STUDY ON SOLAR ROOF TOP SYSTEM IN BANGLADESH UNDER DHAKA POWER DISTRIBUTION COMPANY LIMITED

Field Work Report submitted in partial fulfillment of the requirements

For the Award of Degree of

Bachelor of Science in Electrical and Electronics Engineering

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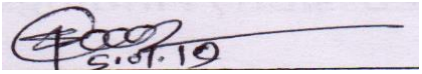
December 2018

Certification

This is to certify that this project and thesis entitled **"Study on solar Roof Top System in Bangladesh Under Dhaka Power Distribution Company Ltd."** is done by the following students under my direct supervision and this work has been carried out by him for the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 29 September 2018.

Countersigned



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The project and thesis entitled **"Study on solar Roof Top System in Bangladesh Under Dhaka Power Distribution Company Ltd."** submitted by **S.M. Sabbir Hossain** ID No: 151-33-2322 and **MD. Raziul Haque** ID No:151-33-2442 Session: Spring 2015 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** 29 September 2018.

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Dedicated to

Our Grandfather

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LIST OF ABBREVIATIONS

DPDC	Dhaka Power Distribution Company
BPDB	Bangladesh Power Development Board
REB	Rural Electrification Board
PGCB	Power Grid Company of Bangladesh
BEZA	Bangladesh Economic Authority Zone
IDCOL	Infrastructure Development Company Limited
SHS	Solar Home System
SRS	Solar Roof Top System
PV	Photo Voltaic
STE	Solar Thermal Energy
GW	Gigawatt
MW	Megawatt
KW	Kilowatt
HV	High Voltage
LV	Low Voltage
DC	Direct Current
AC	Alternating Current
W	Watt

ACKNOWLEDGEMENT

First of all, we give thanks to Allah. Then we would like to take this opportunity to express our appreciation and gratitude to our field work supervisor **Professor Dr. M. Shamsul Alam, Dean Faculty of Engineering** for being dedicated in supporting, motivating and guiding us through this project. This project can't be done without his useful advice and helps. Also thank you very much for giving us the opportunity to choose this project.

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ABSTRACT

This research is an attempt to find out the appropriateness of Solar Rooftop system (SRS). Solar rooftop system is the simplest way to reduce the waste of electricity and to keep the environment green. In this study and survey period, this was the initial basis to research whether the users of the system are taking it in a positive way or not. The study mainly focuses on the importance of the system, benefits and prospect.Solar energy has been the most favorable resource of renewable energy to improve the continuing unavailability of electricity. In this context, the composition of Solar Rooftop system related works is reviewed and later on, the methods and measures of the collected data from various fields of Narayanganj are described elaborately. About 20 solar rooftop systems formed in Fatullah, Woaparpul, Esha Kha Road, Chashara in Narayanganj area have been randomly surveyed. The entire study is mainly based on the data collected from these surveys. After the long process of collecting data and bringing them together, the survey has managed to find out some important outcomes.

Initially, the primary aim of the study was to find out the Consumer information, operation details, in which purpose they use the system, and afterwards, they're asked whether they are satisfied with the system or not. It is found that a majority of the people are completely dissatisfied with the system. After all, the effectiveness of the system was discussed in brief to influence them to come to know about the appropriateness of the system and the proper way to maintain the system. It is seen that a few among them find the system useful and want to increase its capacity. The operating condition and maintenance of the SRS was evaluated as well. Most of the interviewed people do not either maintain the system or want to repair it. It is very unfortunate that most of the systems were found inactive or not connected in a proper way. Although urban people are more likely to know the efficient use of solar energy, they still prefer fossil fuels for their power generation. In this manner, they are indirectly contributing to environmental hazards and wasting a lot of money too. From the reading of an installed solar system, the cost per unit is calculated later as an example.However, the appropriateness of the system to the consumer is very limited due to having a lack of knowledge and training to operate the system productively.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Energy is the capacity of a physical system to do work. Electrical Energy is the most popular form of energy.The basic types of sources used to generate electricity are classified into two categories; renewable & non-renewable sources.Renewable energy is the one which is collected from renewable resources**,** which are naturally replenished on a human timescale. There are many forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight, Solar, Wind Power, Hydroelectric energy, Biomass, Geothermal power.

Solar energy is the most abundant, renewable energy source in the world. It is a type of radiant energy that travels in waves from the sun to other parts of the solar system. Solar cells can be used to generate electricity from sunlight. It is a device that converts light energy into electrical energy.

1.2Problem Statement

The government of Bangladesh is planning to generate 220 megawatts of electricity for around 6 million households by 2017 through the solar home system program. We need to design a solar panel system with improved efficiency. DC appliances have low loss mechanism & hence are more efficient. But the production of DC appliances is very challenging. So, we need to have a plan for the development of cost-effective local manufacturing process for DC appliances. The conventional battery storage system of a solar-powered system has a very high loss & is also hazardous for our environment. We need to design an environmental energy storage facility.

We need to look for alternate energy sources for power generation to check the feasibility of wind or biomass or wave/ tidal energy project.In many rural and hilly areas, it is very difficult to set up distribution infrastructure. In these cases, we need to develop decentralized projects depending on locally available renewable energy resources.(Ref.1).

1.3 Objectives

The objective of the report is to show the total working procedure and the related other aspects of the Dhaka Power Distribution Company Limited. The broad Objectives of this report are mainly understood Installation benefit of the rooftop solar system. Give the information on the grid, off-grid solar system to the consumer. Give advice to the consumer for keeping the clean solar panel.Net metering system. With all the efforts of this entire time, it was the main goal to produce such informative report paper that will be useful to all. Here, we have tried our level best to make the report up to date.

The specific Objective of this report includes:

i. To collect data about the consumer opinions and bring them together to find out what the final result says.

ii. To point out the final output which gives a clearcomparison between the number of people being benefited from the system and the number of people not being benefited.

iii. To gather information about the satisfaction of consumer whether they are properly satisfied with their system or not.

iv. To intend the idea about how much electricity the consumer gets on an average and in which purpose it is being used.

v. To have a conception about how many people are being able to operate the system in a proper way and how many of them is influenced to increase its capacity.

vi. To calculate the per unit cost of solar electricity from the information of solar system.

1.4 Scopes

Bangladesh is widely known as a tropical country has an enormous amount of solar energy. But it is often questioned that how much of the solar energy is being used properly. So, the initial step was to widen the scope of our investigation. No compact study is strangely found for the prospect and scope of solar electricity for the economic development in rural areas of Bangladesh. It is found that the rural area has a minor knowledge on the socioeconomic impact of solar electricity. So, this report will possibly cover the knowledge about renewable energy solar system additionally with Solar rooftop home system, operation of the system, on grid- and off-grid system, world solar energy installed capacity, usefulness of solar home system, prospects of solar system in Bangladesh, Solar panel, Batteries, Charge Controller Power Inverter, Backup Generator, Power Meter, Kilowatt Meter. Moreover, it will also help with newtechnology transfer in rural areas.This includes commercial technical manuals and engineering data pertaining to their particular home rooftop solar panel.

1.5 Thesis Outline

Chapter two describes the Literature Review section.

Chapter three describes the Research Methodology of the study.

Chapter four describes the Thesis Result.

Chapter five describes the Conclusion sector of the Thesis.

CHAPTER 2

LITARATURE REVIEW

2.1 Introduction

In this chapter we've described Energy,Renewable Energy,Non-renewable Energy,Advantage and Disadvantage of Renewable and Nonrenewable Energy,Solar Energy, World Solar Energy such as China solar Power,Indian Solar Power, also Bangladesh Solar Energy,Grid,Mini Grid of Bangladesh,Roof Top Solar Home System, and Solar System Installment.

2.2 Energy

According to the physics, energy is the capacity for doing work which requiresin the process of transfer from one system to another. The common symbol for energy is the uppercase letter E. It generally exists in potential, kinetic, thermal, electrical, chemical, nuclear, or other several forms as well.Electrical Energy is known as the most popular form of energy.Electrical energy defines a form of energy that results from the flow of electric charge. The posture of charged particles through a wire or other medium is entitled as current or electricity. Electrical energy can be mainly classified into two types, renewable and nonrenewable energy.

2.3 Renewable Energy

Renewable energy resources appear from natural resource which can be populated within a short period of time. This is commonly collected from renewable resources. There are

numerous forms of renewable energy available. Most of these renewable energies depend upon one way or another on sunlight.

- Solar
- Biomass
- Hydroelectric energy
- Geothermal energy
- Wind Power

2.3.1Solar energy

Solar energy is simply the energy which is provided by the sun. Solar cells can perform to generate electricity from sunlight. It is a device where light energy is converted into electrical energy.Show in Fig 2.1 Solar energy home system.

