

ANALYSIS OF SOLAR ROOFTOP SYSTEM IN 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.

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Declaration of Authorship

We hereby declare that this thesis paper is based on the result found by our research work and other researchers are mentioned by reference. This thesis has not been submitted before for any degree.

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Certificate of approval

This undergraduate thesis report is named ' Analysis of Solar Roof Top System in Bangladesh' submitted to the department of Electrical & Electronics Engineering in a partial fulfilment on the requirement for the Bachelor of Science has been evaluated by the panel of examiners with a mark of _____

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Abstract

The daily headline makes aware of the dangerous long-term effects of electricity generation from fossil fuels. It is widely believed that fossil fuels continue to depend on production. Power can be a serious environmental problem. Moreover, fossil fuel consumption is limited and as well as spending a lot of money. So, a possible solution to replenish renewable energy. The electricity demand of developing countries like Bangladesh. In all renewable technology, Solar Photo Voltaic (PV) is the most probable, favorable, and promising that transforms the solar energy into electrical energy, with or without battery backup. Although solar technology has succeeded in rural areas, most of the technology based on solar home system (SHS) is adopted, but it has not been implemented in the urban areas after connecting the 3% lighter fan load chairs to a building. . We tested the installed solar roof of 15 homes in Narayangonj. Where the solar system is located most of the rooms were found inactive. Only 11 of them activated the system. Based on this investigation in the study, overall analysis of urban solar potential has been done in three levels. Different solar panels have a comparable discussion on cost efficiency run depending on the amount of load being run. Efficient batteries are modeled in Bangladesh's context to improve PV systems by Homer. A cost analysis is performed by software HOMER for different types of wax peak In addition to this, the reconstructed design of the solar system has been proposed to make the urban rooftop solar system efficient and successful.

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LIST OF ABBREVIATIONS		

SRS: SOLAR ROOFTOP SYSTEM.

DPDC: DHAKA POWER DISTRIBUTION COMPANY.

UNFCC: UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE.

CDM: CLEAN DEVELOPMENT MECHANISM.

MW: MEGA WATT.

CSP: CONCENTRATING SOLAR THERMAL PLANTS.

GHG: GREEN-HOUSE GAS.

GW: GIGA-WATT.

REB: RURAL ELECTRIFICATION BOARD

BPDP: BANGLADESH POWER DEVELOPMENT BOARD.

PV: PHOTOVOLTAIC.

KWH: KILOWATT HOUR.

DC: DIRECT CURRENT.

USA: UNITED STATES OF AMERICA.

LGED: LOCAL GOVERNMENT ENGINEERING DIRECTORATE.

SPV: SOLAR PHOTOVOLTAIC.

STC: STANDARD TESTING CONDITION.

BDT: BANGLADESH TAKA.

WP: WATT POWER.

VMP: VOLTS AT MOST POWER

Chapter 1

Introduction

1.1: Back ground:

What is Energy? In the very simple answer the ability of work is called energy. At the beginning of the world there is a lot of source of energy. The largest storage of energy is the Sun which is called the source of energy. There are different of class of source of energy and they are found in different place. The source of energy are sun wind water coal natural gas nuclear energy etc. There are four types of source of energy which is primary source and secondary source, conventional ad non-conventional source, renewable and non-renewable source, commercial and non-commercial source.

Primary source are those that are either found or stored in the nature. There are lots of source which we found in nature such as coal, oil, natural gas, biomass, wind water source etc.

Secondary source are those who is costly converted to industrial utilities into secondary energy source. They are used to sell in local market for supply of energy such as coal is converted into electrical and heat energy, gas is converted into steam and electrical energy, water is converted into hydro or electrical energy etc.

Commercial source that are available in the market for a variety of price are known as commercial energy. The available commercial energy in our society are electrical energy, coal, natural gas etc.

Non-commercial energy which is not available in the commercial market for a price are classified as non-commercial energy. The non-commercial energy are fire wood in rural area, agro waste, solar energy for heating of energy and the wind energy.

Renewable energy are natural resources that can be replenished in a short period of time such as solar, water, geothermal and biomass energy.

Non-renewable energy is also a natural resource which cannot be re-made or re-grown at a scale comparable to its consumption is called non-renewable energy. Such as coal, natural gas, petroleum etc. if we use them once they cannot re-made again.

For the decreasing of crisis of electricity in a developing country like Bangladesh we must be used in renewable energy sources like solar system which is known as solar photo-voltaic energy, wind energy and if possible biomass energy.

1.2 Problem statement

In the modern time to become modern there is a lot of problem in our daily life. For a small country there is huge problem in Bangladesh. The major problems are population problem, electricity problem, traffic jam etc. As our country is small but the population are more. That's why the agricultural land are decrease day by day. Man make new houses for their living and the demand all their requirement. Without electricity everything is impossible in present time. But for the lacking of electricity govt. cannot supply electricity from the people. On the other hand to produce electricity we have to pay a huge amount of money and the emission of carbon di-oxide is increasing day by day. For that reason the climate is changed naturally. Scientist say that in the future time the coastal area will go onto the sea. Beside that we have a little amount of natural sources for produce electricity such as coal, natural gas and petroleum. For saving our natural resource we should aware of to use renewable energy.

1.3 objective

What is electrical energy? It is an energy which stored charge particles in an electrical field. An electrical field creates by the charge particles surrounding the area. In other words in that field charged particles create electric fields which forced on other charge particles. Electricity is an energy which is must for our life and we cannot think a single moment without electricity. We use electricity in every sector in our life but we don't know how to produce electricity? For the generation of 1kw electricity we need a huge amount of coal or natural gases. But we have a

little amount of storage of coal and natural gas in our country. Beside that for using fossil fuel a large number of emission of co2 is increasing day by day. So the use of solar photo-voltaic energy and solar system make a huge change in our environment and saving money from electricity bill. Our mission is to aware of the people to and inspire them to use solar system in their house and concern them about the benefit of using solar system

1.4 Significant of this Research

Prospects of Solar Energy in Bangladesh. For socio-economic development a reliable, affordable and secure supply of energy is important. It has very limited storage of non renewable energy sources of its own but it's endowed biomass, wind, hydro and solar insolation like renewable energy sources. This thesis paper is based on the solar system in prospects of Bangladesh. Here we discuss about solar photo voltaic and solar home system for Possible implementations of solar technology with their optimum capacity, storage facility cost per unit power and efficiency. Some social, economic and environmental constraints regarding the implementation of solar technology are highlighted and some possible solutions are offered. To promote development in urban areas as well as rural areas it is necessary to fulfil the electricity demand. In rural areas where grid electricity is unavailable, electricity demand can meet using renewable resources like solar, biogas, wind etc. Solar energy is available in all over the country to generate electricity effectively for 5-6 hours with solar irradiation of 4 to 6.5 kWh/m²-day Necessary wind speed in Bangladesh is limited to only coastal and off-shore area. Solar thermal energy has been used for a variety of tasks for thousands of years. With the advancements of technology, the applications of solar thermal energy expanded substantially. This has low operating cost and high efficiency which can be utilized by using thermal storage.

1.5 Thesis Outline

In the first chapter we give some knowledge about the energy sources and different types of energy. Besides that here we give some simple knowledge about our problems and identifying them for solving or decreasing those problem. Some step to need for decreasing the problem. On the other

hand here we discuss a little term of solar system and the implementation of solar system in prospects of Bangladesh.

In the second chapter we will discuss about the literature review about the solar, energy sector, working procedure, using solar system, implementation of solar system, benefit of solar system all things are discuss details in literature review in second chapter.

On the third chapter we will discuss about methodology and finding the area of researching are and finding the problems and benefit for using solar system from the consumers.

In the chapter four after finding the problem we want to solve their problem and collect their advice from the consumers. If we need to take any step we will meet the officers of DPDC and DESCO for solving their problem.

At the last chapter we will make some discussion about our research and finally we give some conclusion about our thesis.

Chapter 2

Literature Review

2.1 Introduction

In the modern world there is nothing without electricity. From industry to a small chip of a device is run with electricity. But in the present time the value of electricity is too much and the quantity of emission of carbon-di-oxide is very large. But the renewable energy like solar home system can decrease the emission of carbon-di-oxide and we can save our energy from the national grid. Recent technological developments and recent technological developments and concerns over the environmental impact of conventional fuel use have increased, with the possibility of producing a fairly clean, sustainable energy from renewable energy sources around the world. This book, with solar, heat, photovoltaic, biotechnology, water, tides, wind, waves and geology, gives a wide range of original renewal energy. In addition, it explains the underlying physical and technical principles of renewable energy and examines the environmental impact and probability of various energy sources. Ideal choice for more than 350 detailed imagery, more than 50 table information and extensive case studies, renewable energy, 2 / E power, sustainable development and postgraduate courses in environmental science. Second edition new · Full color design Updated to reflect on technology, policy, perspectives and perspectives. The energy system edited by Gordfrey Boyle, Bob Everett and Janet Ramez and complementary by the sustainability, all of the open university, the UK.

2.2 Energy Sources:

All the thing in the world are the different form of energy. There are many form of energy and the source of energy is different. There are mainly four types of energy.

1. Conventional & non-conventional energy
2. Primary & secondary energy
3. Renewable and non-renewable energy &

4. Commercial & non-commercial energy.

2.2.1 Primary and secondary energy source

Primary source

Primary energy (PE) is a form of energy found in nature, which has not been converted into a human transformation process. It is the power of raw materials and the power of other energy obtained as a system input. Primary power can be non-renewable or renewable. Where primary energy is used to describe fossil fuels, energy efficiency of the energy is available as heat energy and about 70% are usually lost in the form of electrical or mechanical energy. 60-80% reduction in transit of solar and wind power is transformed, but today's UN conventions consider the wind energy and solar energy as the primary energy for energy sources in energy statistics. One consequence of this calculation method is that air and solar energy contributions are reported compared to fossil energy sources, and thus there is international debate about calculating elementary energy from air and solar. The amount of total primary power supply (TPES) production and the amount of import and reducing the changes in storage. The concept of primary energy is used in the power balance of energy, as well as the energy statistics of energetic field strengths. In energies, a primary energy source (PES) refers to the energy types needed in the energy sector to supply energy carriers used by human society.

Secondary source

Power is a carrier, as power of secondary power. It is produced by the conversion from an initial energy source. As a measure, the initial energy use ignores the conversion skills. So weak forms of energy with conversion skills, especially heat sources, coal, gas and atom are overstated. Power sources such as hydroelectricity that are efficiently transformed, when a small fraction of primary energy is significantly more important than their total raw power supply.

2.2.2 Commercial and non-commercial Energy Sources

Commercial Energy Sources

This coal, petroleum and electricity these are called commercial energy because they have value and consumers have to pay to buy their value.

(a) Coal and Lignite

The main source of coal power. Coal deposits in India are 148790 million tons. Total Lignite reserve available in Neyveli is 3300 million tons. In 1950-51, the annual production of coal was 32 million tons. In 2005-06, the annual production of coal was 343 million tons. Lignite production was 20.44 million tons in 2005-06. According to an estimate, the conservation of coal in India will last for 130 years. India is now the fourth largest coal producing country. Coal deposits are mainly found in Orissa, Bihar, Bengal and Madhya Pradesh. It gives jobs to 7 lakh workers.

