
Hydrogen Sulfide (H <sub>2</sub> S)	0-3
Oxygen (O <sub>2</sub> )	0-2

Table 3. Biogas potentials in Bangladesh from Cattle [25].

Catte	Number(million)	Cattle dung(million tons)	Produ-tion of biogas (m <sup>3</sup> )	Equiv-alent Coal / Equiv-alentKeros-ne (tons)
Cow	22	0.22	2.97 × 10 <sup>9</sup>	Coal= 3.04 × 10 <sup>6</sup>
Buffa-loe				Kerosene=1.52×10 <sup>6</sup>

A biogas plant is shown in figure 6.

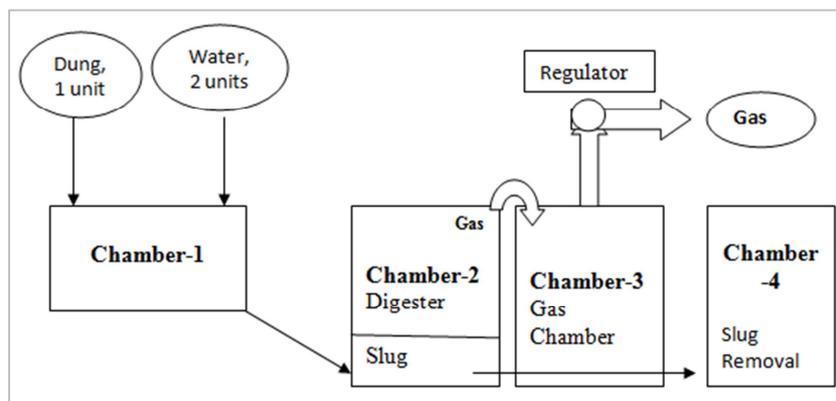


Figure 9. A Biogas plant.

Some government and non-government organizations established some biogas plants over some years in Bangladesh and they are listed in the table 4.

Table 4. Biogas plants by several Organizations [26-28].

Organizations	Up to Year	Number of Biogas plant installed
Grameen Shakti	-	13,500
IDCOL (alone)	2012	37,669
BRAC	-	3,664
IDCOL+ its partner	2011	18,713
NDBMP	2006-2012	24,832

## 2.7. Wind Energy

Wind energy is a renewable energy which is created from the rotational force of a fan blade through the wind. It is a conversion from wind velocity to mechanical and electrical energy. Geologically Bangladesh occupies hilly zone in north-western and south-western part. The Bay of Bengal is situated in southern part of the country.

So Bangladesh has a great possibility to produce wind energy to mitigate the energy crisis.

There are several islands and a 724 km coastal line where the monsoon wind visits from Indian Ocean [7]. The annual average wind speed is more than 5m/s at a height 30m[29].

Wind speed is found big in the month June-July while it low in the month October-February. Wind speed is found more than 4.5m/s in the north-eastern zone and around 3.5m/s in rest of the country [29, 30].

In the coastal area of Bangladesh, windmills with a capacity of 2 MW are in operation and a project to install windmills along the seashore which capacity will be 20 MW has been planned by the government.

If the project will success, another 200 MW of power could be harnessed from wind power [6]. The feasibility of wind condition in some area of Bangladesh is shown in table 5.

*Table 5. Feasibility of Wind Conditions at Different Places [31].*

Site	Reference height (m)	Annual average wind speed(m/s)
Teknaf	5	2.16
Cox's Bazar	10	2.42
Patenga	5	2.45
Kutubdia Island	6	2.09
Sandip Island	5	2.16
Hatia Island	6	2.08
Bhola Island	7	2.44
Khepupara	10	2.36
Comilia Airport	6	2.21

Several organizations installed wind turbine to produce electricity in several times, table 6.

*Table 6. Wind turbine (all are in Functioning) installations in Bangladesh by different organizations [32].*

Organization Name	Installed capacity (watt)	Location
Grameen Shakti	4500	Grameen Offices in the coastal region
	7500	Cyclone shelter in the coastal region
BRACK	5220	coastal region
Bangladesh Army	400	Chittagong Hill Tracts
IFDR	1100	Teknaf
	600	Meghnaghat
LGED	400	Kuakata
Total	19720	

The wide expansion of the potential of wind energy and its proper utilization will be vital in order for Bangladesh as it wants to achieve its national vision of providing electricity to all of its population by 2020.

## 3. Conclusion

This paper conducts the study of renewable energy sectors in Bangladesh. The study provides the information of green energy possibility and its proper utilization in the country. In spite of being a small and populated country, Bangladesh has a great opportunity to achieve its power generation goal by implementation of renewable energy sources. The agro-based organic wastes are a good source of producing biomass and biogas which can further be used for electricity generation. A huge possibility to convert wind energy to electricity in coastal and hilly region can add a good amount of electricity to the national grid. There are several plans for establishing hydropower based electric plant which is a positive sign for Bangladesh. To meet the national energy and power demand, some government and non-government organizations are still working to utilize the renewable energy sources and to lessen

the dependency on fossil fuel like oil, gas or coal.

## 4. Recommendations

- I Bangladesh government should be more careful about renewable energy.
- II A proper waste management and recycling should be operated and controlled by government and non government organizations.
- III Proper wind energy and solar energy utilization should be established in the higher buildings and offices to meet their energy demand.
- IV Proper training should be provided to the rural people to construct biogas plants.

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