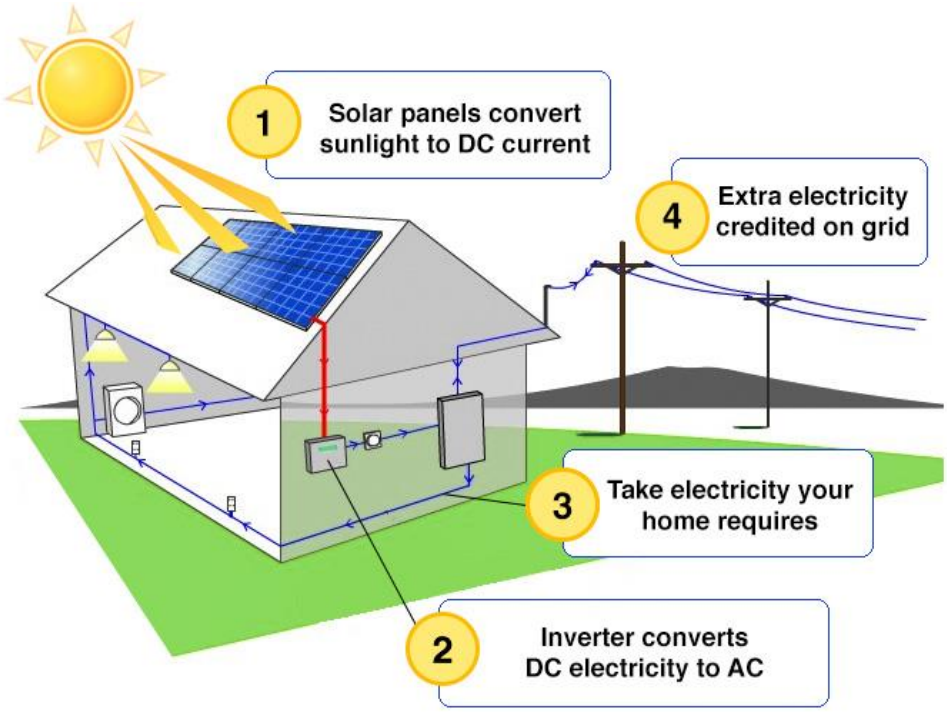


Fig2.1: Solar energy home system.

2.3.2 Biomass

Biomass is also a renewable energy source. It appears from living or recently living plant and animal materials which can be used as fuel. Biomass is a plant material which produces electricity with steam. A biomass-fired power plant generates electricity and heat by burning biomass in a boiler.Show in Fig 2.2 Biomass energy system.

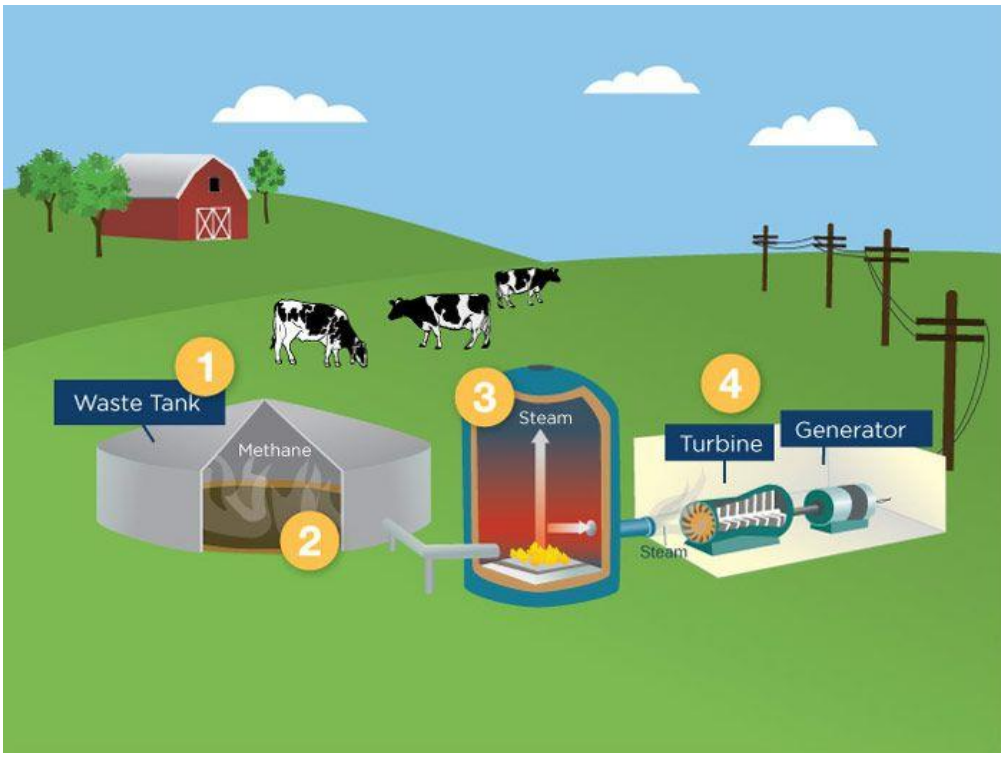


Fig 2.2: Biomass energy system.

2.3.3 Hydroelectric energy

Hydroelectric energy is one that is derived from the water movement. The simplest type of hydroelectric power plant uses a dam on a river which stores water in a reservoir.Water

which is released from the reservoir flows through a turbine, spinning it, which in turn actuates a generator for producing electricity. Show in Fig 2.3 Hydroelectric energy system.

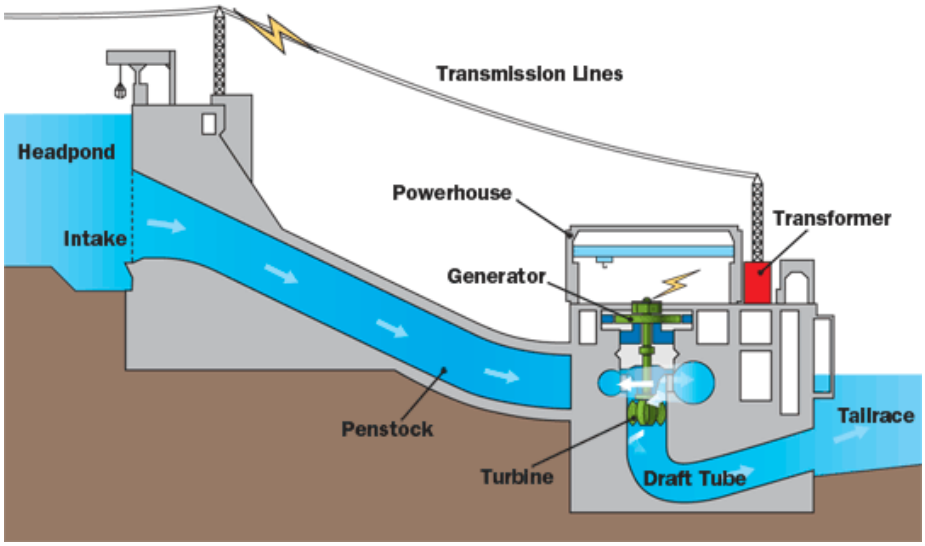


Fig 2.3:Hydroelectric energy system.

2.3.4 Geothermal energy

Geothermal energy is commonly known as thermal energy which is generated and stored in the Earth. Geothermal energy is a renewable energy source which is why heat is continuously produced inside the earth. Earth's internal heats are thermal energy generated from radioactive decay and continual heat loss from Earth's structure. This heat is applique to be used as steam or as hot water for heating buildings or to generate electric.Show in the Fig2.4 Geothermal energy system.

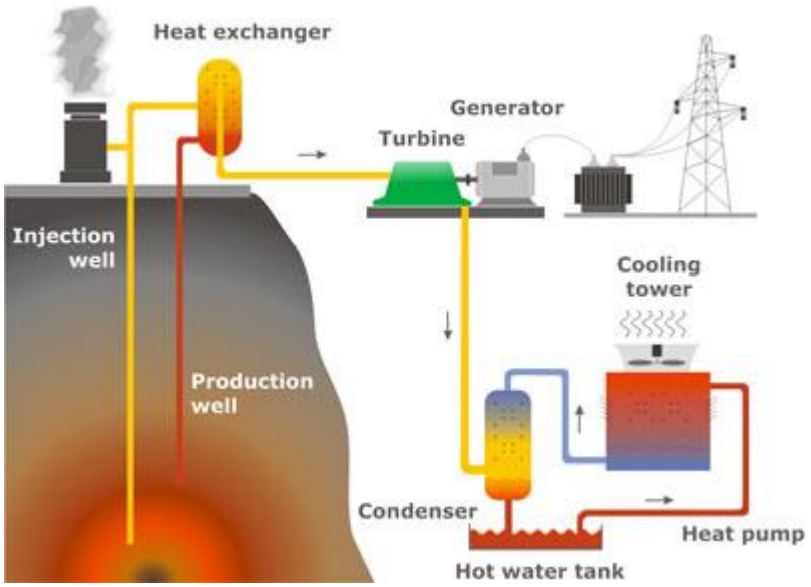


Fig2.4: Geothermal energy system.

2.3.5 Wind power

Wind energy or wind power can be described within a process by which wind is used to generate electricity. The Wind turbine converts the kinetic energy from the wind into mechanical power. The energy in the wind bends two or three propeller-like blades around a rotor. The rotor is connected to the main shaft. A generator converts mechanical power into electricity.

2.4 Advantage and Disadvantage of renewable Energy

Advantage of renewable Energy:

- Renewable energy prevails from a source that will never deplete.
- Renewable energies are non-pollutant and non-contributor to greenhouse effects and global warming.
- Renewable energy facilities generally do not require more maintenance than traditional generators. It is a static form of energy.
- It is economical.
- It is a coherent form of energy to be used.

Disadvantage of renewable Energy:

- Every form of renewable energy is not commercially serviceable.
- It does not require as cost-effective as several energy options.
- Perhaps it is not a perdurable energy resource.
- Several forms of this energy are specifically located.
- Renewable energy often requires appurtenant to prepare them affordable.
- This energy sources are the reliability of support.

