



A Path to Renewable Energy from the Energy Crisis in Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author ZAL designed the study, managed the literature searches, organized different sections and wrote the social impact part, authors HA and MS wrote the first draft of the manuscript and author MRI performed the technical analysis part. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JERR/2020/v11i217055

Editor(s):

(1) Dr. Felipe Silva Semaan, Federal University, Brazil.

Reviewers:

(1) Bankole Adebajji, Ekiti State University, Nigeria.

(2) Wen-Yeau Chang, St. John's University, Taiwan.

(3) Guy Clarence Semassou, University of Abomey-Calavi, Benin.

(4) Alfred Ba'amani Ba'ams, Modibbo Adama University of Technology, Nigeria.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/55315>

Original Research Article

Received 06 January 2020

Accepted 11 March 2020

Published 20 March 2020

ABSTRACT

Bangladesh is facing a tremendous energy crisis and the economic development of this country was jeopardized due to the lack of energy resources. Due to the progression of technology, the consumption of power is rising gradually. Adequate and consistent source of electricity is a key requirement for a constant and successful economic development. Due to the heavy dependence on natural gas and the possibility of this energy source to be exhausted in near future, an alternate way to find an energy source leads us in a path to renewable energy. In this paper, the current energy scenario is analyzed while the sources to renewable energy are explored. These renewable sources are briefly explained while the status and possibility of these resources in Bangladesh are investigated. Finally the social impacts of these renewable energy sources are scrutinized.

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Keywords: Renewable energy; solar energy; wind energy; bio mass energy; social impact.

1. INTRODUCTION

Crisis of power is an important issue in Bangladesh. The gap between demand and production is increasing continuously. With the current population of 167.65 million, Bangladesh is facing a looming energy crisis [1]. Moreover, most of the power plants are gas based and due to the shortage of gas these plants will no longer be available in future. The trio of misuse, system loss and corruption in power sector are the key factors for fueling this crisis. The living standard and prosperity of a nation greatly depends on the use of power. Due to the advancement of technology, the consumption of power is rising steadily. Sufficient and reliable source of electricity is a major requirement for a continuous and successful economic development and poverty reduction [2]. To attain sustainable GDP growth of 6% and above till 2030 and beyond in Bangladesh, it deems necessary to meet the crucial energy needs. Energy sustainability will require improvement not only in the way energy is supplied, but in the way it is used. To meet these requirements, the consumers need to change themselves and use the resources very carefully and very effectively as well as efficiently.

Recently, Bangladesh has made an extraordinary development in energy generation. In 1990, only 8.5 per cent of the total population had an access to electricity whereas, in 2016, 75 per cent of the total population is under electricity coverage [3]. Total Power Generation Capacity in Bangladesh is now 18,970.86 MW [4]. Bangladesh Power Development Board (BPDB) reported that currently 83 per cent of the total population of the country has access to electricity [5]. This increasing rate of access is the effect of the accessibility of fossil fuels (explicitly natural gas) in Bangladesh.

In order to secure energy sources in 2021 especially oil, gas and coal, substitute energy sources such as wind, hydro and solar energy has been brought into attention. Oil, gas and coal are the primary source of fuel for electricity generation in Bangladesh. Primary energy sources need to be secured to ensure electricity generation. In the year 2021, total electricity demand in Bangladesh will be roughly 20,000 MW [6]. In order to achieve such target, relevant sectors must be evaluated by implementing short, medium and long term planning. Due to

heightened electricity generation the demand for gas is increasing and if no alternative fuel source is located, the rate of demand for gas might increase up to several folds. If coal is used as an alternate fuel, then several million tons of coal per year will be required to meet the demand. In section 2, energy sources are explained, section 3 explains electricity generation while section 4 elaborates renewable energy sources and their potentials. Social impacts of the renewable energies are shown in section 5 and then section 6 concludes the paper.

2. ENERGY SOURCES

Different primary energy sources are mainly of two categories. These are fuels and flows. Coal, natural gas and uranium are under fuels category which are dense stores of energy and are consumed when used. But flows are natural processes that have energy related with movement. Using a flow means harnessing energies from the movement like winds and tides [7]. Once the energy is extracted from a fuel, it is gone, but in the case of a flow, it is different. Natural processes put the energy back into flows over time which makes them renewable.

2.1 Fuels

Fuels are dense sources of energy consumed to provide energy services such as heating, transportation and electrical generation [8]. Although most fuels get their energy from the sun, they are usually considered to be primary energy sources.

Fossil fuels are made by geological processes acting on dead organisms, often hundreds of millions of years old. Fossil fuels are not considered as a renewable energy source because the reproduction rate is very much less than the consumption rate. Fossil fuels include coal, oil, natural gas and peat. Chemically these fuels are composed of carbon, hydrogen, oxygen, nitrogen, sulfur and some other smaller elements.

Bio-fuel is a fuel resulting from living matter, usually plant, called biomass. Biodiesel, ethanol, and vegetable oil are some examples of bio-fuels [9]. Since bio-fuel is acquired from current plant growth, they are considered a renewable source of energy. Bio-fuels (biodiesel, ethanol, and vegetable oil) and fossil fuels (coal, oil and

natural gas) are both derived from organic matter, but differ in how recently the organic matter died. Fossil fuels come from organic matter that died millions of years ago and bio-fuels come from recently dead matter.

