

# Power Crisis & Its Solution through Renewable Energy in Bangladesh

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*Abstract— Power is one of the most important factors for a developing country like Bangladesh. Like the rest of the countries of the world, the demand for power is increasing day by day in our country. At present, power failure has become an acute problem for this country. It has become hard to solve the power crisis. There are several reasons behind this problem such as limitation of resources, low generation capacity, high demand, derated capacity of power station machineries etc. To become a developed country, Bangladesh needs to overcome the problem of power crisis soon. Renewable energy can be a great source to solve the power crisis problem at a great extent. Here we have discussed about different forms of renewable energy that we can use to meet the increasing power demand of Bangladesh. We have mainly discussed those renewable energy sources which can be used in solving the power crisis of Bangladesh such as Solar energy, Bioenergy, Geothermal, Wind energy, Micro Hydro, Ocean wave energy and Tidal energy.*

**Index Terms—Renewable Energy, Bangladesh, Power, Solution, Electricity**

## I. INTRODUCTION

Electricity is a very important factor in developing the economy and the standard of living of a country. It must be generated using the national resource of that country. Bangladesh largely depends on natural gas and hydro power stations to generate major portion of power. The country lags behind than its expected production capacity. Though many power generation units have been added to the national grid to solve the power crisis issue, it is not enough. High demand and increasing need of power have created challenge for the power stations to meet the demand. In our country, a major portion of total population still does not have the access to electricity. Only 10% of the rural households have electricity connection and there are some parts of Bangladesh which will not get the access of electricity connection from the national grid within next 30 years [1]. To solve this energy crisis we can use different form of renewable energy to generate power. Renewable energy is the energy that comes from different types of natural resources mainly from sunlight, wind, rain, tides, and geo thermal heat, biodiesel, biofuel etc. In this paper we have discussed the prospects of these renewable energy

sources to eradicate the power crisis of Bangladesh, we have also discussed their present scenario and future potential.

## II. PRESENT SCENARIO

At present, 53% of the total electricity generation of Bangladesh is from the power plants under public sector and 47% of the net generation of the country is from private sector [2]. Even though many extra units both from public and private sector have been added to the national grid, the power crisis is still a big issue in the country. So due to high demand, maximum generation of 2087 MW in 1995-1996, 2114 MW in 1996-1997, 3218 MW in 2001-2002, 3458 MW in 2002-2003, 3622 MW in 2003-2004, 3751 MW in 2004-05, 3812 in 2005-06, 3718 in 2006-07, 4130 MW in 2007-08, 4037 MW in 2008-09 could not remove power crisis in the country [4]. In public sector, most of our power stations of the country have become very old and they are operating lower than their rated capacity with derated machineries. The demand of electricity cannot not be met due to this insufficient production of electricity around the country and as most of our power stations depend primarily on natural gas as fuel, because of the shortage of gas supply some power plants are unable to produce power of their rated generation capacity. Beside natural gas based power plants, other power plants are Hydro Electric Plant at Kaptai, the coal based plant at Barapukuria and several other power plants around the country. But the insufficient gas supply has decreased the power generation capacity in the whole country. In most cases, we have failed to use our national resources to get maximum power output. Industrial production and house hold life are regularly hampered due to regular load shedding problem which is hampering our economy as well as making us lag behind. As a result of the power crisis, degradation of the fossil fuel resource, deforestation, environmental pollution is going on which is causing natural disasters. If this situation continues, industries will face loss due to power crisis, production will become low and eventually economy of the country will fall behind which will cause the major industries to shut down resulting into poverty and unemployment. We can get rid of this situation through renewable energy. Renewable energy can help us improve the condition of power crisis and help us move forward economically and environmentally. Moreover, the environmental drawbacks of renewable energy sources are minimum.

### III. SOLUTION THROUGH RENEWABLE ENERGY

In the perspective of Bangladesh we can solve the power crisis by biodiesel, biogas, solar energy, micro hydro, wind energy, ocean wave energy, tidal power, geothermal which we have discussed thoroughly below.