2.5Solar Energy

Solar energy is known as the most coherent and abundant renewable energy source. Sun is the source of solar power energy which is produced to be converted into electrical energy or thermal energy.The history of photovoltaic (PV) energy started way back in 1876. William Grylls Adams along with one of his student, Richard Day, brought to light that when selenium was exposed to light, it produced electricity. In 1953, Calvin Fuller, Gerald Pearson, and Daryl Chapin unfolded the silicon solar cell. This cell generated enough electricity indeed.In 1956, Solar cells got to be commercially available for the first time.Firstly, the cost, however, wasfar away from the reach of every people in the society. About $300 was imposed for a 1-watt solar cell which was undoubtedly very expensive and beyond affordability for the majority of people. In the 1970s a way to reduce to cost of solar cells was revealed. This brought the cost down from $100 per watt to around $20 per watt. There are currently two principal types of solar energy technology.

- **Solar photovoltaic (PV)**
- **Solar thermal (STE)**

Solar photovoltaic: In this system, sunlight is directly converted into electricity by using photovoltaic (PV) cells. The solar PV cells are linkedwithin panels. These cells are fixed to the surface of a house or tower.

Solar thermal: In this system, the sunlight converts heat energy into heat water. This heat energy is to be used to conduct a refrigeration cycle to provide with solar-based cooling, or to make steam that is got to be used to generate electricity using a steam turbine. Solar thermal

energy can also be used in some industrial processes that currently use gas to generate heat. Solar thermal technology uses the heat propagated by the sun to produce efficient and large-scale power generation.

2.6 Global Scenery of Solar Energy

Solar data on installed capacity (MW) and annual output (GWh) is sourced from the International Renewable Energy Agency. Global installed capacity for solar-powered electricity has seen an exponential growth, reaching around 227 GWe at the end of 2015. It produced 1% of all electricity that is used globally. The global average solar radiation, per m2 and per year, has the ability to generate the same amount of energy as a barrel of oil, 200 kg of coal, or 140 m3 of natural gas.Solar installed capacity by region Africa installed capacity 0.9%. The Middle East and North Africa have a capacity of 0.6%.Latin America and the Caribbean have 0.9%.North America installed capacity is 13.2%. Europe 43.7%. South and Central Asia 2.5%. East Asia 32.2%. South East Asia and Pacific have a capacity of 3.1%. The global solar PV market is going to add over 100 gigawatts of capacity for the first time in 2018. Latin America will affix 5.6 gigawatts as well.The MENA region (The Middle East and Africa) will add 4.7 gigawatts in 2018. (Ref.2).

2.6.1 Solar Energy in China

China is the widest solar market in the world. China is now the world's largest renewable energy investor. The government promises to spend $360 billion on clean energy projects by 2020.China has installed capacity of around 130 GW, far greater than the U.S. at around 60 GW, and Japan's roughly 46 GW.Moreover, Installations in China will fall from 53 gigawatts in 2017 to 48 gigawatts in 2018, although China alone will account for 47 percent of global demand this year. The largest floating solar power plant in the world is Located in the city of Huainan in the Anhui province in China, the system has a power output capacity of 40 megawatts. The panels help to conserve precious freshwater supplies by lowering the amount of evaporation into the surrounding atmosphere.

Sun grow supplied the plant's central inverter unit, which transforms direct current from the solar panels into an alternating current for delivery to the local power grid.(Ref.3).Show in Fig2.5 China Largest Solar Plant.

Fig2.5:China Largest Solar Plant.

2.6.2 Solar Energy in India

India is familiar as thefastest developing country among all. The country's solar installed capacity reached 23 GW by the time 30 June 2018. The Indian state of Gujarat has built the world's largest solar photovoltaic power plant, a field of solar panels the size of Lower Manhattan. With a preparation of about 14 months, they have just switched it on, adjoining 600 megawatts of power to the grid. Show in Fig 2.6 Indian biggest solar plant.

Fig 2.6: Indian biggest solar plant.

2.7 Solar Energy in Bangladesh

There are various forms of renewable energies available in Bangladesh. Solar energy is the most popular and the effective one as compared to any other form of renewable sources, solar energy has probably the brightest prospect from the application point of view. The energy received by the sunlight form of radiation is known as solar energy. Solar radiation is dependent on the atmospheric condition, time of year. Bangladesh could apparently meet its unprecedented energy demand as well as increasing energy security through their progression by acknowledging the potential of solar-energy resources.

Bangladesh is positioned between 24o0'0″ N latitude and 90o0'0″ E longitude, which is an ideal position for preserving solar power. The highest level of radiation is accessible from March to April whereas the least from December to January and the average sunlight hours vary between 6.69/7.6 h, 6.16 h, and 4.81 h respectively in winter, summer and monsoon seasons.Bangladesh has a great prospect to use solar energy not only as a direct production system but also as the accessible infrastructure together with the combined cycle power station.

2.7.1 Solar power plant in Bangladesh

The Bangladesh Power Development Board or BPDB had previously signed a 20-year deal for 20MW of power with the plant's owner, Joules Power subsidiary Technaf Solartech Energy Ltd. TSEL in a statement. The solar plant is the first step towards the government's target of producing 2,000MW of solar power by 2021. Solar photovoltaic cells use panels to absorb sunlight and convert it directly into electricity. The plant emits 20,000 fewer tons of carbon dioxide each year than a similar sized diesel-run plant does.(Ref.4).

2.7.2 Sarishabari solar power plant

This is the first ever solar power plant in Bangladesh located at Shimla bazaar, Sarishabari of Jamalpur cohering eight acres of land. This has been a milestone for Bangladesh in solar energy which can be followed by others. This solar power plant has been added 8,00,000 kWh electricity to national grid line from its starting to mid-October 2017. "It is truly a pleasure to have the opportunity to aid Bangladesh in contributing to the global clean energy revolution to battle the threats of global warming and climate change. The plant installed 11,600 mono-crystalline silicon solar panels in eight acres of land adjacent to a Bangladesh Power Development Board substation. Show in Fig2.7Sarishabari solar power plant. It is an efficient plant with optimum land usage, about 2.5 acres per megawatt which is ideal for Bangladesh.(Ref.5). The solar power is created in photovoltaic cells which are made of silicon. Photons, the light particles, are absorbed in silicon with the release of electrons which flow under potential difference and electricity is produced. It is a direct current and is converted by inverters into alternating current to suit the grid specification. A small portion of incident light is only absorbed and the remaining is lost by reflection and refraction. That is why the efficiency of solar panels is basically low-mono crystalline silicon type18 percent and the thin film type 12 percent. The angle of inclination is 38° in the winter and 7° in the summer. The strong points of grid-connected solar power systems are: there is no fuel cost involved, there is no noise and vibration as plants operate in solid state without any moving components, there are no carbon footprints and no emission of greenhouse gas, and environmentally-friendly. All these advantages made the solar power a favorite choice all over the world. Six more solar parks with foreign collaboration are coming soon with a combined capacity of 320MW. The government goal is 2,000MW by 2021. The Bangladesh

Economic Zone Authority is going to develop a solar power hub of 1,000MW over 4,000 acres of land in the economic zone at Chandpur and another one 600MW over 2,000 acres of land in the economic zone at Mirsarai, Chittagong.

Fig2.7: Sarishabari solar power plant.

2.7.3 Chandpur solar power project

Bangladesh Economic Zone Authority (BEZA) has planned to set up a solar power zone in Baher Char area in Chandpur district with a target of generating at least 1000 megawatts (MW) of electricity. "The authority has started the process of acquiring around 4000 acres of land in Baher Char to develop the solar zone, which will be the country's biggest hub for solar power. Bangladesh Power Development Board (BPDB) and POWERCHINA have shown interest in developing the solar zone hoping that the construction of the solar zone will begin soon so it can start generating electricity from next year. BPDB will get 1,000 acres land and the rest 3,000 acres for POWERCHINA for setting up the solar zone. (Ref.6).

2.8Solar mini-grid in Bangladesh

As national grid cannot be expanded easily in remote off-grid areas, therefore, it is a big challenge to provide electricity in those places. Solar PV based mini-grid is installed in remote areas of the country where a possibility of grid expansion is remote in near future. These provide grid quality electricity to households and small commercial users and thereby encourage commercial activities in the area.

To make the electricity available to remote places, the government has already taken several initiatives and identified 30 off-grid locations where there is no plan to expand grid line in the next 15-20 years. Projects. According to sources at the Power Division, right now electricity is being distributed through 12 solar powered mini-grids to remote regions of the country. Another 13 are currently under production. Up to now, 11 mini-grids has been successfully installed and are in operation. The total capacity of installed solar mini-grid is 2.19 MW. Besides, 15 more mini-grid with 3.17 cumulative capacity is in under process. However, a 650 kWp solar mini-grid at Shalla, Sunamganj has been established by BPDB that is the biggest mini-grid project in South Asia. The government will install the biggest solar power plant of the country at the haor areas of Sunamganj to provide electricity to about 900 families. The plant with a 650-kilowatt peak (kWp) capacity will be set up at Sulla Upazila. The plant is expected to generate 400 kW load per day. The system will consist of 2,300 panels of 280 watts. This is going to be the largest solar PV (photovoltaic) power plant in the country until now and one of the largest off-grid PV plants in the region.

