Study on Present Renewable Energy Status of Bangladesh.

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of
Bachelor of Science in Electrical and Electronic Engineering

By

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October 2020

Certification

This is to certify that this project and thesis entitled "Study on Present Renewable Energy Status of Bangladesh." is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 18 October 2020.

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The project and thesis entitled "Study on Present Renewable Energy Status of Bangladesh" submitted by Name: Md. Jony Ahamed, ID No: 162-33-283, Name: Md. Shafiul Alom, ID No: 162-33-321, Session: PC-A Fall 2016 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering on 18 October 2020.

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Dedicated to:-

“Our Parents”

CONTENTS

LIST OF FIGURES

List of Table:

LIST OF SYMBOLS AND ABBREVIATIONS

PDB = Power Distribution Board.
PPP =Public-private partnership.
UCS = unified computing system.
NREL = National Renewable Energy Laboratory.
NGO = Non-governmental organization.
BRAC = Building Resources Across Communities.
IDCOL = Infrastructure Development Company Limited
SHS =Hollow Structural Section
BDT = Bangladesh Taka
RET = Resolution Enhancement Technology
BCSIR = Bangladesh Council of Scientific and Industrial Research
LGED = Local Government Engineering Department
DFID = Department for International Development
BCAS = Bureau of Civil Aviation Security
MSL = Mean Sea Level
IEC = International Electro technical Commission
SREDA = Sacaton Regional Economic Development Authority
STC = Society for Technical Communication
IPP = Integrated Performance Primitives
DESCO = Dhaka Electric Supply Company Limited
BAEC = Bangladesh Atomic Energy Commission
ADB = Asian Development Bank, LGED = Local Government and Engineering Department
ETSU = Energy Technology and Services Unit
SREDA = Sustainable and Renewable Energy Development Authority
IDCOL = Infrastructure Development Company Limited
GEF = Global Environmental Facility
WECS = Wind Energy Conversion Systems
BCSIR = Bangladesh Council of Scientific and Industrial Research
BPDB = Bangladesh Power Development Board
LGED = Local Government Engineering Department
BUET = Bangladesh University of Engineering and Technology
CWET = Center for Wind Energy Technology

HAWT = hub wind turbines
WT = wind turbines
VAWT = vertical pivot wind turbines
CSP = concentrated sun-oriented power
MPPT = might incorporate a greatest power point tracker
REB = Rural Electrification Board
HDI = Human Development Index

ACKNOWLEDGEMENT

First of all, I am grateful to the God for the good health and well-being that were necessary to complete this book.
We wish to express my sincere thanks to our supervisor professor **Dr. Md. Shahid Ullah** the Head of the Department of Electrical and Electronic Engineering for this invaluable guidance, support, patience, and enormous cooperation to complete this research. He has always been a great inspiration and motivator for us, without his involvement, this work will not have been possible.
we place on record, my sincere thank you to **Dr.M. Shamsul Alam**, Honorable Dean of the Faculty of Engineering, Daffodil International university(DIU) for the continues encouragement.
We are also grateful to **Md.Mahbub-Ud-Jaman**, Lecturer in the Department of Electrical and Electronic Engineering. we are extremely thankful and indebted to him for sharing expertise, and sincere and valuable guidance and encouragement extended to me.
We take this opportunity to express gratitude to all of the Department faculty members for their help and support.
We are also grateful to different online resources and journal from which we have got so much information.
we also thank our parents for the unceasing encouragement, support and attention.

Abstract

This paper reports the renewable energy resources and technology practices in Bangladesh. It also presents the present energy scenario, renewable energy resources and future prospect in Bangladesh. For achieving growth and progress in a developing country like Bangladesh, utilization of the available energy sources is of more importance. Bangladesh is possessing with vast renewable energy resources such as solar energy, wind energy, biomass energy etc.
People all over the world have been using solar energy mainly for drying from the very beginning of the human race. Use of solar energy more efficiently also started a
The wind farms beside the wind farms are capable of generating 1855.25 megawatt of electricity in the range of 7500 meters, wind speed of 5104 horizontal axis and wind speed of 100 meters in height of 7 meters / second. This could reduce energy deficit by 2016, 55.93 percent. Renewable energy sources can provide 11.25% of the total electricity demand by 2020.
People all over the world have been using solar energy mainly for drying from the very beginning of the human race. Use of Solar energy more efficiently also started a long time ago. more recently, concern about the environment and possible shortage of conventional fuels prompted researcher all over the world to look for sustainable and renewable resources. Solar Energy is one of the best among a score of other renewable resources.
This thesis present the most up-to- data scenario of solar energy and the solar energy based project across the country, Bangladesh and finally, authors try to analyze solar home system per unit cost by a case study.

Chapter-1

Introduction

1.1 Background

Renewable energy may be the energy made from renewable, for example, sunlight, wind, rain, tides, waves, and geological warmth. Renewable energy gives strength to four energy, air and water, heating cooling, housing, and major power (closed networks). The country's dominant social and financial change is supported with sufficient power and development. Measuring renewable energy records, measuring renewable energy records, exploring the company's renewable strategies, rapid population growth, population growth, urbanization and global financial development. The Global Status Report's annual renewal reports that the 2020 renewable age cap has increased at its highest growth rate, of which there is a cap of 178 GB. In 2020, the new photovoltaic capacity from sunlight was 98 gigabytes, 29 percent higher than last year, and 52 gigabytes new winds, 4 percent lower than the renewable power cap, while Good 2012 produced 2 195 GW in hydroelectric power compared to last year. The planet has a renewable cap greater than the new age for petroleum products. In 2017, renewables accounted for 70 percent of the world's net increase in demand. About $279 billion (209.05 billion pounds) is new investment in renewable energy and fills, up from $274 billion last year and more than twice the size of the current cap on derivatives of oil and atomic power. Be that as it may, energy request and energy-related carbon dioxide CO_2emanations ascended without precedent for a long time a year ago. Worldwide energy request was 2.1 % higher and CO_2 emanations were 1.4 percent higher because of monetary development in rising economies and populace rise.

REN21 said in an announcement that renewable energy use will not keep pace with this growing energy demand and the continued interest in fossil and warheads. Warming, temperature control and transport elements, which collectively record about four fifths of the last energy demand worldwide, continue behind the power sector. Roughly 92 per quarter of the demand for transport energy is still met by coal, and only 42 countries depend collectively on the transport of renewable energy. In terms of warming cooling and travel we might take the road to 100 percent regenerative capacity, just as if we have always been on the planet. We do not chart, fatally.

1.2 Literature Review

Academic work has been attracted enough by sustainability and environmental responsibility since the 1980s. The volunteer research study has been attempting to check the essence and architecture of sustainability and environmental exposure and the findings in sizes, benefit and industry are analyzed. Identification between developed and emerging literary countries of sustainability and sustainable practices. Therefore, the changes between nature and trends in

stability and environmental knowledge Stability and environmental methods of disclosure in western developed countries demonstrate that companies emphasize the number and number of workers, equal opportunity, employee ownership, policy on disability, and the training of employees and disclosure of human resources. In addition, the inherent quality of the higher level of speech. An estimated of 50174 MW and 4614 MW of solar photovoltaic and wind energy potential are listed and an estimated of 566 and 125 MW of biomass and small hydropower plant energy potential are given. In achieving acceptable energy security RET, particularly solar PV, plays an important part.

The introduction of small and medium-sized village-based enterprises, which can then invest in technology and generate income from rentals to others, could help to encourage solar pumps, mini grids and biogas power plants. The government can also establish women entrepreneurs from the village and enable them to promote better cooking stoves that minimize the amount of domestic smoke and also provide assembly, repair and after-sales services for solar accessories. To achieve the very ambitious national objective of providing electricity for every person by 2020, the Bangladesh government will need to attain a 17,000 MW productive power generation efficiency. They also note, as only 500 MW of electricity had been increased from 2001 to 2008, that this target seems unlikely. Ahmed et al (2013) reported in their survey the key reasons for Bangladesh's continued lag behind the use of renewable energies as the main contributor to RET investment, lack of infrastructure and lack of awareness. Economic, financial, political and technological constraints on renewable energy are mentioned in their paper. A strong investment in RET, alongside policies to encourage renewable energy, is essential to address the obstacles to using renewable energy sources. It is going to help that the energy crisis in the world. A comprehensive energy strategy, including expert and unbiased policies, can solve the current problems with renewable energy policies Bangladesh needs suitable measures for sustainable energy development. Detailed and accurate strategies and instruments are necessary to obtain actual benefits from the introduction of new technologies. However, we are still falling far behind in the scientific use of this renewable energy due to reasons such as lack of technology and expertise in this field [45]

According to in order to achieve the very ambitious national goal of providing electricity to every person by 2020, the Bangladeshi government will need an efficient electricity generation capacity of 17000 MW. They also note, as only 500 MW of electricity had been increased from 2001 to 2008, that this target seems unlikely. Ahmed et al (2013) reported in their survey the key reasons for Bangladesh's continued lag behind the use of renewable energies as the main contributor to RET investment, lack of infrastructure and lack of awareness. Economic, financial, political and technological constraints on renewable energy are mentioned in their paper. A strong investment in RET, alongside policies to encourage renewable energy, is essential to address the obstacles to using renewable energy sources. It is going to help that the energy crisis in the world. A holistic energy policy, with expert and impartial policies, will tackle existing challenges in terms of renewable energy policies. Sustainable energy technologies Bangladesh needs suitable steps.Detailed and accurate strategies and instruments are needed if new technology is to be successful scientific use of this renewable energy due to reasons such as lack of technology and expertise in this field.

1.3 Motivation

The demand in Bangladesh for electricity in 2030 is expected to reach 34,000 MW. The country primarily produces power from natural gas. Just two thirds of the population of Bangladesh today have electricity grid link. In future years Bangladesh continues its development trajectory suggesting an untapped potential market of up to 60 million individuals linked with the national grid. In the near future Bangladesh is going through a major power cry. Because of the fuel shortage, Bangladesh switches to the renewable resources of a thermal power plant to address the question of roar electricity. We can overcome our project if we set up the solar base in our roar area.

1.4 Thesis Orientation

The electricity demand in Bangladesh is expected to reach 34,000 MW in 2030. The nation produces primarily natural gas electricity. Electricity grid is now available to just two thirds of Bangladesh's population. Bangladesh continues its growth journey in future years and indicates a possible untapped market of up to 60 million people linked to the national grid. Bangladesh undergoes a significant power cry in the near future. Due to the fuel shortage, a Bangladesh thermal power station is shifting to the renewable resources to tackle the rugged electricity problem. If we build a solar base in our roar field, we can overcome our project Our country's energy demand is so high but our power supplies are so low that coal, gas, diesel, petrol and so on are slowly losing resources. We need exceptional services in this situation which do not lead to failure. We read solar and wind energy in this article. Renewable energies which are solar, gain, tidal and geothermal energy. Secondly, the air velocity is average in the South border of Bangladesh that is adequate to mount Air wind turbines. There is a possibility of providing mechanical power or electricity without the development of air pollution. The latitude of North is 20,30 to 26,38 degrees east, with East Bengal 88,04 to 22,44 degrees. The Bangladeshi coastline is 574 kilometers long, with several islands in the Bay of Bangladesh where the wind in the air and sea is the most essential for winter, both in southwest and North-easterly winds. And the world is gloomy. Analyze the wind speed measurements here and find out how wind farms can generate wind power.

Thirdly, the increasing number of projects coordinated by various organizations and governments' clearly solar energy and the reasons for choosing solar power. Apps for this energy source can demonstrate a variety that is appropriate for the needs of a developing country, from vehicles to single rooms and wide grids. This can be seen that environmental problems are now a common concern and the energy quality of greenhouse gas, health and atmosphere is increasingly adverse. Through this context, the production of renewable energy and relative technologies is a strategic option of great importance. Communities in rural areas and mainly remote areas have very less potential for electricity supply. Therefore, and in the field of environmental protection, renewable energy can contribute substantially to provide alternative alternatives to users. Some important things that determine the technological innovation requirements to solve fuel problems in rural areas.

Finally, we develop our plans to empower all the people of our country.

1.5 Objective

- The relationship between renewable energy and economic development must be established.
- The goal is to encourage everybody to make use of electricity.
  Replacement of energy sources with emissions of CO2 and other pollutants.
- The objective is to maintain a habitable and friendly place for us. Replacement of sources of energy that need to be imported.
- The objective is to be less dependent on other people (i.e. oil countries).

- To examine the potential contribution of renewable energy to the power supply in Bangladesh.
- Setup of the Solar Home System (SHS).
  to provide the roar area with power supply. To lower National Power Grade Strain. Supplying society with electricity.
- The objective is to permit everybody to use electricity. Replacing energy sources that submit emissions (co2, other pollutants). The objective is to keep our place habitable and pleasant. Replacing energy sources that need to be imported. The objective is to be less dependent on other people.

Chapter-2

Renewable Energy in Bangladesh

2.1 Energy Situation in Bangladesh

In 1971, when the Bengali-speaking population fought for independence from West Pakistan, the Republic of Bangladesh was created, as it was then known as the eastern province of Pakistan. When natural disasters strike the world more often, the nation is considered one of the most affected countries by climate change throughout the year. For example, tropical cyclones have reached the country's coastal regions about twice a year, both rising sea levels and heavy floods are escalating the degradation of river banks and the loss of arable land Bangladesh has also recently experienced sustained heat waves, threatening both natural hazards and environmental threats to the livelihoods of Bangladeshi citizens, who depend mainly on agriculture.
Bangladesh is perceived to be one of the fastest growing economies in Southern Asia, with 64 per cent of the total population living in rural areas. By 2020, Bangladesh ranked 8th of the largest populated countries in the world.

The country has a very small energy reserve; a moderate amount of crude oil , coal and natural gas reserves. The country is struggling internally with energy, as some 93% of the country's thermal power plants are coal-based, but coal is still needed in the industrial sector. The government must also continue to make such concessions between the production of energy and the creation of the industrial sector. The nation must therefore aim to make similar choices between the generation of electricity and the growth of the manufacturing sector.
Bangladesh is one of the poorest and most densely populated countries in the world. The last Household Income and Expenditure Survey (2010) classified 32% (from 56.6% in 1990/91) of the country's population as "poor" (i.e. income below the upper poverty line of BDT 1311-2038, calculated on the regional basis-see graph below). 17 percent of the population is considered to be "extremely poor" with income below the lower poverty line. In rural areas where more than 70 per cent of the population lives, 35 per cent are below the upper limit and 21 per cent are below the lower regional poverty line (BDT 1192-1495).
The estimated per capita income of consumers below the upper poverty line is BDT1271 per month , compared with BDT 1102.84 per month below the lower poverty line at national level.

According to the 2010 census, the number of per household workers is 1.31 at national level, 1.27 in rural areas and 1.40 in urban areas. Since 1995-96, the number of earners per household has seen a decreasing pattern and a favorable outlook. In 2010 the GDP per earner was calculated to be BDT 8795 for the world as a whole. This was BDT 7592 in rural areas and BDT 11778 in urban areas. Income per earner rose from BDT 5145 in 2005 to BDT 8795 in 2010, an improvement of BDT 3650 (70.94 per cent) over that period. The average household income, on the other hand, was 9648 tk in rural areas and 16477 tk in urban areas at national level.
In 2020, the International Renewable Energy Agency (IRENA) ranked Bangladesh as having the sixth-largest renewable energy–related workforce in the world with 214,000 jobs.

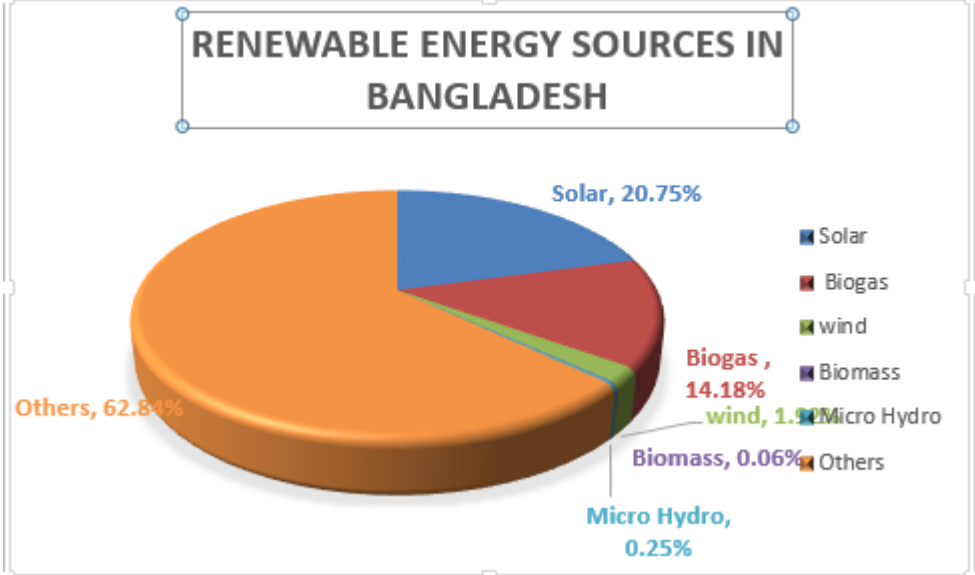


Figure 2.1: Energy Situation in Bangladesh

Renewable Energy:

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

How these types of renewable energy work:

1. Solar energy -Sunlight is one of our planets most abundant and freely available energy resources.
2. Wind energy-Wind is a plentiful source of clean energy.
3. Hydro Energy.
4. Tidal energy.
5. Geothermal energy.
6. Biomass energy.

Biomass power plant from Spanner Re²

Convert biomass into clean energy with biomass power plant

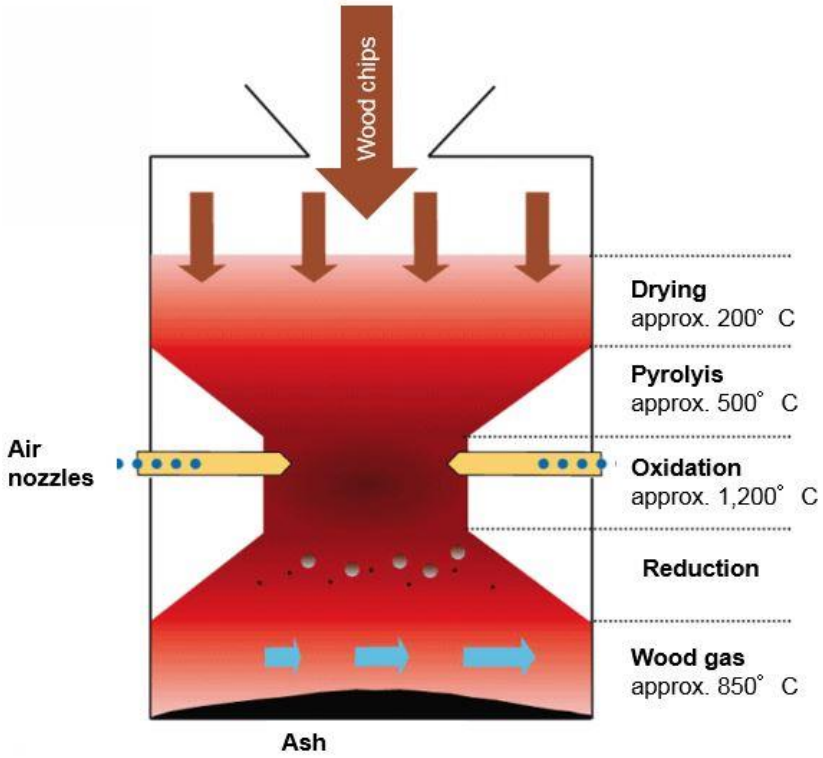
The biomass power plant from Spanner Re² generates electricity and heat according to the principle of combined heat and power (CHP). The biomass power plant consists of a wood gasified and the combined heat and power unit (CHP). The generated power will either be consumed by the owner or sold into the grid. The heat generated during the process can be used

for the heating of buildings, for drying grain and biomass or in district heating systems. Re² biomass power plants only use biomass for power generation and convert locally-sourced biomass or organic wastes into clean, efficient energy.

1. Feed of fuel at biomass power plant

The conveyor screw from Spanner Re2 automatically transfers the fuel (biomass) from the fuel bunker to the biomass power station. An incorporated metal interceptor in the fuel sewer port is used to isolate foreign material. The second conveyor screw conveys the biomass to the wood gasified unit reformer.

2. Reformer in wood gasified for clean wood gas



The reformer is the heart of the biomass power plant. It produces almost tar-less wood gas from biomass in a controlled process, which works on the downdraft principle: the wood chips and the wood gas moves in the same direction. The innovative structure of the reformer offers high fuel flexibility. Using a compact fire bed with temperature monitoring, we guarantee a regulated wood gas production that ensures the efficiency of our biomass power plant. With our patented and proven biomass gasification technology we produce an extremely clean wood gas, which we can prove.

3. Wood gas filter at wood gasified unit

The produced wood gas is cooled by the heat exchanger and passes through a wood gas filter with integrated self-cleaning at the gasified unit. Spanner Re² biomass power plants have a second wood gas filter (emergency filter) for optimal plant secure. The cooled wood gas passes through two filter systems, before it drives a powerful engine, which produces the electricity and heat.

4. Efficient wood gas CHP

The solid gas engine burns the wood gas and transforms the energy of the wood gas to kinetic energy. A efficient natural gas generator turns the rotation into energy. In addition, the wood gas CHP generates heat, making the entire process highly efficient**.**

2.2 Reasons of use renewable Energy

1. Better for the environment

Fossil fuels are overloading the air with greenhouse gases, which are having an alarmingly damaging effect on our planet.

Sea levels are rising, ice caps are melting and temperatures are soaring. The climate crisis is real, and we need to do all we can to cut down the effects of global warming.

Enter, renewable energy: a cleaner, more sustainable and recyclable means of powering our homes.

Saving the planet feels good, we know as its part of our Green Team's key mission! Is it time you joined us in embracing more natural means to power your home?

2. Better for our health

"Every year in the UK, it's estimated that the equivalent of 40,000 early deaths can be linked to breathing in polluted air," according to British Lung Foundation.

Meanwhile, it is also reported that 248 hospitals are in areas where "air pollution is above the World Health Organization's limit".

Not only are fossil fuels and global warming damaging our wildlife and environment, they are also having a seriously detrimental effect on our health.

Renewable energy sources such as wind power, solar panels and hydroelectric energy, on the other hand, are much more natural, and therefore ensure cleaner air.

3. Energy in abundance

It is widely reported that the amount of energy we can pull from coal is finite, while nuclear energy is detrimental to the state of our planet.

Renewable energy is a whole different story, though.

As the name suggests, renewable energy produces a vast supply of power, with the Earth's resources able to consistently top up the tank.

