

A Study on Future aspects of Renewable Energy in Bangladesh

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APPROVAL

This thesis titled “**A Study on Future aspects of Renewable Energy in Bangladesh**”, was submitted by **Mahmudul-Hasan** to the Department of Electrical and Electronic Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electrical and Electronic Engineering and approved as to its style and contents. The presentation has been held on

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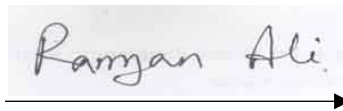
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DECLARATION

We hereby declare that this thesis has been done by us under the supervision of **Md. Ramjan Ali, Lecturer, Department of EEE**, Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for the award of any degree.

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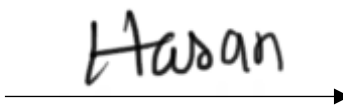
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Abstract

This thesis is on “Future aspects of Renewable Energy in Bangladesh”.

Our research paper is all about the use of renewable energy. We know that the nonrenewable energy is not good for environment. Nonrenewable energy will finish in anytime. So there is a high time to find the alternative way of nonrenewable energy. The alternative must be as like that they not pollute environment and also have the low cost possibilities. So we recommended and the researcher also recommended that renewable energy resources, because the renewable energy won't pollute environment and it has low cost also.

Bangladesh has a great geographical position like that which has a great potential of renewable energy to use it. It's a great opportunity to the perfectly use our resources. That means the renewable resources. Solar power and Hyderabad is the one of them. It is a great news and also a very important or effective for solar plant implementation. In the world, the top countries also achieved their generation system to renewable energy. Bangladesh has a great potential of the renewable energy. Biomass as like that better option also. The top countries like America, China, Germany, Argentina, and Brazil used the biomass or biofuel to fulfill their demand. In the scenario of Bangladesh, there is a big possibility. From home garbage and the waste. Because there are huge amount of villages in this country.

Finally, we can say that the renewable energy resources is the great alternative of nonrenewable energy for our country. Research must on this topic and prove that idea that renewable energy has a great potential for Bangladesh and it can be the future of Bangladesh.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction: As the population grows, the reserves of natural energy resources are dwindling, so we need to focus on increasing the use of renewable energy. At present the effects of global warming and climate change are burning problems everywhere

Bangladesh will suffer the most from the effects of global climate change. There are many causes of global warming. Power generation is one of them. Without electricity we cannot think of development. Finally, fossil fuels such as natural gas and conventional energy sources coal are limited. At the current rate, their use will soon be over, so there is no way to think about the source of environmentally friendly renewable energy production. In the context of Bangladesh, solar energy is the most effective source of renewable energy production. These may decrease in developing countries. Even if fuel is available in the country.



Figure 1.1: The example of some renewable energy.

Transporting that fuel to remote, rural villages can be difficult. Many remote villages have no road or support infrastructure where livestock transportation is still common. Carrying load capacity by animals and some loads, diesel limited generators, for example, may be impossible to bring to such a position. The use of renewable energy for the application of solar energy is attractive to many. This technology, known as photovoltaics (PV), converts the sun's energy through electricity when it comes in contact with sunlight.

1.2 Bangladesh energy consumption respect to the world: Actually, the global energy and supply and consumption is the preparation for global production and energy, power generation and energy, transport and energy costs. It is fundamental part of economic activity. It does not include energy from food, cold oil and natural gas remain the primary Sort of global energy. Although renewables have begun to grow rapidly.

In the world energy mix, 1965 to 2020, There are many countries publish power supply and usage statistics for their own country, other countries of interest, or all countries combined in one chart. One of the largest companies in the field, the International Energy Agency (IEA), publishes annual comprehensive energy data. So, this collection of energy balances is very large. From this article provides an overview of energy supply and consumption using brief statistics in the table, which countries and regions produce and use the most.

Here, the energy production is 80% fossil. Half of it is produced by China, the United States and the Arab states of the Persian Gulf. The Gulf States and Russia export most of their products, mainly to the European Union and China, where not enough energy is produced to meet demand. Excluding solar and wind energy, energy production is slowly increasing, increasing by more than 20% per year.

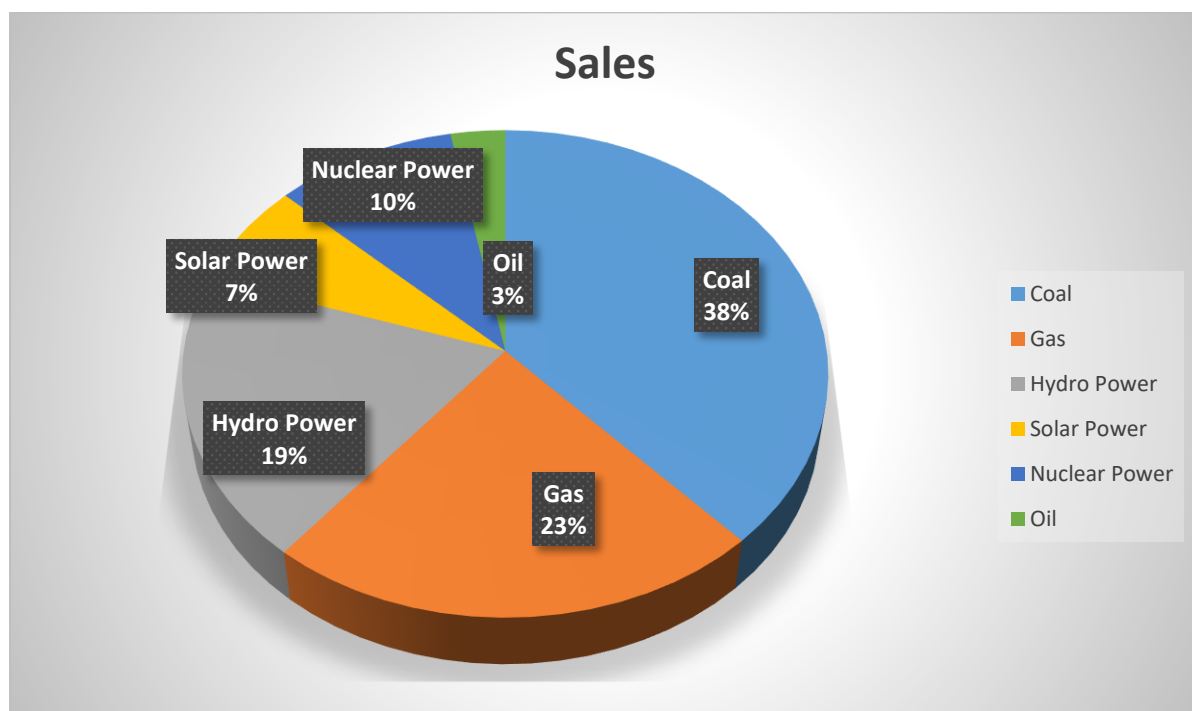


Figure 1.2: World electricity generation on 2018

In the primary energy is converted into energy carriers in many ways, also known as secondary energy. The coal is mainly goes to thermal power plants. Coke is obtained by destructive distillation of bituminous coal. Crude oil mainly goes to oil refineries. Natural-gas goes to natural-gas processing plants to remove contaminants such as water, carbon dioxide and hydrogen sulfide and to adjust heating standards. It is also used as fuel gas in thermal power plants. The thermal power plants use nuclear reaction heat. Biomass is used directly or converted to biofuels.

Final consumption is the worldwide consumption of energy. Total energy supply by IEA is total energy demand. This also is included what the energy sector uses itself and transformation and distribution losses. This Energy consist 78% of fuel and electricity is 22%. Where is the tables which expressed in million tons of oil equivalent per year? Add also note that how much of this is renewable energy. More energy products are not considered here.

Fuel: There are various kinds of fuel in this world. Some are natural gas. Which, derived from petroleum gasoline, kerosene. And there are some renewable energy also. These are by fuel and fuel derived from WASP. Here is the table which list final consumption in the countries. In developing countries, will consumption per person is low and more renewable and eventual A and Brazil generate most electricity with hydropower. [1]

Country	Total fuel	From renewable %	Electricity	From renewable .0%
China	1436	6	555	30
USA	1106	8	339	19
Europe	982	11	309	39
Africa	531	58	57	23
India	487	32	104	25
Russia	369	1	65	26
Japan	201	3	81	19
Brazil	166	38	45	78
Canada	139	8	45	83
Iran	147	0	22	6
Mexico	95	7	25	18
Australia	60	5	18	21
Argentina	42	11	11	27

Table 1.1: Fuel consumption of world

Here is the table. There we see that the whole world condition of electricity from the fuel Is nonrenewable or renewable. That we see the big country has tendency to shift their electricity generation process to renewable energy. So that we can say that Renewable energy has a great opportunity to replace the nonrenewable process because this is not good for environment.