Solar mini grid project is one of the greatest initiatives to make electricity access for deprived rural people. The government has given financial support to IDCOL mainly to establish the solar mini-grid. The per unit production cost of electricity is Tk30. The consumers are fine with paying extra to get electricity. According to Infrastructure Development Company Limited (IDCOL), it costs Tk600 per month for a family to get lighting using kerosene powered lanterns. On the other hand, it only costs Tk400 to consume electricity through the solar powered mini-grids.

Even fans, refrigerators, and televisions can be run bit Far flung rural consumers are shifting to solar power to raisetheir standard of living, even if it costs them more, as they cannot avail electricity from the National Power Grid. The plants are being built according to the design and plans of IDCOL. (Ref 7).The electricity is provided through 11 mini-grids, also called micro or Nano-grid systems. Almost 16 percent of the off-grid areas of the country are under this system. An independent solar power plant has also been set up at Bhola's Monpura where the mini-grid has a production capacity of 177 kilowatts. 30 thousands of local people are being benefited by the Monpura solar power plant and significant business development has been a noticeable milestone in the area.

2.9Solar Home System

There is a strong prospect of rooftop grid-connected solar power generation. The very positive side of roof top solar is that it saves the arable land. This sector is waiting for the 'feed-in tariff' policy from the government. In this scheme the utility authority, the Power Development Board is supposed to buy power at a premium price from qualified roof-top producers. As a result, the owners of buildings and industries will be motivated to install solar panels on the roof to feed electricity to the national grid and earn a gainful side income. A good example of this is Germany where the roof-top solar units under 'feed in tariff' policy made a major contribution to the solar power generation. These units are basically small between 10kW to 100 kW and will face a challenge to connect to the existing grid. The area near the substations will be suitable to initiate this program for easy grid connection. A collective approach can possibly provide with a good result. It is possible that the qualified buildings in the vicinity of the substations can be grouped together within a network.There are some NGO's such as IDCOL, Grameen Shakti, Rahimafrooz and Energypac which are coming forward to promote the solar technology for power generation. In SHS, PV panel is used to generate electricity. The purpose of launching SHS in Bangladesh was toensure electricity access to off-grid rural people. Bangladesh has achieved tremendous success in SHS. Up to now, the total number of installed SHS is 5.2 million with 218.48 MW capacities. Infrastructure Development Company Limited (IDCOL) has been a major contributing company which installed 4.5 million SHS out of total 5.2 million SHS. The other 0.7 million SHS was mainly installed by Bangladesh Rural Electrification Board (BREB),German Organization for Technical Cooperation (GIZ),Infrastructure Development Company Limited

(TR/KABIKHA project). The increasing trend of SHS installation of the last seven years is shown in the figure. It is observed that from the year 2011 to2017 the number of SHS increases more than four times.Besides, thenumber of SHS installation in the last five years is 3.3 million that has brought almost 150 million people into access to electricity.

2.10 Solar Home System working procedure

On grid On-Grid Systems are solar PV systems which only produce power while getting the utility power grid available. They must connect to the grid to function. They can send excess power generated back to the grid when you are overproducing.

Off gridsystems generally allow you to store your solar power in batteries for uses when the power grid goes down or if you are not on the grid. Hybrid systems provide power to offset the grid power whenever the sun is shining and will even send excess power to the grid. We see the Fig

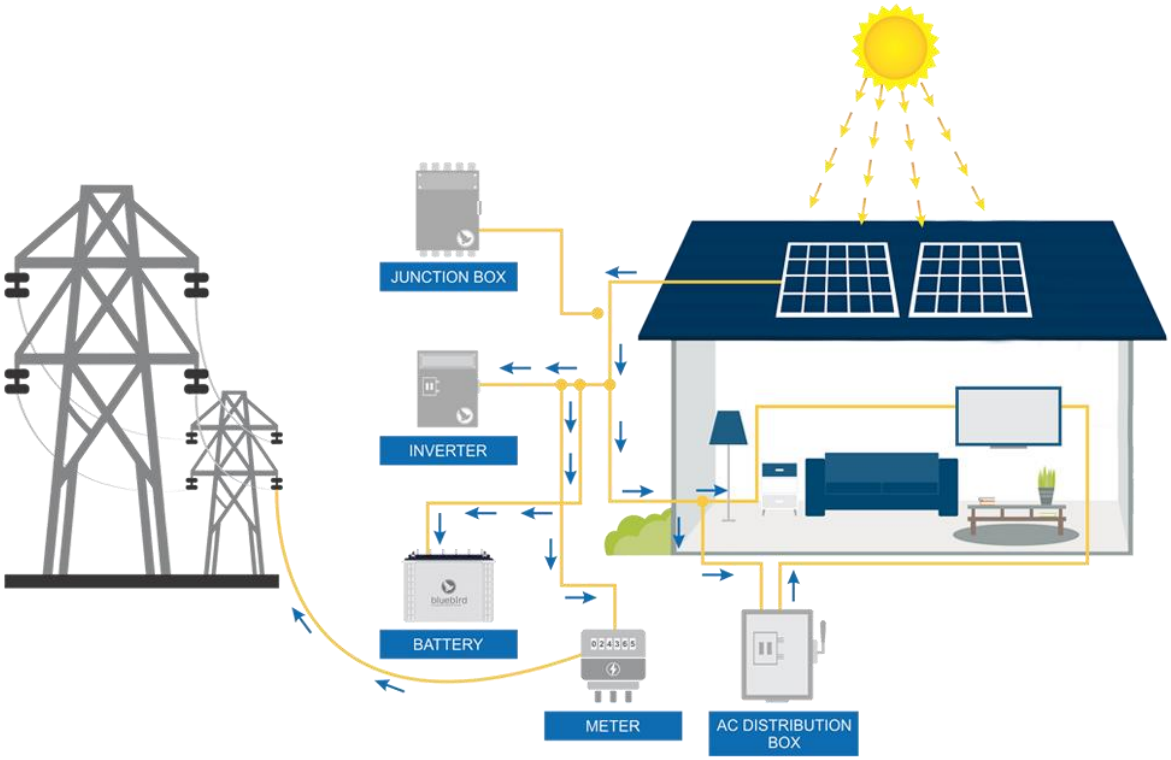


Fig2.8: Solar home system working principle.

The sun shines on the solar panels generating DC electricity.The DC electricity is fed into a solar inverter that converts it to 240V 50Hz AC electricity.The 240V AC electricity is used to power appliances in your home.Surplus electricity is fed back into the main grid.The grid connects inverter which is used to convert the DC electricity produced by the solar panels into 240V AC electricity, which can then be used by the property/household.If a grid connects system is producing more power than is being consumed, the surplus is fed into the mains power grid. Some electricity companies will meter the electricity fed into the grid by your system and provide a credit on your bill.

When the solar cells do not produce power, for example at night, your power is supplied by the main power grid as usual. The energy retailer charges the usual rate for the power used.(Ref 8)

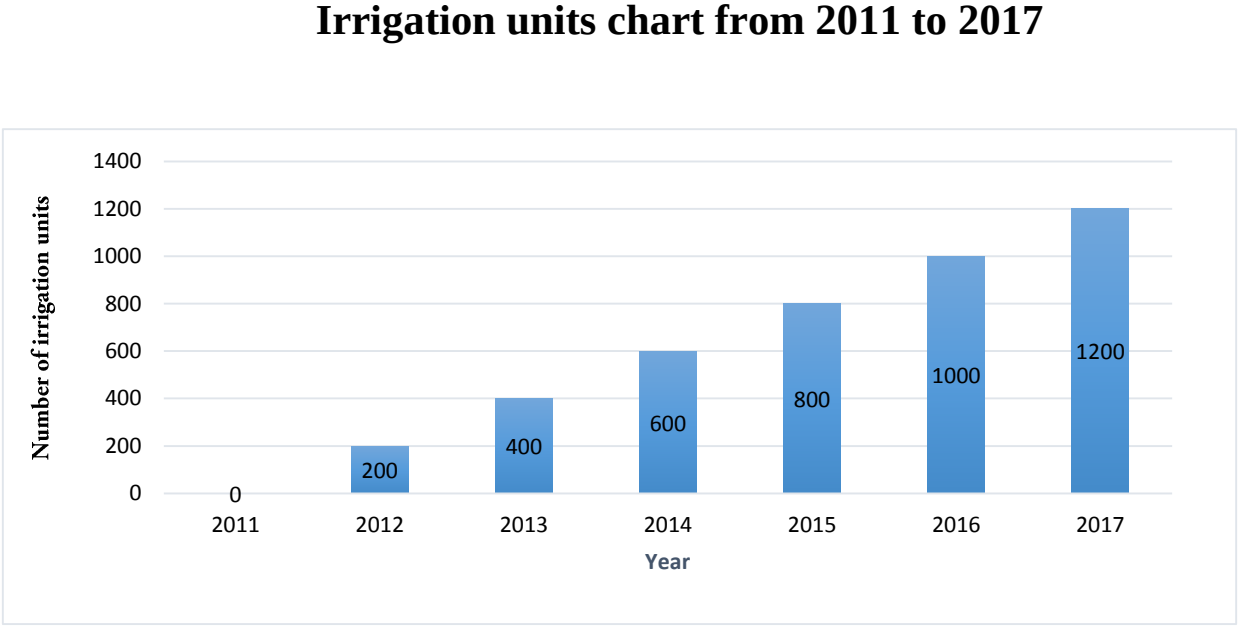


Fig 2.9: Irrigation Chart.