### IV. BIODIESEL

In recent years fossil fuel depletion and global warming issues are the point of concern around the world. To reduce Carbon emissions and decreasing reserves of fossil fuels, Biofuel can be an attractive source of energy. In comparison to fossil fuels, biofuel can reduce the emission of CO<sub>2</sub>. Next generation bio-fuels can be a great solution to the global warming and the crying need of fossil fuels. Biofuel or Biodiesel is clean burning oil produced by Transesterification of oils with short chain alcohols. Now-a-days, researchers are turning their attention into the production of biodiesel from algae because of their higher productivity, abundance in the nature, high Triacylglycerides and they can be a major source for biodiesel production. Production of biodiesel from algae is less time consuming and cheaper than the petroleum diesel. So rather using petroleum diesel in the diesel generators in the power plants, we can use biodiesel which will both save our money and reduce our dependence on the diminishing fossil fuel reserves. This biodiesel can be used in the diesel generator to produce electricity. This will be cost efficient and as well as environment friendly. Algae grow in abundant in Bangladesh. So we can produce biodiesel from algae which we can use in the power plants to generate electricity. Biodiesel can be a great source of power generation for Bangladesh. Microalgae can take waste from CO<sub>2</sub> and convert it into natural oil. Table 1 [5] below shows a comparison of oil yield of various oil seed crops.

TABLE-1

PRODUCTION AVERAGES FOR COMMON OIL CROPS

Production Averages for Common Oil Crops		
Plant	lb. oil/acre	Gallons of Biodiesel/acre
Algae	6757	700
Coconut	2070	285
Jatropha	1460	201
Rapeseed	915	126
Peanut	715	112
Sunflower	720	99
Soybean	415	62

From Table-1 it is clear that Algae are preferable to produce biodiesel.

The climate of Bangladesh is perfect for the production of algae. It has plenty of ponds and canals which are perfect for the algae growth. With these huge amounts of algae we can easily produce biodiesel which are relatively cheaper than the

petroleum diesel. The conventional petroleum diesel we are using in the diesel generators is costly. We can reduce the cost by using biofuel in Bangladesh in these diesel generators to produce more electricity with lesser cost. So with favorable algae growth, cheaper production cost than the conventional diesel and more eco-friendly nature biodiesel can be a great source of renewable energy in Bangladesh.

### V. BIOGAS

Natural resources in the form of fossil fuels are the raw materials from which electrical energy is generated and the day to day life of the people of today's world is solely dependent on the electrical energy in this present world [11]. Scientists around the world have already indicated that our natural reserve of gas is decreasing day by day and the time is not too far when we will have no natural gas resource. Although previously it was believed that Bangladesh has plenty amount of gas, but recent study has shown that natural gas reserve of Bangladesh is not sufficient to meet the daily cooking purpose of the people for next few decades, let alone generation of electricity. However, waste materials produced from natural day to day life usage and also from animal wastes, can be good sources of energy in this purpose and can help to meet the electricity demand by generating electricity through biogas. Many countries around the world are now paying their attention to biogas because of its environment friendly technology and as a supplement for the gradually decreasing fossil fuel reserves [7]. Many countries now-a-days are producing electricity from biogas. Some of them are using biogas technology in mass production of electricity rather than using it in a distributed ways around the country.

In Bangladesh biogas is still a relatively new technology. In most of the places it is used to generate electricity to meet the household demands. But an agro-based country like Bangladesh produces huge amount of waste materials. Converting these waste materials into energy is economically advantageous as well as helpful to solve the issue of power crisis. In Bangladesh, recycling industry wastes raises a total of 436 t/d [8] of material recovery. Moreover, 3,054 t/d of wastes is expected to be collected in 2015 and cumulative disposal volume is estimated at about 9 million tones by the end of 2015 [9]. This huge amount of waste, most of which are compostable and have very good fermentation property can be easily used to produce electricity as well as the generated gas can be used for the cooking purpose. Waste to energy technology can be a huge asset for a developing country like Bangladesh. Although some small farms and houses in the rural areas are using wastes produced from their livestock to produce electricity for daily purposes, it should be used commercially to produce electricity in the areas where there is still no electricity from the national grid. It will help the people of these areas to meet their demand of electricity and the government and the companies related to this technology can earn money which is also beneficial.