(b) Oil and Natural Gas

On this day oil and India are considered as the most important source of energy in the world. It is widely used in automobiles, trains, aircraft and ships etc. In India it is found in Assam, Mumbai High and Gujarat. Oil resources are small in India. After independence, 13 refineries were set up in the public sector and their refining capacity was 604 million tones. After the implementation of economic reforms, private refineries are also involved in oil refinancing. According to the present rate of intake, oil preservation in India can last 20 to 25 years.

(c) Electricity

Power Generation is a common and popular source. It is used for commercial and domestic purposes. It is used for lighting, cooking, air conditioning and electrical appliances like TV, refrigerator and washing machine. In 2000-01 agriculture sector 26.8%, industrial sector 34.6% and 24% electricity is used for domestic purposes and 7% is used for commercial purpose. Railways 2.6% and consumer spending 5.6%.

There are three main sources of power generation:

1. Thermal Power
2. Hydro-electric power
3. Nuclear Power

Non-commercial source

These sources include fuel wood, straw and dried dung. These are commonly used in rural India. According to an estimate, the total availability of fuel wood in India was only 50 million of tones per year. It is 50% less than the total requirements. In the coming years, there will be fire wood deficiency.

Harvested agricultural waste is used as fuel for cooking. According to one estimate, agricultural waste used for energy use can be 65 million of tones. Animal dung is also used for cooking purposes when dried. The total production of animals is 324 million tons, of which 73 million tons are used as fuel. Straw and dung can be used as valuable organic fertilizers to increase soil and fertile productivity. The energy generated through the sunlight is called solar energy. Under this program, solar photovoltaic cells are produced with sunlight and produced in the form of electricity. Photovoltaic cells are converted into electricity in the light of the sun. In 1999-2000, 975 grams were enlightened by solar energy. Under solar thermal program, solar power is obtained directly. Sunlight is converted into heat energy. Solar energy is used for cooking, hot water and water emission. The energy produced by absorption of the tide of the ocean is called energy tide strength. Due to the absence of cost-effective technology, this source has not been tapped yet.

2.2.3 Renewable & Non-Renewable Energy

Renewable energy

Natural resources, known as renewable resources, are replaced by permanent natural processes and energy in the natural environment. Repetitive and reusable materials, and reusable materials, which are used during a cycle throughout a certain time, and can be harnessed for any cycle. During production of product and services by manufacturing products in the financial system, it produces lots of waste during production and consumers use it. The object is then broken, buried in a landfill or recycled for reuse. Recycling values will again become waste in the materials that again one of the most valuable assets. Natural environment, soil, water, forests, plants and animals are all renewable resources, until they are adequately monitored, protected and protected. Permanent agricultural plants and animals are cultivated in the process of preserving the environment of plants and animals in the lasting soil. Excessive phishing of oceans is an example where art tradition or methods can threaten an ecosystem. Determines whether the endangered species and possibly a fishery are durable for use by humans. An irregular industrial practice or method may lead to a

complete wealth reduction. Based on renewable energy renewable energy from the sun, wind, wave, biomass and geological power. Renewable resources such as water movement (hydroelectricity, tidal power and wave power Wind and bright energy from the sunlight (used for solar power) and solar energy (used for solar power) can be reduced, unlike the virtually infinite and their non-renewable equivalent, which can be run at least if not used.

Potential waves of coastal region can provide 1 / 5th of world demand. The power of hydroelectricity can supply 1/3 of our global total energy needs. Geothermal power can supply up to 1.5 times more energy. There is enough wind to get the planet 30 times higher, the wind power can only give strength to all the needs of humanity. Solar currently supplies only 0.1% of our world's energy needs, but humanity has the power to get 4,000 times more, energy demand by the world around 2050.

Renewable energy and energy efficiency is not a specific field which is only propagated by governments and environmentalists. From the growing scale of investment and capital to more current financial actors, both offer that the sustainable energy is becoming the mainstream and the future of energy production, non-renewable resources have diminished. It is strengthened by the increase in government aid for climate change concerns, nuclear disaster and radioactive waste, high oil prices, top oil and renewable energy. These factors are commercializing renewable energy, increasing market and increasing demand, adopting new products to replace obsolete technology and converting existing infrastructure into the re-standard standards.

Non-renewable energy

A non-renewable asset (called a restricted asset) is a wealth which is not renewed at an adequate rate for sustainable economic exhaustion in meaningful human time frames. An example is carbon-based, organization-fed fuel. The main organic material with the help of heat and pressure becomes fuel like oil or gas. Different elements of the earth are almost always preserved, although the earth's minerals and metal ores, fossil fuels (coal, petroleum, (natural gas) and all underground water in the specific aquatic are regarded as renewable resources. On the other hand, wood (when used in a sustainable crop) and air (used in the power conversion mode) resources are considered renewable resources, because locally rescheduling may occur in a man-made financial time frame.

2.2 Present Scenario of Power Generation in Bangladesh

Due to the division of power generation, distribution and transmission system in 1971 after partition and independence in 1971, there is a certain shortage of electricity supply and demand, and the situation still continues [6]. Autonomous institutions, including various institutional, semi-government, statutory organizations, are charged for the operation and monitoring of three main components of distribution, distribution and transmission of the generation of Bangladesh, but sadly, the demand for supply and supply is still in the deficit.

With some fast rental power plants, the government produces the necessary amount of electricity for the country as well as purchasing power at high rates. Most of the generation of generation plants are operated by conventional energy sources, such as natural gas, coal and other types of energy. Present day energy situation Bangladesh is very critical. Lions of natural gas operated units of Bangladesh. Due to the strong increase in population and the slow growth of industrialization, the gas reserve has fallen to a dangerous level in order to meet current power demand. And it is expected that the remaining reserve can last for another 7-8 years unless no alternative reserve is discovered and used as soon as possible.

The Bangladesh government has adopted a systematic method for the development of renewable energy. With the official steps, the Bangladesh Power Development Board constituted "Directorate of Renewable Energy and Research and Development" in 2010. The director keeps a sign from the very beginning of the establishment increasing the use of renewable energy in the power sector. Bangladesh has a good opportunity for solar, wind, biomass, Micro-hydro power generation. In order to achieve the objectives of the 2008 renewable energy policy, BDPB has taken steps to improve the development of renewable energy projects for the past few years as well as to implement and promote energy efficiency. The Board of Directors is established to study the feasibility study, plan, evaluation, examination, as well as to undertake necessary research studies

in project monitoring and relative fields. There are current Manpower Directors of the Board of Directors, two deputy directors, five assistant engineers and six employees.

The government has set a goal to provide electricity to all by 2020 and to provide reliable and quality supply of electricity at a reasonable and affordable price. Permanent social and economic development depends on the adequate power generation capacity of a country. There is no other way for the development of electricity by means of energy diversification. Renewable energy development is one of the key strategies adopted as part of the energy diversity program. According to the Renewable Energy Policy 2009, the government is committed to facilitate both public and private sector investment in renewable energy projects for renewal and renewable energy. Existing Renewable Energy-Based Power Generation Contribution The total energy production that envisions renewable energy policies will achieve 10% by 2015 and 2020 [7]. In order to achieve this goal, GOB is searching specifically for renewable energy companies for various options. Renewable energy is a small proportion of the total generation under the current generation of Bangladesh. Renewable energy share has so far surpassed 1%. The current government is giving priority to the development of renewable energy sources in order to improve the safety of the people and to establish a sustainable energy regime in addition to the sources of conventional energy. The government has already started a "500 MW Solar Power Mission" to promote the use of renewable energy to meet the growing demand for electricity.

According to BPDB, it started with only 200 megawatts of power generation installed. Established generation capacity (April 2016) increased to 12,365 megawatts. A number of Generation and Distribution organizations have been formed as part of the reform and reconstruction. BPDB's helpers are:

- Ashuganj Power Station Company Ltd. (APSCL)

- Electricity Generation Company of Bangladesh (EGCB)

- North West Power Generation Company Ltd. (NWPGL)

- West Zone Power Distribution Company Ltd. (WZPDCL)

BPDB is responsible for the main part of power generation and distribution of urban areas except Dhaka and the western region of the country. Government of Bangladesh under the Power Division of the Board, Power, Energy and Mineral Resources Ministry. BPDB has taken extensive capacity expansion plans to add 11,600 MW generation capacity in the next 5 years to achieve 24,000 MW. By 2021, according to PSMP-2010, Capacity aims to provide standard and reliable electricity for the preferred economic and social development of all the people of the country. Electricity has been expanded to speed up the fast growing demand.

According to BPDB statistical data, the current demand for the main part of the country's expansion and distribution is about 11,405 megawatt and the production is about 9,036 MW or less. So in reality, electricity shortage can be a frequent cause of power cuts and excessive load shedding. Currently all the people of the country have access to electricity. Many remote rural areas are still not connected to the national grid. There are more than 87,000 villages in the country. Due to low demand, expansion of the area, cost of production-in-transit, especially the distribution of electricity is costly for this region. 62% of the total population has access to electricity and the cost of electricity in every capital is 321 kilowatt.

Table 2.1: Total energy generation by public and private sectors according to BPDB (percentages)

<u>Public sector</u>	<u>install generation capacity (MW)</u>
BPDB	4320
APSCL	904
EGCP	622
NWPGCL	440
RPCL	77
BPDB-RPCL JV	149
Subtotal	6512(53%)

<u>Private sector</u>	<u>install generation capacity (MW)</u>
IPPs	2875
SIPPs (BPDB)	99
SIPPs (REB)	251
15 YR. Rental	167
3/5 YR. Rental	1861
Power Import	600
Subtotal	5853 (47%)
Total	12365

Now if we concentrate on using energy resources, we will see that about 72% of the country's energy comes from conventional fuel such as fuel wood, animal biomass and residue of crops, when 28% of commercial power supply with hydroelectric power. All commercial fuels are imported without natural gas. Coal can be a possible source of power generation and it is available in large quantities in the country. But coal-based power generation is not economically feasible due to its deep position, although a small percentage of the total generation is produced by coal.

Invisible potentials of solar, wind, biomass, biogas, and non-extinct sources of energy can be used to ensure energy security, environmental stability. Understanding the inevitability of renewable energy sources in various available forms, its effective use has been adopted by the government as a policy. Between 2021, the Government has a plan to generate 2000 megawatts of solar-based facilities. At the signing ceremony of the agreement of Bangladesh Power Development Board and MKG Consortium Limited, the agreement was signed at the signing ceremony of Power Development Board (PDB) Additional Secretary (Administration) Mazharul Haque and managing director of HKGE Consortium, Key Young Li, in today (February 15). From their respective organizations. According to the contract, PDB will purchase electricity from the upcoming 32 MW

solar power plant at \$ 0.17 per unit of MKG Consortium. [7] Solar power plants will be set up on the basis of Build & Open (BOO) in Dharmapasha upazila of Sunamganj in the next 18 months. The contract is valid for 20 years. Currently, 200 MW solar based electricity is generated in the country.