Installation of SHS from 96 to 2013

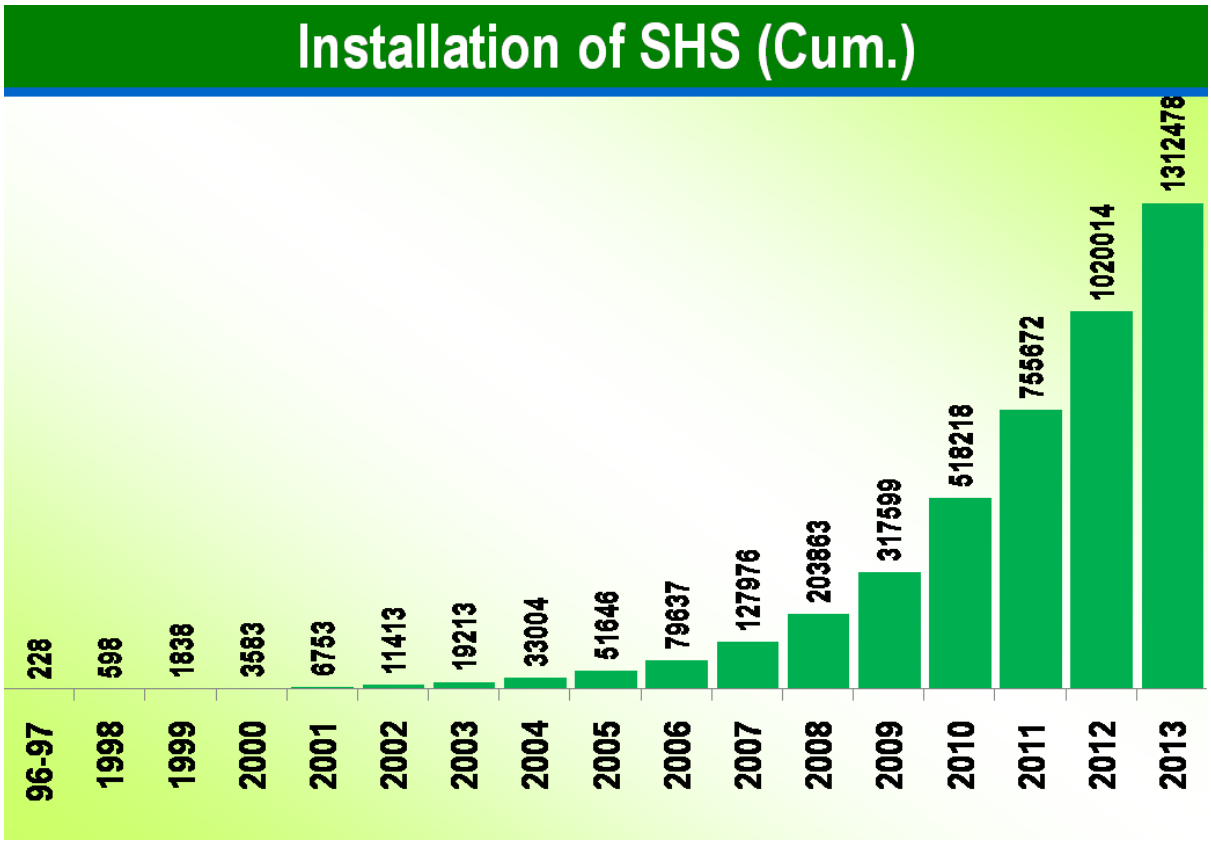


Fig 2.10: Installation chart.

2.11Solar System Equipment

Solar system equipment is an essential component of a solar energy system. Component Residential Solar Electric System Component, Solar Panels, Solar Array Mounting Racks, Array DC Disconnect, Inverter, Battery Pack, Power Meter, Utility Meter, Kilowatt Meter, Backup Generator, Charge Controller.

The Basics Four Pieces of Solar Energy Equipment

Solar Panels.

Batteries.

Charge Controller.

Power Inverter.

2.12 Solar panels

Solar panels are the devices which are used to convert light into electricity. A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to produce electricity through the photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so spacecraft are usually designed with solar panels that can always be pointed at the Sun.

2.12.1 Parallel connection of two solar panels of same power

If two solar panels of the identical voltage and power are found, the connection becomes very easy. It will be sufficient to connect the positive terminal of one panel to the positive pole of the other and connect the negative terminal of one panel to the negative terminal of the other. In series to each panel, a blocking diode is inserted to protect the entire string from possible faults or short circuits that can occur on the individual panels of the string.

Wiring solar panel in parallel, the amperage (current) is additive, but the voltage remains the same as before.If 2 solar panels in parallel are found and each panel was rated at 12 volts and 10 amps, the entire array would be 12 volts and 20 amps.Show in Fig2.10 Parallel connection of two solar panels of same power.

This type of connection is very proficient if the following conditions are found:

1. Put the panels next to each other and oriented in the sun at the same angle.

2. Check that the panels do not shade each other and are far from possible causes of shading.

3. Choose an appropriate section of the electric connection cable according to the distance of the panels.

4. Uses of junction boxes are to be connected neatly between the terminals of the panels.

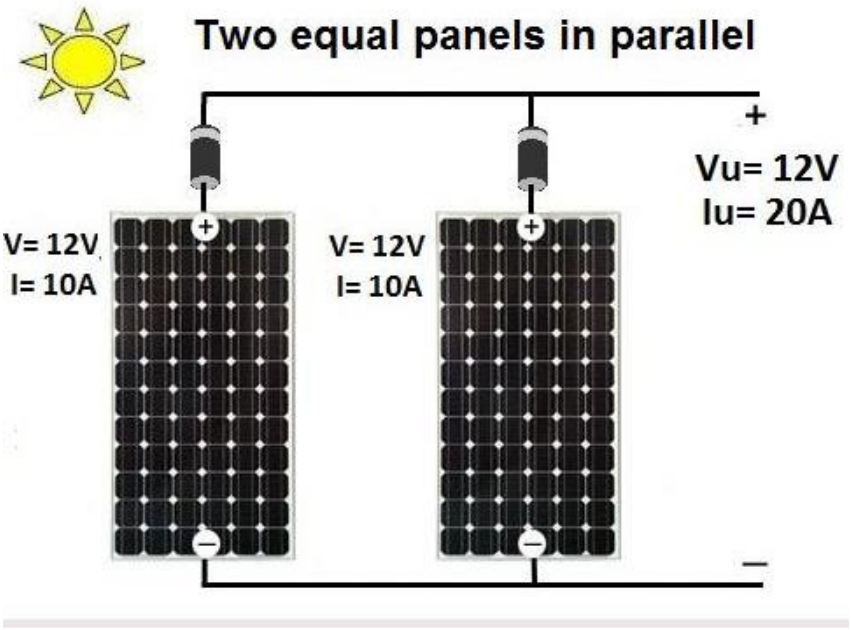


Fig2.11: Parallel connection of two solar panels of same power.

2.12.2 Parallel connection of two solar panels of different power

If two solar panels of the same voltage but with different power are found, they can be easily connected in parallel. If instead, the two photo-voltaic panels are with different power and voltage, then it may not be practical to be connected in parallel anymore, because the panel with a lower voltage would act as a load, and would begin to absorb current, instead of producing with the related consequences. However, if there is a single panel of 10V and two panels each of 5V, then the two panels from 5V can be connected in series and then the series obtained can be connected in parallel to the panel 10V. Wiring solar panel in parallel, the amperage (current) is additive, but the voltage remains different. If 2 solar panels in parallel are found and each panel was rated at 12 volts and the first panel produces 10 amps, and another 5 amps, the entire array would be 12 volts and 15 amps.Show in Fig 2.11Parallel connection of two solar panels of different power.

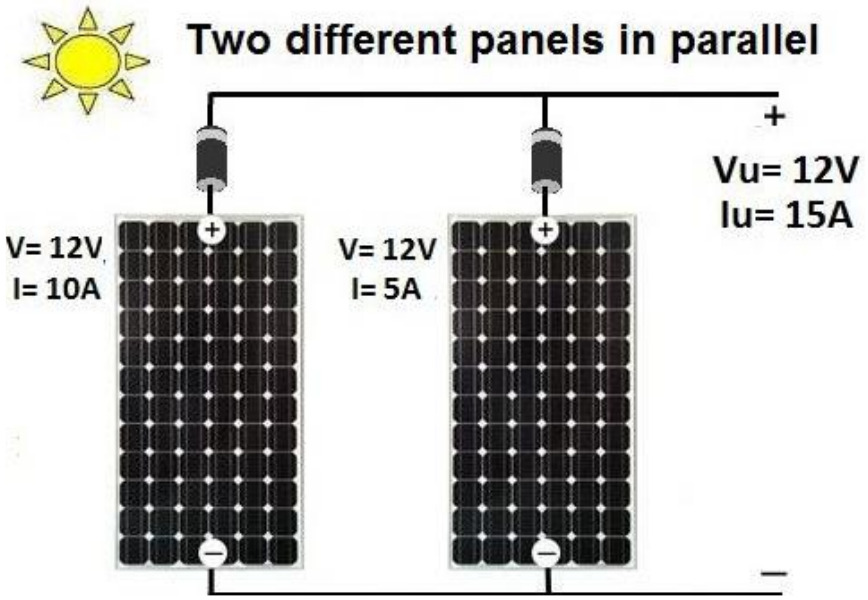


Fig 2.12:Parallel connection of two solar panels of different power.