Nuclear fuel is used in a nuclear reactor to sustain a nuclear chain reaction. The most common nuclear fuels are the radioactive metals like uranium-235 and plutonium-239 [10].

2.2 Flows

An energy flow refers to natural processes with energy which can be extracted for use. Energy flows start with solar radiation shining on the Earth to water flowing downstream in a river. Flows include wind power, solar power with photovoltaic and solar thermal, hydropower, wave power, tidal power and geothermal power. Since flows take advantage of the energy in Earth's systems, flows tend to refill their energy supply. This is the reason flows are usually thought of as renewable and sustainable [11].

Hydropower is the process of utilizing the mechanical potential energy of flowing water into electrical energy to generate electricity. This is not the energy obtained by flowing water in the form of tides. By obtaining energy from the tides we get the tidal power [12].

Solar power uses the radiation from the sun to create electricity. There are two different forms of energy from the sun. The first one is solar thermal power plants which use the heat from the sun to spin turbines, whereas the second one is photovoltaic systems which convert the energy directly.

Wind power is the generation of electricity from the wind which is harvested by the flow of energy in the atmosphere generated from the irregular heating of the Earth's surface by the Sun. Therefore, wind power is an indirect way to acquire solar energy. Then the wind power is transformed to electrical energy by wind turbines [13].

3. ELECTRICITY GENERATION

Electricity generation is the process of producing electric power from sources of primary energy. For electric utilities in the electric power industry, there are several stages for the delivery of electricity to end users. These are electricity

generation, transmission, distribution, energy storage and recovery.

3.1 Electricity Generation in the World

Electricity is normally generated at a power plant by electromechanical generators. It is primarily driven by heat engines fueled by combustion or nuclear fission. Sometimes it is done by the kinetic energy of flowing water and wind. Other energy sources include solar photovoltaic and geothermal power [14]. World electricity generation by sources is given in the following Fig. 1.

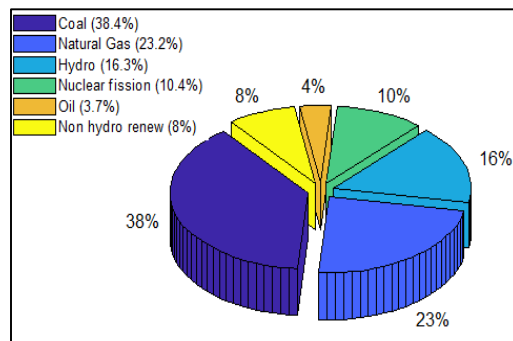


Fig. 1. World electricity generation by sources [15]

3.2 Electricity Generation in Bangladesh

Electricity generation in Bangladesh is different from the electricity generation in the world. There is no electricity generation from the nuclear power plant so far. But Rooppur Nuclear Power Plant is under-construction with 2400 MW capacity. The nuclear power plant is being constructed in the northwestern part of Bangladesh. It will be the first nuclear power plant of this nation, and the first two units are expected to go into operation in 2023. Currently, Bangladesh is using a unique mixture of different energy resources for producing electricity. The electricity generation mixture is shown in Fig. 2.

High Speed Diesel (HSD) is normally used as a fuel in medium and high speed compression ignition engines in commercial vehicles. These engines are operating above 750 rpm. HSD is also used in stationary diesel engines, locomotives and pumps etc. The diesel engine is high compression and self-ignition engine where the fuel is ignited by the heat of high compression.

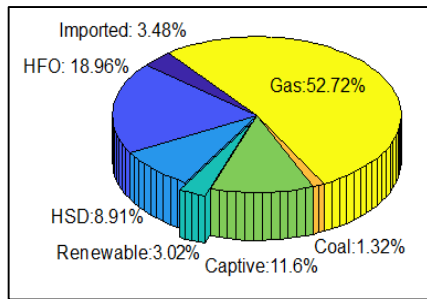


Fig. 2. Electricity generation mixture in Bangladesh

Heavy Fuel Oil (HFO) is also known as residual fuel oil and it is based on the high viscosity, tar-like mass, which remains after the refinement and subsequent cracking of crude oil in order to produce lighter hydrocarbon products like petrol, distillate diesel fuels and heating oil or feed stocks for lubricants. HFO power generators are suitable for tough operating conditions. In the absence of grid power, it is the ideal cost effective option to meet the power needs quickly [16].

Renewable energy is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves and geothermal heat. Hydroelectric power is also included in this section. A large amount of power in Bangladesh is generated from this source. Karnafuli Hydroelectric Power Station is the only hydroelectric power station in Bangladesh and generates 230 MW power.

Captive power plant is a facility which is dedicated for providing a localized source of power to an energy user. These are used in industrial facilities or in large offices. The plants may operate in grid parallel mode with the ability to transfer surplus power to the local electricity grid. Alternatively they may have the ability to operate in island mode; i.e. independently of the local electricity grid. In those places where there is a localized supply of gas, gas engines make ideal captive power plants. The supply of gas can be from a gas pipeline, or can be transported via vehicle as compressed natural gas (CNG) or liquefied natural gas (LNG) [17].