## VI. SOLAR ENERGY

Solar Energy can be 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 [19]. At this position the amount of hours of sunlight each day throughout a year is shown in the following graph in the Figure-1 [6]. The highest and the lowest intensity of direct radiation in  $W/m^2$  are also shown in the Figure-2 [6].

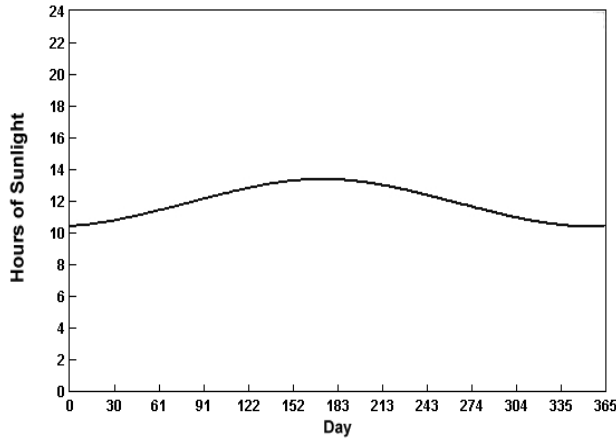


Fig.1. The amount of hours of sunlight in Bangladesh

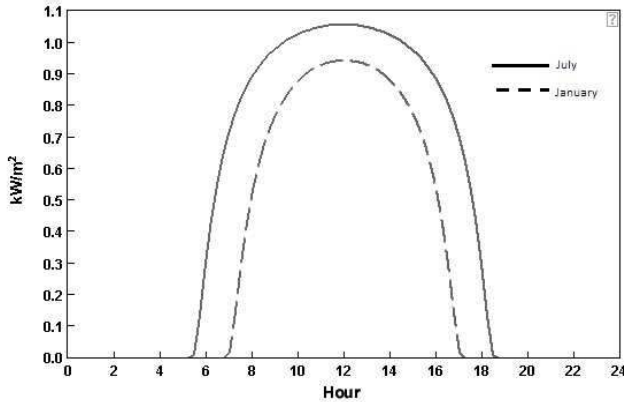


Figure 2: The highest and the lowest intensity of direct radiation in  $W/m^2$

In a recent study conducted by Renewable Energy Research Centre, it is found that average solar radiation varies between 4 to 6.5  $kWhm^{-2}day^{-1}$  and maximum amounts of radiation are available in the month of March-April and minimum in December-January [19]. So from the above figure and discussion we can say that there is a good prospect of harnessing solar power in Bangladesh.

Moreover, in the rural areas where there is no electricity connection, photovoltaic technology can be a blessing. Although, the installment cost of solar systems in the house is very much costly, but once installed it can give service up to 20-25 years with proper maintenance. Moreover, in the northern territories of Bangladesh where the solar intensity is very high, solar thermal power plant can be installed. For both photovoltaic technology and solar thermal technology,

Bangladesh is at a perfect location. In fact, Bangladesh government has recently taken many steps to encourage people to use photovoltaic energy. Almost every newly built apartment buildings are now using solar panels along with the grid connection to get support during the load shedding period. Even in the rural areas, some NGO's have been working to provide solar panels to the villagers in a cheap price.

### A. Solar Cooker

Though Bangladesh is among the countries of the world which has substantial volume of natural gas resource, the reserve is degrading day by day as mentioned in the previous section because of our continuous dependence on natural gas for cooking purpose, electricity generation and industrial work. So if we can minimize the use of natural gas as a fuel in our house hold replacing it with solar cooker we can increase the production of electricity. Solar cooker is a device that uses the energy of sunlight to cook food. Solar cooker is mainly advantageous because they do not use fuel and cost nothing to operate. There are many more advantages of solar cooker. For example, as it does not require any fuel, it reduces fuel costs for low-income people, it does not create air pollution, minimize deforestation and desertification which are caused by the use of firewood for cooking. An ideal solar cooker is cheap and simple to construct. It can be made using the normal day to day materials. As solar cooker can compensate the use of natural gas to some extent, these amount of natural gas can be used in the steam based power plants of Bangladesh to produce electricity. Finally, we can say that adoption of solar cooker for the cooking purpose will reduce the power crisis of our country as the pressure on natural gas will be reduced which we can be used for power generation.