In fact, solar, wind, biomass and hydroelectric power is already generating half of Germany's output, while Costa Rica recently went 300 days on renewable energy.

4. More control over your own energy

Fed up of paying for power from the grid? Why not self-consume your own supply and gain control of your electricity?

Our green products, in particular our eddy energy diverter, enable you to reduce your reliance on the national grid and instead focus on maximizing the energy generated from your wind turbines and/or solar panels.
For more details on our award-winning products and the benefits of self-consumption, please refer to our helpful guides:

5. Cheaper to run
While the initial installation of renewable energy sources can be significant, the truth of the matter is that, in the long run, it will save you money.
It's important to see the likes of wind turbines and solar panels as an investment. The moment you start consuming your own energy – which is effectively endless and recyclable you will soon see more disposable income in your bank account at the end of each month.

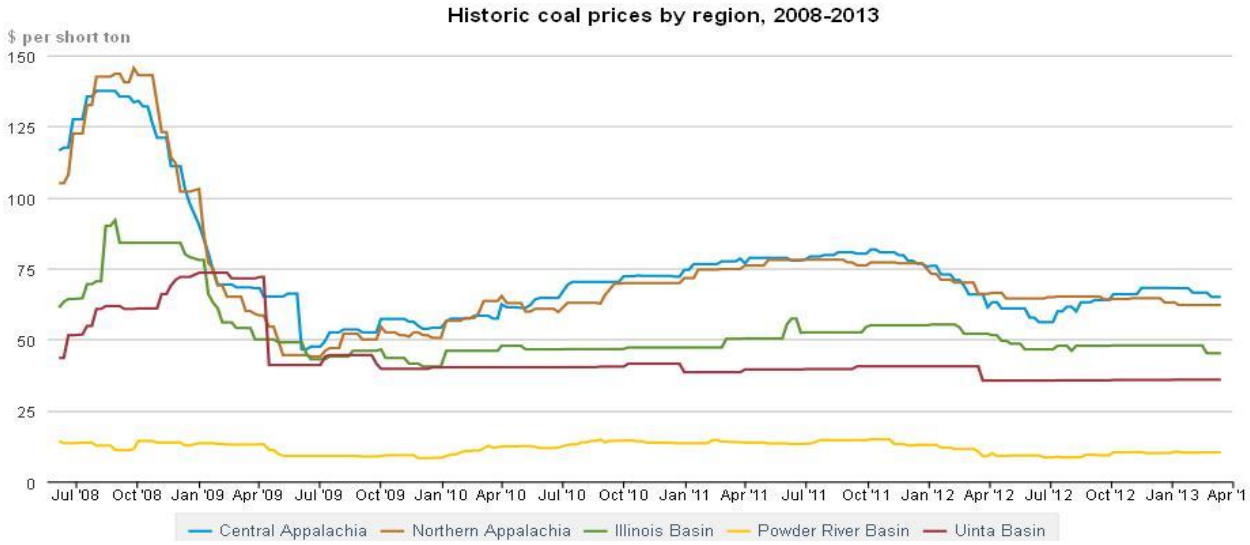


Figure 2.2: Reasons of use renewable Energy

What is CO_2e?
Carbon dioxide is the most commonly used substance that depletes the ozone, but other air toxins, e.g., methane, also cause dangerous devotion to the atmosphere. These toxins are distinguished by various sources of vitality. We use a carbon dioxide equivalent to make associations more difficult; or a carbon dioxide calculation equal to CO2, to have a proportionate warming indicator. Conversely, nearly zero sustainable energy sources create a dangerous outflow of the atmosphere. Although the releases of healthy vitality (i.e. the emanations of each stage of life making, setting-up, job or decommissioning) comprise the life cycle, hazardous air devotion outflows associated with renewable sources of energy are negligible.

When you take a gander to the numbers the correlation is clear. Gas oil consumption in the energy discharges range anywhere between 0.6 and 2 pound carbon dioxide equal to per kilowatt hour — per kilowatt hour per kilowatt hour per kw.; coal output somewhere in the 1.4 and 3.6 pound range of — per kw. Per kW. Twist, once more, is responsible for the assumptions of a real life cycle for 0.02 to 0.04 pounds of everyday life: 0,07 to 0,2 sunlight; the geothermal value is 0,1 to 0,2; and the spectrum of the hydroelectric energy is 0.1 to 0,5 anywhere.

Inexhaustible biomass power age may have a large range of dangerous atmospheric deviation discharges based on assets and whether they are economically derived and harvested.
Different tests of energy gathering gases arise from distinctive sources of vitality. Sustainable energy sources tend to have significantly lower outflows than various sources such as flammable gas or coal, as this outline shows.

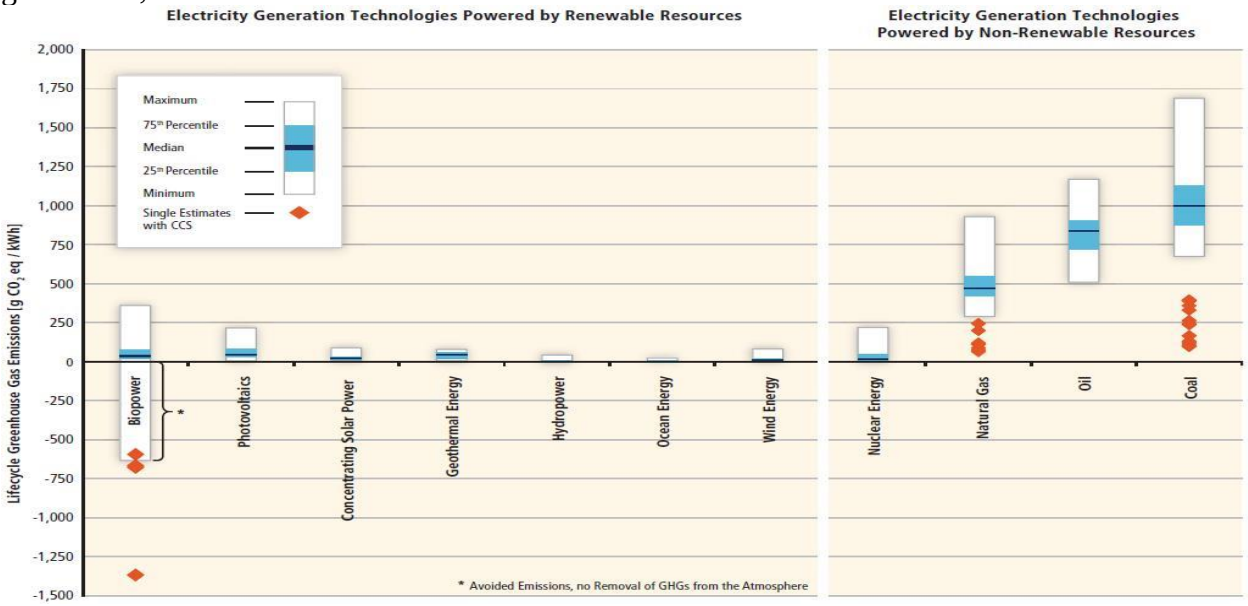


Figure 2.3: Electric generating graph

The extension of renewable energy supply will allow us to supplant carbon-focused energy sources and reduce total US outflows by boosting Earth's temperature.
The UCS study finds, for instance, 2025 new coal-fired plants in 2025 in 2009. CO2 22525 metric tons of new coal plant (600 megawatts) per year 270 million per annum.
In addition, a recent study from the NEEMEM showed that over 80 percent of the country's energy sources were searched before 2050. Sustainable energy sources were found to help reduce electricity consumption by around 81%.

2.3 Renewable energy attractive Bangladesh

1. Bangladesh is situated between 20.30 – 26.38 degrees north latitude and 88.04 – 92.44 degrees east longitude.
2. Maximum amount of radiation is available on the month of March – April (7.6h) and minimum on December – January (4.7h).

Locations	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Men
Barisal	2.90	2.57	2.57	3.56	3.32	2.90	2.71	2.65	2.57	2.11	2.07	2.05	2.66

Bogra	1.95	2.20	3.05	4.03	4.15	3.66	3.42	3.05	2.56	2.20	1.83	1.71	2.82
Chittagong	3.64	2.88	4.95	5.01	5.11	6.89	7.09	6.83	4.64	2.20	3.39	2.20	4.65
Comilla	2.26	2.70	2.57	5.45	3.83	3.20	2.88	2.95	1.82	2.38	1.63	1.70	2.78
Cox's Bazar	3.76	3.83	4.51	5.58	3.83	4.14	3.83	3.95	3.20	3.26	2.57	3.26	3.81
Dhaka	3.39	3.26	4.39	5.77	6.33	5.71	6.01	5.89	4.39	3.45	2.64	2.95	4.52
Dinajpur	2.68	2.44	4.88	2.44	2.93	2.68	2.56	2.44	2.44	3.54	2.44	2.44	2.83
Hatiya	3.04	2.64	4.16	3.97	4.82	6.47	5.75	2.64	2.96	2.77	3.06	2.57	3.74
Jessore	2.88	2.95	4.95	8.34	8.34	6.27	6.15	4.95	4.33	3.45	3.32	3.20	4.93
Khepupara	4.20	4.39	3.38	7.09	5.83	4.71	4.14	3.95	3.57	3.70	2.95	2.57	4.24
Khulna	2.96	1.65	3.04	3.05	4.16	3.89	3.31	2.44	2.51	1.98	3.31	2.38	2.89
Kutubdia	1.77	1.82	2.32	2.70	2.77	3.65	3.61	3.14	2.11	1.45	1.19	1.29	2.32
Mongla	1.07	1.25	1.72	2.51	2.92	2.63	2.48	2.35	1.83	1.27	1.02	1.01	2.20
Rangamati	1.45	1.65	4.42	3.10	2.11	3.23	1.72	2.24	1.45	1.45	1.39	1.59	2.15
Sandwip	2.32	3.01	3.20	4.83	2.44	3.83	3.39	2.70	2.32	1.63	1.70	1.70	2.75
Sylhet	2.20	2.93	3.29	3.17	2.44	3.68	3.44	2.71	2.71	1.95	1.89	1.83	2.76
Teknaf	3.70	4.01	4.39	4.01	3.32	3.89	3.43	2.88	2.44	2.20	1.57	1.76	3.17
Patenga	6.22	6.34	7.37	7.92	8.47	8.69	9.20	8.54	7.84	6.93	6.71	5.91	7.48
Satkhira	4.21	4.40	3.84	7.10	6.11	4.76	4.27	4.03	3.62	3.78	3.54	2.81	4.37
Thakurgaon	4.15	5.06	7.93	8.43	8.66	4.05	7.93	6.59	6.34	5.98	5.25	4.76	6.59

Table2.1: Renewable energy attractive

2.4 The Toper Country using renewable energy

Research carried out by scientists at Stanford University has predicted that the world could be run by renewable energy alone in 20-40 years. Great news, right?

There are a number of countries leading the way with this, by generating a significant proportion of the energy they use from renewable sources.

Norway

Norway derives 98% of its electricity from renewable energy sources. Hydropower has been the main source of supply for some time, but both wind and thermal energy have contributed to the output of Norwegian electricity.

Kenya

Kenya currently produces 70% of energy from renewable sources and aiming to be 100% powered by green energy by 2020.

Germany

You may not think that Germany has the atmosphere to be a hotspot for solar energy, but they are one of the world's pioneers in the field. At present, green energy produces more electricity in Germany than combined coal and nuclear power.

China

China is among the most prominent investors in renewable energy. They produce around 25% of their total energy from renewable sources, however, they still use huge volumes of energy from non-renewable sources. This has meant that although China is one of the most prominent investors in renewables an increase in the growth of the country resulted in a surge of CO2 emissions in 2018.

UK

In the UK, wind power is the main contributor to renewable energy production. Currently, Scotland able to produce enough renewable energy to power all its homes and businesses without the need for any fossil fuels. The UK now produces more energy from wind farms than it does from coal.

USA

Just 18% of energy comes from renewable sources, and this could fall further. In the country's 2020 budget, renewable energy budget fell to $700 million, a significant drop from figures as high as $2.3 billion in previous years.

2.5. Renewable Energy

Renewable energy is energy obtained from renewable fuels that are naturally replenished on a human scale, such as solar , wind, rain, oceans, waves and geothermal heat.

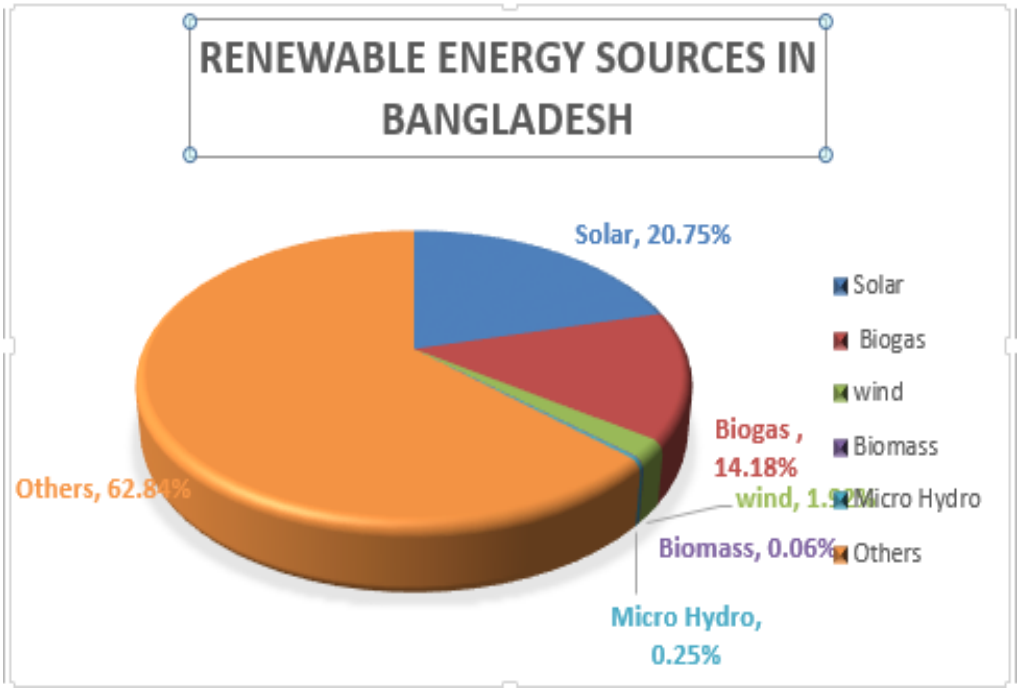


Figure 2.4:Energy in Bangladesh

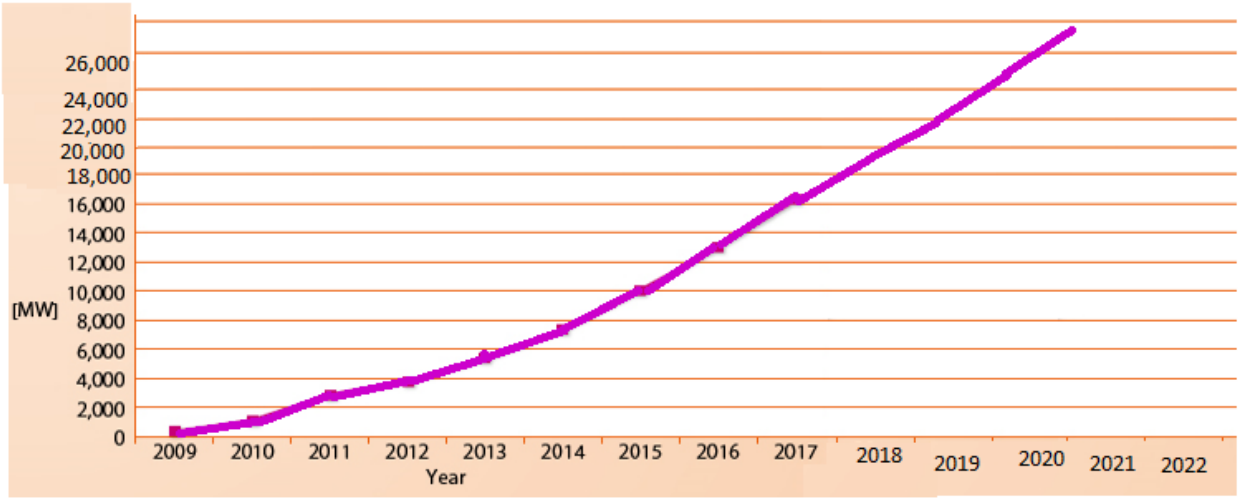


Figure 2.5:Total power in Bangladesh (MW)

2.5.1 Solar Energy

Solar energy is actually the light and heat that comes from the sun. People can use the energy of The sun in a variety of different ways: photovoltaic cells that turn sunlight into electricity. Passive solar heating, which can be as basic as allowing the sun. To shine through the windows to warm the interior of the house.

What kind of solar energy is used for?

Solar energy uses captured sunlight to produce photovoltaic (PV) or concentrated solar (CSP) ele ctricity for solar heating.
This energy conversion enables the use of solar Energy to fuel auto
motives, cameras, ponds, heaters and gadgets. Solar energy is the radiant sunlight and heat that harnessed using a range of ever-presents.

Evolving technology such as solar heating, Photovoltaic, solar thermal technology, solar design, molten salt power plants and artificial photosynthesis. As a result of rural energy efforts PV systems provide access to credit cards in their family units since 1996, access to the solar home system (SHS) was rapidly improved through a comprehensive system. For the first time. Example, Some NGOs, CMES and BRAC PV, as well as innovation development, have been established. The use of solar power fell by 60% from 1991 to 2003 and declined by 47% from 2006 to 2010. To achieve dependence on small household funding from IDCL, it is necessary to pick up a hole. There have been over 500000 solar home systems in the provincial cities and demand is improving, and every month, over 20000 solar panels are launched and doubled over the coming years.. In our country, solar energy is collected in the dry season for solar power, especially for solar products, especially animal production. There are 11, 00,000 shallow tube-wells in Bangladesh, of which 903,000 diesel is run and the remaining 197,000 electricity is carried out.

The ultimate goal is to provide the solar energy grid with water to reduce Russia's fuel costs and maintain a gasoline deficit. Then, in the Provincial Region of Bangladesh, solar pumps with solar pumps will further encourage development of the particular SHS power and management standard.
B. For solar pumping systems, managers should contact Russian financial groups for each shallow draw in exchange for fuel and electricity..
C. Due to the high priority initiative of the PV network system, this area should have a standard approach. They must first establish an objective to send renewable energy and use tools to achieve such goals. Renewable power innovation sets up renewable energy facilities for input materials, customer credit plans, restrictions, and empowerment development.
Whatever the adequacy of the solar heating system for DSD Exercise, these applications were not discovered in the general or personal categories. These application of logical motivation is attractive. To raise the efficiency of each commodity in different parts, the appropriate systems and devices will be improved. In Bangladesh, it is essential to have fake charges for financial growth. In Bangladesh there are over 87,000 cities, most of which are not part of the national network, the PV network power age system can expand the framework association and provide accessible power to all. The study of the facilities' PV matrix system per unit, which is roughly costing 15-18 BDs with diesel power, analyzed the cost of the exhausted system considering the energy cost per device. Spotless factors of growth, carbon assessment and oil prices are expected to increase, unit cost should fall below the age-related frameworks for diesel power. The first solar small country actually operates entirely on the remote island of Bali Island as compared with its conventional matrix. This modern and urban primary solar network is a limited limitation network.

A 100 kW solar stop is established by the power station with the electronic inverter, which enables the 220V AC control to be adjusted from the 3-story small frame line solar network with

a maximum of 25 kilowatts can produce 4.5 hours of power and provide 113 kilowatt energy, which is long-term reduced to 82 gaga watts. The government aims to operate a megaproject with the help of Asia Development Bank (ADB) to build 500 MW of solar power plants. Solar warm development for Asia's anticipation solar heating systems, solar dryers and solar cookers. Solar radiators can absorb insert and soothing electrical pressures, solar cookers save biomass and solar materials are useful for drying the wood, leafy paddy and foods, such as environmental impacts. Also with BRAC 260 implementation There are seven open technical universities in Bangladesh and 3 extensive research facilities, where feasibility can be achieved and fantastic RET studies can be carried out. NGOs are interested in implementing 5 000 hot-box dogs in the world. Power resources in the absence of property of good quality they do not even want sound human capital. In this university some research and research exercises at various universities focus and certain NGOs. It will boost the potential solar power by 10 percent, could ozone depleting substances, threaten and hinder the kitchen recovery. The Bangladesh Council for Science and Industrial Research (BCSIR) Energy Research and Development Foundation (IFRD) successfully completed multiple stove studies. Their extended familial stove is opposed to traditional fuel types of 40-60 percent. Almost 0.2 million stoves are available, but they are not used regularly. Increased biomass use in families, businesses and foundations reduces fuel consumption, quicker handling, enhanced item quality and timely use of products.

2.5.2 Wind energy

Without contamination, wind vitality can give mechanical vitality or power. This has proved to be a source of mechanic strength, e.g. crushing maize or pumping water, in many countries, in particular the Netherlands. Wind vitality has also been utilized in Bangladesh, as in many different nations, to give pontoons with varying planes moral control. Very little work has been carried out in these regions, however, even though restorations have been carried out since late when wind pumps and floating water crafts have taken on the vitality of torsion. There has now been some respect for twisting energy for decentralized frame or half age for certain sources of vitality, similar to wind energy and this could be suitable for limited matrix systems or battery charging in low brisk administrations. Wind pumps can also be a convenient option for low breeze speeds. Bangladesh was arranged between 20o34'-26038 northeast latitudes and 88001'-92041 'East longitude. The country's 724 km long drift line and numerous small islands of the Bay of Bengal, in the spring months, the air and air divides in the south-west and in the winter months the north-east wind and the land are good.

Lowest wind speed was taken into account in Bangladesh. The weather department's knowledge is generally allowed to interfere with the atmosphere and there is no air speed. The initial 1982 survey report considers weather information from the whole station of the country for 30 years. The air speed was found to be predominant, and definitely, in Chittagong and Cox Bazar. Windpipe area and islands wind guarantee growth, renewable energy.