1.3 Why renewable energy is important: All of we know that there is an energy crisis worldwide as fossil fuels reserve decrease and the power plants are going to close in near future. Well, from the aspect of global warming and shortage of natural gas or natural Fossil fuels, then the scientists and engineers, are looking for renewable energies. Yeah, the solar energy is one of the best option for the future. And Bangladesh is also the facing and acute shortage of energy. So Bangladesh also think that remove or replace the energy sources by renewable energy. In Bangladesh, natural gas is the main source of electricity generation, but the limited gas reserves cannot fulfill our demands. Our domestic requirements and industrial and commercial demands especially demands for electricity generation for long. Our present power generation capacity is only around 10,289 MW. But we are able to generate only 70% of our total electricity demand. Due to the shortage of electricity, not only we are facing load shedding across the country, but also the industrial sector in badly affected. So, we have to move another alternative way to fulfill our demands. Solar energy, hydropower, wind energy is a good. This government plans to make it mandatory to install solar panel or rooftops of every multistoried and high-rise building. So that solar energy is one of the cleanest and simplest forms of energy, and we hope that it is very helpful to solve this problem.

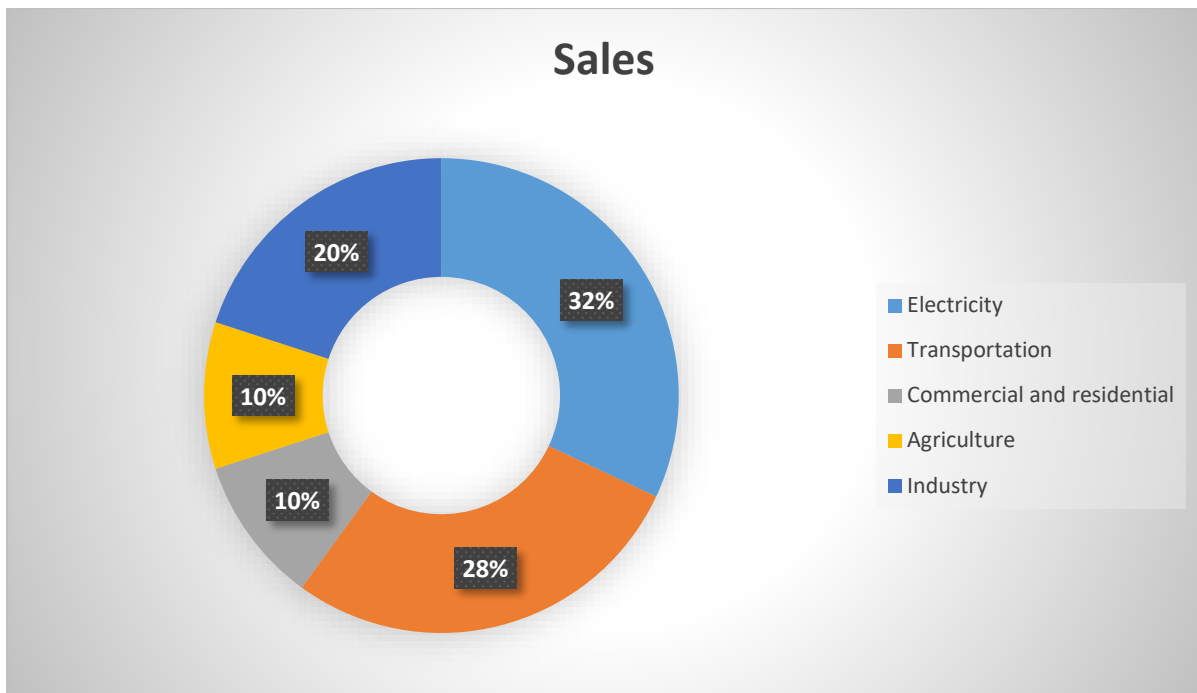


Figure 1.3: Sectors, where use fuels.

From this figure we clearly see that the actual condition of fuel which we use. We see the electricity and the transportation side is major part where we use the fuel. So if we remain decides to be safe that we don't use so much fuel for this site then our total country conditions must be improved.

So now we can decide that we should use renewable energy as the alternative of this type of energy. And that's the better decision for our country and our nation.

Mainly there are various kinds of reasons that solar power is excellent and alternative energy resource.

1. First of all, it's a free source of energy.
2. It can make use of the underutilized land.
3. It can cause less electricity loss and. System loss.
4. It can make our home go up the great.
5. Actually, it's good for the environment. It helps improve our grades security.

And like that, there are huge reasons in solar, wind and hydro resource.

1.4 Significance of this thesis: In this thesis, we want to establish our statement that renewable energy is better than nonrenewable energy as future of Bangladesh. Non deniable energy is limited so that it can be finished or it has so much disadvantage that it pollutes environment. On the other hand, renewable energy is a green energy or fresh energy that don't polluted environment. Besides, it has left cost. Many countries which are top in the world, they also interested to switch their electricity generation system to renewable energy. Bangladesh also should think about that process. So here in the thesis we established this statement.

1.5 Objectives of this thesis: Though we clear that our vision is established, that statement is renewable energy is good rather than nonrenewable energy. We have to two objectives. First of all, our vision is a target is. Establish this statement that nonrenewable energy has a very much disadvantage. On the other hand, our stacking target is established this statement as renewable energy is very much advantage.

Primary objectives: We have to find out or point out the disadvantage of nonrenewable energy. On the other hand, we tried to say that renewable energy is better than nonrenewable energy as a future of Bangladesh.

Secondary Objectives: We have to figure out the advantage of renewable energy. Also find out that how renewable energy is very effective for future of Bangladesh.

1.6 Impact of this thesis on society: If we successfully established this statement, that Renewable energy is very Effective or important for future of Bangladesh? There are various types of positive impacts. Because when people use the renewable energy, they don't pollute the environment. They also saved their money. People and companies try to made that kind of machines that are ecofriendly. Day by day, our whole world, become fresh. Job opportunities created for many people.

CHAPTER TWO

Electrical Sector In

Bangladesh

2.1 Electricity sector in Bangladesh

Day by day the demand of electricity is increasing for transport, telecommunication, industrial work, home appliances and consumer goods. Total demand for electricity in Bangladesh is 20,000 MW. Besides the cost of production is high with the production structure is weak and insufficient. Bangladesh's electricity comes from 7.96% coal, 51.83% gas and 26.28% oil. Although Bangladesh has a relatively small amount of gas, the amount of coal and oil is very low. Gas, oil, coal is a commercial energy resource but solar is a non-commercial energy source. The amount of electricity generated from solar energy is about 1.08%.

Ensuring uninterrupted power supply is crucial for a country's economic development. Although 99% of the people in Bangladesh use electricity, for some reason the price of electricity is comparatively much higher. Some of the reasons are administrative shortcomings, due to system losses, use more time to build new power plants, decreased plant efficiencies, electricity theft, blackouts, and power plants do not have proper knowledge and staff for maintenance.

2.2 Estimated available energy

The main components of power generation are oil, gas and coal. For ensuring electricity generation, the main components are essential. The power department has adopted long-term, medium and micro-plans to meet the electricity demand of Bangladesh. Demand for gas continues to rise due to over-generation of electricity and demand for gas will continue to rise if we cannot find alternative sources of fuel. If we start using coal as an alternative to gas, millions of tons of coal will be needed every year to generate electricity.

We consider indigenous natural gas coal, imported oil, LPG, imported LNG, imported electricity and hydroelectricity as commercial energy resources of Bangladesh. About 27% of total energy comes from biomass and the remaining 73% comes from commercial energy sources. 62% of commercial energy comes from natural gas, of which 8% is imported LNG. Bangladesh imports about 8.5 million metric tons of crude oil and refined petroleum every year.

In addition, about 401.26 MW of power is generated in Bangladesh using solar energy. Besides, 1.03 MW of electricity is generated through a biogas plant from a dairy farm.

Based on this, energy consumption is around 55.50 MTOE every year in Bangladesh. The amount of this consumption increases by 6% every year. Per capita consumption of energy in Bangladesh is on an average 334 kgoe (Kilogram Oil Equivalent) and per capita generation of electricity is 512 kWh with an access to electricity 97%.

Name	Unit (K ton)	Mtoe
Oil (Crude + Refined)	8234	8.23
LPG	854	0.85
Natural Gas	886.93	20.56
LNG	202.88	4.7
Coal (Imported)	6828	4.32
Coal (Local)	808	0.51
RE (Hydro)	230	0.17
RE (Solar+ wind)	417.51	0.31
Electricity (Imported)	1160	0.86

Table 2.1: Energy calculation for 2019-20. (MTOE)

2.3 Natural Gas

Overall Structure

Bangladesh Oil, gas, coal import, distribution and transmission etc are done by Ministry of Power Energy and Mineral Resource with the help of Energy and Mineral Resources Division.