## VII. MICRO HYDRO

Because of the geographic position, Bangladesh is a riverine country which is a huge advantage for the country. This huge amount of river currents and sources of low head of water falls can be used for generating microhydro-power. Micro hydro means generating up to 5-300 KW of electricity through hydroelectric power [10]. It is a simple technology that converts hydropower to mechanical power. Micro-Hydro technology is very much suitable for a developing country like Bangladesh because it is an special source of energy which can generate energy without of fuel and the technology is very cheap. Because of the presence of many canals and tributaries of main river Karnafuli, Shangu, Matamuhuri which have very good potentials for setting up micro hydropower unit in Chittagong Hill Tracts region [10], recently Sustainable Rural Energy (SRE) under LGED has successfully demonstrated first micro-hydro power unit at Bamerchara, Chittagong. Although the installed capacity of the unit was 10 kW but due to insufficient water head only 4kW power was generated [10].

### A. Potential of Micro hydro power in Bangladesh

In 1981, Bangladesh Water Development Board and Bangladesh Power Development Board explored potential sites which are suitable for micro-hydro power generation which are listed in Table 2 [10].

Sustainable Rural Energy (SRE) has explored some potential micro-hydro sites in Chittagong region in 2004 which is listed in Table 3 [10].

From the Tables 2 and 3 and the related discussions, it is clear that there is massive possibility of extracting electricity from the micro hydro energy.

TABLE 2  
POTENTIAL SMALL HYDRO SITES IDENTIFIED BY BPDB AND BWDB.

Serial No	District	Name River/Chara/Stream	Potential of Electrical Energy KW
1	Chittagong	Foy's lake	4
2	Chittagong	ChotoKumira	15
3	Chittagong	HinguliChara	12
4	Chittagong Hill Track	Sealock	81
5	Chittagong	Lungichara	10
6	Chittagong	Budiachara	10
7	Sylhet	NikhariChara	26
8	Sylhet	Madhab Chara1500ft. from fall	78
9	Sylhet	Rangapani Gung	616
10	Jamalpur	Bhugai-Kongsa at 2 miles U/S. of Nalitabari P.S	69 KW for 10 months 48 KW for 2 months
11	Jamalpur	Marisi at Dukabad near Jhinaigati Thana Head Quarter	35 KW for 10 months 20 KW for 2 months
12	Dinajpur	Dahuk at Burabari	24
13	Dinajpur	Chawai at U/S. of Chawai L.L.P	32
14	Dinajpur	Talam at U/S. of Talam L.L.P	24
15	Dinajpur	Pathraj at Fulbari	32
16	Dinajpur	Tangon at D/S of Nargun L.L.P	48
17	Dinajpur	Punarbhaba at Singraban	11
18	Rangpur	BuriKhoraChikli at Nizbari	32
19	Rangpur	Fulkumar at Raiganj Bazar	48

TABLE 3  
MICRO-HYDROPOWER SITES IDENTIFIED BY SRE STUDY IN 2004

Site	Expected Power Generation (KW)	Socio-economic Infrastructure within 1 Km		
		House hold	School / Mosque / Bazaar / Clinic	Small Industry
Nunchari Tholipara, Khagrachari	3	100	3	1
Chang-oo-Para, Bandarban	30	200	5	2
Bangchari, Bandarban	25	600	12	5
Liragaon, Bandarban	20	500	8	3
Kamalchar, Rangamati	20	150	8	9
ThangKhrue, Rangamati	30	300	6	3
Monjaipara, Bandarban	7.5	50	3	-