2.3 Using Renewable Energy as an alternative Source

Bangladesh is a large and widely densely populated country in South Asia on the Burma, India, Nepal and Bhutan border. Bangladesh has an estimated 168.9 million population in 2016. Poverty reduction, rapid and sustainable economic growth, the technical development power is more clearly the most basic pre-requisite for electricity. The country is faced with a lack of tough power over the last few decades and it is a matter of sadness over the coming decades. Our natural resources will end and we will fall into the deep sea due to the lack of resources, so it is now less time to think about the source of natural resources and renewable energy. Our country is happy with the number of possible and renewable sources. After a period of time, the renewed energy sources are commonly known as energy renewable sources. Solar, wind, hydro, biomass and biogas are generally the sources of renewable energy.

In Bangladesh, solar power, biomass, biological gas have been used since past. Grid connections and gas coverage, the use of organic gas for cooking, air power for drying grains and clothes, and the use of solar power, especially those areas are known to all. But due to proper technology advancement, policy implementation and lack of implementation, we are still in the process of developing and utilizing mass of renewable sources compared to other developed and developing countries of the world. Renewable energy is clean, sound and environmentally friendly. A summary of all the renewable energy sources found in this region is provided in the section.

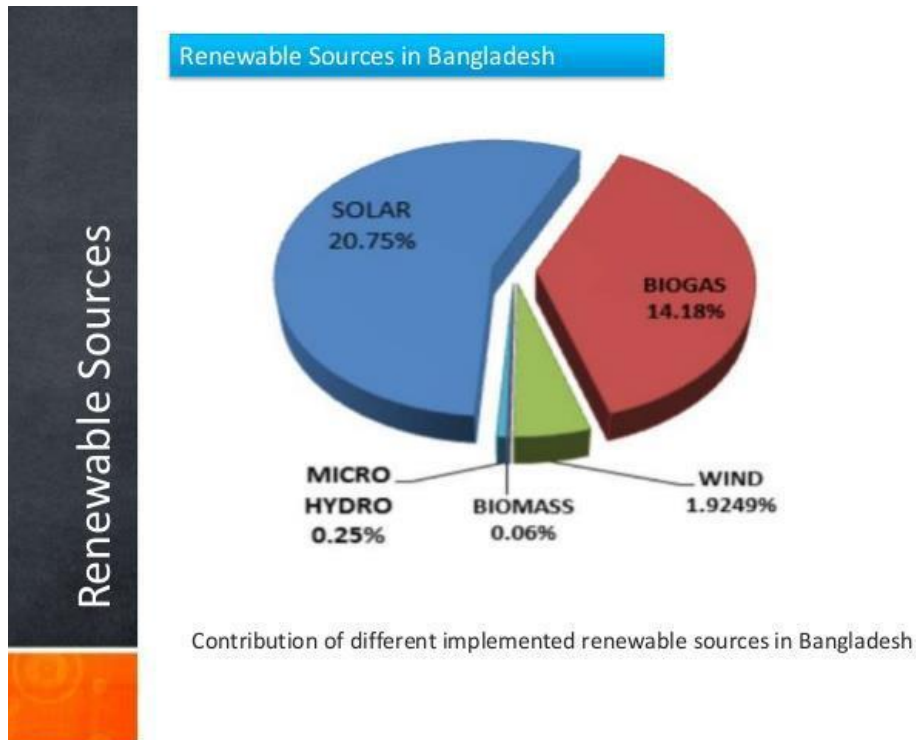


Fig 2.1 Renewable Energy Source in Bangladesh according to Bangladesh Economic review

2.3.1 Hydro energy

Hydro power is another alternative energy that requires water current and height to generate operational power. These achievable energy systems are considered as conservation and the absorption power in the energy outline of the energy of the automatic stream. Micro-hydro power is capable of producing 5-300 kilowatt power. It is one of the simplest technologies that can transfer hydropower to the mechanical energy power. Developing countries like Bangladesh are very suitable for micro-hydro technology and the most sophisticated technology. Many canals and branches of Karnafuli, Shangu and Matamuhuri rivers are thought to be good possibilities for setting up micro-hydro power along the Chittagong Hill Tracts. Recently, permanent micro-energy (SRE) was established under the first micro-hydro power unit LGED in Bamerchar Upazila of Chittagong. However, only 4 kilowatt electricity is not possible because the inadequate current is water. In 1981 Bangladesh Water Development Board (BWDB) and Bangladesh Power

Development Board (BPDB) discovered potential sites suitable for micro-hydro power generation in 1981. Sustainable Rural Energy (SRE) has also discovered some possible locations for micro-hydro sites in Chittagong areas in 2004.

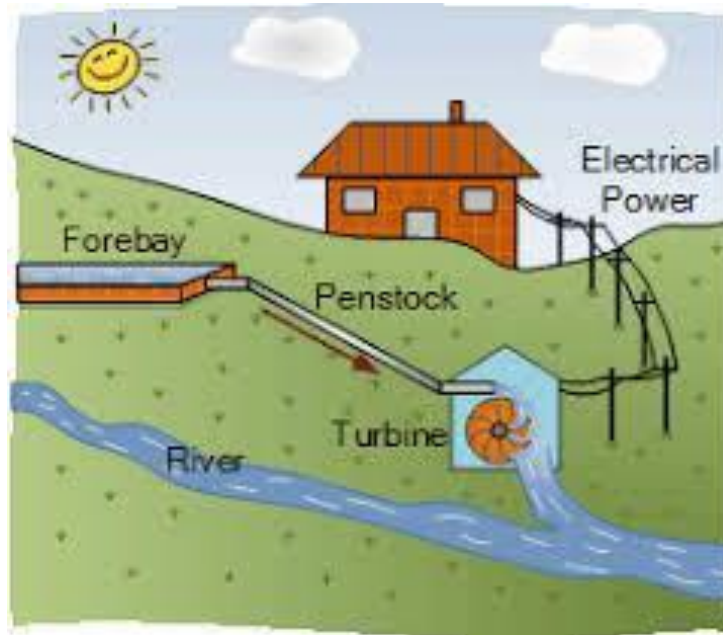


Fig 2.2 layout of hydro power plant

It is clear that Micro-Hydro power has infinite options for generating power. However, unfortunately, Bangladesh is unable to generate energy from hydro power. The total hydropower potential of Bangladesh in the three locations (Kaptai, Sangu and Matamuhuri) is about GWh/year (755MW) of which 1000GWh/year (230MW) has been harnessed at Kaptai through 5 operational units of hydro power plants.

To get hydroelectric benefits, it should be given proper attention for further development. BPDB has proposed to the government to set up 25 kilowatt power plants in Teesta Barrage. [7] More analyzes can open a new door to success in this regard. The Bangladesh Water Development Board (BWDB) and the Power Development Board (PDB) are participating in joint research for possible future prospects of the country's small power. Due to proper planning, we can use hydroelectric

power to make the best use, so the whole nation can benefit greatly from the point of view of energy conservation and energy conservation.

Table 2.2 Potential small hydro sites identified by BPDB and BWDB in Bangladesh

District	River/ Chara /Stream	Potential of electrical energy (kW)
Chittagong	Foy's lake	4
Chittagong	Choto Kumira	15
Chittagong	Hinguli Chara	12
Chittagong	Sea lock	81
Chittagong	Lungi chara	10
Chittagong	Budia chara	10
Sylhet	Nikhari Chara	26
Sylhet	MadhabChara 1500ft.fromfall	78
Sylhet	Rangapani Gung	616
Dinajpur	DahukatBurabari	24
Dinajpur	ChawaiatU/SofChawaiL.L.P	32
Dinajpur	TalamatU/SofTalamL.L.P	24
Dinajpur	PathrajatFulbari	32
Dinajpur	TangonatD/SofNargunL.L.P	48
Dinajpur	PunarbhabaatSingraban	11
Rangpur	BuriKhoraChikliatNizbari	32
Rangpur	FulkumaratRaiganjBazar	48

Table 2.1

2.3.2 Wind energy

Air power technology exchanges airflow in the motorcycle, which ultimately results in electricity conversion. The Bay of Bengal and the 724 kilometer-long coastal region occupy huge highlands and islands, which can bring much potential for electricity generation from wind power, especially in the monsoon, the strong south and southwest monsoon wind usually flows from the Indian Ocean in the atmosphere. Entered the Bay of Bengal and the coastal areas. These winds flow from March to September, where their monthly average speed is 3-6 m / s [10]. It shows that the wind eruption once entered the country's V-shaped coastal region. Recently, due to the improvement of air rotor aircrafts, it has made it easy to drain even the wind speed of less than 2.5 meters / second. Studies in the study of BUET, BCAS, LGED and Meteorological Department have said that in the monsoon, air winds are usually available for several months before or after the monsoon.

One year data from Bangladesh Center for Advanced Studies has started, which focuses on turbines of 50 meters in the coastal areas, which are separated by wind power, which vary between 4.1 and 5.8m / sec, and the power density is about 100-250 watts / m. Electricity from the coastal wind can be transferred to various areas across the country through high voltage transmitted connections. Although the operation and maintenance cost of wind turbines are very low throughout the lifetime, the economic aspects are many Therefore, with the help of coastal region wind power stations, the power deficit can be compensated. As well as wind power in the Bay of Bengal, wind turbines, such as Kuakata, Sandwich, and Saint Martin Island, can be considered as potential areas for wind energy. It is clear that many of these islands are unable to access electricity from prison and national grids. Therefore, wind power in the coastal areas can be an efficient solution for power generation and electricity, because there is a facility to install wind turbines and to develop wind power in coastal areas.

Small air wind turbines like St. Martin Island, Patanga, Bhola, Barguna, Dinajpur, Thakurgaon and Panchagarh may be set up to verify the feasibility of renewable sources for power generation. However, some wind energy sources of different agencies are available in Bangladesh, but their contribution to the national grid is insignificant. Therefore, government intervention in this regard is widely needed.