Natural Gas Stocked

Bangladesh's first gas field was discovered in 1955. Since then, 26 gas fields have been discovered in Bangladesh among this 24 in the onshore and 2 in the offshore. 20 of the gas fields in Bangladesh are always producing and one field located in the sea is now closed after 14 years of production and there are many more gas fields in Bangladesh with more small reserves. Bangladesh is expected to get 40.09 TCF of gas by June 2020. Of this, 17.79 TCF gas has been extracted and 12.26 TCF gas reserves are assumed.

Description	Amount
Total number of gas fields	26
Number of gas fields in production	20
Number of producing wells	112
Present gas production capacity	2750 MMcfd
Avg. gas production rate	1744-2750 MMcfd
Present Demand	3508 MMcfd
Present Deficit	530 MMcfd (along with LNG)
Total recoverable (Proven + Probable) reserve	40.09 Tcf
Cumulative Production (June,2020)	17.79 Tcf
Annual Production by NOC	332.51 Bcf (38%)
Annual Production by IOC	554.43 Bcf (62%)
Remaining Reserve (Proven + Probable)	12.26 Tcf
Avg. Gas Production/day	2978 MMcfd
Number of Customer	43 Lakh (Appx.)

Table 2.2: Natural Gas Uses Scenario of Bangladesh

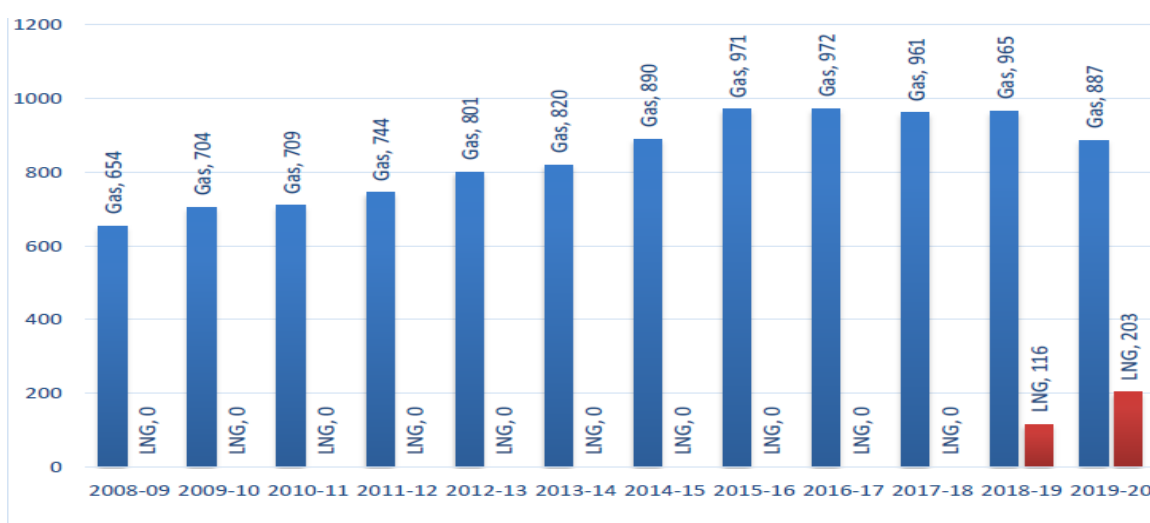


Figure 2.1: Gas Production in Bangladesh (2008-20)

Natural Gas Consumption:

At present production of natural gas in Bangladesh is average 2978 MMcfd (Million Cubic Feet Per Day). In the 2019-20 financial year 994 billion cubic feet (BCF) gas was produced, of which 46% was used in power generation, 15% capacitive power, 16% in industry, 13% in domestic work, 4% CNG and 5% in agriculture. Bangladesh uses 71.80% of its electricity generation from natural gas. The role of gas is essential for the industrial development of a country. About 13% of the total population of Bangladesh uses natural gas for cooking through pipelines. Gas is used for the operation of motorized vehicles whose number 5,04,293.

LNG:

Bangladesh is completely dependent on LNG imports. The government has to import around 1000 MMcfd LNG every year. We need LNG terminal to import LNG. LNG terminal has been constructed in Maheshkhali upazila of Cox's Bazar district.

Natural Gas Demand

The demand for natural gas has been steadily rising for the last few decades. Development of a country, contribution everything depends on natural gas. At present the demand for natural gas is 3508 MMcfd as against the supply of 2978 MMcfd which shows that our supply Shortage is about 530 MMcfd. It is also expected that by 2030, the demand will reach 4622 MMcfd.

2.4 Oil Sector

Bangladesh Petroleum Corporation imports, refines and distributes crude oil. Bangladesh Petroleum Corporation (BPC) is a subsidiary of Ministry of Power Energy and Mineral Resource with the help of Energy and Mineral Resources Division. At present government of Bangladesh as well as non-governmental organizations are participating in the work of oil importing and refining.

Sources and uses of Oil

By oil it usually mean diesel, petrol, octane and furniture etc. Commercially 20% of total energy is from oil. In all cases, it is important for the country to ensure liquid fuel. Bangladesh imports 1.26 million metric tons of crude oil every year. In addition, it imports 4.04 million metric tons of refined petroleum products annually. The most widely used of imported oil is transport, power generation, in agriculture and industry. Sector-wise consumption of petroleum products is: transport-62.89 %, power 6.84 %, agriculture 19.51 %, industry 6.48 %, domestic 3.02 % and others 1.26 %. All things considered, the Bangladesh oil market is completely dependent on imports

Sector	Uses Amount in MT 2019-20	%
Agriculture	1070586	19.51
Industry	355757.9	6.48
Power	375559.4	6.84
Transport	3451580	62.89
Domestic & Others	166285.4	3.02
Others	68899.11	1.26
Total	5488668	100

Table 2.3: Total Oil consumption

2.5 Coal

Energy is a major indicator of a country's economic development and one of the most important infrastructural inputs for socio-economic development. Natural gas is currently used as a source of energy. Excessive use of natural gas will lead to crisis in the distant future. So coal can be used as an alternative source of energy. At present 2.55% of electricity is being generated using coal and all these used coal are obtained from our own mines.

Bangladesh has five coal mines. These coal mines are located in the north-western part of Bangladesh. It is noted that high quality temperature is obtained from coal in Bangladesh. Which the amount of sulfur emitted is very low.

Coal has been extracted commercially from Bara Pukuria coal mine since 10 September 2005. One million metric tons of coal is extracted from it every year. The Power Development Board of Bangladesh generates 250 MW of electricity from the coal of Bara Pukuria Coal Mine out of the number of coal based power plants in Bangladesh. Which is about 65% of the extracted coal. The remaining 35% of coal is used in brick fields and others domestic purpose. 808,358 MT of coal is extracted from the mine and 6,828,032 MT of coal is imported. [2]

2.6 Renewable

In a developing country like Bangladesh, providing uninterrupted power supply is very much challenging. Bangladesh use natural gas as primary source of energy but there is a limit to the reserves of this natural gas. Bangladesh accounts for 72% of the amount of energy used. 81% of the electricity generated comes from natural gas. A country like Bangladesh should make proper use of renewable energy. Solar, wind, biomass, biogas energy are the source of renewable energy. Government, Private, Semi-Government and NGOs of Bangladesh have adopted long term plans to make proper use of this renewable energy.

2.7 Hydroelectricity

The only hydro power plant in Bangladesh is Karnafuly hydro-power station. Its capacity is 230 MW. It is managed by Bangladesh Power Development Board (BPDB). BPDB has taken plans to increase the capacity to 330 MW.

2.8 Biomass & Biogas

Bangladesh is an agricultural country so there are a lot of biomass is available here. Cattle dung, agricultural residue, poultry dropping, water hyacinth, rice husk etc. From these we generate electricity.

The role of Bangladesh biogas is very important. Government, non-government organization and NGO are playing a special role in biogas production.

2.9 Solar Energy

Bangladesh receives $19,000 \text{ kWh/m}^2$ of solar radiation per year. Its amount per day is about 4 to 6.5 kWh/m^2 . The amount of electricity generated capacity from solar renewable sources in Bangladesh is 229 MW. According to the target of the Government of Bangladesh, by 2041, the amount of electricity generated from this solar energy is about 40 GW. About 40% of which will come from the solar plant installed on the rooftop.