2.12.3 Series Parallel combination of solar panels

In an off-grid photovoltaic system, the choice of the total power of the system and the tension of the battery bank must be carefully considered in the design phase. For those who want we have made available a free program to perform a correct design of a photovoltaic system, the calculation of the daily energy requirements, up to the size of the panels according to the area where it will be installed. Show in Fig2.12: A Series-Parallel combination of solar panels.

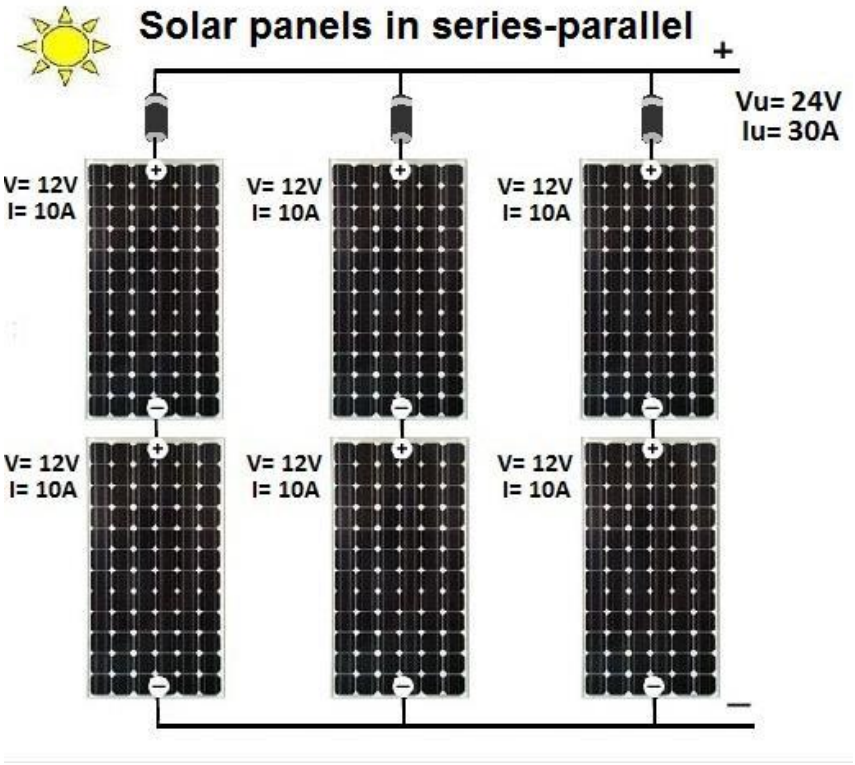


Fig2.13: Series Parallel combination of solar panels.

2.13Battery

The Battery is another vital piece of solar energy equipment, which is defined by a schematic to discharge and recharge energy countless times on a given day. So, if the sun isn't shining, the consistent power supply will be provided by the battery storage. Solar batteries are recommended as they are designed to be charged and discharged repeatedly. Naturally, deep cycle Lead Acid Batteries are compatible with solar system operation due to its longtime energy delivery. Deep cycle batteries have thicker plates and can survive for a number of discharge cycles. Naturally, the 12V Lead Acid batteries have internal resistance less than 100 ohms. It morally suggests that C/10 ratio should be maintained for safe discharge and charging operation. For instance, a 100Ah battery should be charged at maximum 10A and should be discharged at a maximum of 10A.

Series Connecting:A negative terminal of one battery to the positive terminal of another battery to increase the Voltage. This method is known as series connection.Show in Fig2.13: Series connection between batteries.

Fig2.14: Series connection between batteries.

Parallel Connection: To join batteries in parallel, use a jumper wire to connect both the positive terminals, and another jumper wire to connect both the negative terminals of both batteries to each other. Negative to negative and positive to positive. Show in Fig2.14: Parallel connection between batteries

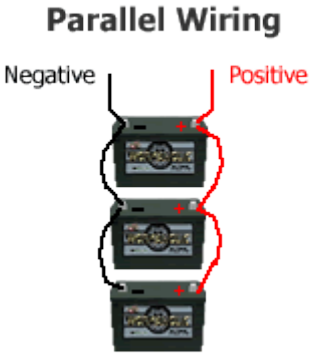


Fig2.15: Parallel connection between batteries.

2.14 Charge Controller

In high sun exposure, the voltage produced by the solar panels has the potential to damage the batteries. Solar energy equipment to restrain overcharging a charge controller is required to regulate the charge, ultimately increasing battery life and performance.

2.15 Power Inverter

A power inverter is known as a solar energy equipment which is needed unless on battery power exclusively. There are two uses for a power inverter, one is for the conversion of low voltage DC to the 120 volts AC needed for appliances, and the other is for the conversion of charge batteries if connected to a utility grid or an AC Generator.

2.16 Different Types of Solar Panels

A solar cell is nothing but an electrical device that is known to convert the light energy to electrical energy directly through the process of the photovoltaic effect. Essentially the component of this solar cell is silicon. There are three common types of the panel available on the market and they are:

1. Monocrystalline Panels.
2. Polycrystalline Panels.
3. Thin Film Panels (Amorphous Silicon).

2.16.1 Monocrystalline solar panels

To make solar cells for Monocrystalline solar panels, silicon is formed into bars and cut into wafers. These types of panels are known as “Monocrystalline” to indicate that the silicon used is single-crystal silicon. Because the cell is composed of a single crystal, the electrons that generate a flow of electricity have more room to move.Show in Fig 2.15: Monocrystalline solar panel,as a result, Monocrystalline panels are more essential than their polycrystalline counterparts.

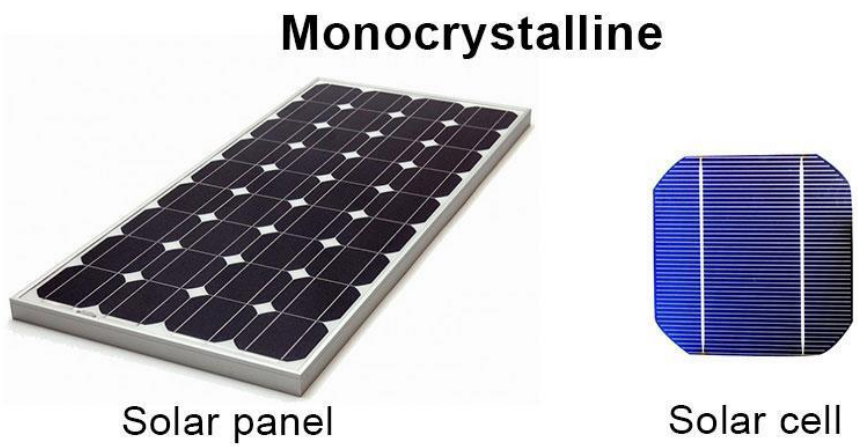


Fig 2.16: Monocrystalline solar panel.

2.16.2 Polycrystalline solar panels

Polycrystalline solar panels are also made of silicon. However, manufacturers melt many fragments of silicon together to form the wafers for the panel instead of using a single crystal of silicon. Polycrystalline solar panels are also referred to as "multi-crystalline," or many-crystal silicon. Because there are many crystals in each cell, there is to less freedom for the electrons to move. As a result, polycrystalline solar panels have lower efficiency ratings than Monocrystalline panels.Show in Fig 2.16 Polycrystalline solar panels

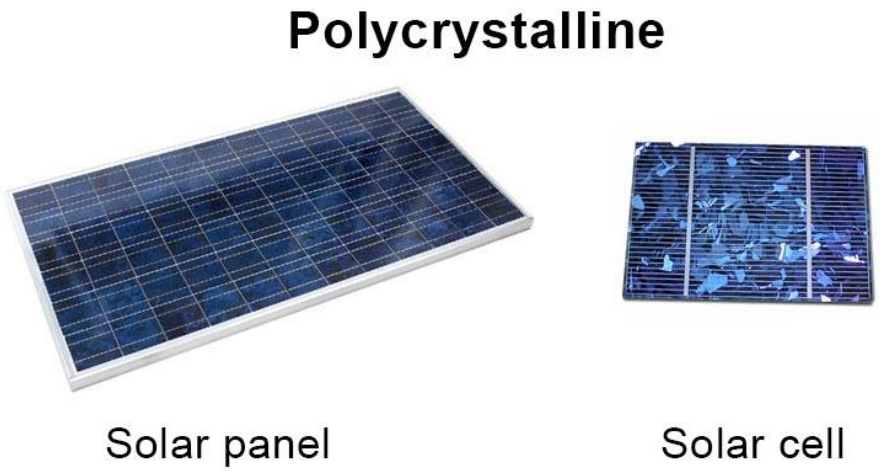


Fig 2.17:Polycrystalline solar panels.

Advantages:

1. Low cost.

2. Waste of silicon is much lower than Monocrystalline for the manufacture.

3. Performance gets higher in the higher temperature. 4. Excellent life span, usually come with a 25yr warrant.

2.16.3 Amorphous Thin Film

Thin film, or amorphous, silicon cells are made up of silicon atoms in a thin layer rather than a crystal structure. Amorphous silicon can absorb light more readily than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also familiar as ‘thin film’ photovoltaic (PV) technology.Show in Fig 2.17 Amorphous Thin Film.The efficiency of Thin Film is very low which is usually between 7-13%.