Finally, in 1995, in the Peikganga (Chittagong), one year as 20 years, some beaches in front of the beach. Some estimates are made by Rahman. It has been discovered that weather office is faster than air quality. As a team of the Department of Local Government and Engineering (LGED) and the Department of Energy Technology in 1996-97, it can learn about one year

winds in the seven years of the sea coast at a wind speed of 25 years. Advanced Studies (BCAS) and Service Unit (ETSU), UK, which is supported by the Daily British Government (DFID). A parallel report is similarly managed by another group (REVB1 GTZ).
The BCAS examine first made an examination of accessible meteorological information and built up the accompanying advantageous data-

1. Wind rates are higher in seaside territories.
2. Point rate shows regular watches, bring down from September to February and low in summer (March to August).
3. Dots show a daily cycle, evening maximum crusting and weak (comparatively West Bengal, India, comparison patterns).
4. Wind speed estimates of BCAS Group and GTZ Group ensure that the speed is significantly higher in the summer months than in the winter months. The real wind speed achieved by GTZ was slightly higher than that of BCAS Group; however, the repeat approval was comparable. Daily diversity ensures the pattern seen by the weather department.
5. Twist Turbine PowerPoint is used to calculate the age of two with two primary initial limitations from two different producers. Annual lively production in Kutubdia and Kuakata is 133 megawatt and 160 kilo wind turbine 160 megawatt. These spots differ from 250 kg of 250 megawatt and 250 megawatt.

2.5.3 Hydro Energy

Hydropower uses fuel — water — that is not being decreased or used in the process. As the water cycle is a continuous, continuously recharging device, hydropower is known to be green energy. When flowing water is captured and turned into electricity, it is called hydroelectric or hydropower.
The only hydroelectric power plant at Copai, 50 kilometers from Chittagong harbor, is the Karnaphuli Hydropower plant. This Plan was created in 1926 and is one of the major aspects of the 'Project for Multipurpose' of the Karnafuli project.
The plant could operate with 80 megawatts of power after it had been approved in 1962. The two levels of 23 megawatts were increased in the following years. The plant takes no critical work to meet the electricity needs of the country, but the provincial basic flow control system is fundamental.
Earth filled embankment Kaptai Earth is a filling embankment, it is 45.7 meters high (36 mm MSL or average sea level) and 670.6 meters long. The most extreme width is 7.6 meters and the width of the feet is 45.7 meters. 16-gated spillway, each 12.2 meters 11.3 meters, can cross 625,000 cusec flow simultaneously.

The annual annual flow of the reserve is approximately 15,646 mcm. The wave range is 8.25 million feet in one and 33 meters. MSL Land area 777 sq km.
Following many reports, in the middle of 1952, the Kaptai site was chosen to build the dam. The reality is that Kaptai is the curve that passes across the stream of water and the coastal end of France. The water stream will stop because of hard strength, due to the structure and the way water can be processed would then generate immense storage quantities, and it will certainly

provide a way of producing machines. In the United States, Pakistan's legislature has funded the hydro-electric Capital project in addition to this form of electric power. The proposal was adopted and in 1952 the IEC was occupied with the construction of the dam. The research was followed in 1957 by another Utah International Inc. This pattern stopped at the end of 1961 and it closed down in 1962. The rainy and hydropower plants in the Chittagong region established the highest level of water, and electricity was supplied to the national network. Kaptai Lac is considered to have a wide pool power plant due to the construction of the Kaptai River Dam.

There is an odd place in the shop and thousands of owners and land owners are absent. The property owners do not have all the land in the mountain area manual in the state property area as soon as possible. But people say that proper wage management and recovery is necessary. The mission archive shows that the lake reaches an MSL area of 33,22 metros. The river is approx. 665 km2 with a river of approximately 777 km2. The wealth of the family has risen to 18,000, 28,870 hectares of cultivated land and 688,94sq km of covered land. The Tk 41,5 million is fined by law enforcement agencies. In all instances, not everyone got the cash payout. The atmospheric duty zone is in the direction of the strongly bent wind path of the storm. Between July to November, rainy season increased and this season nearly 80 percent. The yearly precipitation in the area varies between 2200 mm and 3600 mm. Given the 35-45% finish between November and November, 80% or more drowned in the air during the stormy season. In dry season, intangible disappear. Thanks to the natural absence of about 500 mm, the climate is seen as mild because of extreme weather and cyclone. 96,54 km / h is the best wind speed. Generally large floods are from June to October. High surges remain for 4 to 5 days and are probably going to occur in high tide of spring. The storm is torn by the storm of storm, which increases tide levels. Due to extreme flooding in low flowing areas, light flow of the coordinates of the cartridge wave waves.

In the middle of 1962, electricity was started generating 80 MW of three National Energy Network generators. In January 1982, 50 generations began under the power of the 3rd generator. At first, the upper limit was 25 percent of the stores. The flow estimates of open source are higher than the start of the irradiation. Each water introduced in 1988 has two generators in 50 megawatts of water after the exploitation of these additional opportunities. Total age cap 230 MW of Karnafuli Hydro Control Station.

Figure 2.6: Karnaphuli hydroelectric power station

This dam accessory power has speeded up Bangladesh's foundation and development and made a major landing in the distance trade that is needed for the import of finished goods. Likewise, the water pumping board produced enables the work to be finished. The storage of the building has secured Chittagong City officially from the biggest loss of real industry. Lake Kaptai is suitable for fish farming and fills with hotspots. In 2007, ongoing experiments were conducted to make

74 species of watermelon species and two weed species visible. In 2007-2008, Kaptai was supplied with about 8,250 metric tons of fish. Ideally, in the dam, at CHH every potential possible angle is dispersed by sending smoothly the winter's continuous explosive, the most distant Barakil Rapid in the east and sending it to the Kassalong tree shop shop in the north. Panton and other features. Kaptai's previous Rangamati, all the drilling cargo is transferred to the dam by the electric overhead trolley.

2.5.4 Biogas Energy

The standard has improved steadily in recent years in the provincial cities of Bangladesh cooked main foods with wood-burner. Most women go to biogas stoves, which take non-smoker cooking into account and create a beneficial side effect: organic slurries that are ideal for farming and livestock. Some families reduce organic slurry by providing other people with the raw materials, including traditional combustion plants.

Ashulia is a passing city in this animated country, only 50 kilometers from Dhaka, where these modifications are made. There have been about 50 family units in this area, 35 biogas burners, which use their milk and poultry waste to efficiently alter. For the first time Akhtar's progress was excellent. Five years ago, he used to stop using a conventional burner and introduced the biogas chamber to a 3.2 cubic feet limit. He uses unauthorized materials from his three bovines.

In recent years, the quality in the province of Bangladesh cooked key wood-burning foods gradually improved. Most women go to biogas stoves that take into account non-smoking cooking and produce a beneficial neighborhood effect: organic slurries, ideal for farming or livestock. Some families minimize organic slurry by raw materials, like conventional burning plants, supplied by other citizens.

In this lively country, only 50 kilometers from Dhaka and where these changes take place, Ashulia is a passing area. Around 50 family units, 35 biogas combustion facility, have made productive use of milk and poultry waste.

He said, after installing a biogas plant in my house, I am using the lake as a feed of fish in the lake where my family earns 100,000 rupees ($ 1,123) per year.

According to the Right and Renewable Energy Development Authority (SREDA), 71,396 biogas plants are running in Bangladeshi cities, which maintain 8.52 large quantities of carbon dioxide.

In 1975, Bangladesh introduced biogas based cooking plant by reducing the succession of biogas and the harmful sufferers, but it was adopted in the late 1990's. The government of Bangladesh has approved the setting up of 44,000 biogas plants through Infrastructure Development Company Limited (IDCOL), which provides cleanliness of about 200,000 people.

More interested groups

They also want to set green technologies without the use of other biogas burner systems. My family is trying to set up a plant because we think it's nasty and boring that a person should have an ordinary burner-a person should have biomass burners in charge. None will be there, since the biogas burner is used for heating, either as a gas or as an electric burner. The biggest challenge is the space he needs. The Rural Energy City Eco Village Development project is being implemented by a major NGO in Bangladesh. "Despite the conspiracy in the third rural power division, it was reported that the family's own units could not be produced for its own family unit due to lack of space, poultry or cow farming.

Plans ahead
Bangladesh is committed to rising sustainable electricity production by 10 percent by 2030 and developing a one-year system for that purpose. Air resource mapping takes place at 13 locations and at the end of 2017 several air transportation programs will start. In the meantime, SREDA began operations with solar-based climate projects in various areas like sunsets. The housing and energy system relies on biogas and biomass. "In the coming years we will be planning our biogas plants as we will extend our viability in the use of the provincial Bangladesh," said SREDA Tide, the SREDA official. Thunder pole.

2.5.5 Biomass Energy

The state-claimed Bangladesh Infrastructure Development Firm, IDCOL, named Dreams Power after having funded a minor vitality organization? Today, a joint project between the World Bank and the Global Environment Facility has begun the country's best decentralized biomass control plant. The office is located in a charged town named Kapashia, a rustic jolt project that aims to hit around 700,000 renewable energy sources.

A 250 km biomass gasification bureau is Green Power Station, the first of its kind in Bangladesh, which generate incredible power to create large farmland, including rice sculptures. IDCOL has received and is recognized in the collective income of 25 million (€ 250,000) of 60 percent of the joint revenue paid by IDA and the Global Environmental Benefits (GEF). Power to dream? The poultry farmer Asaduzzaman Manik has experienced his incredible problems running his business outside of control. Fatigued with the usual business, he chose the "miniaturized institution of biography".

A few years ago, I went to India and visited a small husk-let control plant fortuitously. I thought that in further Bangladesh it was possible to grow this form of plant, as we have husk galore throughout the region. In India, these hostage control plants are open, but we use our own new network in South Asia for business purposes. Manik, head of Dreams Power Being in unjolted territory, Asaduzzaman, currently provides earth to approximately 500 family units and business elements, inviting a high quality grid capacity. The one plant of a kind in the city. An aggregate of 220 purchasers have been associated with the neighborhood framework, while another 2,300 candidates anticipate associations. Through the Rural Electrification and Renewable Energy Development Project, usually known as RERED, the World Bank is supporting these sorts of activities in Bangladesh. Under this venture, IDCOL is introducing a huge number of sun oriented home vitality and biogas frameworks. The Rural Electrification Board currently needs to recreate the exertion for biomass control plants.

As indicated by Asaduzzaman Manik, overseeing chief of Dreams Power?, at present just about 38% of the populace in Bangladesh approaches power. Extending country zap is vital to the success and advancement of provincial zones: While development in power utilization is straightforwardly identified with monetary development, charge is additionally required to achieve Millennium Development Goals: control is expected to keep up the 'chilly chain' for immunizations; the probability of children making due to five years is altogether higher in towns with power than those without; power likewise opens new roads for employment creation and therefore expands pay.

The World Bank trusts that IDCOL will advance biomass control plants in provincial Bangladesh a similar way it advanced sun oriented home frameworks. The exercises gained from introducing this plant could be viably utilized while getting ready different biomass plants. This will absolutely lessen the difficulties for the following participants and can pull in new business visionaries to introduce biomass control plants in rustic Bangladesh to take care of the power demand. This will likewise make business openings in rustic Bangladesh. Other than supporting the ordinary lattice based power area, Bangladesh's relative preference in the sustainable power source assets is valued and the World Bank? says it will bolster Bangladesh's future needs to build up its sustainable power source part if the administration so requests. Given the absence of sufficient power age limit in Bangladesh, advancing this sort of decentralized sustainable power source control plants will add to the nation's vitality security and will take care of vitality demand.

Figure 2.7 In Biomass

2.6 Advantage of Renewable Energy.

1. The use of renewable energy sources ensures that it will never stop, since it is inexhaustible and can therefore be sponsored.
2. In the majority of situations, renewable power supply offices require less maintenance than traditional generators. Their fuel obtained by raising and available assets decreases operation expenses.
3. Next to zero waste material, such as carbon dioxide or other industrial pollutants, comes with a renewable energy source, which has a marginal impact on earth.
4. Sustainable energy sources will also support many local regions, as most activities are far away from major urban centers and rural areas of national capital societies. The expanded use of the neighborhood and the travel sector could contribute to this financial gain.

Solar Power Projects:

Implemented Projects:
Under the Hill Tracts Electrification Project BPDB has already implemented three solar

Projects in Juraichori Upazilla, Barkal Upazilla and Thanchi Upazilla of Rangamati District. Under 1st, 2nd and 3rd Phases, 1200 sets Solar Home Systems of 120 Wp each, 30 sets Solar PV Street Light Systems of 75 Wp each, 3 sets Solar PV Submersible Water Pumps of 1800 Wp each, 6 stes Solar PV Vaccine Refrigerators for the Health Care Centers of 360 Wp each and 2 sets 10 kWp capacity Centralized Solar System for Market electrification has been installed. So, a total of 173.81 kWp Solar PV Systems Have been installed in Juraichori, Barkal and Thanchi upazilla of Rangamati District under the Hill Tracts Electrification Project.

In the fiscal year 2008-09, BPDB implemented another two solar electrification Projects in Angoorpota and Dohogram Chit Mohol. Under this program, BPDB Implemented 2 sets Solar Home System of 50Wp each, 2 sets Solar Home System of 80Wp each and 8 sets Solar Home System of 100Wp each. A total of 1.06 kWp Solar PV Systems have been installed in Angoorpota and Dohogram Chitmohol.

BPDB implemented 20.16 KWp Solar PV System and that was inaugurated by Prime Minister at the Office of the Prime Minister on December 2009.

Major solar PV systems implemented by BPDB in the fiscal year 2010-2011 are as Follows:

1. 32.75 kWp at WAPDA Building, Motjheeel.
2. 2.82 kWp at Chairman Banglo, BPDB.
3. 6 kWp at Agrabad Bidyut Bhaban, Chittagong.
4. 1.8 kWp at Cox's BPDB Rest House.

Major solar PV systems implemented in the fiscal year 2011-2012 are as follows:

1. 37.5 kWp Solar Roof Top System on15th floor of Bidyut Bhaban.
2. 3 kWp at PC Pole Factory, Chittagong.
3. 3 kWp at Khagrachori BPDB Rest House.
4. 2.16 kWp at Swandip Power House and Rest House.
5. 2.16 kWp at Sales & Distribution Division, HatHajari.
6. 3.12 kWp at Sales & Distribution Division, Fouzdarhat.
7. 3.12 kWp at Sales & Distribution Division, Rangamati.
8. 1.6 kWp Solar Power System at Titas 50 MW Peaking Power Plant.
9. 1.6 kWp Solar Power System at t Baghabari 50 MW Peaking Power Plant.
10. 1.6 kWp Solar Power System at Bera 70 MW Peaking Power Plant.
11. 1.5 kWp Solar Power System at Chittagong Power Plant.
12. 3.5 kWp Solar Power System at Ghorashal Power Plant.

In the fiscal year 2012-2013 BPDB has implemented the following solar PV systems:

1. 4 kWp Solar Power System at Khulna Power Station.

2. 1.6 kWp Solar Power System at Faridpur 50 MW Peaking Power Plant.
3. 1.6 kWp Solar Power System at Goplagonj 100 MW Peaking Power Plant.
4. 2 kWp at Sales & Distribution Division, Bakolia.

5. 2 kWp at Sales & Distribution Division, Pathorghata and Madarbari.
6. 2 kWp at Sales & Distribution Division, Stadium.
7. 2 kWp at Sales & Distribution Division, Agrabad.
8. 2 kWp at Sales & Distribution Division, Halishohor.
9. 2 kWp at Sales & Distribution Division, Khulshi.
10. 2 kWp at Sales & Distribution Division, Pahartoli.
11. 2 kWp at Sales & Distribution Division, Mohora.
12. 2 kWp at Distribution Division, Patiya.
13. 2 kWp at Distribution Division, Bandarban.
14. 6 kWp at Regional Civil Construction Division, Medical centre and Magistrate Building.
15. 2 kWp at Sales & Distribution Division, Feni.
16. 2 kWp at Sales & Distribution Division, Chowmuhuni, Noakhali.
17. 1 kWp Solar Power System at the non-residential building and 2 kWp Solar Power System athe residential building of Santahar 50 MW Peaking Power Plant.
18. 1 kWp Solar Power System at the non-residential building and 2 kWp Solar Power System at the residential building of Katakhali 50 MW Peaking Power Plant.
19. 1.6 kWp Solar Power System at Dohazari 100 MW Peaking Power Plant.
20. 27.2 kWp Solar Power System at Chandpur 150 MW Combined Cycle Power Plant.
21. 25 kWp Grid Tied Power System at Chittagong Power Station.

•Ongoing Projects:

1. 650 KWp (400 kW load) Solar Mini Grid Power Plant at remote Haor area of Sullah upazila in Sunamgonj district under Climate Change Trust Fund (CCTF) on turnkey Basis.
2. 8 MW_p Grid Connected Solar PV Power Plant at Kaptai Hydro Power Station, at Rangamati on turnkey basis.
3. 3 MW_p Grid Connected Solar PV Power Plant at Sharishabari, Jamalpur on IPP Basis.
4. 30 MW_p Solar Park Project adjacent to new Dhorola Bridge, Kurigram on IPP basis.
5. Solar Street Lighting Projects in seven (7) City Corporations of the country.

N.B Installation of Solar Roof Top Systems in all BPDB offices across the country is a Continuous process. More than 223 kW_p solar PV systems have already been installed And installations of about 407 kW_p solar PV systems are under planning/implementing Stages.

Wind Power Projects:

•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.
Another project of 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.

•Ongoing Projects:

1.Repairing work of the existing 900 kW grid connected Wind Power Project at Muhuri Dam of Sonagazi in Feni is going on.
2.Repair and operation & maintenance of the existing Kutubdia 1000 kW Wind Battery Hybrid Power Project is underway
3.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, Megnamaghat of Cox'sbazar, 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 Megnamaghat of Cox'sbazar by Region Powertech Ltd. of India.
4.Installation of Wind Monitoring Stations at Inani Beach of Cox'sbazar, Parky Beach of Anawara, Sitakundu of Chittagong and at Chandpur under USAID TA Project is underway

Hybrid Projects:

•Ongoing Projects:
1.7.5 MW off Grid Wind-Solar Hybrid System with HFO/Diesel Based Engine Driven Generator in Hatiya Island, Noakhali.
8.1.4. 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 Barkla Upazilla of Rangamati district in 2005.

•Ongoing Projects:
1.50-70 kW Mohamaya Irrigation-cum-Hydro Power Project at Mirersorai, Chittagong.
2.Rehabilation of 50 kW Micro-Hydro Power Plant at Barkal Upazila of Rangamati district.

• Projects under Planning: Micro-hydro power projects on the potential streams/chars/rivers of Regions will be implemented after detail Feasibility Study.

Energy Efficiency Measures:

For energy saving the use of CFLs by consumers, free CFL
(Compact Fluorescent Lamp) Distribution Program in different offices of BPDB along With headquarter has been conducted. CFLs, T-5 tube light instead of incandescent bulb Will be installed in all offices of BPDB in different phases.

For the efficient use of energy, steps have been taken to encourage/promote the use of heat reflective glasses for Passive Cooling of commercial buildings, Solar Powered Security lighting in urban buildings and replacement of Diesel/Electric Pumps by Solar Irrigation Pumps, replacement of Electric/Gas Dryer by Solar Dryer, replacement of Electric/Gas Heater by Solar Water Heater among the consumers of distribution zones of BPDB. In addition to that energy efficiency measures, alternative and renewable energy subjects have been introduced in the national Text Book Curriculum of schools, Madrasas and colleges.

Energy Star labeling Program has been started by BSTI to motivate the users to use Energy efficient appliances. Electricity Week Program has already been launched since 2010 with a view to promote energy savings campaigns at consumer and school level. This program is nationally observed on 7th December each year.

Renewable Energy & Research and Develop
is also continuing its own research works in different renewable energy sectors. At this Moment engineers of the directorate are constructing fully operational prototype based Wind Turbine System, Hydro Emulator Set, Solar Power Converter.

The wind turbine system consists of three different types of turbine technology including Horizontal axis and vertical axis turbine. The total capacity of the system is expected to be 200 W depending on wind velocity. Complete design, assembly and installation of the Turbine system has been done by the respective engineers.
The Hydro Emulator Set will be a small prototype based hydro turbine system which Consists of two different type of turbine technology, Peloton wheel and Kaplan turbine. The turbine system will run from a small water reservoir tank. Generation capacity of the two turbines is expected to be 20 W.

The complete design of the Emulator Set has been done by the engineers of the respective directorate. The engineers of the directorate are also trying to design Solar Power Converter with innovative ideas and new concept. All the prototypes will be Installed at the concern office Lab.

Chapter-3

An Overview of Power Plant.

3.1. What is Power plant:

The power plant is the arrangement of devices or subsystems for the production of electricity, i.e. water.
For the economy and the needs. The power plant itself must be environmentally and economically efficient.
Environmentally beneficial to community.
The present book reflects on both traditional and non-conventional energies Generation. Although the energy efficiency mechanism is under stress in comparison to traditional capacity Systems visz, to improve the efficiency of the system conversion, the ultimate aim is to create, Plan and Manufacturing of non-conventional power generation technologies in the future Decades hopefully after 2050 AD that are both social-friendly and social-friendly.
Affordable energy conversion efficiency and pollution-free, bearing in mind .

An act of waste.

As a whole, the subject can also be stated as modern power plants for power vz.

Production of electricity in the 21st century. The term modern means time-related.
At present, due to the oil shortages, the first priority is to save resources for the future and at the same time saving energy for the future.
The second phase is the development of renewable energy systems, including direct conversion of energy.
Phones, with attention, commitment and determination to recall the word,
"Delve and Delve to Wade again."

3.2. Types of Power plant:

Power plants are mainly two types:

- Conventional
- Steam Energy Power Plant.
- Steam Turbine Power Plants.
- Diesel Power Plants.
- Gas Turbine Power Plants.

- Hydro-Electric Power Plants.
- Nuclear Power Plants.

2. Non-conventional

- Thermoelectric Generator.
- Thermionic generator.
- Fuel-cells Power Plants.
- Photovoltaic solar cells Power System.
- MHD Power Plants.
- Fusion Reactor NPP Power System.
- Biogas, Biomass Energy Power system.
- Geothermal Energy.
- Wind Energy Power System.
- Ocean Thermal energy conversion (OTEC).
- Wave and Tidal Wave.
- Energy Plantation Scheme.

3.3. Requirement for Power plant Design:

The factor to be kept in view while designing a power station are follows:

1. Economy of Expenditure should be minimum -
   a. Capital Cost.
   b. Operating and maintenance cost.
2. Safety of plant and human resources.
3. Reliability.
4. Efficiency.
5. Ease of maintenance.
6. Good working conditions.
7. Minimum transmission loss.

3.4. Principle of Power plant design:

Principles of power plant are described below:

1. Low capital cost.
2. Reliability of supplying power.
3. Low maintenance cost.
4. High efficiency.
5. Low cost of energy generated.
6. Reserve capacity to meet future power demand.
7. Simplicity of design.