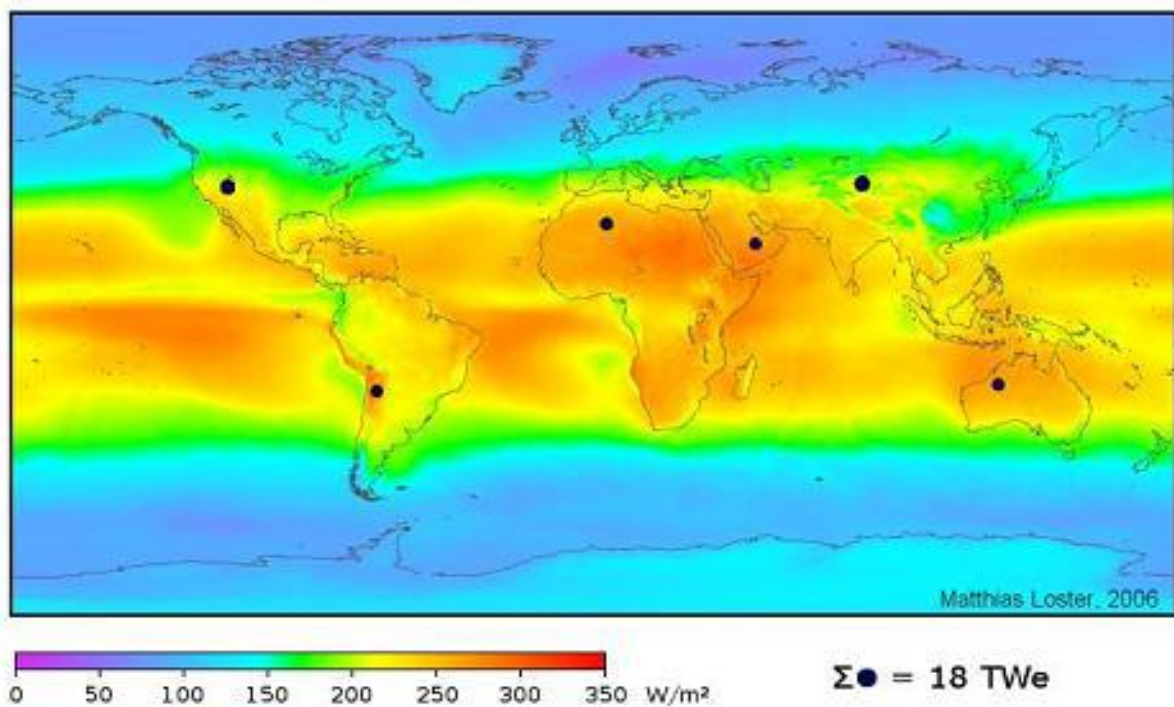


Figure 2.2: Average Insulation showing land area. Insulation for most people is from 150 to 300 W/m^2 or 3.5 to $7.0 \text{ kWh/m}^2/\text{day}$.

Possibility of solar energy in Bangladesh

In Bangladesh receive maximum solar radiation from March to April and minimum from December to January.

Installed Capacity of Solar Plant in Bangladesh

One of the main sources of energy in Bangladesh is solar energy. Geographical Position Bangladesh is located at 20.30 and 26.38 degrees north latitude and 88.04 and 92.44 degrees east latitude. This location is a great way to use solar energy. Villagers were the first to use solar panels to electrify their homes and businesses. Then the Ruler Electrification Board (REB) and the government jointly took initiative to commercialize the solar energy to be used in domestic, commercial and irrigation in rural area. However, day by day the use of this solar energy has become popular among the people. As a result, the government is setting up various solar power plants in Bangladesh. According to report of SREDA, Bangladesh has seven solar power parks of which Gauripur Mymensingh generates the most about 50 MW. The solar power plant located in Shibalaya upazila of Manikganj district generates 35 MW electricity which is connected to the national grid. Solar Park in Teknaf upazila of Cox's Bazar district generates about 20 MW of electricity. These solar plants operate through IPP (Independent Production Production).

Solar Home System in Bangladesh

Solar Home System is a process that uses solar energy to generate very little electricity, to run light, radio, television, electric fan, etc. In this solar home system process batteries are charged using solar energy during the day and used later. BRDB provides Solar Home Systems in off-grit areas.

2.10 Wind Energy

At present, the government of Bangladesh is focusing on power generation using wind energy. There is a lot of potential in wind power. Bangladesh has about 724 km of coastline and using the wind power of this coast we can generate about 2000 MW of electricity. Despite having a lot of potential, we are not able to use this wind power because the communication system with the coast is not good. Despite these adversities, the Bangladesh government has adopted all plans to use wind energy and is working on infrastructure development as Bangladesh Power Development Board has found that using wind energy is less than the cost of a solar power plant to generate 1 kilowatt of electricity.

2.11 Nuclear Power Plant

Nuclear power is characterized by huge amount investment, technological complexity and there are significant technical, market and regulatory risks, but very few operating based on the cost and can deliver large amount of electricity with production of almost no CO₂ emissions. On 25th December 2015, an agreement was signed between the Government of Bangladesh and Russia for the construction of this nuclear power plant at Rooppur in Pabna district of Bangladesh. It cost about \$12.65 billion. Russia's nuclear agency, Rosatom, will supply all the fuel used at Rooppur and will work to properly dispose of the nuclear material after use.

Unit	Type	Capacity	Construction start	Commercial Operation
Rooppur 1	VVER-1200/ V-523	1200 MW	Oct 2017	2023/2024
Rooppur 2	VVER-1200/ V-523	1200 MW	2018	2024/2025

Table 2.4: Capacity of nuclear power plant

2.12 Energy policy

Oil, gas, coal as well as renewable energy sources are meeting the energy needs of Bangladesh. Biomass are playing an important role as a source of energy in rural areas of Bangladesh. All of this has been linked to nuclear power generation.

Oil-gas-coal these are the sources of non-renewable energy, which have no chance of long-term use, at some point they will stock out, so we should take a long-term plan. So that we can get the benefits in the long run.

The first National Energy Policy (NEP) was formulated in 1996. Which has drawn the attention of the government to the urgency of ensuring proper exploration, production, distribution and rational use of energy sources to meet the country's growing energy demand. In addition, there is a growing focus on global warming and the changing energy needs of the people. This plan further aims to ensure that production and decision-making is properly implemented according to demand.

Besides everything we have some shortcomings which are not able to produce as per the demand. Various government agencies are working to solve this problem and making decisions.

- Exploring for hydrocarbons so that future demand for gas can be reduced.
- Most of the electricity generated in Bangladesh is using gas so reduce dependence on gas and look for alternative sources.
- Proper use of gas and electricity must be ensured.
- Transparent transactions of subsidy should be ensured through supervision regulatory body.
- We also need a lot of investment to meet the demand for fuel.
- Power plants built to meet the demand for electricity need to generate electricity as per the demand through proper use and these plants need to be properly maintained and maintained.
- Power plants can be built to meet all the needs of the public and private sector.
- Institutional capacity needs to be created through necessary legal and administrative means reform and intensive investment programs.
- We want to meet all the needs in a very short time by using nuclear energy.

CHAPTER THREE

Approaches of Renewable
Energy for Future
Development

3.1 Introduction: In this chapter we try our best to explain the key approaches about renewable energy. This is our main target and chapter of this thesis book. Here we discuss about the conditions of other countries with respect to Bangladesh, about renewable energy and nonrenewable energy. Top countries has tendency to switch fully to their generation system in renewable energy. Because they know that nonrenewable energy can finish any time. So they have to find the alternative way to generate electricity. They have also concerned that nature will not polluted. Renewable energy has lower efficiency. But they tried to their best to solve the problems. Here also we explain the potential of renewable energy in Bangladesh like Hydro, solar and wind also biomass. This is we know that Bangladesh is a. nice position in earth coordinates. That receives the best solar energy. So here is the great potential to solar generation system. As like that also we explain the cost calculation or efficiency. This all about the Chapter 3.

3.2 Bangladesh with respect to other country: It is a great progress that other countries that means top countries has tendency to switch their electricity generation system to renewable energy. Bangladesh has also tendency, but they can't progress because of so many reasons. If we overcome this regions and focus on that reasons that top countries has to tendency or apply to their process to switch renewable energy, then our country also has a great potential to generate electricity by renewable energy. It's such a great news that in the world there are so many countries that 100% dependent on renewable energy to produce their electricity. [3]

1. Sweden: In 2015, Sweden has a great mission or ambitious about fossil fuel and nonrenewable energy. Eliminating hassle fuel uses. And immediately, rapid investment in solar wind energy storage. They also create smart grids and clean transport. And this is the best part that the Swedish are challenging everyone to join them in a race to become the first 100% renewable energy dependent countries. And that is the great news that Swedish are wins. So we are happy or glad to know that Sweden has 100% dependent on renewable energy and they don't bulleted environment by their fossil fuels.