Fig 2.18: Amorphous Thin Film.

2.17 Summary

In this chapter, we have come to know about the energy, renewable energy, nonrenewable energy, global solar energy,Bangladesh solar energy,solar home system, solar rooftop system, solar mini-grid in Bangladesh, solar equipment, panel, Inverter, Controller,Battery connection, and panelconnection.

Chapter 3
Methodology

3.1Introduction

This chapter eventually comprises the analysis methodology of the survey. NOCS Narayanganj (East) -DPDC was infrequently visited for this survey.In additional details, during this section, the originator outlines the analysis strategy, the analysis methodology, the analysis approach, and the strategies of information assortment, the choice of the sample, the analysis method, the sort of information analysis, the moral issues and therefore the analysis limitations of the project.This audit was intended to research the socio-economic effects of the solar roof system and find the answers about what do the users think about its appropriateness. Thisstudy is applied to the business and industrial areas of Bangladesh. As the surveyinitially based on social analysis, some qualitative and quantitative methodologicalapproaches are applied. The survey also pointed out that solar panel failed to catch public interest as the distributing agencies(DPDC) did not take any awareness program for the consumers as well as they faced a serious obstacle to get service from the agencies (DPDC). Some of the houses were listed under DPDC and others were not. Necessary data from panel, battery was collected. User feedback was also collected from every possible individual consumer.

3.2Site Selection

The site of NOCS Nayranganj (EAST) DPDC was visited. The survey was mainly covered in one of the busiest cities of the country, Narayanganj regarding 24 kilometers far away from Dhaka. It is known as a town in central Bangladesh. It's within the Narayanganj district, close to the capital town of Dhaka and features a population of concerning a pair of 2.2 million. The town is on the bank of the river called Shitalakshya. The area of the city is 33.57 km^2 (12.96 square meters). The area of Narayanganj is a very important shipping and industrial center of the country. It's conjointly a middle of business and trade, particularly the jute trade and process plants, and also the textile sector of the country. It's nicknamed the Dundee of Bangladesh because of the presence of its several jute mills. According to the basis of the

analysis, this city was chosen for this study. About 40 fields regarding industries and buildings are infrequently visited for the analysis of the thesis. These fields are circulated under the assistance of DPDC. Some areas regarding new chasara, Allama Iqbal Road, north chasara, Chandpura Adarsha Chasara, Nag road, kotubai, Hajiganj, Maleh Road were given for the survey. Around 40 SRH-owned household data were collected from the areas. Survey places were randomly chosen as there are a lot of SRS-owned buildings and industries available.

NOCS NARAYANGANG (EAST) DPDC.

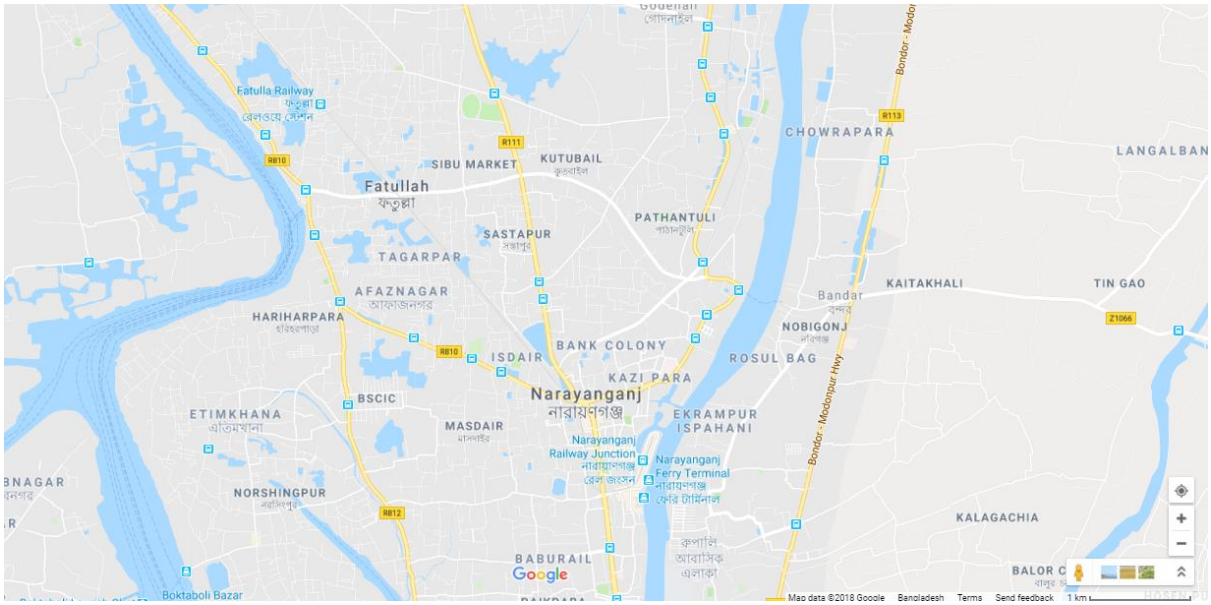
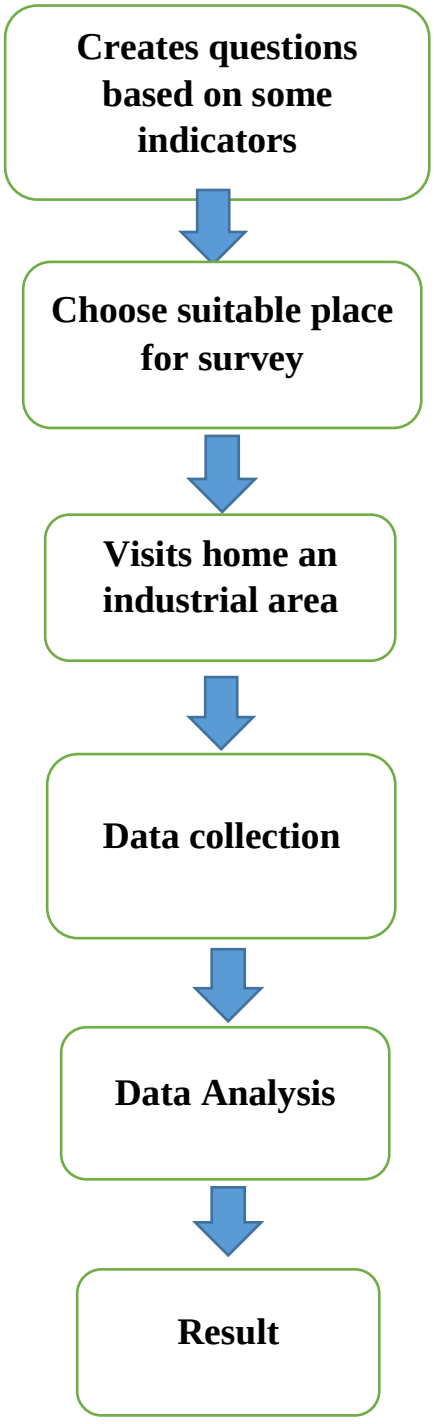


Fig 3.1: Site map of NOCS Narayanganj DPDC.

3.3 Flow chart of theworking procedure



3.4 Survey Questionnaires System

SL No	Indicator	Question	Description
01	Consumer Information	Owner Name: Mobile No: Address: Capacity: Date of Installation:	Consumer information and correlated data for several systems are collected in this method.
02	Installation Information	i) Why do you install this SRS? ii) How many days ago you install this SRS? iii) What kind of solar roof top system SRS are you using? iv) Are you fed your solar electricity to the grid?	The reason behind installing the system, type of the systemhas been asked in this step.
03	Maintenance	i) Is your SRS in operation? ii) Do you test it regular basis? iii) What is the main reason of system disorder? iv) Do you want to repair it? v) Do you get any training for SRS operation? vi) Do you clean your SRS?	In this step, we tried to find out the operating condition of the system whether it is in operation or not. Sequentially, the information about the maintenance of the system and training way was also noted here.

04	Consumer Satisfaction	i) Do you think this SRS are useful? ii) Do you think it is a waste of money? iii) Do you face any kind of survey? iv) DO you want to increase capacity of your SRS? v) Do you satisfied to use SRS?	In this step, the main discussion was about to point out their satisfaction with the system. It was intended to find out that how many of them take it as a way of wasting money. Moreover, People who were found pretty satisfied with the system were questioned whetherthey want to increase the capacity or not.
05	Cost Analysis	i) What is the total cost of your SRS? ii) Is the meter reading of the solar electricity taken? iii) Do you have record on solar electricity? iv) How much electricity do you get SRS?	In this section, theelectricity generation and its per unit cost are calculated.

Table3.1: Survey questionnaires.

3.5 Summary

In this chapter, the proper details over Survey site are explained. In addition, the consumer name, consumer address, survey questions, and visited area are also described elaborately.

Chapter 4

RESULT

4.1 Introduction

This chapter contains the judgment of the study where the analysis of the Thesis result is prominently described. Moreover, it takes a look overthe consumer information about how many consumers use the SRS system and the chart is also demonstrated in this article. It also provides the maintenance result, consumer satisfaction, and cost analysis according to the consumer answer, additionally with all the correlated charts.