Coal fired power plants use the combustion of coal in order to generate electricity. 40% of the world's electricity is provided these and they are primarily used in developing countries. Coal power plants have many associated environmental impacts on the local ecosystem

[18]. Barapukuria Power Station is a coal-fired power station and generates 525MW power. The Matarbari Power Plant is a proposed 1,200 MW coal-fired power station to be built in Maheshkhali Upazila of Cox's Bazar District in Bangladesh. The Payra Power Plant is a proposed 1,320 MW coal-fired power station to be built in Kalapara Upazila of Patuakhali District in Bangladesh. The Rampal power station is a proposed 1,320 MW coal-fired power station at Rampal Upazila of Bagerhat District in Bangladesh.

Gas is the largest source of energy in our country. It takes the largest portion in the pie chart due to its availability throughout the country. It is used in Bangladesh in different power stations in mainly three ways such as Oil and Gas fired Thermal, Gas turbines and Gas engines. Oil and Gas fired Thermal stations are placed in Ashuganj Power Station (1627 MW), Ghorasal (950 MW), Shikalbaha (150 MW), Siddhirganj (260 MW), Orion Group (4 plants, 400 MW), Lakdhanavi Bangla Power Limited (52.2 MW). Gas turbines are used in Meghnaghat (450 MW), Ashuganj (146 MW), Haripur (360 MW), Goalpara, Khulna (265 MW), Mymensingh (210 MW), Siddhirganj (240 MW). Gas engines are used in Fenchuganj (51 MW), Dhaka (7 MW), Gazipur (53 MW), Gopalganj (100 MW), Maona (35 MW), Raozan (240 MW), Ghorashal Regent (108 MW), Baghabari, Sirajgonj (50 MW).

Imported electricity is a considerable part in the energy combination of total energy generation of Bangladesh. Bangladesh already imports 660MW electricity from India. Prime Minister Sheikh Hasina has expressed hope that India will help Bangladesh implement its plan to import 9,000 megawatt (MW) electricity from the neighboring countries by 2041 [19].

4. RENEWABLE ENERGY POTENTIAL IN BANGLADESH

Bangladesh has a long history in the field of Renewable energy, which started in 1957 with the start of construction of Country's first hydroelectric project on Karnaphully River at Kaptai, Chittagong. This current government has taken this issue seriously and we can see the result in front of us. Solar Home System has become now the largest renewable energy program in Bangladesh and so far installed 4.5 million units. At present, the different categories of renewable energy in Bangladesh are Hydro-electricity, Solar power using solar PV, Wind power, Electricity from municipal waste, Bio-gas

using cattle dung and poultry litter and Electricity and Thermal energy generation from Biomass like rice husk bagasse, waste residues from industrial processes etc. Depending on the status of generation of electricity from the renewable energy sources in Bangladesh, we are dividing the renewable energy sources in two types. Renewable energy sources in operation and Renewable energy sources to be operated.

4.1 Renewable Energy Sources in Operation

There are four renewable energy sources which are being used to generate electricity. Biogas is a form of biomass. The total renewable energy for electricity generation is shown in the following Fig. 3.

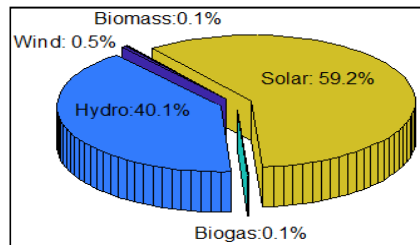


Fig. 3. Renewable Energy Sources in Bangladesh

4.1.1 Hydropower

Hydropower is using water to produce electricity. Water constantly moves through a vast universal cycle, evaporating from different water sources such as ocean, forming clouds and then precipitating as rain or snow, and after that flowing back down to the ocean. The energy in this water cycle can be tapped to produce electricity. Hydropower uses water as a fuel which is not used up in the process. The water cycle is an endless, constantly recharging system and that is why the hydropower is considered a renewable energy. When flowing water is turned into electricity, it is called hydroelectric power or hydropower [20]. Among all the renewable energy sources in Bangladesh, around 40.1% of energy comes from hydroelectric power. And Karnafuli Hydroelectric Power Station is the only hydroelectric power station in Bangladesh.

4.1.2 Biomass

Biomass is organic material that comes from plants and animals. It is considered as a

renewable energy source because biomass contains energy from the sun. Plants absorb the sun's energy by using photosynthesis. When biomass is burned, the chemical energy is released as heat from the biomass. It also can be burned directly or converted to liquid biofuels or biogas and can be burned as fuels. Biogas is a fuel gas which is a mixture of 65% methane and of 35% carbon dioxide.

It is a renewable energy which can be obtained from biomass. There are different types of biomass which has different energy uses. Wood and wood processing wastes are burned for heating, for producing process heat, and for generating electricity. Agricultural crops and waste materials are converted to liquid biofuels or burned as a fuel. Food, wood waste and yard are converted to biogas in landfills or burned to generate electricity. Animal manure and human sewage can be converted to biogas and can be burned as a fuel [22]. Among these different uses, electricity production from biomass and biogas contributes 0.2% in the renewable energy sources in Bangladesh. Different types of waste materials are shown in Fig. 4.

Bangladesh Power Development Board (BPDB) has been assigned to implement Waste to Energy Generation Plant on test basis. The project will be set up in BPDB's owned land in Keraniganj. The combined heat and power unit's capacity will be 1 MW where 430 kW Electricity will be produced and Heat production will be 480 kW. The Experts recommended Dry Fermentation or Anaerobic Digestion technology for Keraniganj Waste to Energy Project. This is due to the fact that the nature of the municipal waste (household waste, markets or commercial waste, Agro-industrial Waste, Medical Waste and so on) generated in Keraniganj are mostly organic [4].