3.5. Present structure for power generation, transmission & distribution:

Present structure of Power sector can be described by below:

- Apex Institution:

1. Power Division
2. Ministry of Power
3. Energy & Mineral Resources (MPEMR)

- Regulator:

-Bangladesh Energy Regulatory Commission (BERC)

- Generation:

1. Bangladesh Power Development Board (BPDB)
2. Ashuganj Power Station Company Ltd. (APSCL)
3. Electricity Generation Company of Bangladesh (EGCB)
4. North West Power Generation Company Ltd. (NWPGCL)
5. Independent Power Producers (IPPs)

- Transmission:

-Power Grid Company of Bangladesh Ltd (PGCB)

- Distribution:

1. Bangladesh Power Development Board (BPDB)
2. Dhaka Power Distribution Company (DPDC)
3. Dhaka Electric Supply Company Ltd (DESCO)
4. West Zone Power Distribution Company (WZPDC)

Rural Electrification Board (REB)

3.6. The Bangladesh Energy Regulatory:

Commission was established on March 13, 2003 through a legislative Act of the Government of Bangladesh. The commission became effective on April 27, 2004 with the appointment of two, of the five member commission including the chairman. The chairman was appointed on June 4, 2005 .The Commission has been established with the vision "To make provisions for the establishment of an independent and impartial regulatory commission for the energy sector"

Commission's missions include:

1. Enforcement of fiscal discipline of the energy sector.
2. Introduction of performance targets and incentive-based regulation.
3. Introduction of uniform operational standards and quality of supply.
4. Transparency in tariff determination and economic efficiency.
5. Increased opportunities for development of competitive markets.

6. Increased opportunities for efficiency and economic growth.
7. Public involvement into the energy sector.

3.7. Bangladesh Power Development Board (BPDB):

Bangladesh Board is a statutory body created in May 1, 1972, by Presidential Order No. 59 after bifurcation of erstwhile Bangladesh Water and Power Development Authority. BPDB started its operation with Installed Generation capacity of Only 200 MW.
Installed Generation capacity (August 2014) has increased to 10618 MW. The BPDB is Responsible for major portion of generation and distribution of electricity mainly in urban Areas except Dhaka and West Zone of the country.

The Board is under the Power Division of the Ministry of power, Energy and Mineral Resources, Government of Bangladesh.

BPDB has taken a massive capacity expansion plan to add about 10500 MW Generation Capacities in next 5 years to achieve 24000 MW Capacity according to PSMP-2010 by 2021 with the aim to provide quality and reliable electricity to all the people of Country For desired economic and social development. The power system has been expanded to Keep pace with the fast growing demand.

3.8.Ashuganj Power Station:

Ashuganj Power Station is the second largest power station in Bangladesh. The present Total power (electricity) generation capacity of its 7 units is 671 MW. As a part of the Power Sector Development and Reform Program of the Government of Bangladesh (GOB) Ashuganj Power Station Company Ltd.
(APSCL) has been incorporated under the Companies Act 1994 on 28 June 2000. The Registration No. of APSCL is 40630 (2328) / 2000. Ashuganj Power Station (APS) Complex (with its Assets and Liabilities) had been transferred to the APSCL through a Provisional Vendor's Agreement signed between BPDB and APSCL on 22 May 2003.

All the activities of the company started formally on 01 June 2003. From that day the Overall activities of the Company along with operation, maintenance and development of the Power Station are vested upon a Management Team consisting of the Managing

Director, the Director (Technical) & the Director (Finance).

According to the Articles of Association of the Company, 51% of total shares is held by BPDB and the rest 49% is distributed among Ministry of Finance, Ministry of Planning, Power Division, MOPEMR & Energy Division, MOPEMR of GOB. Electricity generated in this power station is supplied to the national grid and it is distributed to the consumers Throughout the whole country through the national grid.

This power station plays a significant role in the national economic development by Generating more than 10% of total demand for electricity in the country. In this power Station, Natural Gas from Titas Gas Transmission & Distribution Company Ltd. is used as Fuel. Water from the Meghna is used through in-take channels for steam generation and Cooling of generated steam and used water (for cooling) is again thrown into the Meghna Through discharge channels. Huge water from the discharge channels are used for Irrigation in the dry season. It is known that about 36,000 acres of land of Ashuganj are Irrigated by this water.

3.9. Electricity Generation company Of Bangladesh:

On 23rd November 1996 BPDB formed Meghnaghat Power Company (MPC) Ltd. On 16th February 2004 the Meghnaghat Power Company (MPC) Ltd. has been re-named as Electricity Generation Company of Bangladesh (EGCB) Ltd. (an Enterprise of BPDB).

Electricity Generation Company of Bangladesh (EGCB) Ltd. (An Enterprise of Bangladesh Power Development Board) was incorporated with Registrar of joint stock Companies on February 16, 2004 to produce and sale of Electricity.

EGCB has a plan to become a leading electricity generation company across the country. Electricity generation-related business services are among the fastest growing and key Area of the economy, EGCB intends to capitalize on the opportunity in that area. The Company's major share is currently held by BPDB.

3.10. North-West Power Generation Company:

Electricity is the driving force of modern civilization as well as the back-bone of all Development activities of the country. But the present generation capacity of the country is not sufficient enough to meet the prevailing load demand of the country and causes Insurmountable impedance to the development activities in industrial, commercial, Agricultural and other social sectors.

Furthermore, the load demand is increasing at a faster rate which needs more power plants to generate electricity for supporting the development activities for total Development of the country. In spite of this, the Government is committed to provide Electricity for all by 2020.

To cope-up with the growing load demand as well as to comply with the policy of the Government enough generation of electricity needs to be added.

3.11 Rural Power Company Limited:

Bangladesh is presently facing shortage of power and there are always load shading in Some parts of the country. This is threatening to the agriculture, industry, commerce as Well as the whole economy.

Rural Power Company Limited is committed to reliable power generation for Rural Development and also to take part in social & economic development for rural people of The country.
Rural Power Company Limited was the first Independent Power Producer (IPP) of Bangladesh and the first non-Bangladesh Power Development Board (BPDB) entity to be Licensed to take up power generation. Rural Power Company Limited is registered as a Public limited company under company ACT 1913, was incorporated on 31st December, 1994 under the company laws to build, own and operate power generation projects with Business philosophy and principles. The company was established as a Pilot Project of Private Power Generation as per ECNEC decision on 23rd November, 1994 to enhance The privatization in the Power sector of Bangladesh.

Rural Power Company Limited has opened a new dimension of power generation in Private sector of Bangladesh, because the 100% equity investment is mobilized locally. This is absolutely a National Company in the private sector. This will raise the confidence of investors in the Private Power Generation Sector.

3.12. Power Grid Company of Bangladesh:

Power Grid Company of Bangladesh Ltd. (PGCB) was created under the restructuring process of Power Sector in Bangladesh with the objective of bringing about commercial Environment including increase in efficiency, establishment of accountability and Dynamism in accomplishing its objectives.

PGCB was incorporated in November 1996 with an authorized capital of Tk.10 billion. It was entrusted with the responsibility to own the national power grid to operate and expand the same with efficiency. Pursuant to Government decision to transfer transmission assets to PGCB from Bangladesh Power Development Board (BPDB) and
Dhaka Electric Supply Authority (DESA), PGCB completed taking over of all the transmission assets on 31.12.2002. Since then, PGCB is operating those efficiently and effectively.

3.13. Dhaka Power Distribution Company (DPDC):

Dhaka Power Distribution Company (DPDC) launched prepaid power meters for domestic consumers on 1st June, 2014. State minister for power, energy and mineral Resources Nasrul Hamid launched the company's prepaid meters project.
5,000 single-phase prepaid meters are being installed under the pilot project. Azimpur Network Operations and Customer Care Division in the first process. Pilot. Pilot.

Project: Dayra Sharif, Eden Academy, Salimullah orphanage, Government quarters
And the surrounding parts of Azimpur. An extra 5,000 conventional meters will be replaced by Prepaid. Prepaid.
DPDC and Bangladesh Diesel Plant Limited, a commercial undertaking under the supervision of the DPDC.
The project is being initiated by the management of Bangladesh Army.
Consumers would have to obtain a smart card from the network service and the customer.
Products and deposit the money against the wallet. The card has to be put into the
The prepaid meter would cause the slot to start the supply. DPDC will set up 36 vending stations.
Offer and reload your coupons. Power supply would be suspended immediately whether it is credited
Deposited against the card has been drained.

3.14 DESCO Power Distribution Company:

Shortly after the formation of an independent Bangladesh, the first government of Bangladesh was established in 1972.
Bangladesh has released an Ordinance to boost investment in the sector
Creation of the Bangladesh Power Development Board (BPDB) as a successor
Organization of the EWAPDA Power Side. The Ordinance acknowledged that there was a difference
Energy related concerns for growth.
During the period 1972 to 1995, BPDB expanded the country's generating capacity to 2818.
MW and the duration of the 230 and 132 KV transmission networks to 419 KM and 2469 KV
KM. The eastern and western part of the world for the first time in December 1982.
The two-circuit 230 KV is electrically connected by commissioning
Transmission line over the river Jamuna energized at 132 kV between Ishurdi and Ishurdi.
Tongi named the first interconnector between East and West. Generation sources have been diversified to
Include a 230 MW hydropower plant at Kaptai on the Karnaphuli River and a natural gas plant.
and imported fuel-based, open-cycle and combined-cycle power plants at various locations
The eastern and western parts of the world. Distribution networks across all big cities and
The cities were linked by 230 kV and 132 kV inter-links.

3.15. WEST ZONE POWER DISTRIBUTION COMPANY:

The Electricity Directorate was set up in 1947 to prepare and develop power
The supply situation of the nation and subsequently of the EPWAPDA was constituted in 1959.
After the independence of Bangladesh, "WAPDA" was divided into "Bangladesh Force"
Control Commission "and" Bangladesh Water Development Board
Order 59 (PO-59) of 1972. As a result, Bangladesh Power Development Board was entrusted with the responsibilities of Generation,

Transmission and distribution of electricity in the region. Farmland
The Electrical Board (REB) was created by Ordinance No-LI in 1977.
Creation of electricity in rural areas for the benefit of rural citizens

October of 1977. Under the reform program, Dhaka Electric Supply Authority (DESA) was created for the better management and efficient electricity supply in Dhaka City and its adjoining districts in 1990 and after that, DESA was reformed as Dhaka Power Distribution Company Ltd. (DPDC) in 2008.
Dhaka Electric Supply Company Ltd. (DESCO) was founded as part of DESA in 1997.
Power Grid Company of Bangladesh (PGCB) was created under the Companies Act of 1994.
Founded in 1996 to supervise the transmission system. Following the reform activities, Ashuganj Power Station Complex has been upgraded to Ashuganj Power Station.
Company Ltd (APSCL) was founded in 1996. As a part of reform activities, Electricity Generation
Company of Bangladesh (EGCB) was formed in 2004 and the North West Zone Power Generation Company Limited (NWZPGCL) was also formed in 2007.

As part of the ongoing program of restructuring of the Power Sector by unbundling the Power Sector and improve productivity in the areas of generation , transmission and distribution;
West Zone Power Distribution Co. Ltd. (WZPDCL) was incorporated as an energy company.
Distribution business as a public corporation in November 2002 under the Companies Act 1994
Private Partnership Private. The Western Zone Distribution Force (Khulna Division,
Barisal Division and Greater Faridpur, covering 21 districts and 20 upazillas.
Except the former Bangladesh Power Development Board (BPDB) REB field,

In the sense of Lien becoming workers of WZPDCL, 1 October 2003.

WZPDCL signed Provisional Vendors and Provisional Power Sales Arrangement (VA) Agreement (PSA) with the BPDB of 23 March 2005. After the two deals have been concluded,
The operating activities of WZPDCL started on 1 April 2005 by taking over
Distribution scheme of the Western Distribution Region of the BPDB. The employees of the BPDB joined WZPDCL in December 16, 2007 with the end of Lien
and thus started functioning in WZPDCL independently according to the Company Act of 1994.

3.16.Bangladesh Rural Electrification Board:

The Rural Electrification Board of Bangladesh has been delivering rural services
Part customers for more than 37 years. Continued funding from the Government
Bangladesh, the donor group, advisors and members of the customer sector can support.
The scheme continues to grow, offering a gift of energy to millions more.
Bangladeshi homes, corporations, and industries.
Rural Electrification Board Act, 2013 has been formed in place of rural electrification Board of Directors, 1977 (Ordinance No. LI, 1977) and the term of the Board of Directors is
The Rural Electrification Board of Bangladesh. which was responsible for electrifying rural areas Bangladesh, huh? From its inception, the aim of the program has been to use electricity as a means of transport.
A way of providing opportunities to boost agricultural production and increase agricultural output
Socio-economic growth in rural areas, which will lead to changes in rural areas
Living conditions and quality of living for rural residents.

3.17. PRESENT POWER SITUATION OF BANGLADESH

3.17.1 Bangladesh's Power Sector at a Glance (July 2014):

Generation Capacity : 10,648 MW (Sep'2014)

- Total Consumers : 15.4 Million
- Transmission Line : 9,500 Ckt. Km
- Distribution Line : 3,03,000 km
- Distribution Loss : 11.96%
- Per Capita Generation : 348 KWh
- Access to Electricity : 68%

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- Distribution Line : 3,03,000 km
- Distribution Loss : 11.96%
- Per Capita Generation : 348 KWh
- Access to Electricity : 68%

3.17.2. Generation Capacity (July, 2014):

- Public Sector: 5,880 MW (55 %)
- Private Sector: 4,238 MW (40 %
- Power Import: 500 MW (5%)
- Total: 10,618 MW (100 %)

3.17.3. Present Generation Capacity (November, 2013):

Public Sector Installed Generation Capacity(MW)	Private Sector Installed Generation Capacity(MW)

BPDB 4186	IPPs 1655
APSCL 777	Rental 2096
EGCB 622	Power Import 500
NWPGCL 300	Subtotal 4,251 (42%)
RPCL 77	
Subtotal 5,962 (58%)	
	Total 10,213

3.17.4. Year wise Maximum Power Generation:

- 2014 : 7418.00 MW (Date:-18/07/2014)
- 2013 : 6675.00 MW (Date:-12/07/2013)
- 2012 : 6350.00 MW (Date:-04/08/2012)
- 2011 : 5174.00 MW (Date:-23/11/2011)
- 2010 : 4698.50 MW (Date:-20/08/2010)
- 2009 : 4296.00 MW (Date:-18/09/2009)

3.17.5. Demand in Bangladesh:

In the Power System Master Plan (PSMP) -2010 demand forecast was made based on 7 % GDP growth rate. The electricity development is required to be accelerated to increase Access and attain economic development. The desirable economic growth rate would be about 7% p.a.

Based upon this study the peak demand would be about 10,283 MW in FY2015, 17,304 MW in FY2020 and 25,199 MW in 2025. According to PSMP- 2010 Study year-wise peak demand forecast is given below.

Fiscal Year	Peak Demand (MW)

2010	6,454
2011	6,765
2012	7,518
2013	8,349
2014	9,268
2015	10,283
2016	11,405
2017	12,644
2018	14,014
2019	15,527
2020	17,304
2021	18,838
2022	20,443
2023	21,993
2024	23,581
2025	25,199
2026	26,838
2027	28,487
2028	30,134
2029	31,873
2030	33,708

3.17.6. Installed Capacity of BPDB Power Plants as on November 2014:

Unit Type	Capacity(Unit)		Total(%)
Coal	250.00	MW	2.39 %
FO	0.00	MW	0 %
Gas	6719.00	MW	64.33 %
HFO	1963.00	MW	18.79 %
HSD	783.00	MW	7.5 %
Hydro	230.00	MW	2.2 %
Imported	500.00	MW	4.79 %
Total	10445.00	MW	100 %

LIST OF POWER STATIONS IN BANGLADESH
Present Power Stations In Bangladesh:
Coal fired

Power station	Location	Capacity (MW)	Turbines	Coal Type	Plant type	Year	Refs
Barapukuria Power Station	Durgapur, Dinajpur	525		Anthracite			[1]
Sun Solar Power Plant Ltd.	Sylhet, Sylhet	5		Solar Energy			[2]

Under Construction

Power station	Location	Capacity (MW)	Turbines	Coal Type	Plant type	Expected in Operation	Refs
Matarbari Power Station	Maheshkhali Upazila, Cox's Bazar District	1200		Sub-bituminous [3]	Ultra Super Critical[3]	2024[4]	[5]
Payra Thermal Power Plant	Kalapara Upazila, Patuakhali District	1320		Sub-bituminous [3]	Ultra Super Critical[3]	1st unit in August 2019[6]	[7]
Rampal Power Plant	Rampal Upazila, Bagerhat District	1320		Sub-bituminous [3]	Ultra Super Critical[3]		[7]

Oil and Gas-fired Thermal

See also: Category: Fossil fuel power stations in Bangladesh.

Power station	Location	Capacity (MW)	Refs
Ashuganj Power Station	Brahmanbaria	1627	[8][9]
Ghorasal	Ghorasal	950	[10]
Shikalbaha	Shikalbaha, Chattagram	150	
Siddhirganj	Siddhirganj	260	
Orion Group(4 plant)	Narayangonj & Khulna	400	
Lakdhanavi Bangla Power Limited	Comilla	52.2	
Desh Energy Chandpur Power Company Ltd.	Chandpur	200	
Doreen Power Generations and Systems Limited Group(3 plant)	Nababganj, Manikganj & Munshiganj	165	

Under Construction

Power Station	Location	Capacity(MW)	Expected in operation	Ref
Feni Lanka Power Limited	Feni	114	End of September 2019	
Manikganj Power Generations Limited	Manikganj	162	January 2020	
Bhairob Power Limited	Bhairab	55	January 2020	
Payra LNG Power Plant	Kalapara Upazila, Patuakhali District	3600	1st Phase in December 2022 2nd Phase in December 2023	[6]

Gas turbines

Power station	Max. Capacity (MW)	Turbines	Fuel type	Refs
Meghnaghat	450	2+1	natural gas	[11]
Ashuganj	146	2+1	natural gas	[9]
Haripur	360	1+1	natural gas	
Goalpara Khulna	265		Heavy fuel oil (HFO)	
Mymensingh	210	4+1	natural gas	
Siddhirganj	240		natural gas	

Gas engines

Power station	Max. Capacity (MW)	Engines	Fuel type	Refs

Power station	Max. Capacity (MW)	Engines	Fuel type	Refs
Baraka Power Ltd.	51	16	natural gas	[12]
Dhaka	7	2	natural gas	
Gazipur	53	6	natural gas	
Gopalganj	100	16	natural gas	
Maona	35	4	natural gas	
Raozan	240	6	natural gas	
Ghorashal Regent	108	34	natural gas	
Baghabari, Sirajgonj	50		natural gas	
APSCL, Ashuganj	50		natural gas	

Hydroelectric

Power station	Max. Capacity (MW)	Turbines	Refs
Karnafuli	230	5	[13]

Chapter-4

Wind turbine

4.1 Power Generation Scenario in Bangladesh

A wind turbine turns wind energy into electricity using the aerodynamic force from the rotor blades, which work like an airplane wing or helicopter rotor blade. When wind flows across the blade, the air pressure on one side of the blade decreases.

A average household consumes roughly 10,932 kilowatt-hours of electricity per year (about 911 kilowatt-hours per month). Depending on the average wind speed in the region, a wind turbine of 5–15 kilowatts will be needed to make a substantial contribution to this market.

Power utilization is extremely irrelevant in Bangladesh (by KGWR HR). Table 1 shows electricity utilization in different countries worldwide between 2011 and 2015. Bahrain is a country with a capacity of 17325 kilowatts nationally, and Canada is 15,615 kilowatts per second square meter. Cape Area, Nepal has a maximum reduction value of 119 kW.

Solar PV capacity by country (MW) and share of total electricity consumption [view/edit]

	2015		2016		2017		2018		Share of total consumption[1]
Country	Added	Total	Added	Total	Added	Total	Added	Total	
China	15,150	43,530	34,540	78,070	53,000	131,000	45,000	175,018	3.3% (2018)
European Union	7,230	94,570		101,433		107,150	8,300	115,234	4.3% (2018)[]
United	7,30	25,62	14,73	40,30	10,60	51,00	10,600	62,200	2.3%

Solar PV capacity by country (MW) and share of total electricity consumption [view/edit]

Country	2015		2016		2017		2018		Share of total consumption[1]
	Added	Total	Added	Total	Added	Total	Added	Total	
States	0	0	0	0	0	0			(2018)
Japan	11,000	34,410	8,600	42,750	7,000	49,000	6,500	55,500	6.8% (2018)
Germany	1,450	39,700	1,520	41,220	1,800	42,000	3,000	45,930	7.9% (2018)

Table 4.1: Electric power consumption (KW-hr per capita)

Just 266 kilograms HR is required in Bangladesh; electricity is only 59.60%[10]. In Bangladesh, there are over 87,319 cities and most are not National Matrix. Many issues are caused by energy production such as gas shortages, suspicious old power stations, population growth, etc. It relies on petroleum gas of 63 percent. There are a few issues with this irrational dependency. The production of electricity is hampered, in the absence of fuel or oil gas. Vegetation control is developed with 23 percent intensity over 20 years of age. The strength of BPDB in February 2016 is seen in Figure 1. Figure 1. The BPDB power plant was 1,222 MW by April 2020

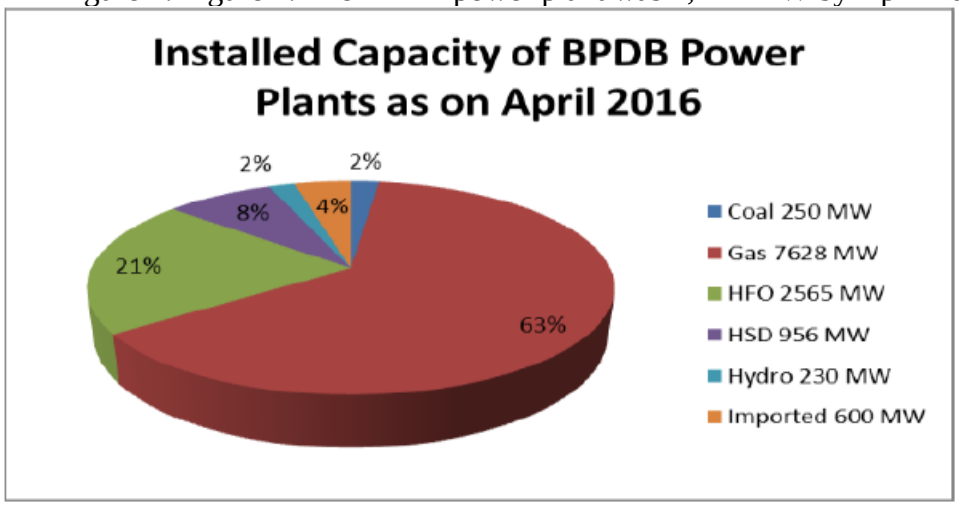


Figure 4. 1: Installed Capacity of BPDB Power Plants as on April 2016

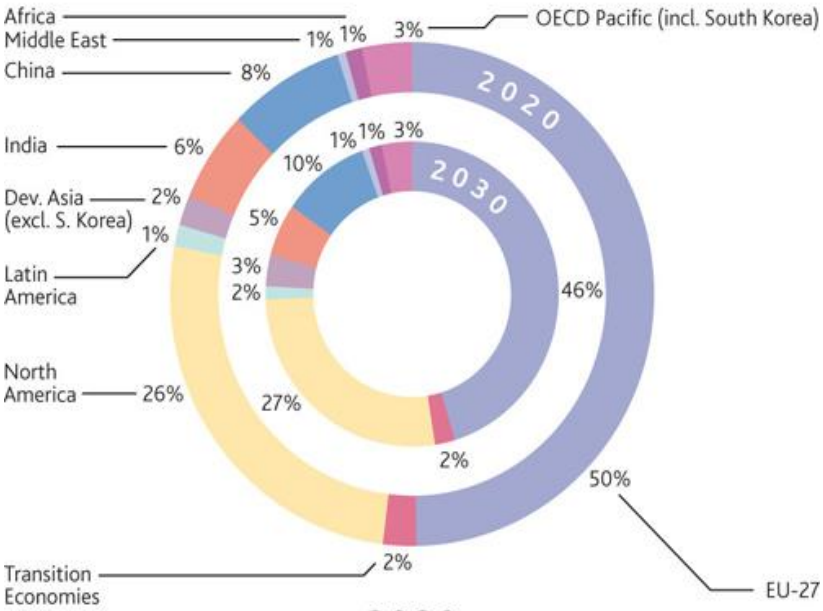
The Chittagong hydropower station has a small range of Kaptai. A nuclear power plant with 2 reactors, each with a output capacity of 1,200 megawatts, will be constructed in Rooppur. Bangladesh is struggling with financial growth challenges. In Bangladesh 2016, 11,405 megawatts of electricity were the highest interest. The 2016 age limit is 8,088 MW, which leads

to a 3,317 MW deficit. By 2021 the government plans to build 19,000 megawatts. Bangladesh has to focus on the correct calculation of a renewable power source in order to get the goals together. The provincial family has 15 megawatts of sun-based efficiency and Kut's 1.9 megawatts [11].