2. Nicaragua: Nicaragua has also Create reputation too dependent on renewable energy. In 2015, they comprise up to 54% of all electricity production by renewable energy. In 2007, the president of Nicaragua began emphasizing. Enable energy investment. And it is a great step. In 2012, Nicaragua invested the fifth death highest percentage worldwide of its GDP in developing renewable energy. So in the next year is amazing for 95%. With the majority of energy coming from wine, solar and biomass sources.

3. Scotland: In the use of renewable energy, the Scotland also has a great reputation. In 2015, wind power produced the equivalent of 97% of the country's household electricity needs by renewable energy in Scotland. This is the great progress and the great news for earth that Scotland use renewable energy and Scotland also is a top economical country. By this process, if Scotland grows that it will be great progress to the earth that renewable energy is a great impact on society.

4. Germany: Germany also has great mind set the trend when it comes to renewable energy. Germany has leads the world in solar PV capacity and has even been very able to fulfill as much of 78% of a day's electricity demand and generation from renewables. For a relatively cloudy country of over 80 million people, Germany is looking forward to a seriously bright future for solar energy that means renewable energy.



Figure 3.1: PV module of solar plant or solar system.

5. Uruguay: In renewable doesn't have to take a lot of time and generation subsidies. IT also has great mind set the trend when it comes to renewable energy. It has leads the world Uruguay is now 95% powered by renewable energy after less than 10 years of has serious effort. The country invested very seriously in wind and solar with no tax or increases in household costs. That is a great progress for a country.

3.3 What is the prospect of solar energy in Bangladesh?

Actually, the government of Bangladesh has already made a decision to utilize the solar energy in different ways. They have a plan to capacity development target of 600 megawatts by the end of 2021 year. And already in 2018, a total capacity of 220 MW of solar plant would be achieved by installing. There are so many solar plants in Bangladesh and they have so much Contribution to our total generation. And this is enormous for our country.

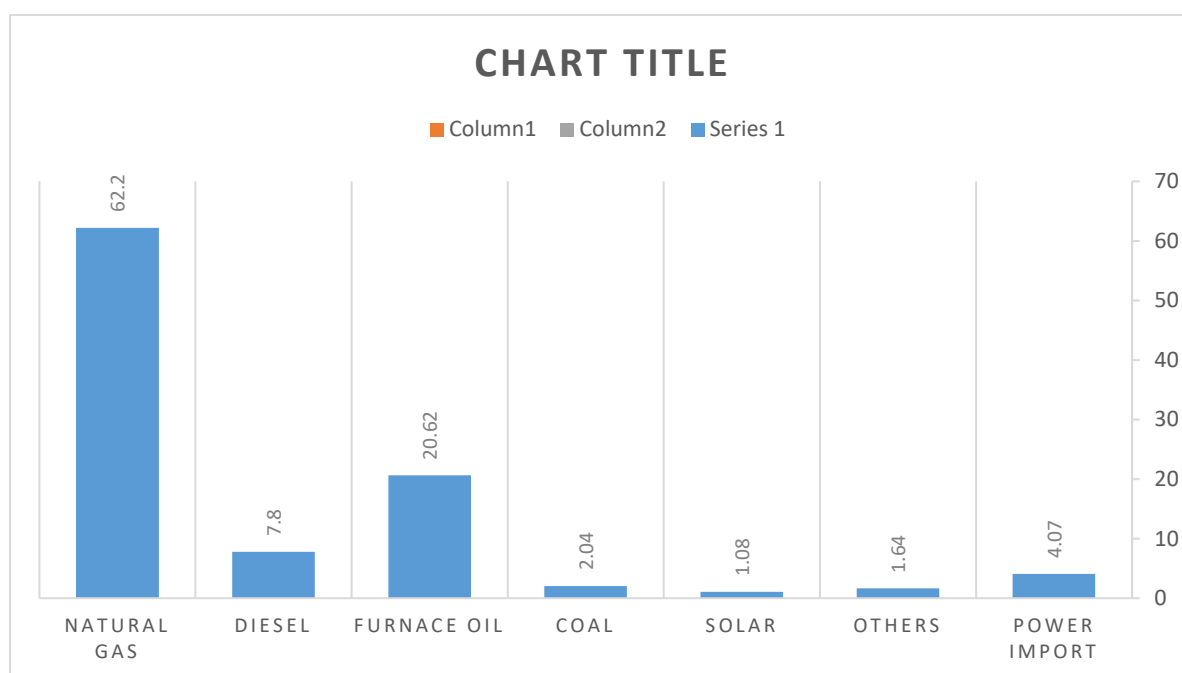


Figure 3.2: Fuels which are used to produce electricity

3.4 Potential of Solar Energy: Top countries has tendency to switch fully to their generation system in renewable energy. Because they know that nonrenewable energy can finish any time. So they have to find the alternative way to generate electricity. They have also concerned that nature will not polluted. Renewable energy has lower efficiency. But they tried to their best to solve the problems. Here also we explain the potential of renewable energy in Bangladesh like solar energy.

Actually, which location is Bangladesh locate this is very tropical climate. Bangladesh is located between 200 30 and 260 45 north latitude. So this is the very amazing location makes Bangladesh good recipient of solar energy. The maximum solar radiation falls on this land over 300 days per annual. This figure clearly shows that Bangladesh got an average around 200 to 250 W/m² of sunlight. Maximum amount of radiation is available on the month of March, April and minimum on December, January. Because March April is the summer season and

December and January is the winter season. That's why in this season, the solar radiation is not good. This figure shows the situation of Bangladesh which receive the solar energy.

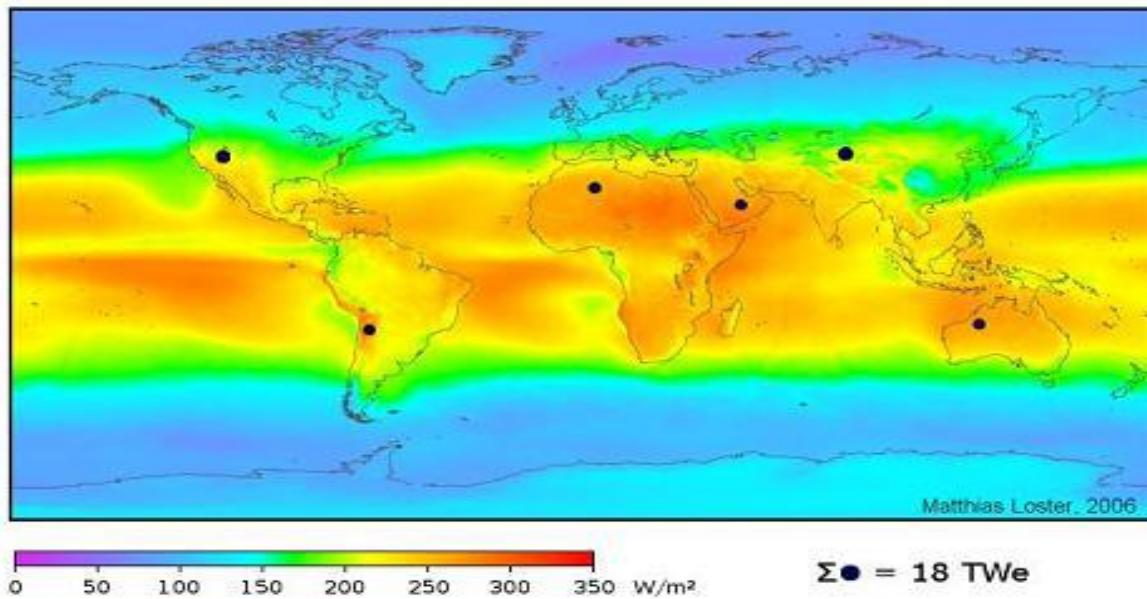


Figure 3.3: Solar region of earth

So the total solar energy reaching Bangladesh is 180×10^9 Mwhr/year which is 105 times the energy generated as electricity, the monthly solar insolation at different location of Bangladesh is very nice.