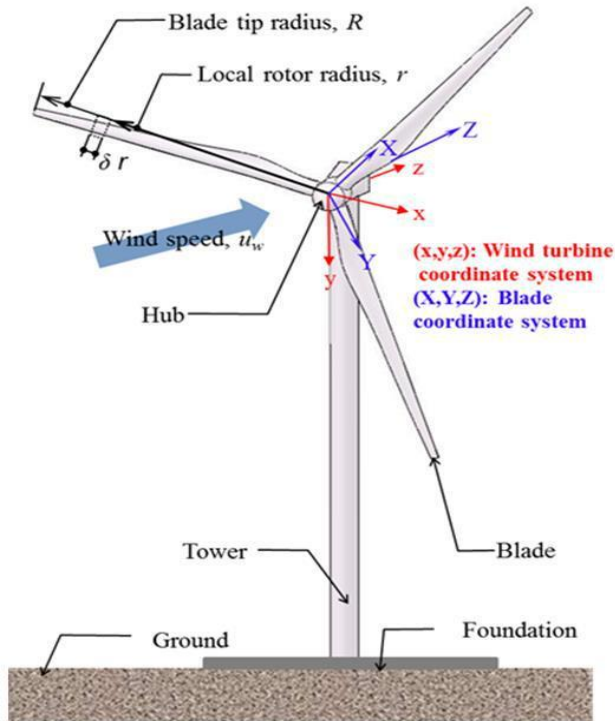


Fig 2.3: Wind mill topology

Table 2.3: Wind turbine installations in Bangladesh by different organizations

Organizations	Type of application	Installed capacity (Watt)	location	Present Status
Grameen Shakti	3 hybrid	4500	Grameen offices in the coastal region	Functioning
	hybrid	7500	Cyclone shelter in the coastal region	Functioning
BRAC	Stand-alone	900		Functioning

	hybrid	4320	Coastal region	
Bangladesh Army	Stand-alone	400	Chittagong hill tracts	Functioning
LGED	Hybrid	400	kuakata	Functioning
	Total	18020		

Table 2.2

2.3.3 Biogas

Biomass may be considered as the biggest energy source in Bangladesh. About 70% of its total production power supply is supplied to the family's basic strength and to the households of the household. [7] Biomass contains various types of natural and organic materials from organic materials to organic materials. There are many existing technologies available to translate the energy of biomass in power and heat energy. There are two types of broad technology, which are directly ignited.

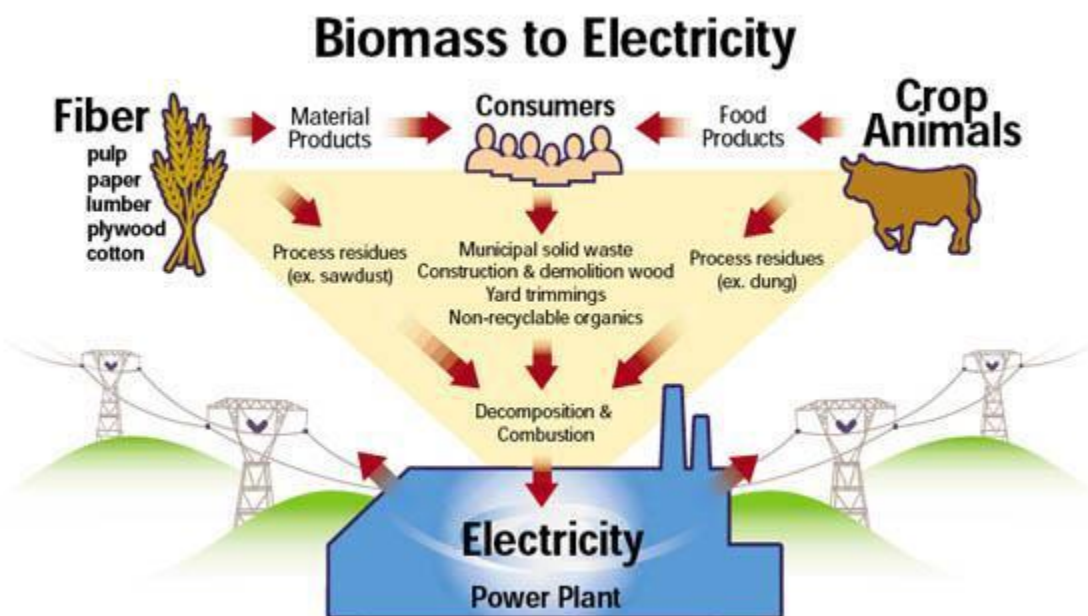


Fig 2.4 biomass to electricity

The direct ignition process captures the biomass corrosion with surplus air, produces warm chimney gas which produces vapor, which is finally applied for power generate.

On the contrary, gifting reduce the conversion of biomass and produces lower secondary calorific gases and then the received gas uses joint-cycle power for the production of the plant. It is recognized in a short time with the ability to achieve 30 megawatts of power in translation. Generally, organic gas refers to the gas produced by the biological breakdown of various organic matter in the absence of oxygen. Countries like Bangladesh, where the main part of the economy depends on agricultural production, there is a huge potential for using biogas technology. Raw materials for biogas production are easily available everywhere and simply. Various NGOs including the government are working together to produce electricity from biogas recently. Among these, rural power is notable. They set up 13,500 biogas plants across the country. Besides, by installing 18,713 biogas plants from May 2010, along with other companies, a government-owned Infrastructure Company named IDCOL

The cost of limiting the broad application of biogas-based energy production is the most influential element. This technology requires proper planning, technology and economic support to create more effective and popular medium for getting electricity among the people. Stocks of various foods such as organic home waste, waste, fertilizer, sludge, and others have been shown and commercially related to organic hygiene of biomass. Biogas contains 40-70% CH₄, 30-60% CO₂ and 15% other gas [10], which is produced from certain fertilizers and poultry fertilizers in certain bio-digester. Therefore, the produced gas is usable for the production of electricity and is also usable. Bangladesh is a country where its main agricultural production rice and the average production is approximately 35,000,000 metric tons. 20% of the produced rice (such as 7,000,000 metric) may be beneficial for biomass, then the production of biomass power from rice corn may be more necessary [7]. In addition, Bangladesh is an agricultural based country which produces different products of discrimination which can become biogas energy which can be economically economical and able to overcome national energy crisis. Besides, 436tones of recyclable industrial waste is operated every day in Bangladesh. In addition, 3054tones of waste will be collected by 2015 and the joint dumping capacity of 9 million tons by the end of 2015. [10] The technology option to convert from waste to energy can be an alternative to support the national level. Although the rural population is using a small amount of power from domestic waste for household chores, the government will have to focus on these issues and it should be commercialized in connection

with the national grid, where there is no electricity in rural areas yet. However, various biogas and biomass power sources of different organizations in Bangladesh are in power, but their inputs at the national level are not significant. Therefore, the government's intervention on this issue as a concern of rural energy source is widely needed.

2.3.4 Solar Energy

Among the various forms of renewable energy in Bangladesh, solar power is the most likely to be the most popular and functional one and renewable sources have a bright prospect in terms of solar energy applications than any other. The Sun is known as the solar energy by forming the sun as the energy radiation obtained by the Earth's surface. Solar radiation is strongly dependent on the atmospheric condition of the year, the surface of the earth and the other related geological aspects of the sun ray incident angle. By acknowledging the potential of solar energy resources, Bangladesh can increase the energy security by their unprecedented energy demand as well as their progress. Therefore, as an alternative to the current energy crisis, solar power such as solar photovoltaic (PV) can be a part of the power demand to solve problems and problems. Bangladesh 24°0'0" N Latitude and 90°0'0" E. Longitude, which is located in the ideal location for the conservation of solar energy. For years, the cost of PV, production and installation has decreased, and it is an opportunity to invest as an economic scale for a developing country like Bangladesh. Recent literature of solar photovoltaic (PV) indicates that daily average diversity of solar discharge follows the pattern of dry and wet season in Bangladesh between 4 to 6.5 kilowatts [11]. The maximum level of radiation from March to April is accessible, from December to January and the average sunlight hours are respectively 6.69 / 7.6 s, 6.16 and 4.81 in the summer and summer seasons respectively. By the month of March-May, the predominant value of solar radiation is highest, where there is a possibility to produce 1 (one) square meter area of 4-5 some / m² / day. The maximum sunlight hours in Khulna are 2.86 to 9.04. It is 255 to 8.75 in Barisal. [11]. Therefore, there is a great possibility of using solar power as a direct manufacturing system in Bangladesh, but not accessible as well as accessible frameworks with a combined power station.

Solar technologies are being promoted to some NGOs such as Idkol, Rural Energy, Rahimafrooz and Energypac. After Infrastructure Development Company Limited (IDCOL), RSF, BRAC and Sreejoni Bangladesh contributed the highest effort by establishing 1,320,965 solar home systems

(SHSs) with 36.5 megawatt capacity till January 2012. Bangladesh 345,161 (b) Chittagong 257,578 (c) Barisal (d) Rajshahi 185, 267 (e) Khulna 146,388 and Sylhet 140, 386 units but are being considered for installation capacity. Very little compared to national energy demand. Currently, the cost of PV technology is an important question of ability for at least developing countries like Bangladesh. Although geographical location is ideal for solar energy conservation and PV technology is very capable of enlightening the electricity. We understand from literature that for the geographical location of Bangladesh, it may be very potential for solar power generation in near future. Even solar thermal power plants can show the intensity of the sun in the northern provinces of Bangladesh. Therefore, the issue is understood to address concerns about long-term policy issues, appropriate consolidation of action plans, national budgets, subsidy issues and the gap between national energy planning policy. In addition to these things, the use of solar power has not been widely recognized as the lack of technical progress, absence of appropriate policy and popularity as a commercial power across the country. Implement current policy. Whereas, the government has made it popular among the general public and proposed a renewable energy policy (Proposed Renewable Energy Policy, 2014) where solar power is given more importance. In addition, the government and many other relevant organizations are trying to address the problem of energy crisis through the promotion of both the Solar Home System (SHS), the Grid Rural Area and the Grid Urban Area of the country.

The IDCOL Solar Home System (SHS) has supported various NGOs in the installation and installed 1320,965 SASs in February 2013 with 36.5 MW capacity. Besides, BPDB has implemented an excellent solar PV-based electrification project in the Chittagong Hill Tracts. A 10 kilowatt AC solar PV system has been installed in each of the three sub-districts of Rangamati district. In addition to this, the government proposes to install 3% light and fan load powered by solar PV system to get utility connections, although the results of the proposal are not very positive

In our thesis, we actually worked on the problems of solar system installations in the urban area and offered some effective, renewable, economically feasible designs so that customers can have a positive impact from these new systems except for grief.

Along with the family's electrical realization, solar-based recharging stations can be used in solar-based recharge stations at solar-based recharge stations, which are the top of the rooftops of filling stations where most of the cases are on top of the roof and the PV system can be installed to track the maximum power by adjusting the weighing angle of the module.



Fig 2.5 off grid solar panel

Using technology possibilities with the economic power of the country, only proper planning, public awareness, solar power based photovoltaic systems across the country can be best utilized and therefore can reduce the pressure of the grid which can greatly reduce the dependency of fossil fuel.

2.4 Solar: The best form of energy

Measurement of the development of any society today is equivalent to the amount of energy used. So power is recognized as a critical input parameter for national economic development. Today, the energy needs are met from fossil fuels such as coal, oil and natural gas. In 1980, global electricity demand was only 728.8 million tons of oil equivalent but by 2005 it increased to 11,422.