3.2 Wind Energy Scenario

By **2020**, the annual market grows to 81.5 GW, and the cumulative global **wind power** capacity reaches a level of over 700 GW. By 2030, a total of over 1420 MW would be installed, with annual installations in the region of 84 GW.

REGIONAL BREAK DOWN: REFERENCE SCENARIO [GW]



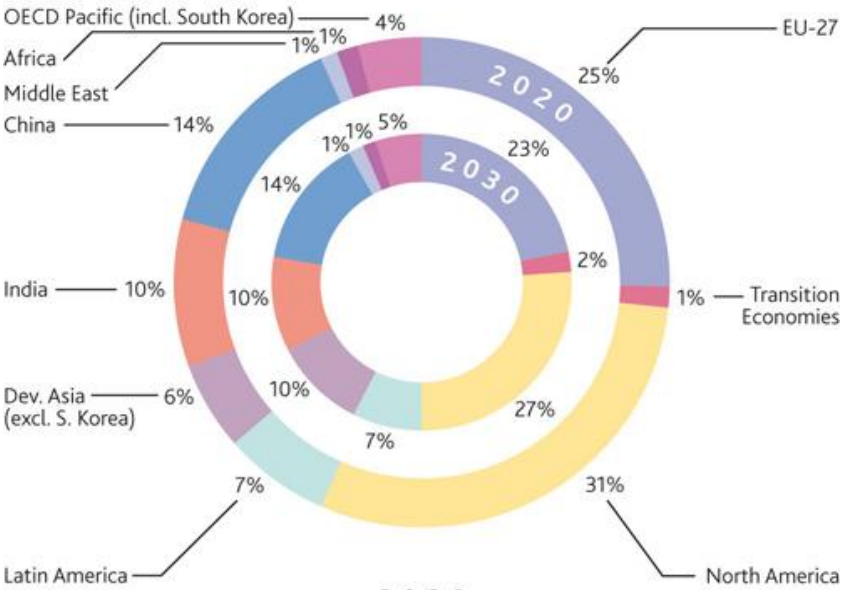
2020

EU-27	175 GW
Transition Economies	7 GW
North America	92 GW
Latin America	5 GW
Dev. Asia (excl. S. Korea)	7 GW
India	20 GW
China	27 GW
Middle East	2 GW
Africa	4 GW
OECD Pacific (incl. South Korea)	12 GW

2030

EU-27	224 GW
Transition Economies	11 GW
North America	132 GW
Latin America	8 GW
Dev. Asia (excl. S. Korea)	16 GW
India	27 GW
China	49 GW
Middle East	4 GW
Africa	7 GW
OECD Pacific (incl. South Korea)	16 GW

REGIONAL BREAK DOWN: MODERATE SCENARIO [GW]



2020

EU-27	180 GW
Transition Economies	9 GW
North America	214 GW
Latin America	50 GW
Dev. Asia (excl. S. Korea)	40 GW
India	69 GW
China	101 GW
Middle East	8 GW
Africa	10 GW
OECD Pacific (incl. South Korea)	30 GW

2030

EU-27	302 GW
Transition Economies	34 GW
North America	366 GW
Latin America	103 GW
Dev. Asia (excl. S. Korea)	140 GW
India	142 GW
China	201 GW
Middle East	20 GW
Africa	21 GW
OECD Pacific (incl. South Korea)	70 GW

Fig4.2 (b): Contribution and growth of wind energy

4.2. Wind Energy Scenario in Bangladesh:

References indicate that with a population of 146.2 million, the electrification rate is 59.60 per cent. Total electrical capacity installed is 12229 MW (2016)[10] and the total installed wind energy is 1.9 MW. The wind energy capacity in Bangladesh is over 20,000 MW[39] and the wind speed is < 7 m / sec. In Bangladesh a analysis of wind energy started a few years ago, showing that there are very strong wind power in some districts of Bangladesh. For the Locale Government and Department of Engineering (LGED) and Foreign and International Development (DFID), the Bangladesh Government for Advanced Studies (BCAS) has been seeking to cooperate with its global organization the International Technology and Service Unit (ETSU).. In the UK's 1996-97 observation of wind conditions on seven coastal sites for one year. They measure the 25 meter air parameters [16]. Currently, Bangladesh Power Development Board (BPDB), Bangladesh Scientific and Industrial Research Council (BCSIR), Local Government Engineering Department (LGED) and Bangladesh University of Engineering and Technology (BUET) are working in different countries of Bangladesh. They have already started measuring the wind speed in certain places in Bangladesh Feni has a capacity of 0.9 MW (225 KW, 4 turbines) and Kutubdia Island (20 KW, 50 turbines) for the first time in Bangladesh to produce electricity from the Mukti dam. In Denmark's West company Patuakhali, a 100 MW wind power station will be built. It will be Bangladesh 's biggest wind turbine. The latitude of North is 20.30 to 26.38 and of East Bengal is 88.04 to 22.44. A Center for Wind Energy Technology Center (CWT) atmospheric analysis analyzes that network resources (< 7 m/s) due to grid wind are inadequate for generating electricity in many regions of the world.. The coastal areas of this sector are primarily being researched. On the coast of Bengal, Bangladesh has a coastline of 574 km long. The southwesterly mountain season from the South Sea reached the coasts of Bangladesh after moving from north to south. From March to October, this trade wind hit the region. If the country moves to the coastal area, the wind speed will increase. The maximum wind velocity in Bangladesh is 3 m / second to 6 m / second. The wind speed is relatively low between October and February. In June-July the average wind velocity is attained. In coastal areas of Bangladesh, the average wind speed is 30 meters / sec. Winter Air For excellent power extraction, the site must have at least 7 m / s wind speed. For proper operation of the wind turbine, hub height is usually 20 to 40 meters [17]. After correcting height, potting, Cox's Bazar, Teknaf, Char Faison, Kuakata, Kutubdia etc. 30 meters to the wind power to maintain electricity.

4.3. Wind Energy Study Project (West):

One of the government's initiatives was the Wind Energy Research Project (West). Bangladesh. In 1996-1997, he learnt the speed of a one-year wind speed of 27 meters at seven ocean destinations Statistical figures 3(a)-3(f) apply to the speed of regular monthly air from six Western stations, Patenga, Bazar Cox, Teknaf, Faison Char, Kuakata and Kutubdia, which are 25 meters wide month..

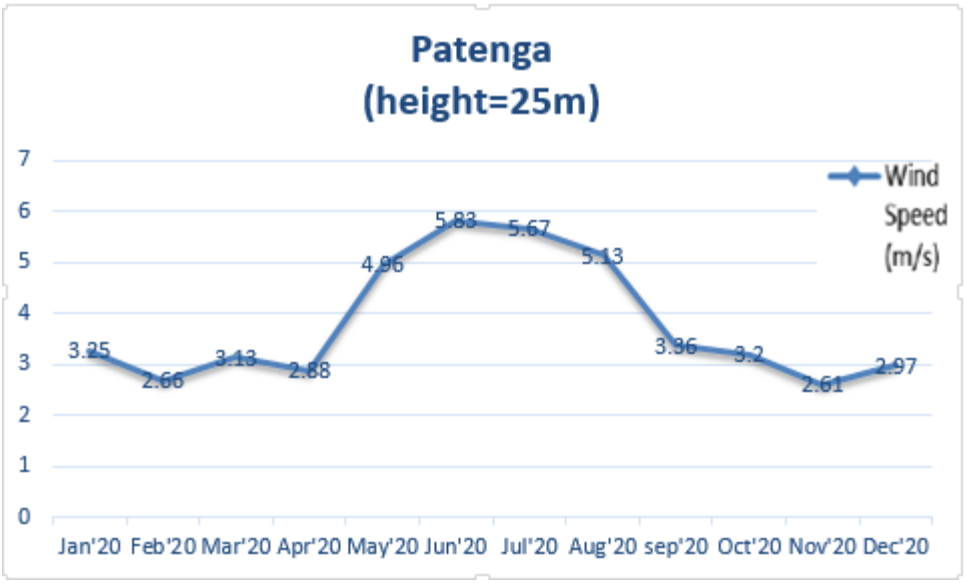


Figure 4.3.(a): Monthly average wind speed at Patenga

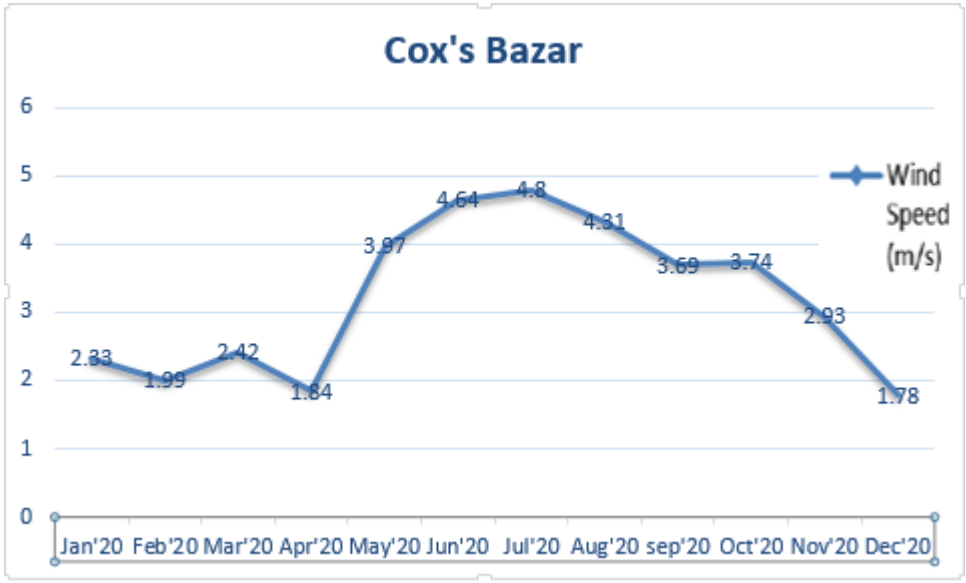


Figure 4.3. (b): Monthly average wind speed a Cox's Bazar

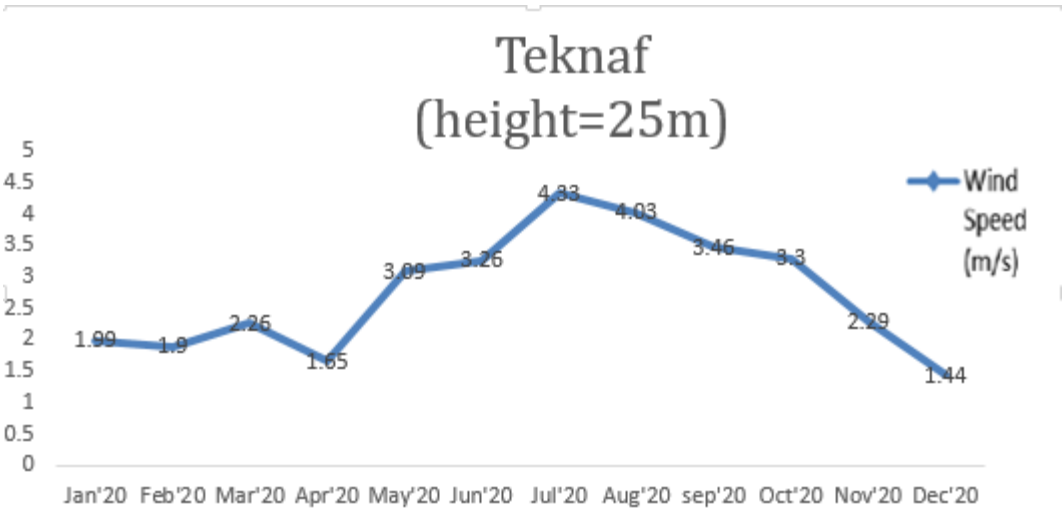


Figure 4.3. (c): Monthly average wind speed at Teknaf

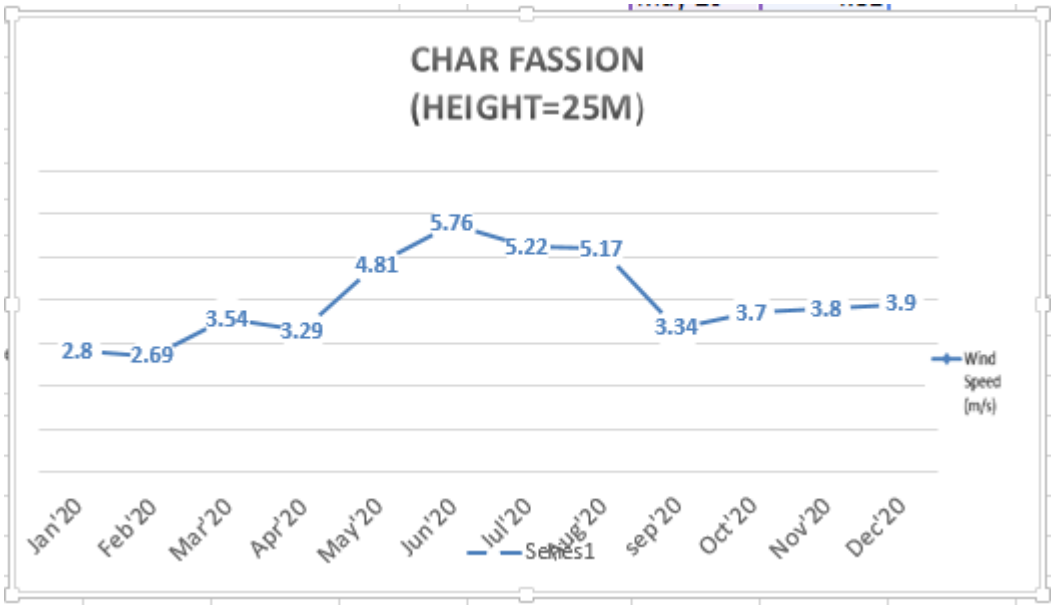


Figure 4.3. (d): Monthly average wind speed at Char fashion

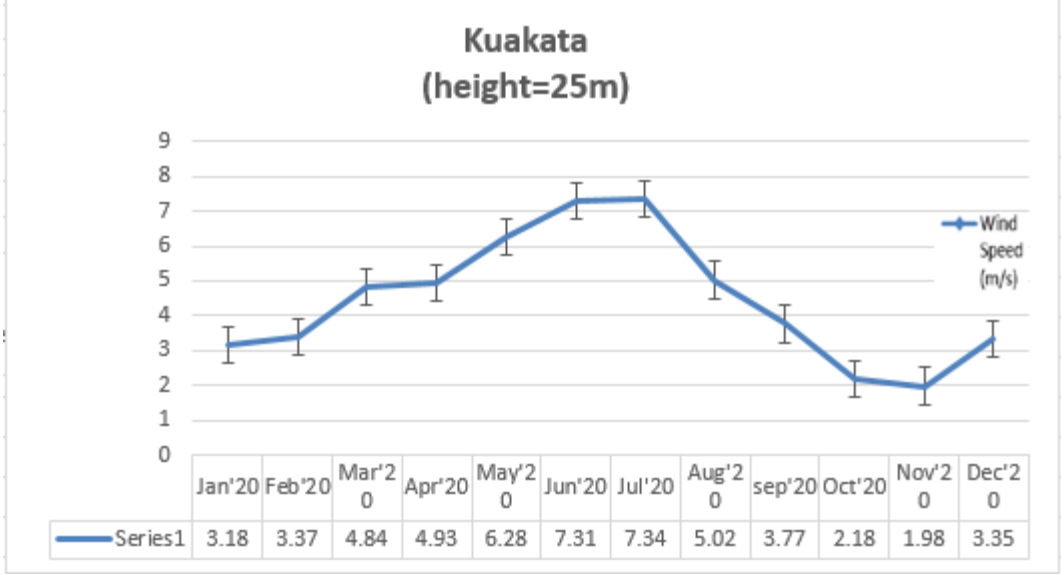


Figure 4.3. (e): Monthly average wind speed at Kuakata

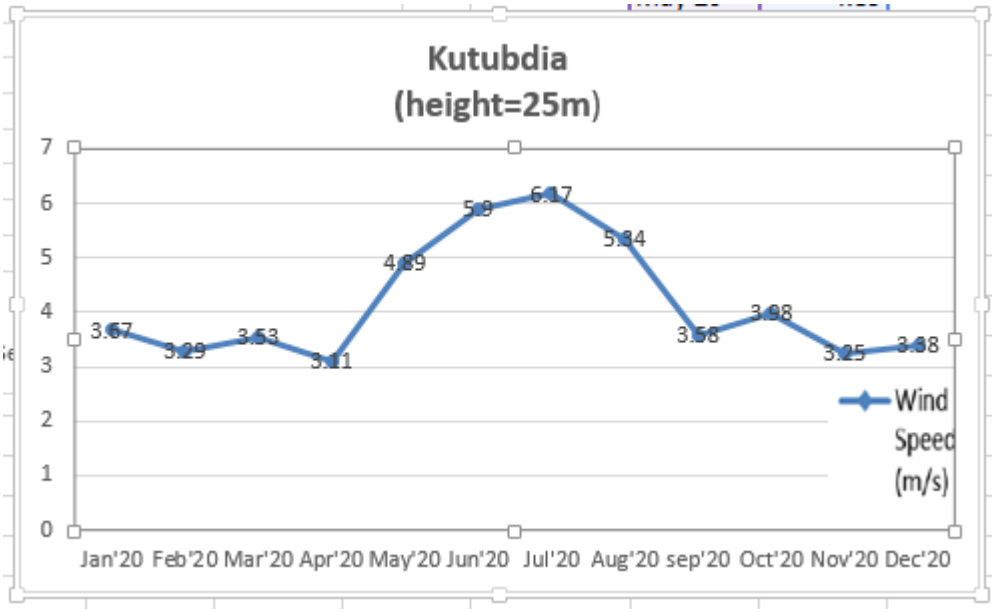


Figure 4.3. (f): Monthly average wind speed at Kutubdia

are the front part of the Bay of Bengal. According to this review, monthly wind speed varies from 3m / sec to 5m / sec. Teknaf has the best wind speed and minimum air speed. It could be that, in almost six places, the air vapor can be mixed in every place.

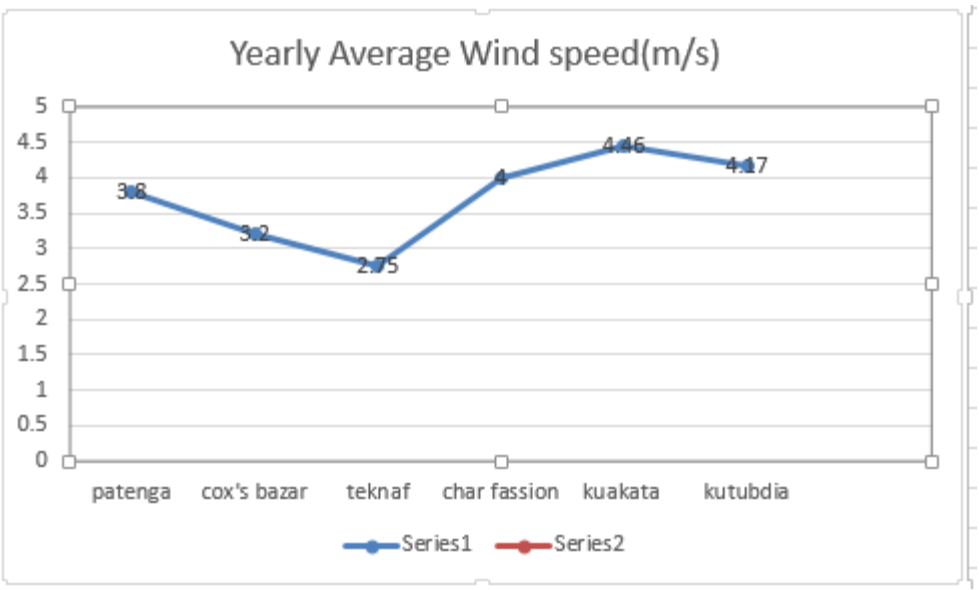


Figure 4.3. (g)**:** Yearly Average Wind Speed at six WEST stations at 25 m height

4.4. Working Principle of a Wind Turbine

The majority of wind turbines consist of three blades mounted to a tower made from tubular steel. There are less common varieties with two blades, or with concrete or steel lattice towers. At 100 feet or more above the ground, the tower allows the turbine to take advantage of faster wind speeds found at higher altitudes.