20 MW (AC) Grid-tied Solar PV Power Plant	20 MWp	Debiganj, Panchagarh	BPDB
50 MW Solar Park	50 MWp	Panchagarh Sadar, Panchagarh	BPDB
Construction of 90.25 MWp (68.60 MW AC) Solar Photovoltaic Grid Connected Power Plant	90.25 MWp	Gangachara, Rangpur	BPDB
100 MW Solar Park	100 MWp	Pabna Sadar Upazila, Pabna	BPDB
Madargonj 100MW Solar PV Power Project	100 MWp	Madargonj Upazila, Jamalpur	RPCL
30 MW Solar Park	30 MWp	Boda, Panchagarh	RPCL
Madargonj 100 MW Grid Tied Solar Power Plant Project	100 MWp	Madargonj Upazila, Jamalpur	B-R PowerGen

Table 3.1: The solar power plant in Bangladesh [2]

3.5 How to choose a place for solar plant:

Geographical location: For a better solar panel, placement is dependent on the location of geography. Geographical location actually determines whether and where solar panels should be installed? Because some areas receive place for more sun than others throughout the year. So we should very carefully place the PV module. People also think that life near the Poles have access to less and during different periods. In that they are compared to those living on or close on the equator. So if we live in cloudy areas and areas that receive less than it is pretty and that you install more solar panels to make up for reduced power generation. So for avoiding this critical situation, we have to follow the rules. For example, if I live in the northern states in the US. I will receive less throughout the year then if I live in the desert and southern states. So I should be careful for install Solar PV module.



Figure 3.4: How to set a solar panel

Roof condition materials and layout: Nowadays, solar panels are very durable. That means that they can last for many years. I must consider that the condition of I roof and the materials used in the construction of my roof. In wildness solar panels last for upwards of 30 years. And this is very common. Last for less than 20 hours. If I have an asphalt roof, I should ensure that it is in tiptop condition for solar panel installation to prevent costly repair down the road. So I should be very careful that removal and reinstallation should be needed. So solar panels to do repairs on my roof are both challenging and costly. So I have a flat roof made of concrete or ceramic tiles. That was the better plan. So I strictly ensured that this plan should be followed. I meant in correctional cost, since these materials make solar panel installation even more challenging.

Orientation and Inclination: Actually, Solar panel location is depends on the access to the sun that can receive light very nice. Because the sun has a path through the year depending on the location. In fact, the easy mode is the specific angle for a solar plan or power generation is very important thing. Arrangement is the also important thing and desert location for our campus is relative in the sun. Whereas the compass is the best for the optimum solar plant generation or solar plant system. In general, the rule or the condition is solar panels should face south if the sun is on the northern hemisphere and the north if I live on the southern hemisphere. For example, you live in the US, so your solar panel should face south. Because it is the right position, so you can't roof is already facing south. And the southwest or southeast, that is the ideal for solar plant installation? So this is the perfect thing. And if you group faces north is EU S it is better to face a different location.

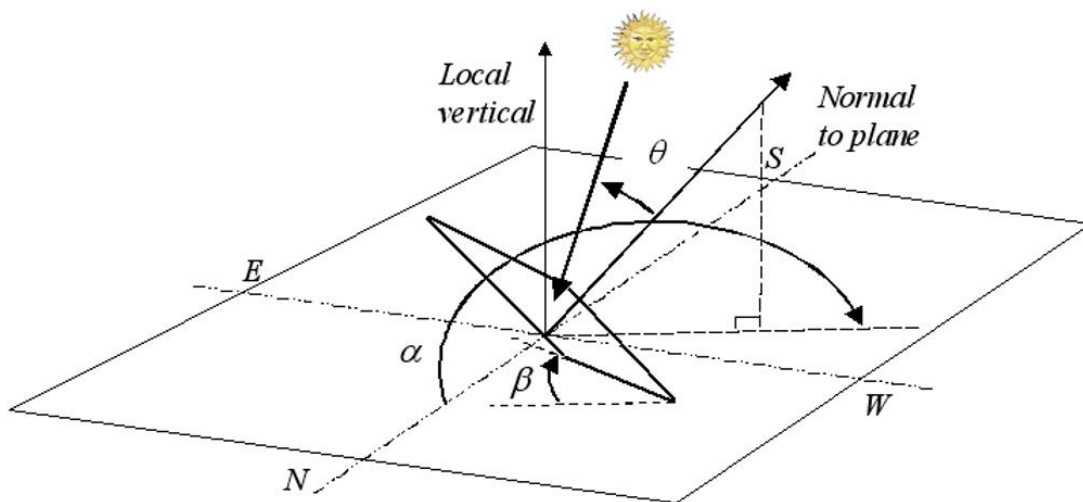


Figure 3.5: solar panel properties which is used to calculate to set a panel

Space: For a better installation of a solar panel available space is very important. If the size of your roof is not good, that is not the right process of the solar plant installation. So the size of your room is ground space and you have chosen the right way and your solar panels determines the number of panels that can be installed. Consequently, the number of or that means the amount of solar energy that can be created. So if you have enough space and that is not good for a solar plant installation, you have the space available for your solar panels is irregular or limited. So there is that means there will be mismatch losses resulting from inappropriate positions and angles. Also, the orientation and the leading processes should be reduced. Performance of the solar panels. Then you came forward about the available space for solar panel placements influences the types. Also, the numbers and placements of inverters. So you think that the available space also helps determine whether a backup system. As like a battery is needed to cover, increase the during peak hours. Do you have to understand that the ground system should be limited? Because the size of your backward and the eliminate of the Ori mismatch losses, since it's very important to panels on the ground will face the same direction End location.

Shadings: The presence of sheets is the biggest important factors. For making or establish a solar plan perfectly. So the shades will limit exposure of a solar plants to the sun and we'll reduce their energy. Yes, solar panels cannot. Constantly or continuously create the power with a shade that constantly discharge the angle. The total installation process will empire. So you have to the installers of your solar panels should account for the presence of trees nearby. The antennas and the House and the chimneys that push causes shade on earth solar plants. It is very harmful for solar panels. So the near shedding losses, this power generation nearby 10% which is annually for the optimum power generation. So far, an advance in computer systems allow for modeling before solar panels are installed to determine the impact or influence of near settings. And that's the better process for a perfect installation solar panels.

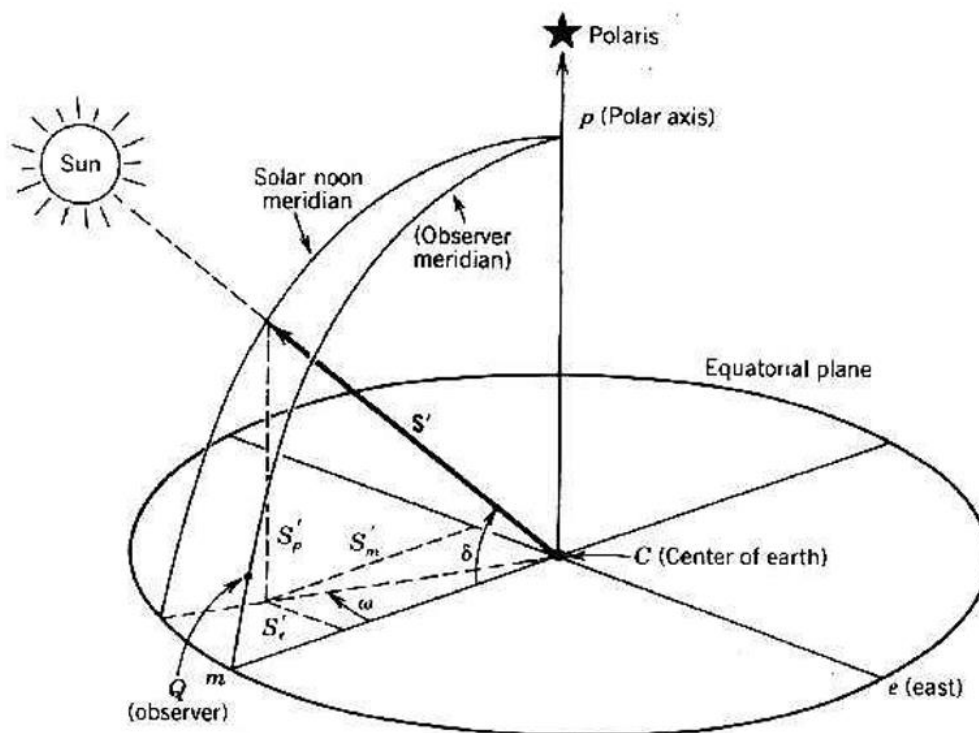


Figure 3.6: solar panel properties which is used to calculate to set a panel

Weight: Here we talk about the main consideration of a solar panels installation. This is the time to decide where to locate a solar panels. Is the strength of your roof? So you must have the structural good condition that is sound to be able to support the weight of the solar panels. So you have to notice that the solar panels come with warranties that run for over 20 years. That means it has to be neat, a strong group to support the panels for a long time period, which is very, very good thing or important factors. A solar panel and can't installation ultimately increase the overall weight of your roof? That means that a way group increase the risk of damage and they may cause the threaten of your safety. Insert is very important thing, but the safety of your loved ones. And the important property. So this is a very important thing that a professional conduct of determination is your route prior to embarking on a solar plant. So this is the professional way that you will determine whether additional support.