4.1.3 Wind energy

Wind energy is fueled by the wind, so it's a clean energy source. Wind energy doesn't pollute the air like power plants because the power plants use fossil fuels such as coal or natural gas for combustion. Wind turbines don't produce atmospheric emissions which is the cause of acid rain or greenhouse gasses. It is affordable, clean and sustainable and one wind turbine is sufficient to generate energy for one household. Production of electricity from wind power contributes 0.5% energy among all the renewable energy sources in Bangladesh. Despite being a small country, it has a 724 km

long coast line and many small islands in the Bay of Bengal. There is 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 in these areas. Wind power density and wind speed for different areas of Bangladesh is shown in the Fig. 5 [24].

4.1.4 Solar energy

Solar energy is radiant light and heat from the Sun that is harnessed using photovoltaic, solar thermal energy, solar heating, molten salt power plants and artificial photosynthesis.

Solar energy is a free source of energy which is inexhaustible and sustainable and thus it is renewable where Fossil fuels are finite and nonrenewable. Solar panels are able to extract the energy from the sun and transform it to electricity. Another advantage of this solar

energy is its non-polluting nature because it does not emit any greenhouse gases while producing electricity. Therefore, the uses of these solar panels are environment friendly.

Among all the renewable energy resource potentials in Bangladesh, solar energy seems to have the greatest potential. The long term average sunshine data indicates that the period of bright sunshine hours in the coastal regions of Bangladesh varies from 3 to 11 hours daily. The insolation in Bangladesh varies from 3.8 kWh/m²/day to 6.4 kWh/m²/day at an average of 5 kWh/ m²/day. These indicate that there are good prospects for solar thermal and photovoltaic application in the country. The Photovoltaic Electricity Potential, Global Horizontal Irradiation and Direct Normal Irradiation for Bangladesh are shown in Fig. 6 and in Fig. 7.