With the increase in the demand for better industrialization and less developed countries, most growth may be expected, which has increased in the country by gross vulnerability. Fossil fuels provide the power of a cheap and concentrated form, and as a result they dominate the energy supply. Total energy demand, about 80% of fossil power, when remaining 20% is supplied by atomic and renewable energy. In 2005, there were 26.6 billion tons of CO₂ emissions worldwide, of which 41% were from electricity generation based on fossil fuels. By increasing CO₂ emissions from electricity production, by 46%, it is expected to increase by 46%. In 1980, the total global electricity consumption was 8027 TBA, which increased to 17,363 TBA by 2005. The installed power generation capacity in 1945 was 1945 GW and it increased by 3878 GW by 2005, which was about 69% of the current fuel. The main problem is that, in the next 20 years, the expected demand for electricity will be to install the same power generation capacity of the entire 20th century. Bangladesh position is an ideal place for solar energy to translate this amazing number of 1000 MW power plants in the next 20 years. The daily average solar radiation is 4 to 6.5 KW per square meter. The lowest radiation in March-April and the lowest radiation in December-January is available. Bangladesh has a good potential for solar power supply. Solar radiation sun radiation is derived from solar energy from the sun. Power generation with solar power depends on photovoltaic and heat engines. In our case, we find solutions to the problems of urban power deficit. It is not possible to use air, ocean, hydropower, etc. in the urban areas as a form of renewable energy for electricity generation. And among the rest we are going to work with solar, it is already being popular in our country. Solar energy is the most diverse form of renewable energy among other renewable energy sources. The sun's heat energy can be used for various purposes to make it versatile. Through technological advances, we have the ability to tap and energy production of solar energy and then save it. Therefore, we can remember to be the true alternative energy source of solar energy. Some of it is in the form of infrared and ultraviolet light, but it is mostly visible in the form of light. This energy falls on some earth, where it warms the surface of our planet, uses ocean currents, windows, food used by plants etc. Life and earth depend on the sun. The application point of the solar bright prospect form compared to any other renewable sources. To make a good guess, earth radiation (black body) acts as a perfect emitter. The solar radiation is known as the solar constant when the average distance from Earth to the Sun in the outer boundary of the atmosphere. Solar radiation intensity is strongly dependent in the angle of atmospheric conditions, time of year and sunlight on the surface of the Earth. The solar radiation

found on the Earth's surface is very different from the multi-dimensional radiation, from the point of view of usage. In general, a unit is called energy irradiance from a bright source falling into the area. On the other hand the air is essentially made with temperature changes. We also know that winds flow from low pressure areas to high pressure areas. These variations of temperature and pressure are due to the difference in amount of heat energy received in different regions from the Sun, depending on the Earth's rotation. This energy stored in the form of air can be converted into electrical, electrical or chemical energy. An air faucet can produce enough energy to power a home. But the electric power produced from the turbine is not enough compared to the energy produced by fossil fuels. The disadvantage is that it is expensive and not completely renewable; so it is necessary to discover a good way to lift energy and produce environmentally friendly energy. Like the wind does not hit at constant speed and the wind direction is not guaranteed and therefore the output should not be operational. Also, heavy winds and thunderstorms may cause heavy damage subject to a severe damage when hit by storm. There are some advantages over other sources of solar energy. Some of them are stated below:

- 1) Solar energy is non-polluting, clean, reliable and renewable source of electricity
- 2) Solar cells make no noise at all and there are no moving parts in solar cells which make them long lasting and require very little maintenance. Solar energy provides cost effective solutions to energy problems where there is no electricity at all.
- 3) Solar cells generally do not require any maintenance and run for long periods. Time can be added to more solar panels from time to time when needed. However, solar panels have initial cost but no repetition costs. Once spent, the initial cost can be restored in a long run and it does not create any objectionable smell.
- 4) Solar panels are easy to install and require much less wire, rope or power sources. Like wind and geothermal power stations that they need to connect to the drilling machines, solar panels are not needed and installed on the roof, which means that no new space is needed and every home or business user can create their own electricity.

2.4.1 Solar panel

Devices that convert solar panels into light. They are called "solar" panels because most of the time the Sun is called the most powerful source of astronomers. Some scientists call them photovoltaic, which is basically "light-energy". A collection of solar cells in a solar panel. Large solar cells spread across a large area can work together to gain immensely. It makes a cell more enlightening, it generates more power, so spacecraft is usually designed with solar panels, which can always be directed towards the sun, even the rest of the spacecraft can move around, such as the Tank Burge tank, which is going to independently target.



Fig 2.6

2.4.2 Mono-crystalline Panels:

Dark black color solar panels are known as mono-crystalline solar panels. Mono-crystalline panels get their names as silicon wafers are used to spend their single crystals or silicon 'bowls'. Silicon



Fig 2.7

is raised in a laboratory to acquire a high degree of purity and then the wafers are cut very thin. So far, 21.5% of the best solar energy companies have been able to achieve the best efficiency. [18]

Advantages:

1. All solar panels available in the market have the highest efficiency.
2. Space-efficient.
3. Long lifetime, usually come with a 25yr warranty.
4. Perform low light position better than any other solar panel.

Disadvantage

1. The most expensive.
2. A significant amount of silicone ends up as waste.
3. Performance enjoys high temperature

2.4.3 Polycrystalline Panels:

Light or dark blue solar panels are known as polystyrene panels. It is known as Poly silicon (Pc) and multi-crystal silicon (MC-C) these cells are dissolved and re-crystallized silicon is cut from a shaft. Raw silicon is dissolved and poured into a square mold, which is cut into cold and fully square wafers [18]. Polycrystalline solar panel is the efficiency

Usually 13-17%



Fig 2.8

Advantages:

1. Low cost
2. Silicon waste is much less than mono-crystalline for waste production.
3. Performance gets high temperature high.
4. Excellent lifetime, usually come with a 25yr warranty.

Disadvantage

1. A little less efficient than mono-crystalline.
2. The need for more space than mono-crystalline for generating the same amount of electricity.

2.4.4: inverter

An electronic transistor is an electrical device that converts AC voltage from DC voltage, almost always from the battery, to standard family so that it can be used by ordinary equipment. In short, the current transition into an electrode current option is converted. Solar cells are used only in small electrical equipment, such as solar power systems, solar cells are capable of producing only DC. They are used in places where a small amount of voltage is used or generated such as battery batteries that produce only DC. DC production in addition to these fuel cells and other energy sources

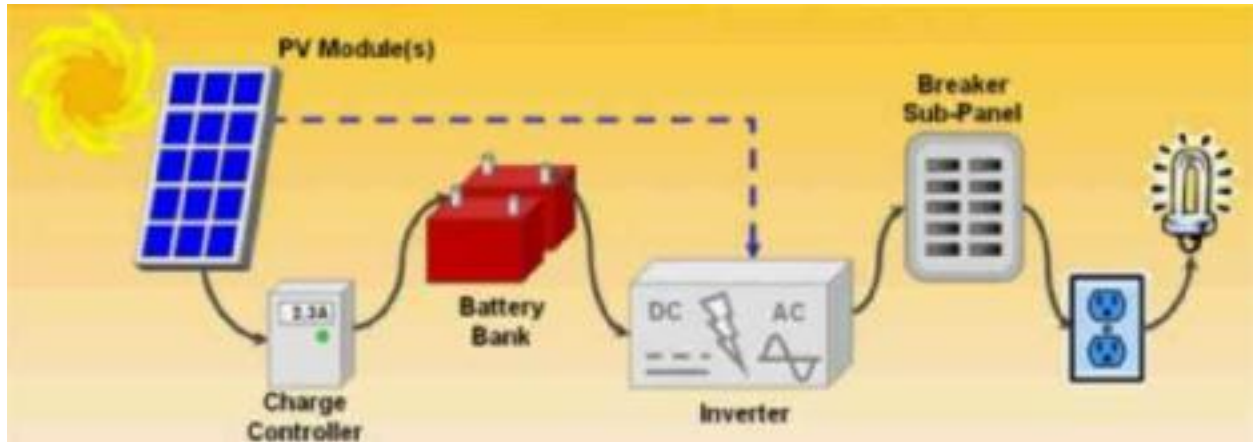


Fig 2.9 inverter

2.4.5 Battery

An electric battery is a device that consists of one or more electrochemical cells, with electric power such as flashlight, smartphones and electric vehicles. [1] When a battery is providing electrical power, its positive terminal cathode and its negative terminal encode. [2] Terminal is the source of negatively charged electrons which will flow through the external circuit in the positive terminal. When a battery is attached to an external electrical load, a redox reaction is distributed as the power energy of the low energy product to convert high energy response, and free energy difference to the outer circuit. [3] Historically the term "battery" refers to a device typically composed of multiple cells, but the usage has improved to include devices connected to a single cell.

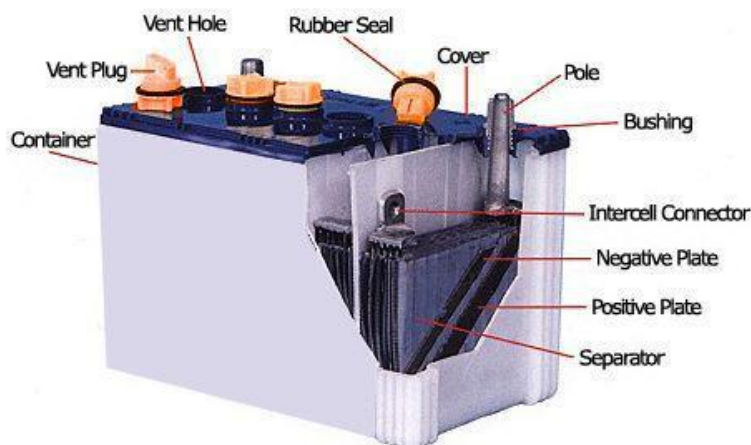


Fig 2.10 battery

2.5 Working technique of solar rooftop system

A roof photovoltaic power station, or a roof top PV system, is a photovoltaic system, which has a solar power generating solar panel that is mounted on the roof of a residential or commercial building or structure. [1] Different components of such a system include photovoltaic modules, mounting systems, cables, solar inverter and other electrical accessories. Rooftop mount system smaller than ground mounted photovoltaic power stations, with a capacity of megawatt range, small. Rooftop systems in residential buildings hold about 5 to 20 kilowatt (KWT) capacity and often mounted in commercial buildings reach 100 kilowatt or more

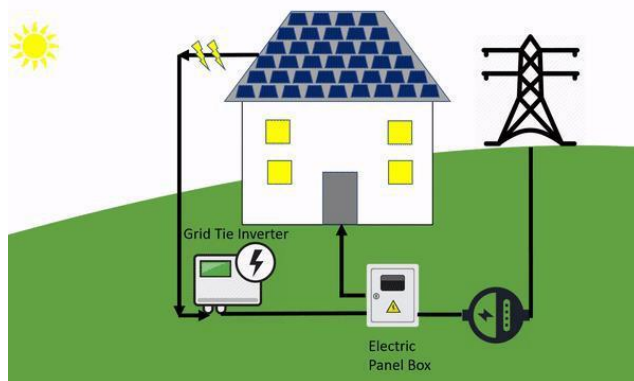


Fig 2.10 working procedure

Potential Solar Home System (SHS) in Bangladesh

The solar home system is being arranged for more than 4.5 million households in the country With a capacity of 175 MW (18 April 2016) [12] The solar home system has improved and both Implemented by BRDE, LGED, IDCOL, GS, BSREA, BRAC, BGFI and more Organization The potential of solar power in the country is so much. Promotion The solar home system (SHS) is widely circulated through IDCOL, GS and BRAC Micro financing and direct sales practice. All the government beside the house and are at the private office Encourages using renewable solar system to reduce power consumption Grid.