Turbines catch the wind's energy with their propeller-like blades, which act much like an airplane wing. When the wind blows, a pocket of low-pressure air forms on one side of the blade. The low-pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called lift. The force of the lift is much stronger than the wind's force against the front side of the blade, which is called drag. The combination of lift and drag causes the rotor to spin like a propeller.

A series of gears increase the rotation of the rotor from about 18 revolutions a minute to roughly 1,800 revolutions per minute -- a speed that allows the turbine’s generator to produce AC electricity.

A streamlined enclosure called a nacelle houses key turbine components -- usually including the gears, rotor and generator -- are found within a housing called the nacelle. Sitting atop the turbine tower, some nacelles are large enough for a helicopter to land on.

Another key component is the turbine’s controller that keeps the rotor speeds from exceeding 55 mph to avoid damage by high winds. An anemometer continuously measures wind speed and transmits the data to the controller. A brake, also housed in the nacelle, stops the rotor mechanically, electrically or hydraulically in emergencies. Explore the interactive graphic above to learn more about the mechanics of wind turbines

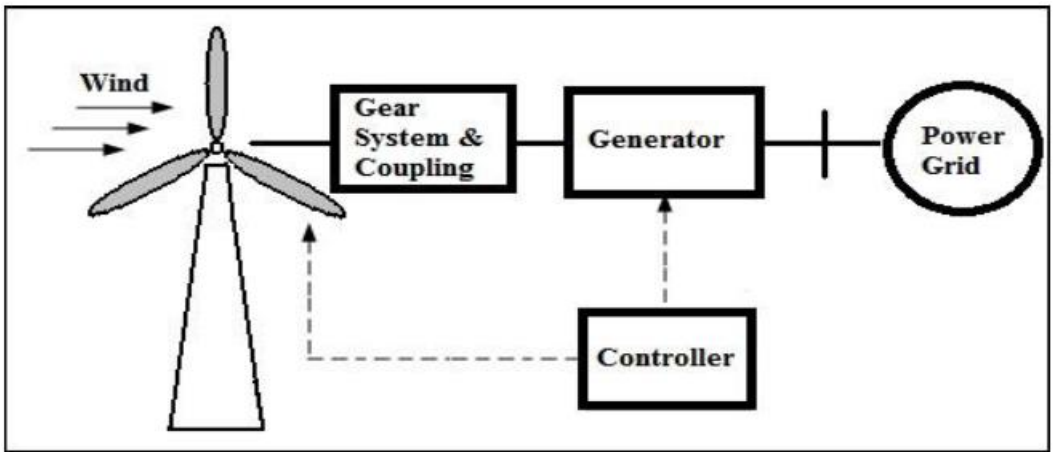


Figure 4.4: Flow Diagram of a Wind Turbine System

Here,

1) Wind turbine : Rolling twist (mechanical) into biological transformation.
2) Gear framework and coupling: it increases speed and sends the generator to the rotator
3) Generator: Rolling organic conversion into electrical biology.
4) Controller: Start the signs of proper control for air courses, wind speed, generator yield and temperature sensitivity and control. There are two essential types
5) Wind turbine (WT): Even hub wind turbine (HAWT) and vertical pivot wind turbine (VAWT).

Figure 4.4. (a): HAWT Figure Figure 4.4. (b): VAWT

Figures 4.4.(a) and 4.4.(b) demonstrate HAWT and VAWT individually.

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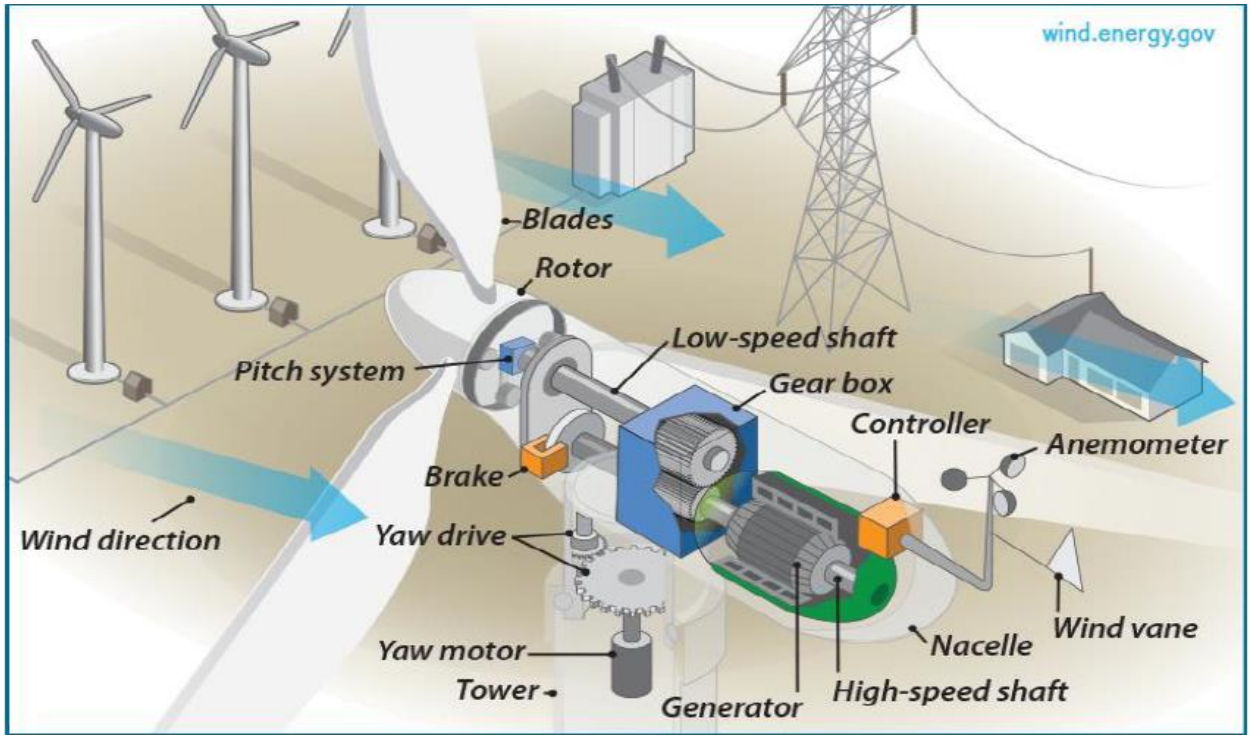

Figure 4.4.(c): Components of a WT

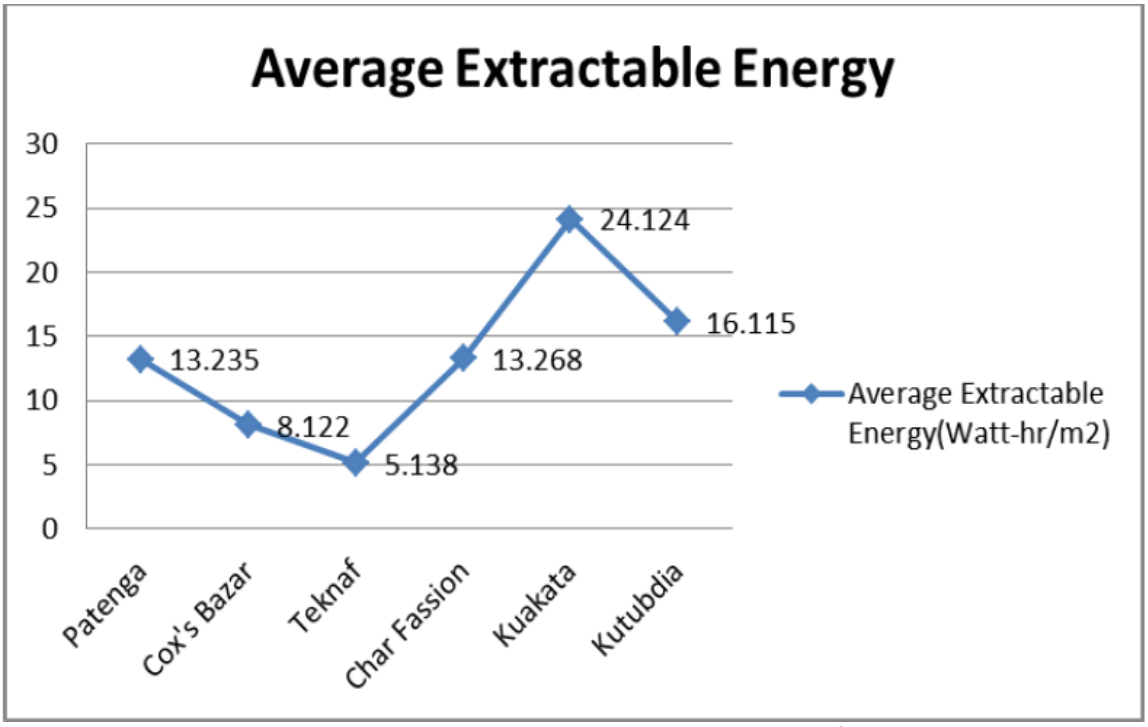

Figure 4.4(d): Average Extractable Wind Energy in Watt-hr/m^2at six WEST stations.

4.5 The Theory of WT

WT works by changing the animated dynamic twists rolling up to the electric germ. Depending on the wind speed and the clear area accessible to the turbine, most of the parts change. Power can be recognized P=$\frac{1}{2}\rho AV^3C_p$

According to extreme energy efficiency in any system, Bits Limit or Bit Act 16/27 or 0,59 worldwide. In other words, 52 percent of the wind can be eradicated by the World Bank. Bits are limited in the real world to daily averages of 3.55-0.45 per ordinary WTs. The pace, barrier, and work marks change. A HAWT was taken into account for our motivation. A HAWT body shows steps

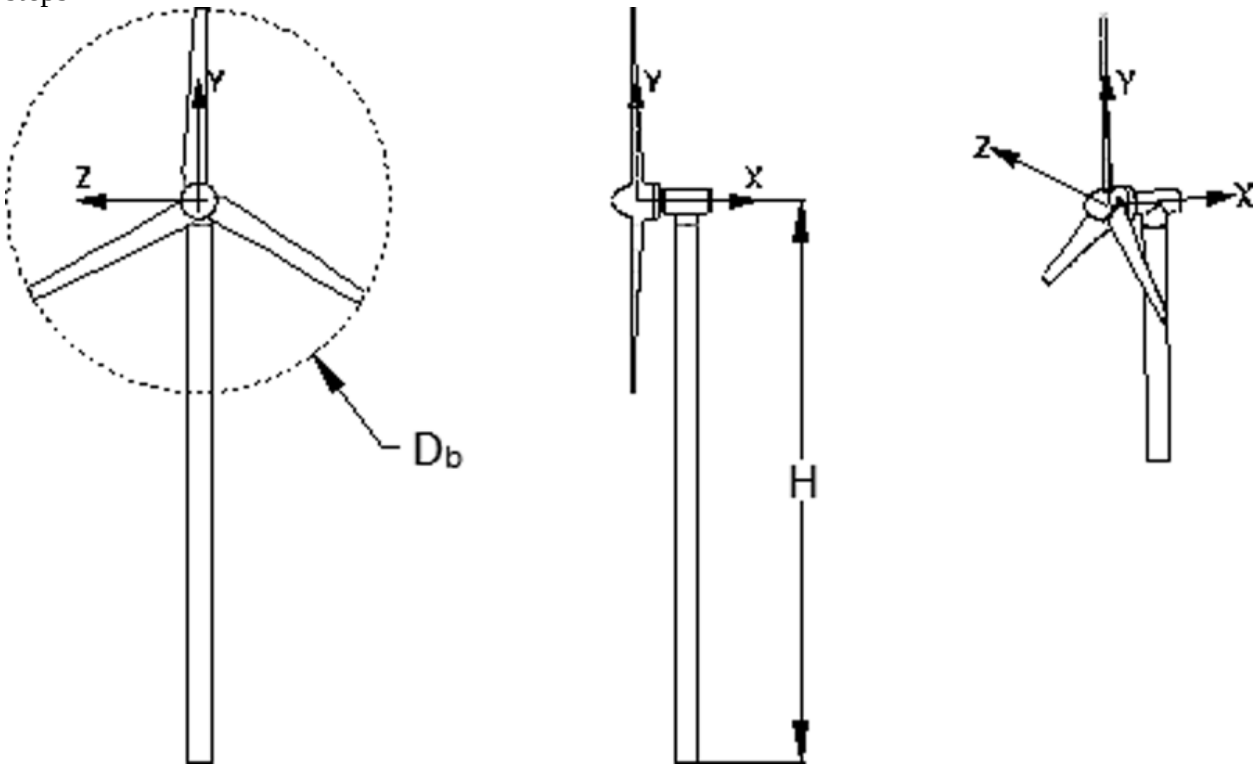

Figure 4.5.(a): Dimensions of the Body of a HAWT

Here,
P= Power Generation (W)
ρ = Density of wind (kg/m^3)
A= Swept area (m^2)
r = Radius (m)
V= Velocity of wind (m/s)
C_p=Power coefficient

Near the coast, wind turbines cover approximately three kilometers. There is a sharp cultivation. This area is critical for wind farming, which makes the weight of the air differently. They could generate more power along these lines. Figure 10 reveals a wind farm near to the coast.

Figure 4.5.(b): Near Shore Wind Farm

In order to maximize power, two water lines, two lines and two HAWT hope columns were taken into account in the front of the sea like our closest wind farms. Turbines split the 7 DT into the general winds, and the 3D stretches around the gap in the opposite direction. Figure 11 WT applies to the wind farming of the surrounding sea.

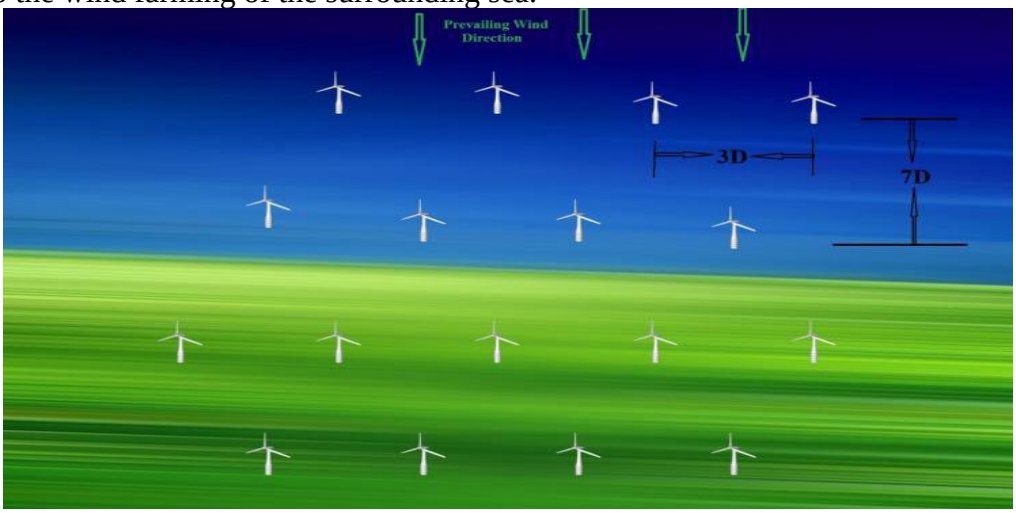

Figure 4.5.(c): Placement of WT in the Near Shore Wind Farm considered.

Our complete beach has a headland area of 574 kilometers. For wind turbines we have taken a half of the sea front zone (28,700 m) and are considering planning operations, business facilities and a 30% more area for safe employee homes and offices. [22] Normal wind velocity has been found to be as high. The extraction capacity is therefore increased. Qi kata 25 meter normal wind 4.463 m / second velocity. At 50 meters in height, normal wind speed is up 6,734 meters per second. Clearly, the air traffic level is older. The connection between the title length and the air control is strengthened. The turbines have a maximum height of 140 m and a rotor diameter of 107 m. According to the wind speed of 5 ° /22 with a distance from the edge, d = 35 m, hour = high, H = 35 m and D = 25 m first supposition. The h = 60 meters, for d = 50 meters. The pace at these three stairs is 7 m / sec, H = 80 m, D = 60 m and H = 100 m, and D = 75 m.

Chapter-5

Solar Energy

5.1 Solar Energy

In essence, solar power is the energy provided by the sun. This energy is like solar radiation that makes solar power generation possible. Basically photovoltaic, PV, panel power can be generated. These cells are made from materials that show the "photo-voltaic impact" i.e. the photons of light energize and cause electrons in the cell to stream, generate power. Solar energy generates energy in search of – especially during hot days when the demand for power from forced air systems rises. Used, solar power does not cause spills. One megawatt hour of solar energy is equal to 0.75 to 1 ton of solar energy.

5.2 Temperature on the Surface of the Sun

The temperature in the photosphere is about 10,000 degrees F (5,500 degrees C). It is here that the sun's radiation is detected as visible light. Sunspots on the photosphere are cooler and darker than the surrounding area. At the center of big sunspots the temperature can be as low as 7,300 degrees F (4,000 degrees C)

5.2.1 The Extraterrestrial Radiation

Extraterrestrial Radiation. Solar **radiation** incident outside the earth's atmosphere is called **extraterrestrial radiation**. On average **the extraterrestrial irradiance** is 1361 Watts/meter^2 (W/m^2). This value varies by ±3% as the earth orbits the sun

• Ultraviolet area (L <0.38 mm). Sunlight-based radiation layer 7%
• Visible area (0.38 <L <0.78 mm) percent radiation 47.3%.
• Providing infrared area (l> 0.78 mm), 45.7%

ON extractor (1 + 360 n / 0.033 cus) is considered to be the almost plane radiation of the outer universe, at all times the ICC supplies based on sun and ion. On January 1, the sun's first N = 1 10 solar radiation in the same area of the opposite planet, which is observed from the sun, differs from the radiation of this field.

The WRC has approximately 0,75 to one ton oscillated in 1367W/ m ^ 2,2.

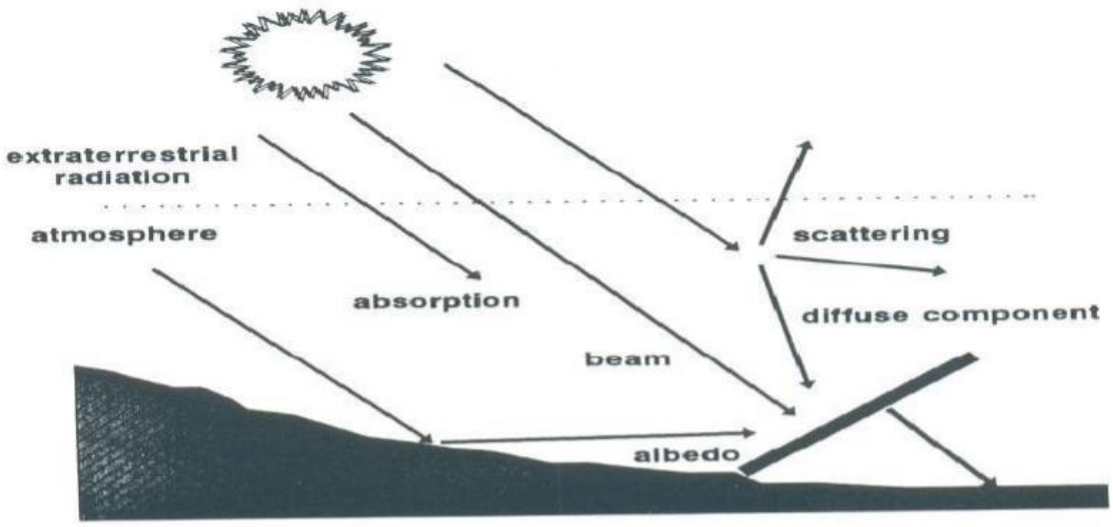

Figure 5.2.1: Extraterrestrial radiation

5.2.2 Equation of time

E = 229.2(0.000075+0.001868 B- 0.032077 sin B - 0.014615 cos 2B 0.04089sin2B)
Where, B = (n-1)360/365 and n is the day of the year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
4.02	4.64	5.01	5.37	4.83	4.22	4.00	4.13	4.15	4.23	4.04	3.80	4.37

Table 5.2.2: Monthly averaged daily global radiation (kWh/m2/day)

5.2.3 Conversion of Sunlight into Electricity

Solar-powered photovoltaic (PV) panels convert the sun's rays into electricity by exciting electrons in silicon cells using the photons of light from the sun. This electricity can then be used to supply renewable energy to your home or business And there is another way to use this abundant energy source: photovoltaic (photo = light, voltaic = electricity formed through chemical reaction) solar cells, which allow us to convert sunlight directly into electricity.

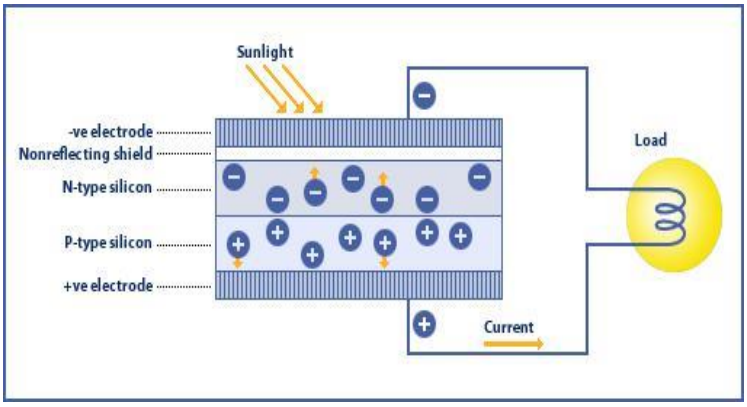

Figure 5.2.3(a): Conversion of sunlight into electricity

When the sunlight decreases in Figure 2-2, an electron becomes slower and the n-type tugs are dragged. It creates more negative electrons between the n-type semiconductor and more positive electrons, which creates the type of flow of type P-type - which is known as photovoltaic effect.