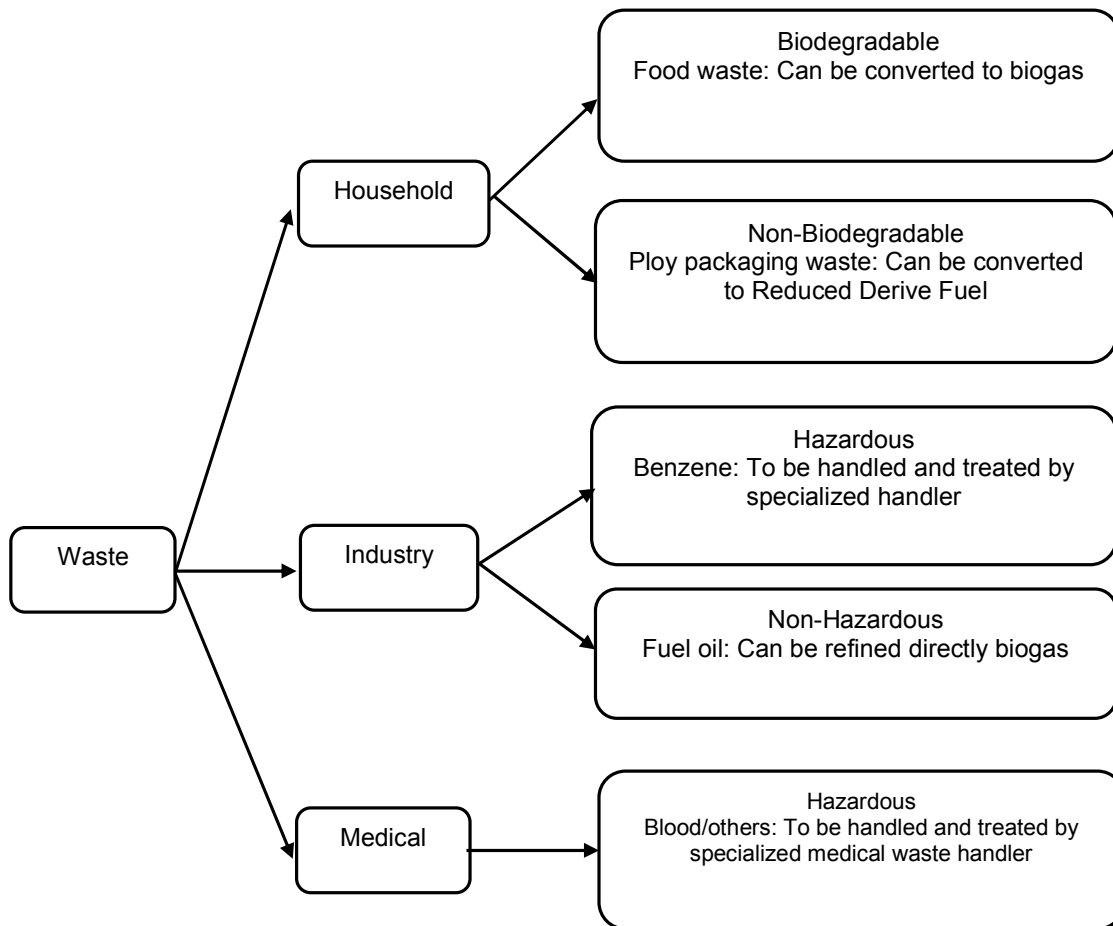
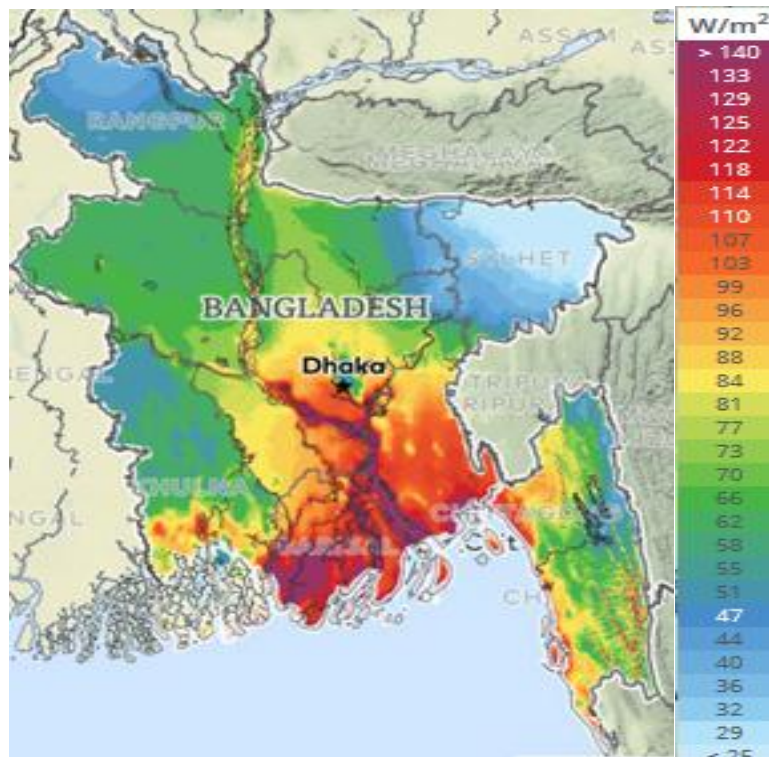
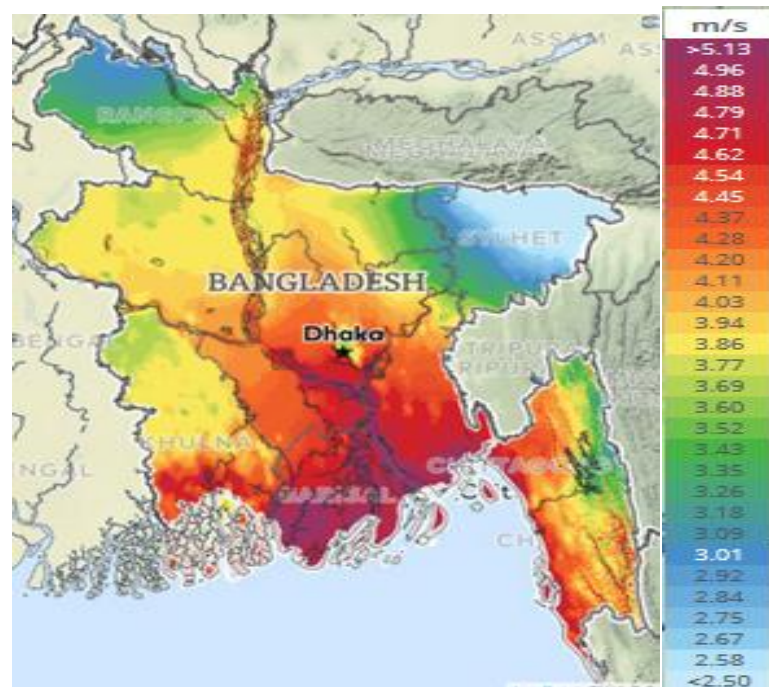


Fig. 4. Type of waste in Bangladesh

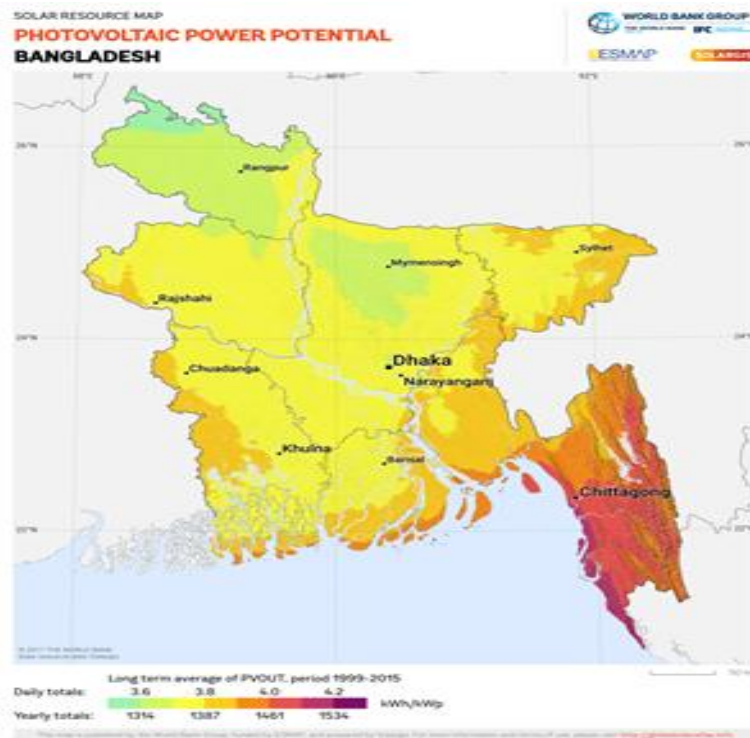


a) Wind power density (W/m^2)