Drainage: Solar panels on roofs can cause various types of problems. Like waterlogging? If they are improperly installed, they can create damages. Water flow and run down to the roof find raining. Alex the gutter, and it's very eventually directed from our home. Solar panels can destroy the flow of rainwater because of the causing of irregular flow of water. Stacks of logins, which is a very serious damage for our home and increase the maintenance. So we should be very careful. Our fairness can maintain the problem. Wire harness and breaking keep Minton used in solar panel very effective way. And it prevents those types of problems. Glenda properly designed process is maintained or planned, then those problems are not covered. That means the solar panels will have to be. So never these problems with solar panels in groups. It is very, very important to that contacted professional. After that, these types of problems will not occur.

Options for panel: The best choice of a solar panel installation is the roof mounted panels. I may consider an area mounted, but it should be on the ground. Especially when I do not have enough ground space. So that our rule contact away from the sun. I should also know about the ground mounted arrays. Armor possibly, but they require more materials. So I should consider whether I want my solar panels mounted with that record. That means it allows to follow the sun. That face the sun can produce more power. So we follow the truth factor. Then we carefully install the solar panels. So far that installing a tracker, it is very substantially increase the cost. I must say that get a best solar panels installation and highest efficiency. I should be very careful. I also looking for discreet panels that I can forget the traditional panels for solar panels installation.

Rebates eligibility: What is better solar panel installation? The cost is the main factor. The cost of installing a solar panels has dramatically reduced. Everyone should still need any weights and stack credits to further reduce the cost of solar panel installation. This is a very great news for the local people. That consideration of hold up our project include permits, insurance and warranties are very much increased. So I should not disobey the rules. Also, should not go for the cheapest solar panels. I should also consider the panels that give a based returns of our investment. So this is the best decision that there are some considerations such as that to buy from certain companies within the fixed warranties. The location and the installation process should be followed with the rules and it is very careful to know that the rules is the main part of solar panels. I also should review that the basic and the state options of our area before making the final decision. Because it's very important for solar panel placement and installation.

Financial conditions: The location of our panels is the main factor to the actual cost of purchasing and installing the solar panels. Enter system sizes and types of panels in the main parts. The company is still the product determines the location. Paying the entire amount for the installation will be the best option is the main profit. So that I can still access loans and the require I have to pay the initial down payment. Then I fulfill this payments after installation is by instrument. There are other factors that can determine the installation of solar panels. Is my own or business including. Do I have to choose the better option for my solar panel installation and the system? Least solar panels exist in a plan where a solar company owns the solar panels, and I just have to pay a small amount of return fee.

3.6 Potential of Biomass Energy: There are four types of biomass in these two Discworld. These are agricultural products and jean field gas. Alcohol fuel like ethanol or biodiesel. The most of the biomass used today is home ground energy. That means the home energy. Sadistic counts food logs is the 44% of biomass energy. Five was like in all biodiesel green desert, bio gas, bio gas in and produced to by the range of feedstocks, including oil, purple palettes, forestry districts, agricultural crops and the industrial of municipal cost. The government of the Brazil and that US is dominated the biofuels market. Because they want to combine share nearly 87% of the world's production by the survey of 2018. So we can say that the worst bio gasoline production in 2018 was the nearby 2000 barrels per day. Which is the total biodiesel produced in the ER, was 702,000 barrels per day.

Top biofuel producing countries in the world:

1. The USA: That USA is the leading position for producing the biofuel in the world at present. They produce the huge amount of biofuel nearby 2000 barrels per day. Actually, this is the most important or the big amount of country that contributed the world sparkle production in cost. Which is near by 45%. The USA, also in the leading position, and that means the fast food position to produce the bio gasoline which is near by 55.4%. In the amount, it is equivalent to the 1000 barrels per day. And this is the great news that the USA is also the worst rating producing country of biodiesel, which is near by 20%. The plans laid to nearly 136,000 barrels per day of oil in the survey of 2018. The USA mainly uses corn as the primary feedstock for producing fuel, and the soybeans for biodiesel production. And this is a very great information for the word that it is the part, the green crashing and product production report published by the United State Department of Enculture. It is near by 5.55 billion bustles of born, which is used for making the bio diesel or bio gasoline products. The Energy Information at Ministration said that the USA produced huge amount of billion gallons of internal like 16,000. It is the animal world with an old production capacity import which said there are two hundred production plants as of 1 January 2019. I must say that the USA contribute to that huge amount of the production of biofuel or biodiesel, which is very good thing.

2. Brazil: Big country called Brazil, which is ranked on the second position among the leading baffled production countries in the world about the survey of 2018. The output of the biofuel is 694,000 square per day by the country of Brazil. The South American country had 26.5% share of the world's total powerful production in 2018, which is very good. Brazil makes their second position to the production of bio Vaseline in the world. Nearby, 31.5% share carry the Brazil. Percentage to the number it's near by the 595.35 thousand barrels per day. It is very great news that Brazil stands at the second position in the list of leading producers of bio gasoline or biodiesel, which is a nice thing. The Latin American country primarily used for producing biofuel or soybeans for the production of five. Sugar cane by crashing his Whitley plans to meet the 4th generation as fuel in sugar mill, considerate demand. But it is just hurting news that is used for supplying surplus electricity for export purposes. Brazil is intimated to have produced used amount of liters of methanol in the survey of 2018, which is near by the 31 million liters. Actually this is the 9% more than the revised figure for 2017. And it is very

important information that in the survey of 2018, the total domestic demand of the economy in Brazil is purpose was estimated at 29 billion liters.

3. Germany: Germany is another important name for the biomass or biodiesel energy production country. They also produced the 75 point 8000 barrels per day in the survey of 2018. And this is very important information or great information that this is the part position of the total biofuel production country in the world. The country accounted for 2.9% of the global bicycle production capacity in the survey of 2018, which is very, very good thing. According to the German government of biodiesel, production is getting important thing and German farms produce 3.2 million tons of biodiesel in 2018 surveys. They make sure that the country and the used cooking oil is the main raw materials for products and their biofuels. Besides, the Netherland is the top importer of oil produced in Germany, which is very important in and according to the report of published by the Belgium and Poland, also Austria that the USA is the other important or importers of the countries by region.

4. Argentina: Argentina also proves that that they also want to contribute to the biofuel production of the wind and biofuel production of the country is very important thing. The established their fourth position in the world, stop by fuel protection countries. The last country report says that the production of the biofuel about Argentina is near by 70 point 6000 barrels per day. And which is very good things. And this is the truth. A panel and the biological. The country's biofuel production is mainly consisted by diet and the biodiesel pitches common with Germany and USA. Operate in 19 plans, which is a big amount of. These plans are capable to producing 1.4 billion liters in all per year. Of 2006, biofuels enacted by the art in demand and mandated of 5% mix of bioethanol in gasoline and biodiesel. Starting from 2010 and this is not a good thing, but they eat and they blend. Maintaining 12 person makes for ethanol and 10% mix for biodiesel since 2016, and which is very good thing and very important. Argentina also passed a law in 2018 to promote the production of bioethanol from sugar cane, and this is a very Revolutionary War. But they currently operates a total of 33 biodiesel blends, which is big amount of plants. And this is the largest capable of producing up to 700 million liters per year. And this is a very good thing.

5. China: China is very reputed country for producing the bio gasoline, or bioethanol, in the world. In the report of 2018 that the production of the to bio gasoline products is 68,000 barrels per day. China accountant that this is the 2.6% of total vehicle production in the yard. But in the last year that he cannot producer in China increased the domestic production capacity by the great technology. By the process of improvement, they produce 25.8 million guitars to a total of 5258 million dollars. China actually produce ethanol by the country's efforts to improve in air quality. The Ministry of China and Ecology and Environment announced leaked Air pollution reduction measures across Beijing. Tanjin and Harvey provides by the 2020. It is a very great news that the China shifted enable fuel production and commercial industry, that cellulosic ethanol. China believe that the world largest pool internal production makes them the best position to the country in the production of renewable or bio gas in the world. China

also required to expand fuel ethanol production from 12,670 to nearby 20,000 million liters to meet that domestic demand.

In summary, I want to say that the top countries which has tendency to the produce biofuel energy or the renewable energy that why not ask? The potential of global biomass energy is sustainable energy, so it is widely recognized. It is very informative information is that the total biofuel energy or the bio gasoline is great opportunity to replace nonrenewable energy. I must has many benefits and the primary one being that it cannot be depleted like fossil fuel. Environment. The great benefits these plants is the best opportunities for the art. I must say that biomass source of renewable energy, which is based stainable and effective for the environment and the total world.