2.5.1 Initiatives Taken by Bangladesh Government

Progress of electricity generation in Bangladesh using renewable energy

The government has adopted some long-term projects. Know the importance of solar photovoltaic (PV) system, the government of Bangladesh started their projects immediately Bangladesh aims to achieve electricity generation! Some of the recent initiatives have been adopted the government and other organizations are as follows:

1. The target was set according to the renewable energy policy on December 18, 2008 2015 generates 5% of the total electricity from renewable sources and 15% of the total Power by 2020

By 2021, the power of 1,740 MW of solar power and 1,370 MW of wind power was added.

3. Establishment of 800000 SASSs in joint and private cooperation

Companies in rural and minority institutions (NGOs) now contribute to urban areas From 47 megawatt to 40.5 megawatts of various renewable resources.

4. To reduce the burden of value, all types of VAT and taxes have been removed from the solar panel Users and also from importers

5. Solar mini grid electricity is expensive for rural people during installation of grid under the personal entrepreneur. Therefore, the government has taken various grid bound solar deposits a total of 793 MW of park projects. They will be implemented by government ownership through utility companies or private entrepreneurs this program is at different stages Implementation.

6. The government of Bangladesh signed additional funding of \$ 78.4 million more scale support for the World Bank's successful solar home systems (SHS) support Bangladesh Program the SHS program is currently installed at 70,000 solar home System every month, making it the fastest growing SBS program in the world.

7. Infrastructure Development Company Limited (IDCOL) has signed a financial contract 168 Barka Renewable Energy Limited (BRL) is located for any solar mini grid Sonargaon Nooneratek Island of Narayanganj District Total cost of the project is 7.14 taka In which IDCL will provide 30% soft loan and 50% as a grant. IDCL got the fund for funding such projects from the World Bank, DFID, JICA, KFW, ADB and USAID.

8. IDCOL, there is an aspect to finance government-owned non-bank Financial Institution 1550 Solar irrigation pump, 50 solar mini grids, 130 biogas based power plants by 2017. [13] It is to make 6 million SBS financing by the end of 2016.

2.5.2 Manuscript of Renewable Energy policy-2015

In Bangladesh, following the many sustainable solutions to the solar system, the government has reconsidered the renewable energy policy. Solar core points Manuscripts of the renewable energy policy-2015 are offered to implement the home system down.

1. Currently 80% of the total population (June, 2016) [21] got access to electricity. We are every year 378 people of NHPP have their per capita. The quantity is not much than the advanced and developing countries in the world. Here urban dwellers have more electricity in Bangladesh Convenience than rural. There is not a large number of electricity in the rural areas. So, they have No access to the modern value of life. Moreover, the opportunity to use modern and standard Fuel is limited by poor people.

2. To increase commercial use, the government has announced a 500 MW solar program Solar power which consists of Solar Mini Grid, Solar Park, Solar Irrigation and Roof Top Solar Establish this includes solar electrification of distant places beyond the grid reach Such as educational institutions, religious institutions, union information centers and healthcare Center.

3. The basic purpose of this policy is to bring people to life, reduce their lives Reduce electricity consumption by using fuel pollution and renewable energy Source sources for 5% by 2015 and 5% to ensure renewable energy for electricity Production.

4. SERDA is also contributing to the power sector as well as other organizations. Under the power division a directorate was formed to help the electricity department to use fuel. DPDB and BRUBO has received such a Directorate. Renewable expansion is the main concern of these two organizations. Many organizations like BUET are conducting various research programs, BRAC, Dhaka University, MIST, ITA and many more.

5. The grid is connected to the production of electricity, where the produced electricity is sold or sold larger buyer through national grid. Wind, solar, water, biomass are all included in it.

6. Off-grid, captive and exclusive electricity generation, which houses a variety of accommodation official, semi-official and autonomous office offices included and as local Solar PV or hybrid system where small grid distribution management system is as good as possible. Central Solar PV system, electricity is allocated to big villages or markets. Electricity production. Biomass or biomass systems such as live-stock, human waste, small hydropower etc. Included.

7. The following sections of projects will be welcomed for private sector: Gr Independent Grid Connected Power Project (IPP) Captain Power Project:

A. Capital Power Project for its own use

B. Captive Power Project to sell utility extra power after its own use Renewable energy project (mini micro / nano-grid) in gr close grid area. All projects of the IPP project will be taken to the connected area of the grid. Based on government / Non official Shareholding projects will be taken in the grid attached area. For renewable energy based power the production is taking the following inspiration:

. To expand renewable energy between 2015 and 2030, the renewable goal

The production of energy determined by the government will end

Government / SREDA Bangladesh will be the Development Board (BPDB)

Buying electricity from renewable energy as a unique power purchase

Company But the electricity distribution facility will buy electricity from 1 megawatt

Power Plant from the direct entrepreneur.

.
Distribution of national grid electricity, produced from renewable fuels the point will be built by the entrepreneur institution at their own expense. If they the grid transmission line will be used to create grid transmission lines and Distribution utility next to their own expense measurement point. For this the entrepreneur agency will give due whiling charge and payment due Suspended commission by system damage.

The entrepreneur will decide on the settlement of the tender for the company Based on the feed in tariff (FIT) implemented by BERC. Benchmark prices will be fixed Based on the prices of various open tender until the FER is implemented by BERC. Based on Consider this benchmark price and size, type and other peripheral costs The price of electricity for the project will be determined Production Entrepreneur Institution For fixing cost plus based tender The following topics will be considered:

- A. Capital cost
- B. Evacuation Cost
- C. Time spent
- D Interest on loan
- E. Return equity
- F. Duration of plant life, machinery and contract period
- G. Depreciation
- H. Debt-Equity Ratio
- I. & M cost
- J. Interest on Working Capital
- K. Inflation rate

2.6 Roof top solar in the cities of Bangladesh

Dhaka power distribution company (DPDC) is planning to set up a solar system for building 1 megawatt roof in different government buildings and their own structure for the potential losses due to the high cost of power purchase of private companies.

According to the plan, private investors will buy DPDC electricity, where roof plant should be established, official sources say.

However, they said that the lack of provision of free electricity generators (IPP) to reduce the possible loss of electricity in power, reducing the pace of the plan. Within a total of one megawatt

(1000 kilowatt) project, the DPDC has already completed the tender process for a 250 kilowatt solar system, which will be set up on four government buildings roofs. DPDC executive director Ramiz Uddin told UNBN that we have already completed a tender process for the agreement of the elected builders and are now waiting for the building owners to agree to the Gaiting Site Lease Agreement. After the site lease agreement is signed, the selected private companies will install these systems as an independent electricity generator (IPP) through which DPDC will purchase electricity for its grid system. But DPDC will buy power from the IPP to power consumers to buy electricity at a higher rate, for which the organization will have to suffer huge losses, those who are in the industry prefer to remain anonymous. Currently, the DPDC purchase has been fixed at Tk.4.90 per unit (per kilowatt hour) from PDB and the bidder for the purchase of electricity from the IPP is Tk.9.80. DPDC officials said they submitted an application to the Bangladesh Energy Regulatory Commission (BERC) to provide financial assistance to face the losses. The Ministry of Power was requested to formulate a rule for damages. According to sources, the DPDC application has been pending for a long time because the regulatory body is no longer the chairman. According to the BERC rule, the regulatory body will not be able to make such a significant decision until it is appointed a full chairman for the body. Prior to DPDC, the solar system was set up in the cabinet division of 50 kWh. Building on the pilot basis, the Bangladesh Secretariat Building on the basis of the pilot. However, sources said that the IPP firm is not getting the bill to sell electricity to the DPDC. Power and Energy Minister Nasril Hamid recently said that the government is working on determining the amount of solar electricity tariff. Feed in tariff (FIT) system. However, he did not give any details about this. DPDC hopes to sign the lease agreement with four government buildings this year.

Chapter 3

Methodology

3.1 Introduction

According to the ministry, according to the renewable energy policy, new connections to the demand over 2KW are now required for the installation of solar panels. For domestic purposes, solar power should meet at least 2 percent demand, commercial 7 percent and industry 10 percent, but how to check the installed systems being operating by the operating system and the user is installed. An official survey recently said that no solar power will be added to the system due to the installation of solar panels in the urban areas, but it will cause serious damage to the system management and huge financial losses to consumers. The survey also noted that solar panels failed to track the public interest because the distribution companies did not take any awareness programs for consumers and prevented them from receiving services from agencies. Considering the results from the survey, a detailed survey was conducted in Narayangonj area to observe the condition of the installed solar system. Some of the cells listed DPDC and others were not. The necessary data panel was measured from the battery. User feedback is also collected from each potential person. The collected data is used to calculate the effective and inefficient system. The efficiency calculation of the HOMER software is carried out using the revised parameters.

3.2 Site selection

For every research there must be select a survey area. Like that for complete and research about our project we need to select a survey area. As a dense populated place we choose Narayangonj for our place. There are to zone under DPDC. One is north Narayangonj and another is south Narayangonj. For domestic purposes, solar energy should meet at least 2 percent of the demand, for commercial 7 percent and for industrial 10 percent. But it is required to check out that how the

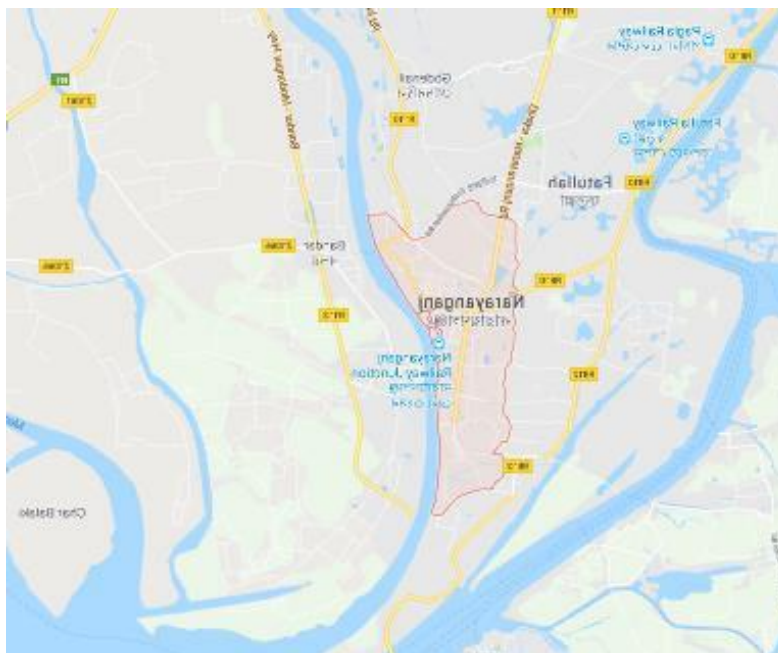


Fig 3.1

installed systems are operating and if the users are being benefited by the installed solar system. A government survey recently pointed out that installation of solar panel on rooftop in urban areas would not add any additional power in the system rather it would create serious havoc in system management and cause huge financial loss to the consumers. Considering the results from the survey, a detail survey was done on Narayanganj area, Dhaka to inspect the working status of the installed solar systems. Some of the houses were DPDC listed and others were not .Necessary possible data was measured from panel, battery. User feedback was also collected from every possible individual. The data collected was used to calculate the effective and ineffective systems. The efficiency calculation was carried out using the modified parameters of HOMER software.