Figure 5.2.3(b): Sun Earth Relation-1

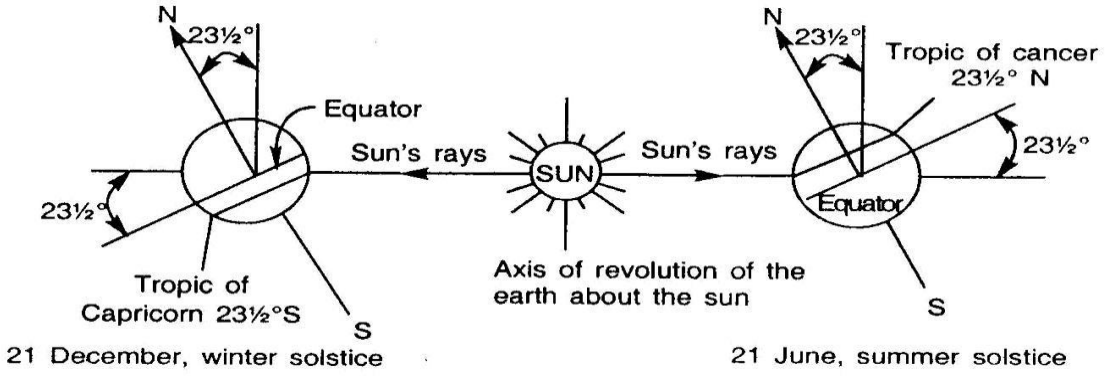

Figure 5.2.3(c): Sun Earth Relation-2

5.2.4 Energy

The 2 basic structures of the planet are vivid, warm and cold. Enjoying ample returns everyday to travel around the world consistently. The life of the sun crosses 4 x 1018, every year. 4 x 1018 cheeks / annuity µ 365 days / year = 1 x 1016 cheeks / day. 1 x 1016 jellies per day¨24 hours a day = 4 x 1014 jellies a hour. The total population will invest roughly 3 x 1014 joys per year.4.3 Solar Power System

Solar power works by converting light from the sun into electricity. ... This is done by installing solar panels on your roof which generate DC (Direct Current) electricity. This is then fed into a solar inverter which converts the DC electricity from your solar panels into AC (Alternating Current) electricity.

5.3.1 Applications of Solar Power System

Cells, modules, panels and systems.
Space applications.
Price reductions.
Research and industrial production.
Subsidies and grid parity.
Crystalline silicon.
Thin film.
Multifunction cells

5.3.2 Photovoltaic system

A photovoltaic (PV) system consists of one or more solar panels coupled with an inverter and other electrical and mechanical devices that use the sun's energy to produce electricity. The size of PV systems can range widely from small rooftop or portable systems to large utility-scale generation plants. Solar PV systems use cells to transform sunlight to electricity. When the light reflects on the neuron, it generates an electrical field through the layers that allows the energy to flow. The higher the strength of the sun, the greater the output of energy.

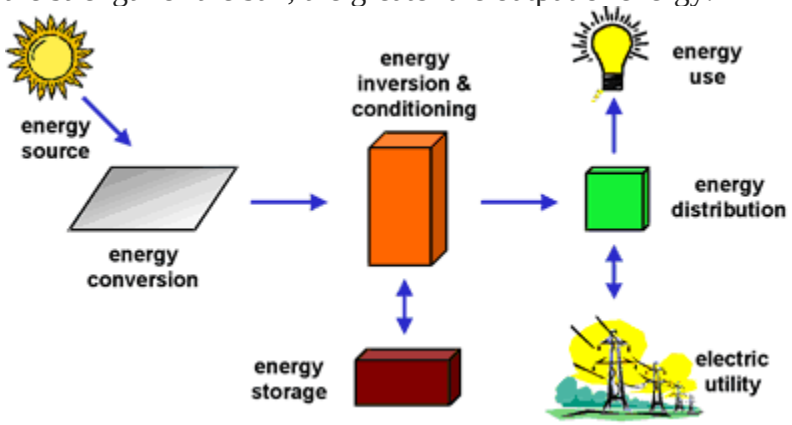

Figure 5.3.2: Solar park or PV farm

5.3.3 Photovoltaic Array:

A **photovoltaic array** is the complete power-generating unit, consisting of any number of **PV** modules and panels. Figure 1. **Photovoltaic** cells, modules, panels and **arrays**. The performance of **PV** modules and **arrays** are generally rated according to their maximum DC power output (watts) under Standard Test Conditions (STC)

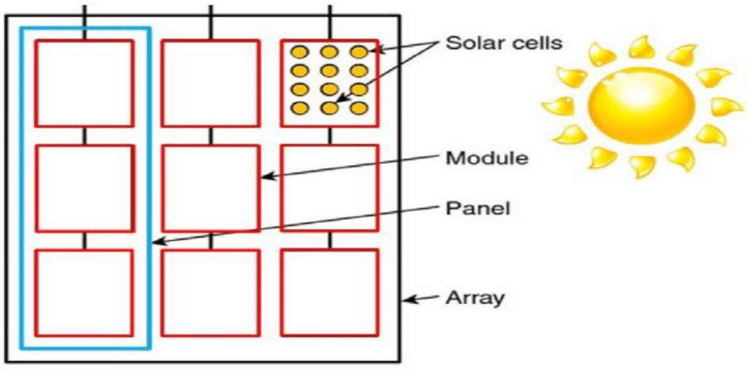

Figure5.3.3: Basic Photovoltaic Components Used to Capture Solar Energy

5.3.4 Module Circuit Design:

• Usually, with a 12V battery, a PV module voltage is perfect.
• An Intelligent Sun-powered Silicone Cell has a voltage of 0.6 ° C and a voltage of 1.5 ° C and a voltage of just 0.6 ° C. Because of the normal reduction in temperature voltage of PV modules and 15V or more battery voltage, 36 sun-based cells in most modules can be found.
• It offers a combined operating power and operating voltage of about 17 or 18V, and provides an open circuit voltage of around 21V standard test conditions..

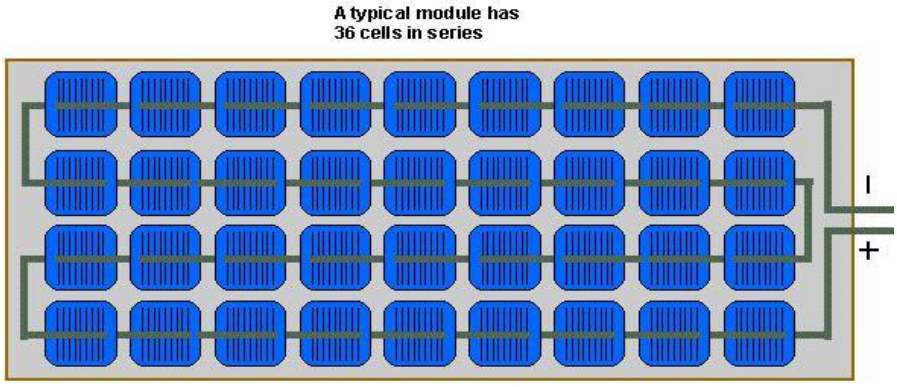

Figure 5.3.4(a): In a typical module, 36 cells are connected in series to produce a voltage sufficient to charge a 12V battery.

• Usually, with a 12V battery, a PV module voltage is perfect.
Smart Silicon Sun powered cell contains only a 0.6 ° C (25 ° C) and a 1.5 m Lighter Voltage (1.5 m). Owing to the daily decrease of the PV module voltage and battery voltage of 15V or more, 36 sun-based cells can be used in most modules.
• Open circuit tension with 21V quality test conditions and maximum operating power and operating voltage of about 17 or 18V.

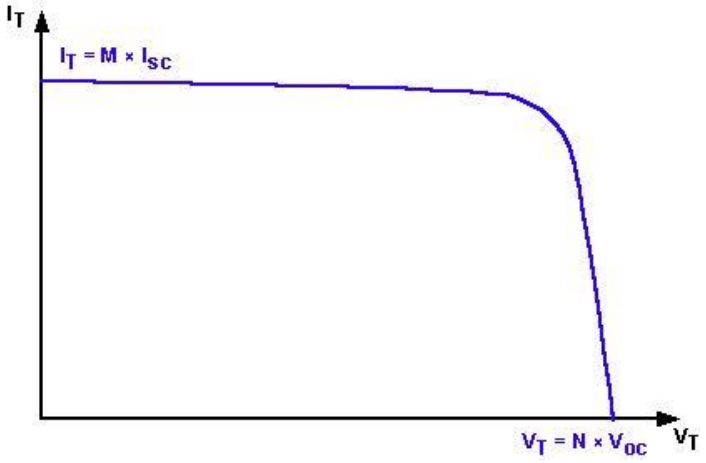

Figure 5.3.4(b): The overall IV curve of a set of identical connected solar cells.

5.3.5 Mismatch of PV cells:

Mismatch happens in PV modules where the electrical parameters of one solar cell are greatly modified from those of the remaining cells. The effect and power loss due to mismatch depends on: the PV module operating point; the circuit layout circuit setup;

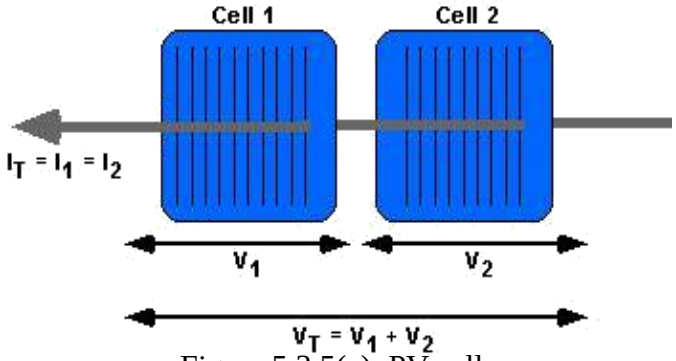

Figure 5.3.5(a): PV cells

Mismatch for Cells Connected in Series

• Besides installing the full PV modules, the most common experience is management misunderstanding. Management misunderstanding.
• Two basic forms of Crisscross
In the present short, I felt reluctant
Feel dull in an open circuit voltage
• Short current than uncertainty, since certain parts of the module can be shadowed. Short current is confusing. This kind of misunderstanding is the same
The current should be equivalent, the particle indicates the current that the total current from the design is at least equal to the current

Open Circuit Voltage Mismatch for Cells Connected in Series

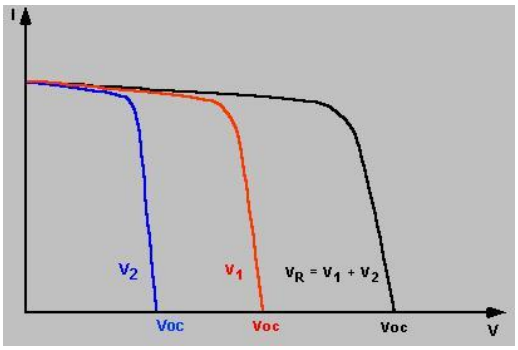

Figure 5.3.5(b): Graph of Open Circuit Voltage

In the most severe point of control, general output is decreased because the weak cell generates less electricity. The current between the two sunlight cells is the same, since the two cells are joined together, and the average voltage is associated for the two voltages at a given current.

Short-Circuit Current Mismatch for Cells Connected in Series

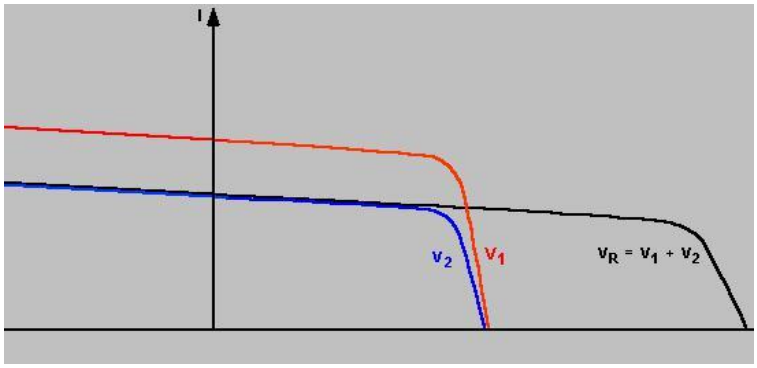

Figure 5.3.5(c): Graph of Short Circuit Current

The present bungle can be very real and very natural in arrangement with two cells. The Isc of the mix is confined to the Isc of the least cell.

• The effect of reduced short output is normally low at open circuit voltage.
• The blend's current cannot surpass the weak cell's short current.
• At low voltages, in which this condition probably occurs, the additional generating capacity of large cells is not dispersed in each cell but is spread to the poor cell.

5.3.6 Hot-Spot Heating

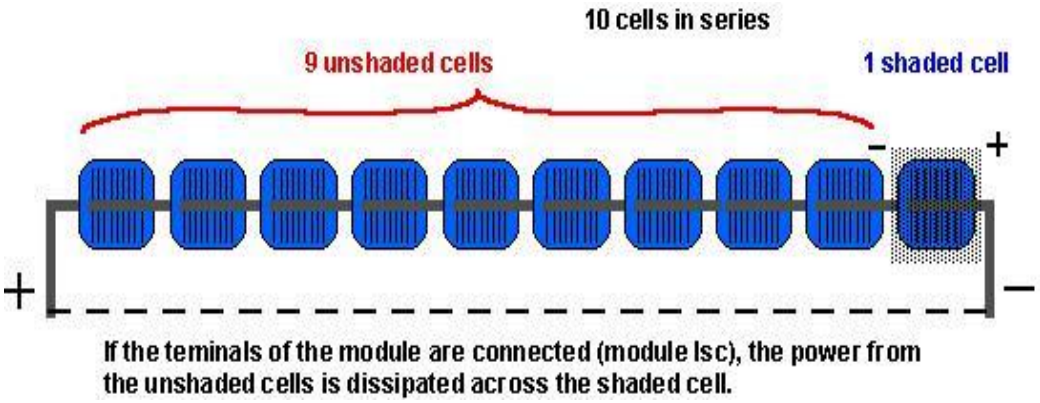

Figure 5.3.6: Module Connected to Series

• Hot point warming occurs when one sun-based cell is low current
• somewhere in a string of some large, thin, sun-oriented cells
• A shaded cell in a string lowers the current in the smaller cells so that the medium cells have higher voltages, which can also transform the terrible cell around

Problem warming occurs when a large number of cells associated with a setting create an expansive tilt over the shaded cell, which induces vast intensity dispersal in the low cell.
1. The entire limit of development of all the major cells is distributed in the bad cell. The big power dispersion in a region causes local overheating, which leads to ruinous impacts, such as cell and glass fracturing, binding liquefying, or sun-based cell debasing.

5.3.7 Blocking diode

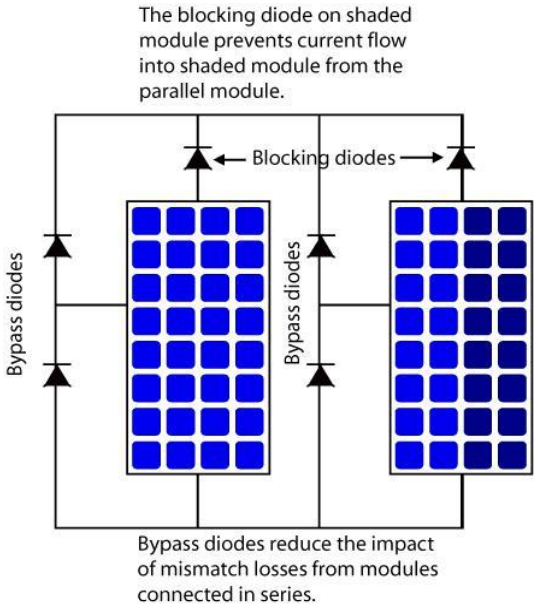

Figure 5.3.7: Circuit Diagram of Blocking Diode

5.3.8 Solar Cell:

A **solar cell**, or **photovoltaic cell**, is an electrical device that converts the energy of light directly into electricity by the **photovoltaic** effect, which is a physical and chemical phenomenon.
In this case, the phone is used as a frequent photograph identifier (for example infrared finders) to detect light or other electromagnetic radiation near the indefinite range or to detect light energy prediction.
A photovoltaic (PV) cell needs three basic properties:
2. Light Holding, Electron-Opening Set or Excel Production.
3. Reverse type of reverse type.
Those separation of external circuitry carry

5.3.8.1 Solar Cell Theory

Solar cells work in three stages:
1. Eating by daylight photos and ceramicon materials on solar boards, for example, silicon.

2. Electron (reverse charge) is thumped to free from their molecules, causing the difference of an electrical potential. The flow starts through coursing through potential drop material and this capability is caught. Due to unique solar cells, electrons allow only neutral bearing transfer.
3. A direct flow of solar cells (DC) shows the change in electricity efficient solar biology.

5.3.8.2 Solar Energy Uses

Solar energy uses in various respects. Such as:
As heat for making hot **water**, heating buildings and **cooking**.
To generate electricity with solar cells or heat engines.
To take the **salt** away from sea **water**.
To use sun rays for drying clothes and towels.
It is used by plants for the process of photosynthesis.

5.4 Aspects of Solar Energy in Bangladesh

Reduce greenhouse gas emissions by up to 20% generate domestic employment of up to 55,000 full-time equivalent jobs. Potential to produce additional **electricity** of 30 GW from the utilization of **solar** PV and 53 gigawatt (GW) of **electricity** potential from all **solar** sources. Exploration paper depends on the possibilities of solar vitality from point of view of Bangladesh. Conceivable executions of solar innovations like photovoltaic cells (PV) and Solar warm vitality (STE) are talked about with their ideal limit, effectiveness, storeroom and cost per unit control. Some social, financial and natural limitations in regard to the execution of solar innovation are featured and some conceivable arrangements are advertised.

5.4.1 Renewable Energy Statistics in Bangladesh

SL.	RE Source	Technology	Quantity	Off-grid MW	On-grid MW	Total MW
1	**Solar**	Solar Park	4	0	38.4	38.4
		Rooftop Solar Except NEM	116	14.201	27.565	41.766
		Net Metering Rooftop Solar	1039	0	16.207	16.207
		Solar Irrigation	1766	42.384	0.025	42.408
		Solar Home System	5804422	251.64	0	251.64
		Solar Minigrid	27	5.656	0	5.656
		Solar Microgrid	0	0	0	0
		Solar Nanogrid	2	0.001	0	0.001
		Solar Charging Station	14	0.262	0.016	0.278
		Solar Street Light	202017	10.59	0	10.59
		Solar Powered Telecom BTS	1933	8.06	0	8.06
		Solar Drinking Water System		0	0	0
2	**Wind**	All Wind Projects	3	2	0.9	2.9
3	**Hydro**	All Hydro Projects	1	0	230	230
4	**Biogas**	Biogas to Electricity	6	0.63	0	0.63
		Biogas Plant	76771	0	0	0
5	**Biomass**	Biomass to Electricity	1	0.4	0	0.4
Total			6088122	335.824	313.112	648.937

Table No:5.4.1.1

Statics of Solar Technologies:
Total Installed Capacity: **415.007** MW
Off-grid Installed Capacity **332.79** MW
On-grid Installed Capacity **82.212** MW

5.4.2 Solar Technologies In Bangladesh:

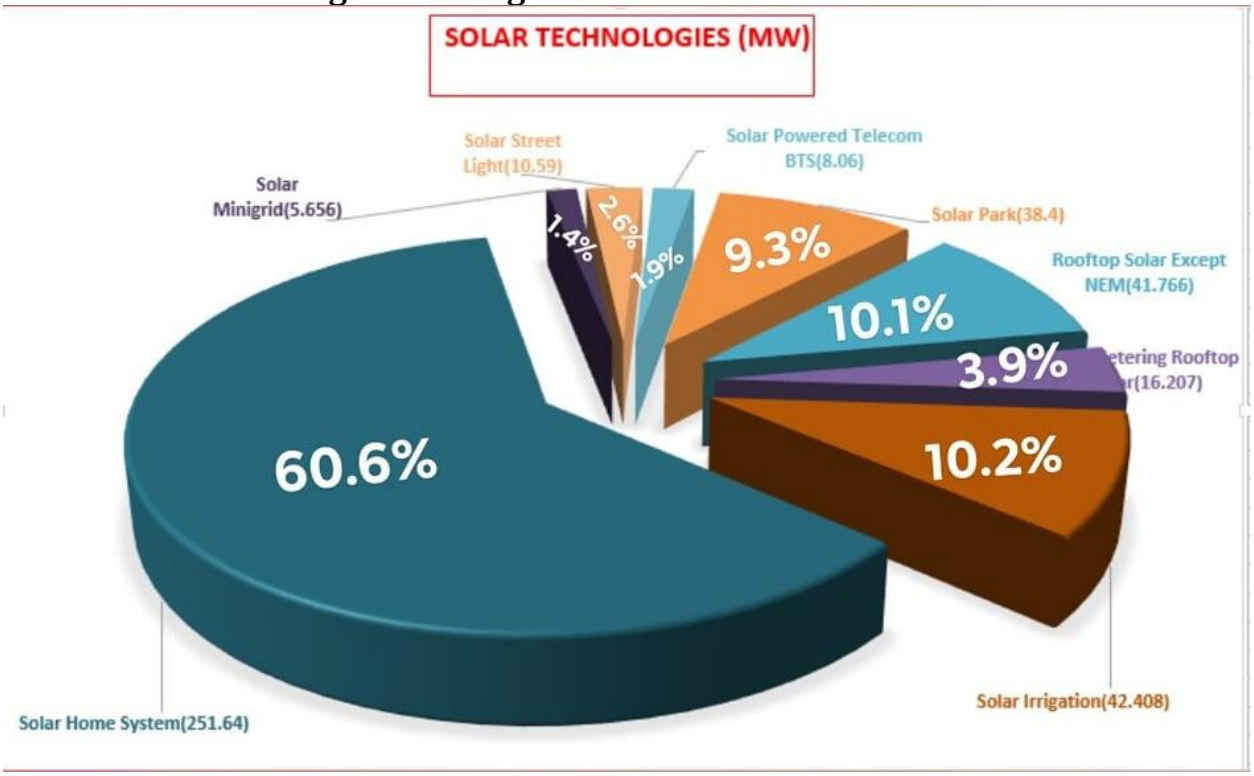

Figure 5.4.2. Solar Technologies

5.4.3 Crisis of Power in Bangladesh

The crisis of power is one of the main issues in Bangladesh. Day after day, the difference between demand and supply is growing. In comparison, most power stations are gas-based, and will be phased out in the future. Misuse, machine malfunction and corruption in the power sector are at the core of this problem.

- Some plants are out of activity for support,
- Rehabilitation and Overhaul
- Due to the capacity of maturing plants due to various plants
- Lack of Gas.