### VIII. WIND ENERGY

There are many hilly and coastal areas in Bangladesh which have huge potential for wind energy generation. Wind energy is a technique which converts the air flow into mechanical energy which is eventually converted into electricity without generating pollutants. Bangladesh 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 [13]. Along the coastal area of Bangladesh, the annual average wind speed at 30m height is more than 5 m/s [3]. Wind speed in northeastern parts in Bangladesh is above 4.5 m/s while for the other parts of the country wind speed is around 3.5 m/s [3, 14]. Coastal locations of Bangladesh such as Chittagong, Kutubdia and Cox's Bazar have immense potential to produce electricity from wind energy. By using one year data of Bangladesh Centre for Advanced Studies, it has been found that at 50 meter height in these areas the wind speed varies from 4.1 to 5.8 meter/second with a power density of 100-250 w/m<sup>2</sup> [16]. An analysis of wind energy measurement done by RISOE shows locations with power density above 200 w/m<sup>2</sup> over 2000 km<sup>2</sup> which is very good to set up wind turbines and expand wind energy in Bangladesh [16]. To check whether wind energy can be a potential renewable source of electricity, small-scale wind turbines can be installed in areas in Bangladesh such as St. Martins Island, Patenga, Bhola, Barguna, Dinajpur, Thakurgaon and Panchagar [3]. So from the above discussion we see that there is a huge possibility of extracting electrical or mechanical energy from the wind in Bangladesh.

## IX. OCEAN WAVE ENERGY

Ocean wave energy is generated directly from the waves of the oceans. It is another special type of renewable energy which helps to decrease the harmful emissions of greenhouse gases associated with the generation of power. It can be potentially a significant source of electricity for Bangladesh. Though the main purpose of ocean wave energy is electricity generation, it can also be used for the pumping of water, water desalination etc. According to Reference [17], *“The Oscillating Water Column method is technically feasible and becoming economically attractive in this purpose. This type of wave energy harnessing device is being commissioned by several countries such as the United Kingdom (500 kW), Ireland (3.5 MW), Norway (100 kW), India (150 kW), etc.. Bangladesh has potential for harnessing ocean wave energy from the BAY OF BENGAL.*

## X. TIDAL POWER

Tidal power or tidal energy is a form of hydropower that converts the energy of tides into electrical power. As tides are more predictable than wind and sunlight, tidal energy can easily be generated from the changing sea levels. The coastal area of Bangladesh has a tidal rise and fall of between 2 to 5 meters [18]. Among these coastal areas, with 5 meter tides experienced, Sandwip has the best prospect to generate tidal energy [18]. Moreover, according to Reference [18], Bangladesh can generate tidal power from these coastal tidal resources by applying Low head tidal movements and Medium head tidal movements, low head tidal movements which uses tides of height within 2m to 5m can be used in areas like Khulna, Barisal, Bagerhat, Satkhira and Cox's Bazar regions and the height tidal movements which use more than 5m of tides can be mainly used in Sandwip. So we can say that with suitable tidal height available, this can be a great source of energy for Bangladesh.

## XI. GEOTHERMAL ENERGY

The thermal energy which is generated and stored inside the earth surface is called Geothermal energy. It is very much cost effective and environmentally friendly. With this technology, we can use the steam and hot water produced inside the earth surface to generate electricity. Geothermal energy is generated about 4,000 miles below the surface, in the earth's core [12]. The process takes place due to the slow decay of radioactive particles, the high temperature produced inside the earth and it happens in all rocks [12]. About 10,715 megawatts (MW) of geothermal energy is generated in 24 countries worldwide [12]. The northern districts of Bangladesh show the prospect to explore the geothermal resources. The demand of electricity in urban as well as in the rural areas are increasing, but our production of electricity is not increasing. The rural demand for electricity can be covered by the production of electricity through geothermal energy. The electricity demand of urban areas can be met then by these saved electricity which is

supposed to be provided in the rural areas. Geothermal energy can balance the electricity consumption in these two areas. According to Reference [15], a Dhaka based private company namely Anglo MGH Energy has initiated a project to setup the country's first geothermal power plant with a capacity to produce 200 MW of electricity close to Saland in Thakurgaon district. They have planned to set up 28 deep tube wells to lift hot steam and the lifted steam will be used to run a turbine and the turbine is connected to the generator to generate electricity [15]. From the above discussion it is clear that geothermal energy can also be a great source of harnessing electrical energy in Bangladesh.

## XII. CONCLUSION

Renewable energy sources discussed above can help Bangladesh produce more power. Time has come to look forward and work in these renewable energy fields to produce electricity rather than depending wholly on conventional method. With the help of these resources Bangladesh can export electricity meeting the internal demand in the future. Therefore, the Government and the Private sector should work hand in hand to emphasize more on renewable energy source to produce electricity to solve our power crisis problem.

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