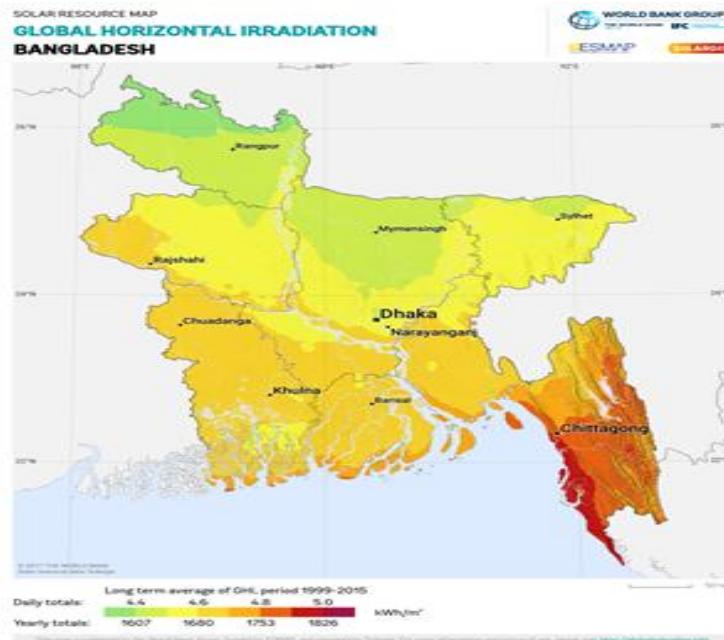


b) Wind speed (m/s)

Fig. 5. Wind power density and wind speed for different areas of Bangladesh [24]



a) Photovoltaic electricity potential



b) Global horizontal irradiation

Fig. 6. Photovoltaic electricity potential and global horizontal irradiation for Bangladesh [25]

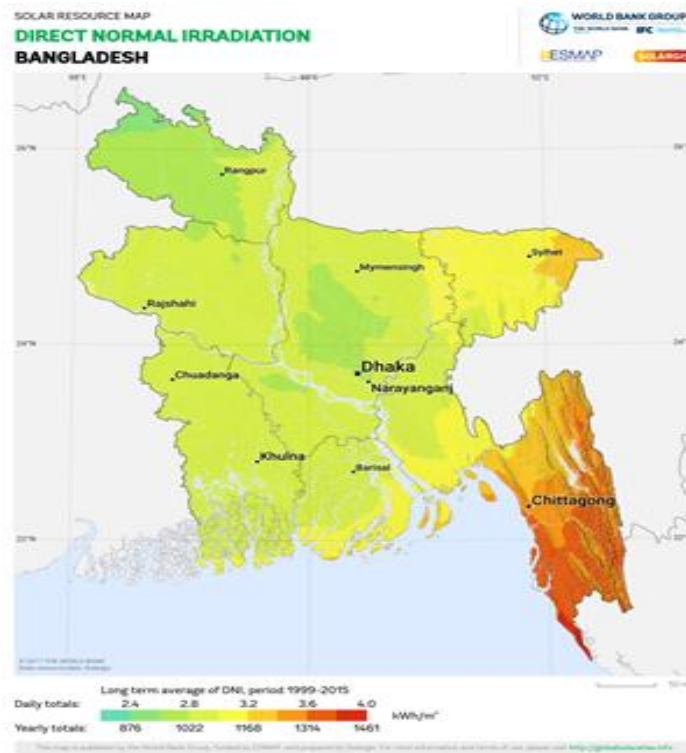


Fig. 7. Direct normal irradiation for Bangladesh [25]



Fig. 8. An optimal spatial partition of the area over Bangladesh into 14 clusters [26]

According to the UNDP report [26], 14 different locations have been selected to install the ground based radiation stations for measuring Solar Irradiance in Bangladesh. They have optimally partitioned the whole country into 14 clusters. And in each cluster they will place a station to measure the irradiation in that region. The optimal clusters of Bangladesh are shown in Fig. 8.

4.2 Renewable Energy Sources to be Operated

There are three more renewable energy sources which can contribute to our electricity generation in near future.

4.2.1 Geothermal energy

Geothermal energy is a source of energy where the renewable energy can be extracted from the earth through natural processes. This can be done on a small scale to deliver heat for a residential unit.

Energy can also be extracted on a very large scale through a geothermal power plant. It is cost effective, reliable and environmentally friendly. With this technology, the steam and hot water is produced inside the earth's surface and can be used to generate electricity [28]. Geothermal energy is produced about 4000 miles beneath the surface where there exists the earth's core. The process happens due to the slow decay of radioactive particles by generating high temperatures and thus produces steam. About 10,716 MW of geothermal energy is generated in total in 24 countries worldwide [29]. Bangladesh has various locations for harnessing geothermal resources. The northern parts of Bangladesh show a worthy prospect of exploring geothermal resources. The demand for electricity is increasing, but our production of electricity is not. The rural demand for electricity can be managed by the production of electricity through geothermal energy. Anglo MGH Energy, a private company, has initiated a project to set up Bangladesh's first 200 MW electricity generation plant from geothermal sources close to Saland in Thakurgaon district [30].