3.7 Biomass Advantages and Disadvantages: Everything has two sides. There is a positive sides and there is the negative side, so the biomass energy or the bio gasoline products has also two sides. There is advantage and there is also this advantage. All of who we know that the biomass is renewable source of energy, which is out. Planned last. In the world, almost all industries, including agriculture or forest hotels, resorts they Ask which can be converted to heat and electricity. And here is the main purpose of our biomass energy potential. So now we explain the actual advantage of biomass energy.

Advantage of Biomass energy:

1. The fast and the most important thing is that resource of biomass energy is always and widely available in the nature. The organic harvest and the worst of materials used to produce the biomass infinite resource. Since our society and our domestic vast also produce the kind of garbage and food are many.
2. Resource is actually a carbon neutral. They produce as a natural part of photosynthesis process. Biomass pools only released the same amount of carbon into the atmosphere as was absorbed by plants in the ports of their hype cycle, which is very good thing.
3. Biomass fuels reduces the overreliance of fossil fuels which very well for environment. It is not only is there is a limited supply of fossil fuels, but also fossil fuels come with environmental garbage, including the release of large amounts of carbon dioxide into the atmosphere. The pollutants that result from removal, transportation and production is a good part.
4. The another important thing is less expensive rather than fossil fuels. Fossil fuel production needs a heavy output of capital, such as oil drills and fuel collection, biomass techniques is much less cost. Manufacturers and producers are able to crate higher profits margin from a lower cost.
5. Biomass production crate a revenue source for manufacturers and impact for the whole country. Producers of waste can create value by challenging for their waste to create a more profit margin use in the form biomass energy.

6. Biomass has a less garbage in land. By burning solid waste, the amount of garbage waste in landfills is replaced by 60 to 90%, and reduces the cost of landfill disposal and amount of land required for landfill and finally they contribute to create this.

Disadvantage:

1. Biomass energy is not as so much efficient rather than fossil fuels. Some biofuels, like Ethanol, is relatively not efficient as compared to gasoline. In fact, it has fossil fuels to increase its efficiency of biomass fuels

2. It is not very clean. While biomass is carbon, the use of animal waste escalates the amount of methane gases, which are also damaging to the environment. The pollution add from burn wood and other materials can be need just as bad as that result from burn coal and other steps of energy.

3. It can lead to deforestation. Since wood is one of the most used as biomass energy resource, Most amounts of wood and other waste things have to be burned to produce the need amount of power. While at present there is good wood waste at the moment, there is a risk of distortion in the future.

4. Biomass plants need a huge of space for install. This it's difficult to create a plant that is in a convenient place in an urban area, maintain onsite hard thing like the technicians, companies can need biomass energy at a fraction of the space of a large environment. Where there are some small to biomass energy, more research and innovation is need to be devoted to the field as a more broadly available, cheaper alternate and needed substitute for as usual electricity and other energy sources for the environment.

3.8 Potential of Hydro Power: The potential of hydropower in Bangladesh is good. Hydropower is one of the cleanest and the natural resource of energy compared to the other conventional energy. That means the nonrenewable energy. Power isn't that kind of energy resource why it is used in massive scale? And another important thing for hydropower implementation is it is so low cost. And the maintenance cost of this power plant is also lower to lower. And these features makes a hydropower implementation an excellent choice for energy harvesting. Hydropower, providing near about 7% of nation's electricity in Bangladesh. The other background of this Hyderabad plant is it's supports more than 1500 people jobs in engineering, manufacturing, construction and utility operations and maintenance. And these all the people is improving this sectors day by day and in fact in environment or strengthening on our economy. Besides, the hydropower is represent the 97% of all energy storage in United States in the survey of 2018, and it's offering the flexibility and reliability the electricity needs need deliver affordable, clean energy to American homes and business, which is. Any nice things and putting? Information which represent the hydropower. The Energy Department has a air collaborate with more than 30 experts from 150 Hyderabad industry companies and environmental organizations.

3.9 Roadmap to the future of hydropower

For a hydropower implementation of Hyderabad power plants and there is so much need, a road map that the project or the process will be success. To the Hyderabad vision report does not make any policy recommendation, but it does provide a road map. That said, code actions that the Hyderabad industry. Unity and others can take to achieve higher levels of hydropower deployment with sustainable national energy mix. In this sector, we have to careful that the route map is masked the follow the rules and which is very effective for all the sites and the people who depends on the water in water side. They should not hamper. By protecting the national energy, environmental and economic interests, they should follow the action areas and which is achieved, including all the things.

Advance Technology: Providing the best technology and innovative technology will help build a better hydropower plant. Which is very effective or Mary efficient for a hydropower plant? It will help reduce costs and improve both power production efficiencies and environmental performance. All the sustainable development and operations also needed for a micro power line. This includes using integrated approaches that balance environmental situations and economic factors. For each, the demand or policies we have to follow the rules that the hydropower plant make a better place or they may also the situations that power plant is good effect on our economy. The revenue and the market structure also showed the analyze because they know about the present situation of hydropower plants, which is very, very important factors. Regulatory process or optimization also needed for this power plant because it includes increasing access to share data, making information or independent scientific advances available or enhancing process efficiency and reducing risk and cost, which is very important for all the power plants and also the higher power plants. The collaboration and the expert people also need for a hydropower plant and sharing the best ideas or best practice for maintaining operating and construction facilities is also needed for develop the hydropower plant, which is a professional start needed to. User in the next area of a hydro power plant..

3.10 Is Renewable Energy is cost effective: When expert provides the solution of alternative of the nonrenewable energy they provide the things of renewable energy which is the best solution for nonrenewable energy. There are many kinds of reasons that they provide the solution of renewable energy. The fastest thing is renewable energy. Plant polluted water and the second thing is renewable energy as low cost. That means renewable energy is very cost effective. We talk about the solar panels or solar power installation. There are no cost of fuel. And these pores can't bullet the water, which is a very good thing. And the other ghost of maintenance costs. In solar Parkland, there is at least low minimum maintaining cost. If we talk about the hydropower plant, there is also the same thing. The word that means what art is enough for supply. And in the Hyderabad plant, there is no cost of maintenance. Wind also the same thing. So according to the research or statement that is true that there is no How it is of higher cost in renewable energy sector? We have to get out full that the rules and regulations must be followed as far as instruction. Then his hector of renewable energy is very efficient. Finally, I can say that there is no tension forecast, but a great tension for the to obey the rules and regulation for implementation and research. [4]

CHAPTER FOUR
RESULT AND DISCUSSION

4.1 Result: From this thesis we found that actually the renewable energy is very important rather than nonrenewable energy. There are various types of reasons and facts that renewable energy is good. Most important thing is renewable energy not polluted environment and it has long lasting duration and lower cost also. We know that the demand of electricity is increasing day by day. So compared to the demand, there is less supply. That's why if we want to fulfill our demand. We have to focus on that process, which is very effective. Though renewable is not very effective but it is high possibility to increase the efficiency of renewable energy in few days. The whole world is busy to do this research. Many countries has huge tendency to switch their full generation based on renewable energy.

1. SWEDEN	100
3. NICARAGUA	54
4. SCOTLAND	97
5. GERMANY	78
6. URUGUAY	95
7. DENMARK	42
11. KENYA	51

Table 4.1: Country name who used solar plant to produce electricity in percentage.

Also, the potential of renewable energy is increasing day by day. Especially solar energy that means Potential of solar energy in Bangladesh is increasing day by day. Because the geographical location of Bangladesh is considerable for solar energy. Also, Bangladesh is a rivers country. They are huge amounts of river in this country. So there is also the potential of hydropower. The weather of the Bangladesh is also we known for his variety seasons. The air flow among the Bangladesh is really nice that we used to create a great potential of wind energy. So overall, we want to say that Bangladesh has a great opportunity to properly use the renewable energy alternative to the nonrenewable energy and this is the main motive and main findings of this thesis.

4.2 Discussion: In today's world the demand for electricity is increasing day by day our Bangladesh is no exception so if we want to move our Bangladesh forward keeping pace with the times then we must meet the demand of electricity our country is mainly based on two natural gas production but natural gas is a non-renewable resource that will run out one day. Besides, the coal power plants of our country all also like that, these are also a non-renewable resource. So we need to find an alternative. Which can be a renewable resource. In our complete thesis, we have proved that renewable resources are our only hope for the future. We have proved with our utmost intelligence and logical statement how important renewable resources are to us. So we need to emphasize this point. Research is needed. After that our country and nation will go on.

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