3.3. List of Inspected Area:

Serial no	House address
1	46/27 A new chasara Narayanganj
2	47/27 A new chasara Narayanganj
3	165/1 north chasara Narayanganj
4	Chandpur adarsha chasara Narayanganj
5	49 adarsha chasara Narayanganj

6	44/3 North chasara Narayangonj
7	Tokio plaza 1, DIT, killarpool, Narayangonj
8	Tokio plaza 2, DIT, killarpool, Narayangonj
9	9/49 hc nagar road , killarpool, Narayangonj
10	23/1 allama iqbal road, killarpool Narayangonj
11	51/12A Fotullah, Narayangonj
12	78/14 B Fotullah, Narayangonj
13	32 shibu market road, fotullah, Narayangonj
14	38 shibu market road, fotullah, Narayangonj
15	45 shibu market road, fotullah, Narayangonj

table 3.1

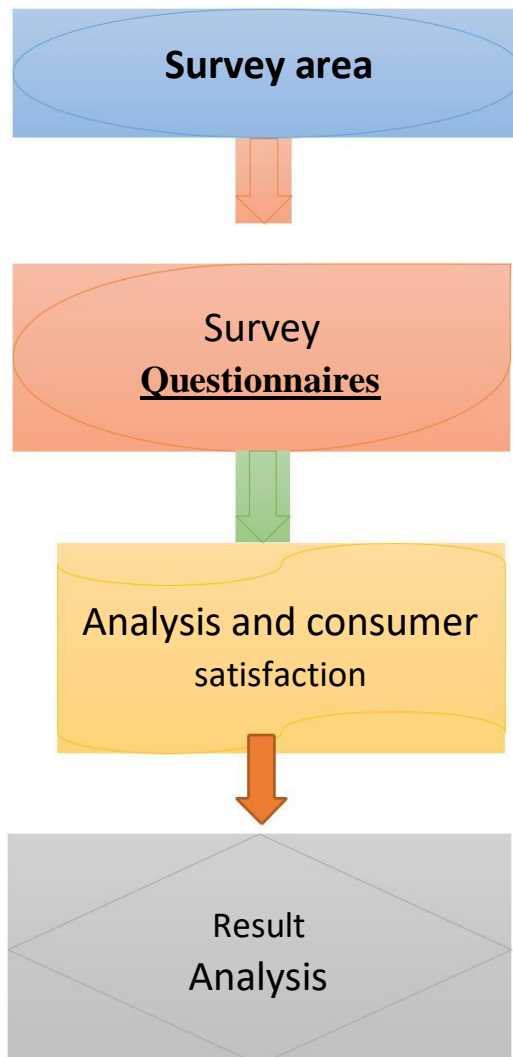
3.4 Indicator and questions for the consumer:

Indicator	Sub indicator	Description
Operation	<ul style="list-style-type: none"> • What kinds of system? • Is system in operation? • Is the system feed electricity to the grid 	We want to know about the system and operation types and feedback electricity to grid
Maintenance	<ul style="list-style-type: none"> • Does it test regular? • How long it test? • Why system is in disorder? • Want to repair the system? 	We want to know about the maintenance of the system, if the system is disorder are they want to repair or not?
System installation	<ul style="list-style-type: none"> • Why install the system? • Own choice? • Policy obligation? • Where from brought the system? 	We want to know why they install the system and where from the brought the system?
satisfaction	<ul style="list-style-type: none"> • Are they satisfied? • Are they expand the system? 	We want to know their comment about solar system

		and are the willing to increase the capacity of system?
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Table 3.2

3.5 Flow chart of the procedure of survey:



When we start our thesis we need a survey area for analysis the solar system. For survey at first we find out the survey area under DPDC. Our selected area was Narayangonj which is in the East side from Dhaka. We made a question form for the consumer. Going there we collected some data and consumers opinion. Here we found many positive ad negating opinion from the consumer. And we also note down their opinion about for using solar rooftop system.

Chapter 4

Result Analysis

4.1. Introduction:

The current situation of solar power distribution for background, ideas, policies and socio-economic development of rural areas has been discussed. From previous discussions, it is seen that energy plays an important role in the development. Due to rising fuel prices and rising worldwide carbon emissions, there are global transfers to renewable energy such as solar, wind, etc. Bangladesh is a solar power-rich country in the tropical region. Solar energy can play a vital and safe energy source for sustainable development. The main objective of this study is to evaluate the effects of solar energy for socio-economic development in rural areas of Bangladesh. 90 cross-section randomly selected for purposefully verifying a structural questionnaire was surveyed in families of three villages. The results of the survey are analyzed as follows in the following sections.

4.2 Consumer information:

SL	Consumer Name	Consumer Id	Date of installation	Phone Number
1	Md. Jahangir Hossen	1435694	2016/09	01711560898
2	Hazi Kamal Hawlader	1456523	2016/03	01754687345
3	Md. Jahangir Alam	1405574	2015/11	01881863078
4	Razzak tower	1421208	2017/01	01733456523
5	Mofizul Islam	1477675	2016/08	01732916536
6	Tapan Saha	1425769	2017/04	01711027651
7	Md. Kawser	1462387	2015/10	01917015119
8	Md. Kawser 2	1462388	2015/10	01917015119
9	Md. Motahar Islam	1413454	2016/6	01929976382

10	Md. Nadim Sheikh	1427743	2016/12	01675673338
11	Eng. Masud Rahman	1438876	2016/05	01713240038
12	Md. Shahin	1437906	2017/03	01677186185
13	M.A, Taher	1432874	2016/09	01684791836
14	Saiful Islam	1445113	2016/4	01914887917
15	Tushar haldar	1435648	2015/11	01832456328

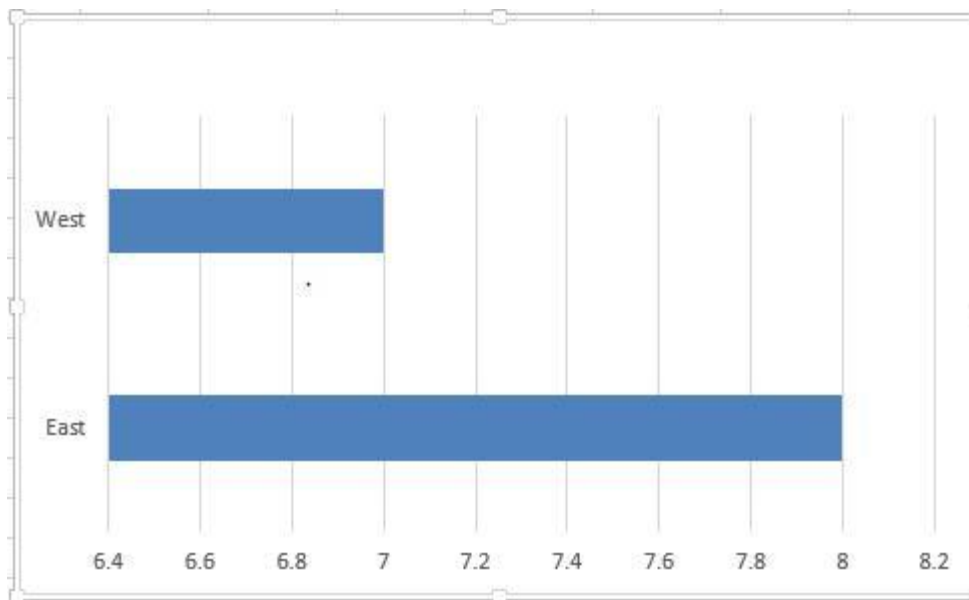
Table 4.1

4.3 table for NOCS of consumers, install capacity & cost of system:

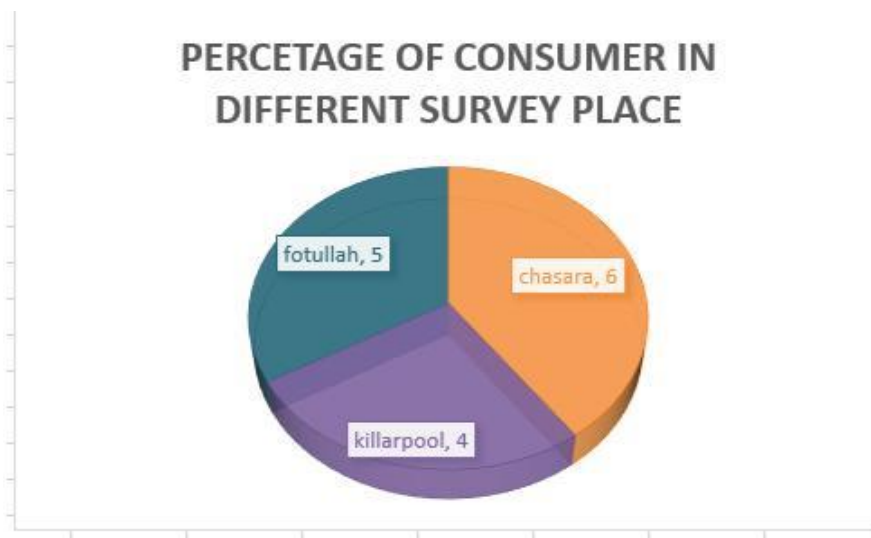
SL	Name of NOCS	Capacity (kW)	Duration	Installation cost(TK)
1	Narayangonj East	2.4	20 year	150000
2	Narayangonj East	1.92	15 year	105000
3	Narayangonj East	3	20 year	200000
4	Narayangonj East	5	20 year	350000
5	Narayangonj East	3.5	20 year	250000
6	Narayangonj East	2.4	15 year	140000
7	Narayangonj East	7.5	20 year	450000
8	Narayangonj East	6	20 year	400000
9	Narayangonj west	2	15 year	120000
10	Narayangonj west	1.5	15 year	100000
11	Narayangonj west	2.4	15 year	145000
12	Narayangonj west	2.8	20 year	195000
13	Narayangonj west	2.5	15 year	150000
14	Narayangonj west	3	20 year	210000
15	Narayangonj west	1.8	15 year	120000

Table 4.2

4.4 percentage of consumer in different zone



Here we see that there are 8% consumer in the East NOCS of Narayangonj and 7% consumer in the West NOCS of Narayangonj. In this two NOCS we were surveyed 15 consumer solar roof top system and check their system is in operation or not. Under those NOCs we have visited in Chasara, Killarpool and Fotullah which consumer percentage is in below:



4.5 Cost analysis:

For Jahangir hossen :