4.2.2 Tidal energy

Tidal energy is a form of hydro energy that converts the energy of tides into electrical energy. Since tides are more predictable than

wind and sunlight, tidal energy can straightforwardly be produced from the varying sea levels. Dams or barrages with water turbines can be placed crosswise in a river's mouth or inlets to produce electricity from the motion of tides. The coast of Bangladesh has an average tidal rise and fall from 2 to 5 meters [30]. Among these coastal areas, Sandwip, has the best prospect in generating tidal energy. It experiences more than 5-meter tidal waves which is the highest in Bangladesh. Moreover, Bangladesh can generate tidal power from these coastal tidal resources by using low and medium head tidal movements. Low head tidal movements are available in Khulna, Barisal, Bagerhat, Satkhira and Cox's Bazar regions and use tide height from 2 m to 5 m. In contrast, medium height tidal movements are available in Sandwip and use tide height more than 5 m high tides [31]. So the potential for Tidal energy is huge for electricity generation in Bangladesh.

4.2.3 Ocean wave energy

Ocean wave energy or ocean energy is another type of renewable energy source that uses the power of the waves of ocean to generate electricity. Tidal energy uses the ebb and flow of the tides but wave energy uses the vertical movement of the surface water that produces tidal waves. Wave power transforms the periodic up and down movement of the waves into electricity by employing equipment on the surface of the oceans. These equipment capture the energy produced by the wave movement and transforms this mechanical energy into electrical energy [21]. It has a potential of being a substantial source of electricity in Bangladesh. The main purpose of ocean wave energy plants is to generate electricity but they can also be used for pumping water, water desalination etc. In many countries, this method is becoming economically attractive now-a-days. U.K (500 kW), Ireland (3.5 MW), Norway (100 kW) and India (150 kW) are using this wave energy harnessing device. Bangladesh has the potential for harnessing ocean wave energy from the Bay of Bengal [29].

5. RESULTS AND DISCUSSION

We have considered Teknaf as our test area and have taken the wind speed there. The time is considered from 01 September, 2018 to 31 August, 2019. During this time the wind speed is shown in the Fig. 9.

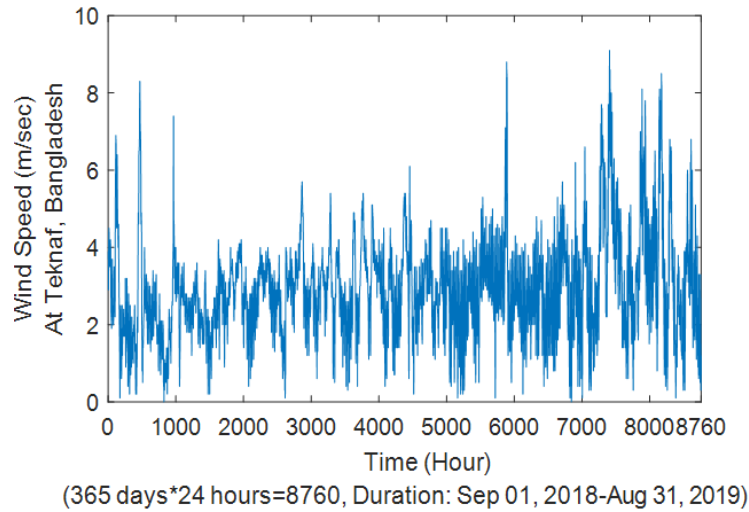


Fig. 9. Wind speed at Teknaf area in Bangladesh

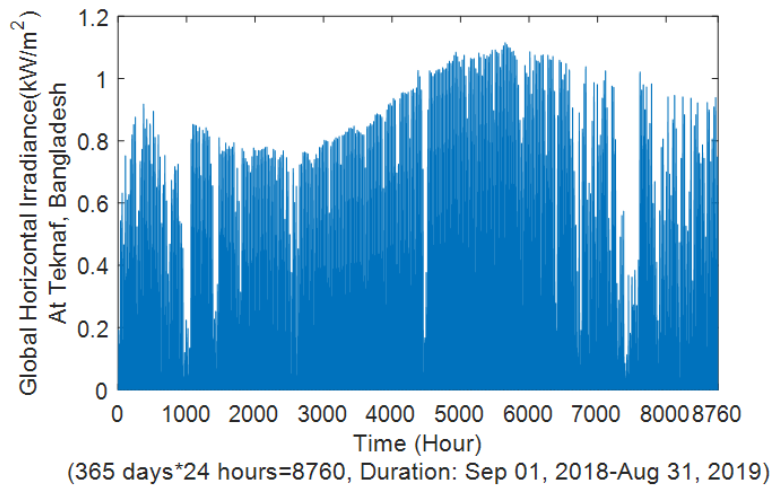


Fig. 10. GHI at Teknaf area in Bangladesh

We have also considered Teknaf as our test area for the data of Global Horizontal Irradiance (GHI). Teknaf is chosen as the test area because the largest solar park in Bangladesh is in this area. The time is considered from 01 September, 2018 to 31 August, 2019. During this time the GHI is shown in the Fig. 10.