5.1.1.1 Data on power crisis in Bangladesh

Year	Installed capacity (MV)	Generation Capability (MW)	Demand forecast (MV)	Load Shedding (MV)
2003-04	4680	3592	4259	694
2004-05	4685	3782	4375	800
2005-06	4690	3810	4490	1312
2006-07	4693	3849	4550	1212
2007-08	5466	4415	4800	385

Table: 5.4.3.1 Data on power crisis in Bangladesh

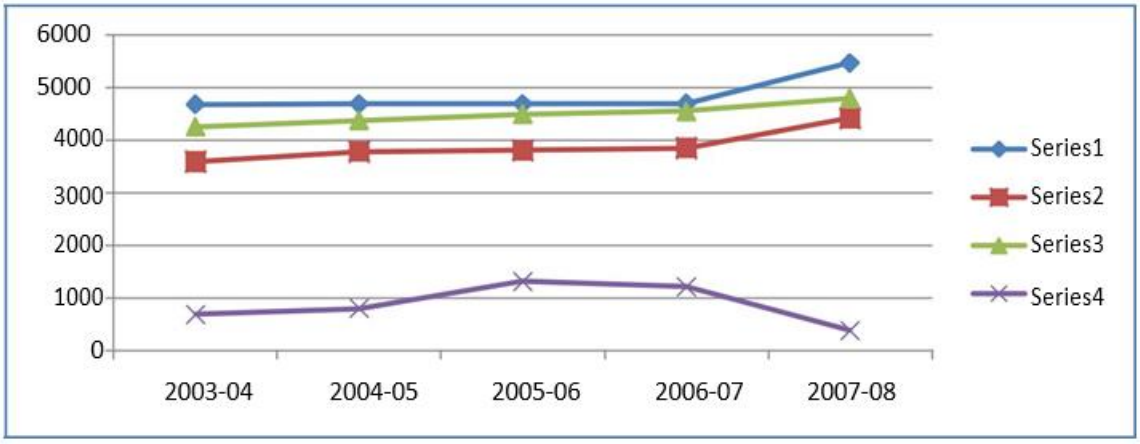

Figure 5.4.3.2: Graph of Power Crisis

5.4.4 Solar Energy Project

Solar energy is nothing but the radiant **energy** emitted by Sun. We may convert this **solar energy** into electricity either directly using photovoltaic (PV), or indirectly using concentrated **solar** power (CSP) with the help of lenses or mirrors and tracking systems to focus a large area of sunlight.

Design of Solar Inverter Circuit for Homes: The concept of this project is to help hobbyists build their own solar inverter to transform the energy generated (DC) from the solar panel into household appliances (AC Power) using fewer components.

Design of Energy Efficient Sensors: This paper focuses on generation of electricity through photo voltaic cells using dual axis system.

Solar Bag: This is simple solar bag project. Using this bag one can charge all the devices with a removable power bank.

Solar Night Light: Solar night lamp uses the solar energy to power up the night lamp.

How to make a solar car: This project shows the making of a simple solar car.

Solar UPS Controller/ Automatic Transfer Switch: This project shows a small box which can utilize the solar energy in a small scale. It has Wi-Fi and hooks into home automation.
Design of Solar Energy Meter: It is a simple project which determines the energy generated by the solar panel. If the solar power generated is sufficient to drive the load, this circuit doesn't allow the power from AC line otherwise remaining amount (in case of less power from PV cells) will be drawn from AC load.
Solar Powered Fans: This article shows the conversion of battery powered fans into solar power fans.

5.4.5 Development in Solar Energy Program

Off-grid solar home systems are improving living standards for people in rural areas of Bangladesh.
Bangladesh has one of the world's largest domestic solar energy programmes.
Solar power is changing the lives of 20 million people in rural areas, who can now work, study and go out after dark.
In Bangladesh, more than a quarter of the rural population still do not have access to electricity. For millions of people, daily activities like cooking, working and studying are difficult, or even impossible, after sundown.
But off-grid solar power is rapidly changing all this.
Have you read?
Rural Bangladesh has already embraced renewable energy. Here's what the rest of the world can learn
Here's what you need to know about Bangladesh's rocketing economy
India is now producing the world's cheapest solar power
Bangladesh has one of the world's largest domestic solar energy programmers. The World Bank and other development organizations, along with the private sector, are working with the government to bring affordable, solar-powered electricity to places where the traditional grid doesn't reach.
Small-scale solar home systems now provide electricity to more than 4 million households and about 20 million people in rural areas, roughly one-eighth of the country's population.
The programme has also introduced 1,000 solar irrigation pumps and 13 solar mini-grids.
.

5.4.6 Solar Home Systems in Rural Bangladesh

In 2000, 68 percent of the Bangladeshi population had no permanent access to electricity.[1] As part of its response to the UN's Millennium Development Goals (MDGs), the Bangladeshi government set a target of providing electricity to all its citizens by 2020.
However, a combination of limited access to infrastructure and the dispersed nature of rural settlements has provided significant obstacles to achieving universal electrification. Therefore, the Bangladeshi government considered off-grid renewable energy technology to be one of the best options for bringing electricity to rural areas, where more than 70 percent of the population live.

5.4.7 Overview on Villages and Household Characteristics

Bases of social **organization**: ...
Group of people: ...
Definite locality: ...
Small size: ...

Importance of neighborhood: ...
Community sentiment: ...
Predominance of primary relations: ...
Joint family system:

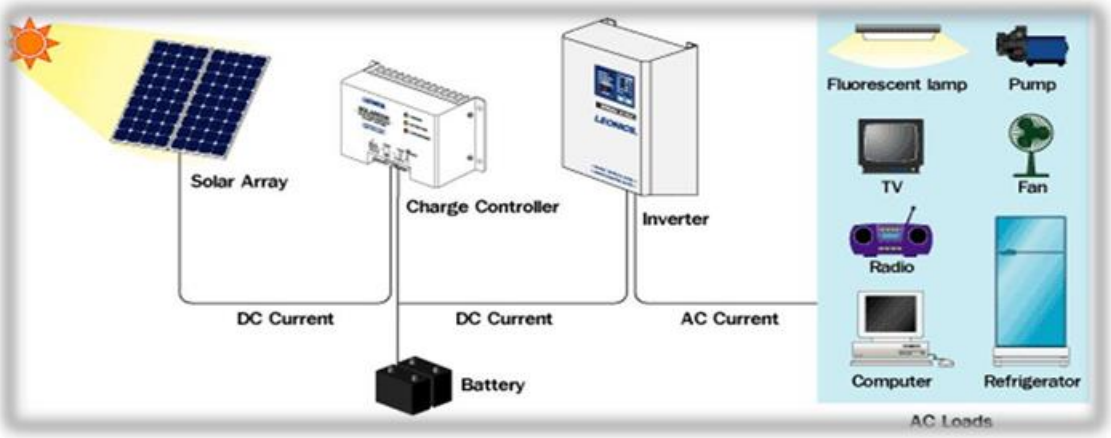

Figure 5.4.7: Solar Home Systems to Produce Light

5.5 Solar Home System Design

Basic Components:
Module
Battery
Charge Controller
Load

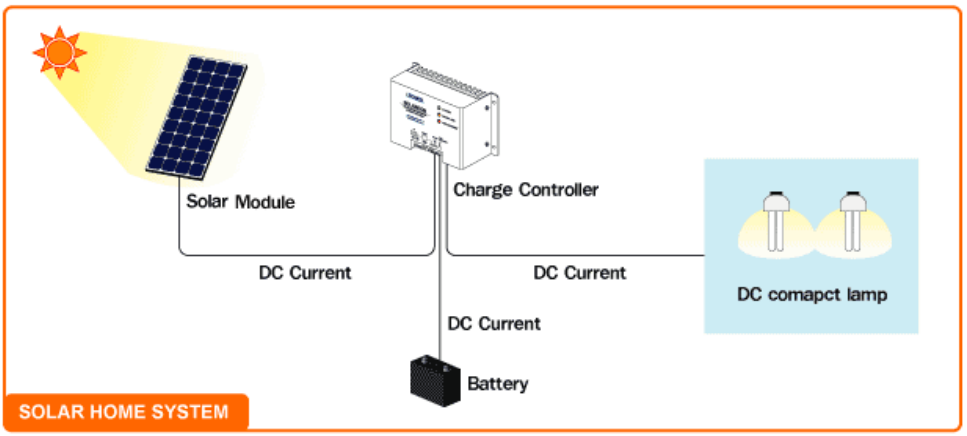

Figure 5.5: Design of Solar Home systems

5.5.1 Block Diagram of solar home system design process

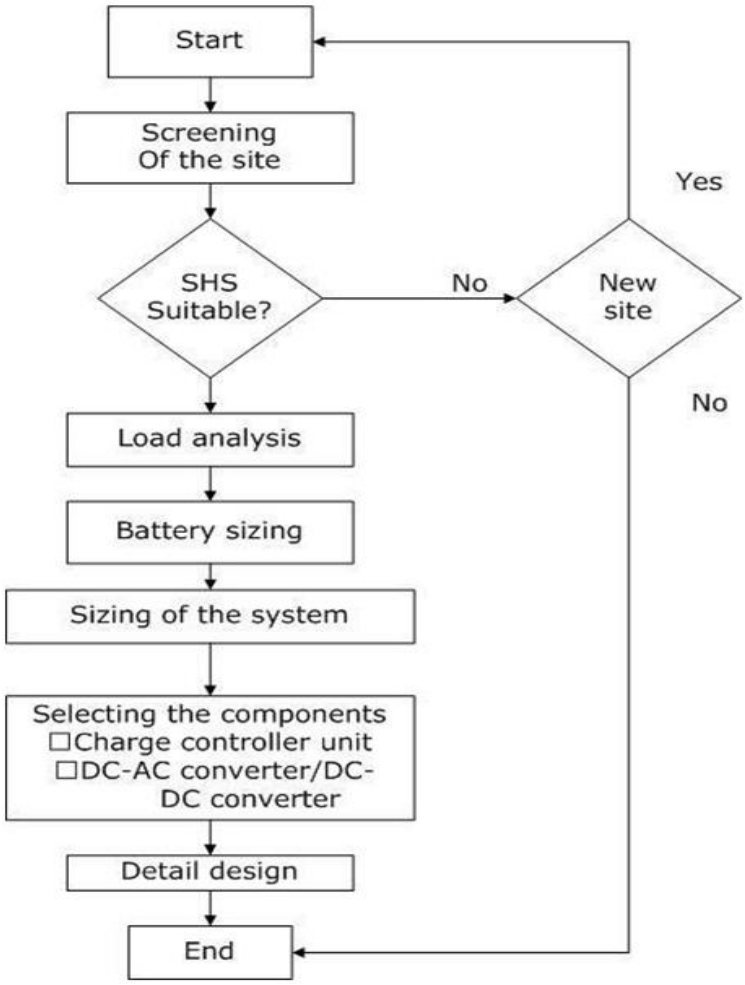

Fig 5.5.1(a):Block Diagram of solar home system design

The method of configuration for the solar home frame is shown in the diagram on top left. It begins with website screening. This means it is situated in a location where ample sunlight exists. After the stack has been evaluated and weighed in the first step of that level. By that time, the charge control unit and the voltage converter, for instance, (if necessary) are selected for various sections of the system. The whole structure is designed in the configuration along this line.

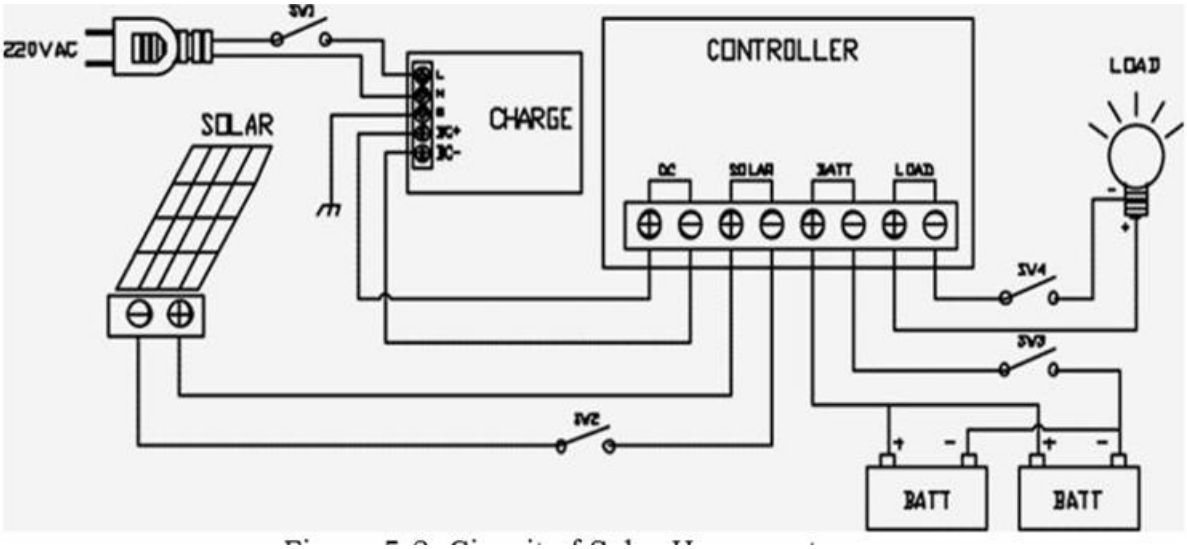

Fig 5.5.1(b): Circuit of Solar Home System

5.6 Site Screening

Selecting the right site for your project is a prerequisite for success. UL uses site screening tools and long-term solar insolation to determine resource potential and identify new opportunities for solar energy development. When evaluating sites, we look at numerous criteria such as solar resource characteristics
Existing land use and area
Proximity to transmission
Thermal screening for line excess capacity
Shading impacts and other important siting parameters
.

5.7 Load Determination

To find out the daily average load, A family consists of 4 persons using TV for 5 hours, 6 Led Bulbs for 6 hours, 3 fan for 15 hours daily, Laptop for 2.5 hours.
So power requirement of various types of loads are given bellow:

Item/loads	Rated Power
Television	50W
Led Bulbs	10W
Electric Fan	60 W
Laptop	70W

Table 5.7: various types of loads

Solution:
The daily energy needed for the given family =5*50+2.5*70+3*15*60+6*6*10

= 3,485 Wh
=3.485 KWh

5.8 Battery Sizing

The battery should be large enough to store sufficient energy to operate the appliances at night and cloudy days. To find out the size of battery, calculate as follows: 5.1 Calculate total Watt-hours per day used by appliances. 5.2 Divide the total Watt-hours per day used by 0.85 for battery loss

5.9 Array Sizing

Array sizing of a PV system means the calculation of the number of PV modules.

5.10 Selection of Charge Controller

Functional parameter of solar home system charge controller

• PV panel receives maximum current
• Capacity to provide full load power
• Mark the low level of voltage
• Mark the level of high voltage
• Thunder electrical defense
• Well regulated
• Reverse polarity security •
• Machine voltage change

5.11 Selection of Converter

High efficiency and low power losses are the most important considerations in the **selection** of a DC/DC **converter**. The efficiency curve, see datasheet, plays a major role and, as shown in the graph (Fig. 5.2), the optimum operating point is mostly found in the mid-range area of the output current (red box).

5.12 System Wiring

Electrical **wiring** is the electrical power distribution through the **wires** in a perfect manner for economic use of **wiring** conductors inside a room or building with better load control. Electrical **wiring system** is classified into five categories: ... Conduit **wiring**. Concealed **wiring**

• The system must be safe
• This system is not created in error for system performance
• Each material works according to their maximum performance
• Use centralized 12volt DC system if possible
• If possible, use the central 24volt DC system

5.13 Wire Standard Size

Cross Section area (mm^2)	Wire Gauge (AWG or SWG)	Current Rating (A)
1.0	18	10
1.5	16	15
2.5	14	20

4.0	12	30
6.0	10	35
10.0	8	50
16.0	6	70
25.0	4	90

Table 5.13(a): Standard Size of wire

Cable Size (mm^2)	Maximum Cable Length (m) for Various Load Requirement							
	Load Power (W)	24	36	48	60	72	96	120
	Current at 12 v (A)	2	3	4	5	6	8	10
1.5		12	8	7	5	5	4	3
2.5		20	13	10	8	7	6	5
4.0		31	21	16	13	11	8	7
6.0		46	31	23	19	16	12	10
10		76	51	38	31	26	20	16

Table 5.13(b): Maximum length of wire for 0.6 volt drop in 12 volt system

Cable Size (mm^2)	Maximum Cable Length (m) for Various Load Requirement							
	Load Power (W)	48	72	96	120	144	192	240

	Current at 12 v (A)	2	3	4	5	6	8	10
1.5		23	16	12	10	8	7	5
2.5		38	26	20	16	13	10	8
4.0		61	41	31	25	21	16	13
6.0		91	61	46	37	31	23	19
10		151	101	76	61	51	38	31

Table 5.13(c): Maximum length of wire for 1.2 volt drop in 12 volt system

5.14 A small size 12 volt Home System Design

Let, Load determination for 3485 Wh/Day design a 12 volt solar home system. Here 100Wp module (Isc = 9.02A, Imp = 8.33A & nominal voltage=12), 660 Ah battery (DOD = 60%, Efficiency=80%) will use.

Cabal voltage drop maximum 5%
Maximum power loss 5%
Inverter efficiency 90%

Battery size
DC Wh/day = 3485 ÷ (0.9*0.95)
=Wh Daily load
= 4076.02 Wh ÷ 12V
=339.67Ah Battery efficiency = 80%
DOD (Depth of Discharge)= 60%
If autonomy of battery 3 day

So Amp-hour for battery = (339.67*3)÷(0.6*0.8)
= 2122.94Ah Number of battery required
= 2122.94 ÷ 660 = 3.21 ≈ 4
So 4 batteries are needed.
Each one is 660Ah.

Array sizing

Daily PV module output = 12*8.33*6
= 599.76 Wh/day
≈ 600 Wh/day Module nominal voltage
= 12V Daily avg. pick insulation = 6 hours
Summarizing 15% loss PV Array Sizing= 600*0.15 =90Wh
DC watt-hours Available = 600-90Wh = 510Wh
So no. of module = 3485/510 = 6.83 ≈ 7

Inverter size
Size of the inverter = 355/ (.9) *1.25 = 493.06W ≈
500W So 500W inverter is needed

Si No	Description of items	BDT
1	Solar Panel (7)	42000
2	Battery (4)	24000
3	Charge Controller	2500
4	Wire	3000
5	Panel Mounting	5000
6	Miscellaneous	2000
7	Maintenance Cost (Labor & Other)	17000
	Total	95500

Table 5.14: Cost of Solar Power System (3.546 kw-h)

5.15 Cost of Power from DESCO (3.546 kw-h)

Per Unit Cost of power from DESCO ≈ BDT 7 Per year cost of power from DESCO= BDT 6360 Tk
Total cost for 20 Years (without considering any maintenance cost)
=BDT 6360×20
= BDT 127200 Tk

Comparison	Solar Home System	Power From DESCO
Cost	Total Cost for 20 Years = BDT 95500 TK	Total Cost for 20 years (without considering any maintenance cost) = BDT 6360*20 = BDT 127200 TK
Load Shedding	No	Yes
Cost Variation Due Time	No	Yes
Utility Bills	Low	High
Buck up Capability	Around 4 Day	No
Source Of production	Sunlight (No green House Gasses)	Coil, Burning, Gas, Water, Garbage etc.

Table 5.15: Comparison between Solar Home System and Power from DESCO

5.16 Identifying Direct Costs

Direct costs items are usually classified into two types:

Capital costs
Operating and maintenance Costs

Capital costs
o Countries and other natural resources with alternative uses

o Engineering and design details
o Work on pre-installation
o Cost of building machinery, raw materials and supplies
o Maintenance expenses and auxiliary facilities
o Building engineering and maintenance costs
o Costs of organization
o Operating costs in cycles
o Eventuals

Operating and maintenance Cost

• Rough and other materials •
• Oil and electricity
• Work;
• And insurance and rent
• Shrinking natural capital
• Possibility.
• The above items would have been identified and expressed in the financial report. Technical research
• Price of sinking
• Assessment of the project was previously expended.
• Ideas sense
• Those prices represent scarcity and outages, relative limitations or availability of project inputs.
o Eventual

5.17 Advantage of Solar Home System

1. Electric bills save money right away

• The complex installation of a solar home system reduces the energy costs substantially. Most Zamindars save about 30% of electricity
• Even elimination of their electric bill
• 3,546 daily electricity is used by a typical family in Bangladesh. Your electricity consumption will be compensated by an 840 kilowatt solar installation a month from the renewable energy company.
The energy needs of your house, the available space for the photovoltaic system and the modification of your PV system will affect your current savings. For analysis and estimates, please contact the Renewable Energy Corporation.
Reduce Your Carbon Footprint
• The average American household produces a annual energy output of 7.4 tons of carbon dioxide (CO2).
• That is equal to 185 tons, or as long as Solar World solar panels are expected to work for 25 years.
• Carbon dioxide generates a dramatic global warming impact
• Our ice loss climate, coastal erosion and the endangerment of many species

The world. The world around.

. Conserve Our Natural Resources

Each hour enough sunlight hits the earth to power the world for year.

That‘s 400 trillion gig watts per second and enough to power 400 quintillion homes.

Putting the sun to work reduces the amount of coal and nuclear energy needed to power your home which helps preserve the earth‘s supply of non-renewable resources.
Coal and nuclear energy production consume vast amounts of water. Consequently, solar on your home can conserve over 16,000 gallons of water per year.

5.18 Limitation of Solar Home System

• Limited supplier number and lack of solar technology experience, resulting in high SHS prices. Therefore, the technology demand must be increased
• Occasionally sunshine is not available during the Rainy season.
• Initial costs are high which is why it can't be handled by any middle class families.

• The panel has to be changed if the solar panel is damaged.

Chapter 6

CONCLUSION

This paper deals more about how Bangladesh uses and operates about renewable energy such as solar energy and wind power. Here we analyze all our energy scenarios and seek to solve the renewable energy issue. Bangladesh's energy situation is extremely costly with nuclear, coal and gas power stations. Such plants are so effective in the environment that they damage our green ecosystem. All three power sources sadly have three faults. Coal and fossil petroleum fuels, thus reducing the internal amount. This fuel is heavily polluted and can't establish a base for a community that is entirely sustainable. Many major sources, hydropower, are the result of adverse effects on local aquatic animals in various waters. There is also a need to cut down on the capacity of hydroelectricity by cutting greenhouse gas emissions, one of the shortcomings that we would want to address in the future due to the extinction of the earth species. The meeting calls for the GOB programs and planning discussions to respond to demand for conventional energy From the previous report, it is clear that in every regional field, wind power plant, biogas plant and hydro power plant that need the capital to build its cost.it, we are able to solve the problem by setting up renewable resources such as the solar system. In Bangladesh's future energy demand, renewable energies will be a decisive solution.

Wind energy will also be definite to meet Bangladesh's potential energy demand with the use of the new advanced PV wind, biomass based and thermal equipment. The plant of renewables, (solar electricity, electricity from biomass, wind, etc.) provides cheap and sustainable energy supplies by providing high-quality, efficient, clean and environmentally friendly services. Engineering is becoming increasingly common each day in Bangladesh especially in the rural areas. The effect of many socio-economic advantages on the lives of our rural people is immense. In Bangladesh. However, other constraints such as high manufacturing costs, the lack of adequate battery support due to dust and rainy season. For school, recreation and commuting, renewables will have better service facilities

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