Life time= 20 year

Total cost= 150000tk

Date of installation= 2016/09

Date of survey= 2018/10

Time duration = 2 year 1 month= 2.082 year

Capacity= 2400 W

Yearly generated electricity= $2400/2.082= 1152.73$ kWh

Total generation = $1152.73*20= 23054.755$ kWh

Cost per unit electricity for solar = $150000/23054.755= 6.50$ tk

For Hazi Kamal Hawlader

Life time= 15 year

Total cost= 105000tk

Date of installation= 2016/03

Date of survey= 2018/10

Time duration = 2 year 7 month= 2.575 year

Capacity= 1920 W

Yearly generated electricity= $1920/2.575= 745.63$ kWh

Total generation= $745.63*15=11184.466$ kWh

Cost per unit electricity of solar = $105000/11184.466 = 9.38$ tk

Similarly we calculate the cost of per unit solar for other consumer in the following table in below:

SL	Installation cost(TK)	Capacity (kW)	Life time (year)	Per unit cost(TK)
1	200000	3	20	9.66

2	350000	5	20	6.08
3	250000	3.5	20	7.72
4	140000	2.4	15	5.80
5	450000	7.5	20	9
6	400000	6	20	10
7	120000	2	15	8.65
8	100000	1.5	15	8.09
9	145000	2.4	15	9.71
10	195000	2.8	20	5.48
11	150000	2.5	15	8.32
12	210000	3	20	8.72
13	120000	1.8	15	12.90

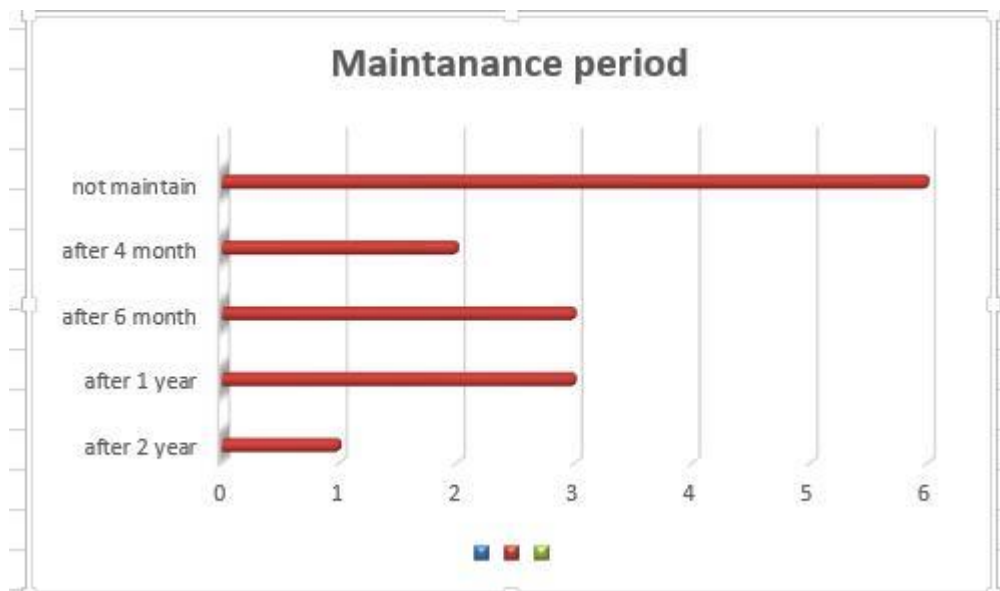
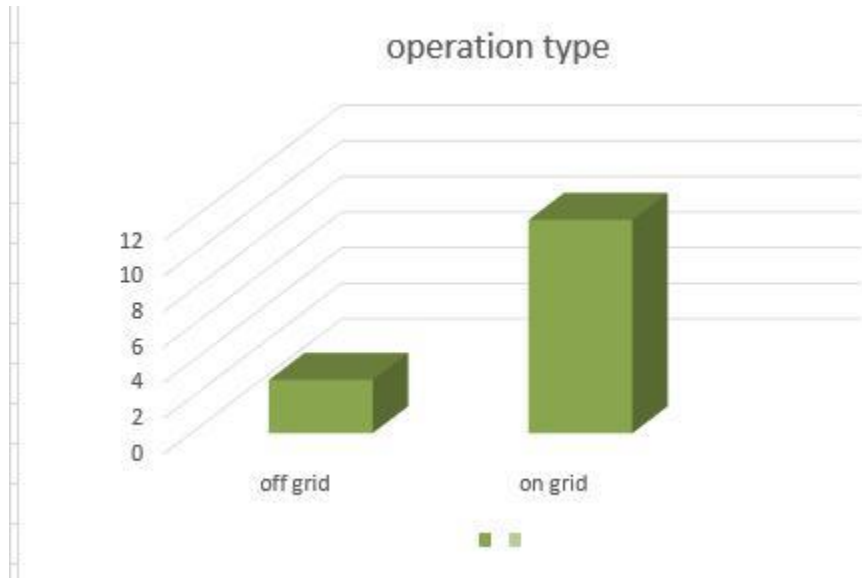
table 4.3

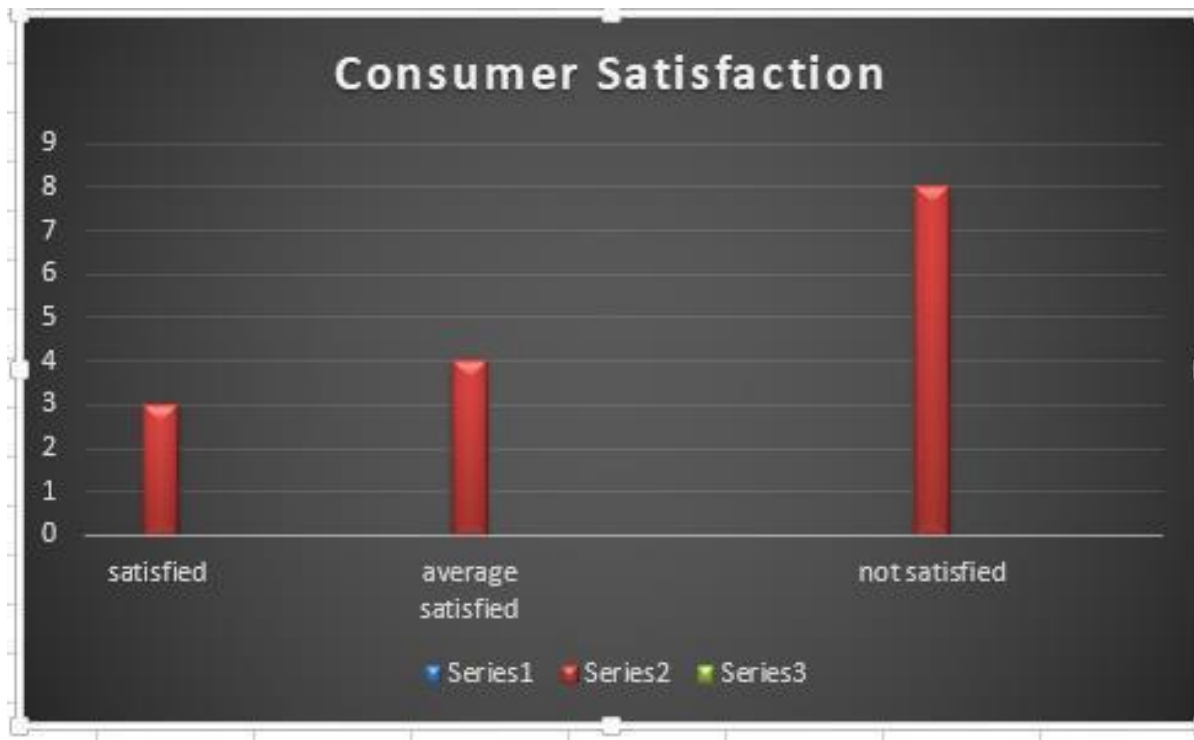
4.6 Operation types, maintenance and consumer satisfaction:

SL	Operation types	Maintenance time period	Consumer Satisfaction
1	On grid	After 4 month	Average satisfaction
2	On grid	2 times in a year	Satisfied
3	On grid	After 1 year	Not satisfied
4	On grid	Not in service	Waste of money
5	Off grid	Not repair after install	Waste of money
6	On grid	After 4 month	Satisfied
7	On grid	Not at once	Can't fulfill demand
8	Off grid	Not at once	Can't fulfill demand
9	On grid	After 1 year	Average satisfaction
10	On grid	After 6 month	Average satisfaction
11	On grid	Once after install	Not satisfied
12	On grid	After 6 month	Satisfied

13	On grid	Not at once	Not satisfied
14	Off grid	Not maintain	Not satisfied
15	On grid	After 1 year	Average satisfaction

Table 4.4





In this survey we have collected different opinion from different consumer. Here some consumer are satisfied for the service of solar system, some consumer are average satisfied and another consumer are not satisfied. The consumer who are satisfied they get energy from solar and their demand are fulfill. The average satisfier are they who use solar system and they can backup from solar energy and can save money from electricity bill. And lastly the not satisfier consumer who think that this system is waste of money. They can't have any backup and the system is not in service. So they think it is waste of money.

4.7 Pi chart of system installation in choice



4.8 Thesis finding:

After completing our survey according to the result analysis and indicator we find out some important point.

1. Consumer are not careful about the solar roof top system which is very important things So here need to motivate to the consumer when they received the SRS
2. They can't have proper knowledge about the maintenance and usefulness of solar system They should must have proper training that they can maintain the SRS system properly
3. Most of the consumer do not have any knowledge about net metering system.

Organization and govt. servant must be concern to the consumer how they will get benefit from net metering.

4. Maximum consumer think that the SRS system is a waste of money but they don't know how much energy they can get from SRS because the installation cost is so high.

Organization should decrease the installation cost of SRS system thus the consumer can't think that it is a waste of money.

5. The analysis data we have collected is roughly in the respective area.

To find out real data we need more time. In future work this survey is must for understanding the SRS in different place in Bangladesh.

Chapter 5

Conclusion

By the middle of the mid-century the demand for energy will be doubled and three times more by the end of the century. Most challenged in the society to meet this demand. Current energy technology can bridge the gap between the renewable energy development and today's production tomorrow is needed. The huge unexpected potential of solar power is a friendly opportunity to meet our future energy needs. Considering this, we have started analyzing our thesis project in the current urban solar home system efficiency.

We have tested 15 solar roof top systems in Narayangonj area. It is very unfortunate that most systems are not inactive or properly connected. Although urban people are more aware of the efficient use of solar power, they still like fossil fuels for them. Electricity production in this way, they indirectly contribute to environmental hazard and too much money wasted. The main purpose of our thesis is to analyze the existing solar system.

Power supply and cost-effective skills. We have used home software to calculate that information efficiently and have been able to offer an effective system to meet our needs. To improve the performance of the solar system, we have rebuilt existing batteries in the home software.

Besides, we also offered some initiatives taken by the Bangladesh government. For solar power and solar power users as well as for generating electricity. So a developing countries like Bangladesh can be self-reliant in power generation, keep environment green and save money using solar energy.

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