6. SOCIAL IMPACT OF RENEWABLE ENERGY SOURCES

Renewable energy is extremely important to ensure future energy security, stability, and prosperity. In addition, it is believed that switch to renewable energy can reduce global warming emissions. Among the renewable energy

sources, solar, wind and biomass are the three potential resources in Bangladesh and their social impacts are explained here. Being nearly inexhaustible, solar energy can help stabilize energy prices, along with providing many other economic benefits. Solar energy has the greatest potential of any almost-continuous energy source [32]. Solar lighting allows rural families to extend their workday into the evening hours. Due to extended study and household work hours, convenience, safety, cleanness, and brightness, lighting is considered to be the most important benefit of solar powers. Due to the high level of illiteracy prevalent in rural areas, radio and television are the most effective means of reaching rural inhabitants, and thus play an

important role in socio-economic development [33]. Solar Power can have significant health and environmental benefits in rural areas especially, for those areas which are geologically isolated, for instance, Haor areas (Wetland areas), and Tea garden or Hill tracks. Because solar power has a minimal installed carbon footprint and solar energy is in almost inexhaustible supply in the foreseeable future, solar powers are likely to have more positive environmental impacts than fossil and biomass fuels. Solar energy can replace kerosene lamps, which emit substantial amounts of fine particulates, carbon monoxide (CO), nitric oxides (NO_x), and sulfur dioxide (SO₂), all of which adversely effects indoor air quality [34]. These pollutants may cause impair lung function and increase infectious illness (including tuberculosis), asthma, and cancer risks [35]. Solar energy has been found to result in less pollution and reduce the inconvenience associated with use of kerosene lamps. Solar Home Systems (SHS) were considered economically beneficial by 71% of the householders. After Solar energy system installation, maintenance costs are projected to be minimal over 25 years. Moreover, due to efficient lighting, householders were able to pursue commercial activities like sewing and handicrafts. Four sewing machines were recently bought by four women with the help of loan by an NGO, which together with solar energy will allow them to earn extra money by sewing in the evening hours using solar light. Owners of tea stalls and local shops reported longer evening business hours and increased profits since the installation of solar energy.

Beside this, there are some problems in using solar energy. In rainy days solar power can't work properly due to lack of direct sunlight. Again, if more power was used at day period they face shortage because it gets charged only at sunlight. So it was also a major problem. Due to the lower productivity people faced shortage of power for using electric tools. Again the cost of a solar panel is high. It was not under the nose of all people especially for poor people. That's why People thought that Government should give solar panels to the poor at free of cost, although government had already started this project. It was not possible to repair the panel by the users when get problems, having no training or knowledge on solar panel they cannot maintain it properly. Only a little numbers of NGOs were providing credit on solar panel. They set installments without any basic calculation which is higher than market price. For this most of the

areas kept out of solar panel credit as well as solar electricity facilities. The credit programs were not available to almost all the areas. The users who buy panels on credit complain that interest rate was very high. Even the people who buy the panels on cash indicated that they rejected credit due to having high interest rate. The users did not have any training to operate solar panel. For this reason many people did not buy solar panel in fear to operate properly. Even, the people working as installer or technician were not well trained or higher degree owners. Some people marked battery capacity as lower. Battery can receive less charge from the sun. For this they get less power to use. So, they hope that the battery capacity should be enriched. Some users faced the problems of choosing of proper place and angle to place the solar panel. Village area is mostly covered with trees or bamboo bushes. So they found hardly a proper place to settle the panel.

Compared with traditional energy sources, the environmental effects of wind power are relatively minor. Wind turbines would have the potential to impact avian species in the local area. The development of wind farms would also typically result in greater adverse aesthetics impacts due to the height of the turbines. Agriculture resources would also still be impacted by the presence of wind turbines and associated facilities. Additionally, wind energy production facilities do not reduce short-term construction-related air quality emissions.

Waste disposal is an emerging problem in almost all urban areas of Bangladesh. The magnitude of the problem is relatively small and manageable in rural areas. Improper management and casual dumping of waste is a noticeable cause of ruin of the environment in most cities. It appears to be a growing concern in recent times. Low collection coverage, unavailable logistic services, and lack of suitable treatment, recycling and disposal facilities are responsible for substandard waste management, leading to water, land and air pollution, and for putting people and the environment at risk. Rapid population growth has made waste management a serious problem today. Narayanganj, just outskirts of Dhaka city, is not an exception regarding poor waste management. The scattered and uncollected waste creates public nuisance, clogs sewers and open drains, encroaches roadways, diminishes aesthetic appearance and causes unpleasant odor. Waste is collected from dustbin or secondary transfer station transported to the

dumping sites. At this moment conscious authorities as well as stakeholders are concerned to make sure the proper management of waste and utilize it in production of electricity. Since the waste materials are converted and used for energy generation, biomass to energy generation has a direct positive impact on the environment of Bangladesh.

7. CONCLUSION

The current depletion and limitations regarding fossil fuel reserves and threats on climate change makes it essential for searching alternative energy sources. An alternate way to find an energy source leads us in a path to renewable energy. In this paper, the sources of renewable energies are explored while the status and possibility of these resources in Bangladesh are investigated. We found that we have used only four types of renewable energies while there are three more sources left to be used. From this paper we recommend to utilize the tidal and wave energy as a potential renewable energy sources. If we can utilize the advantage of the renewable energy source and mitigate the disadvantages of them, energy crisis will no longer be valid in near future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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