4.2 Consumer Information

It is mentioned earlier; the survey area and the list of the consumers were provided by DPDC. The following chart has been made from approximately 20 consumer information.

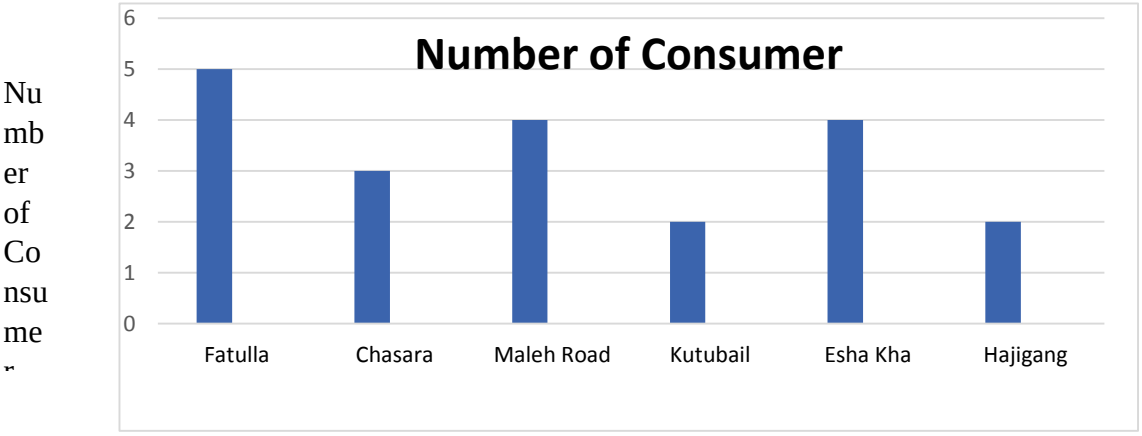


Fig 4.1: Area chart of consumer.

The chart states that the survey area is divided into six different regions. The regions are Fatullah, Chasara, Maleh Road, Kutubail, Esha Kha road, and Hajiganj. It is seen from this Pi-chart that most numbers of consumers are found in Fatullah which is 6. Equally 4 consumers are found both in Maleh road and Esha Kha road. On the contrary, Chasara has 3 consumers and both Kutubail and Hajiganj have equally 2 consumers.

4.3 Installation Information

Most of the consumer informed that the SRS was actually installed by Policy obligation of Electricity connection. Some consumer uses SRS for their own choice to get more electricity for their uses. On the other hand, a majority of the people brought the SRS from the Market. They brought SRS to fulfill the requirement of their electrical connection. Two charts are demonstrated here where one of the charts is about SRS installed policy and another one is about the Installation Year.

4.3.1 The installation policy

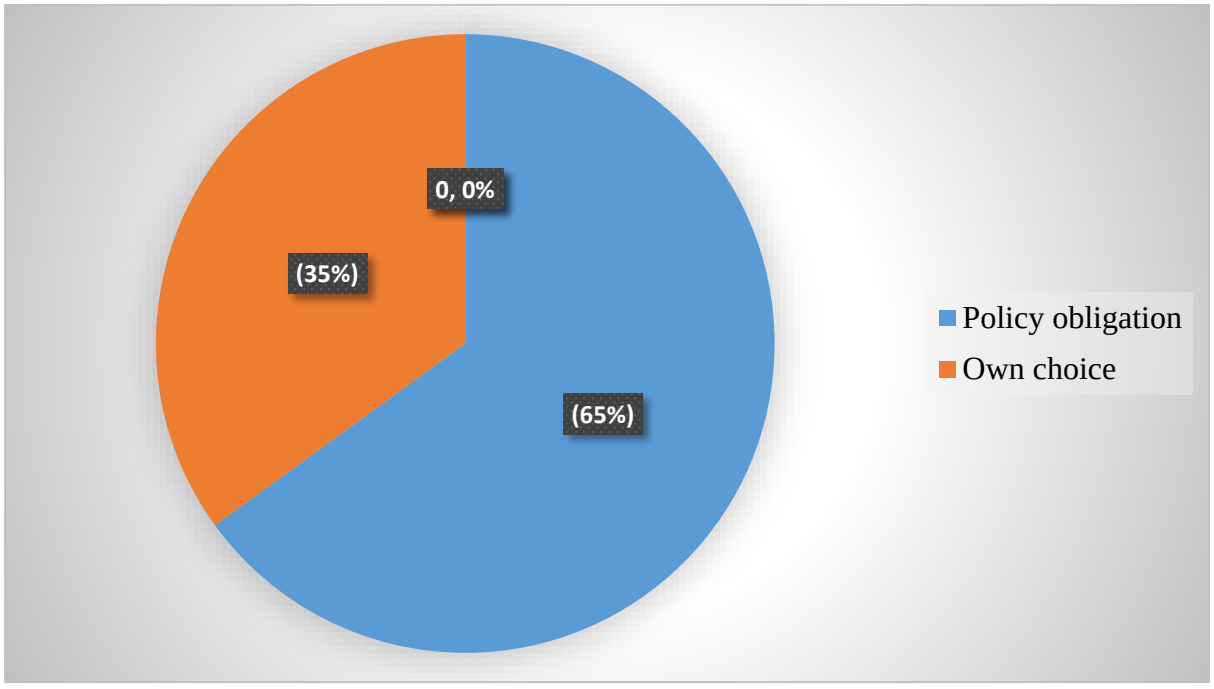


Fig 4.2:Installation policy.

According to the survey, 7 consumers installed SRS by their own choice and the rest 13 consumers installed SRS by various policy obligations. For a better view it is shown by a Pi-chart which says, 35% of the consumers installed the system because of having a proper

knowledge about the system as it is installed by their own choice. On the other hand, 65% of the consumers installed the system just as a cause of Policy obligation which means they did not have any kind of intention to install the system.

4.3.2 Source ofBrought SRS

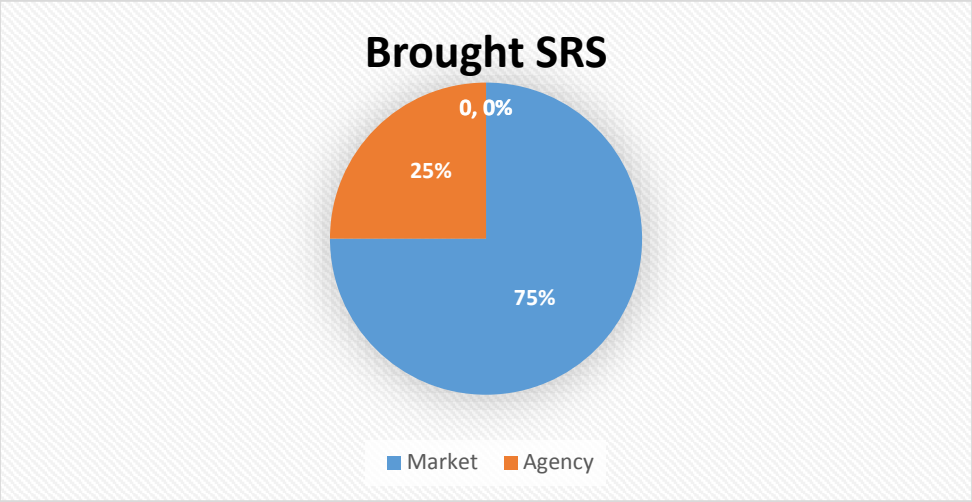


Fig 4.3:brought SRS

This chart shows the comparison between the market and the Agency. From the survey, 5 consumers are found who brought the SRS from an agency and opposite 15 consumers brought the system from the market. That means, 75% of the consumers brought the SRS from the local market and comparatively, less percentage of the consumers brought the system from an Agency.

4.3.3 Installation year

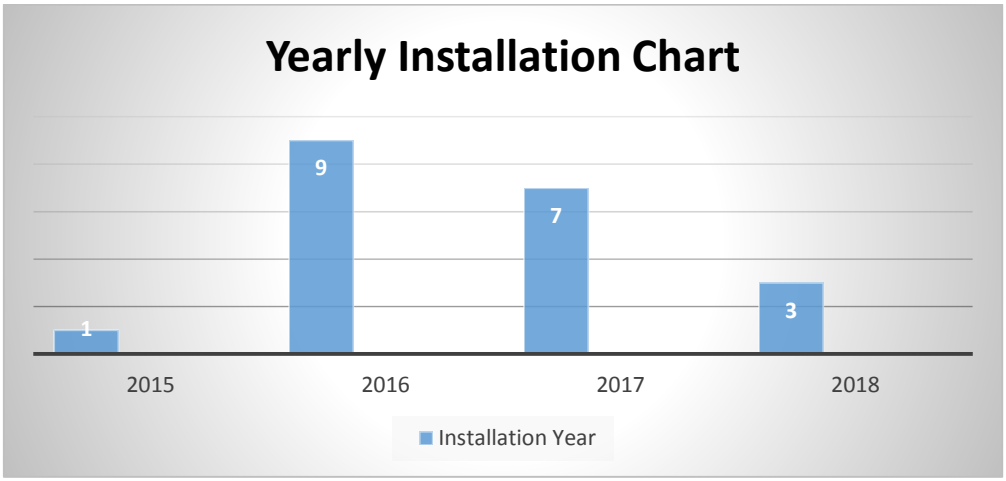


Fig 4.4: Installation SRS chart.

The maximum Installation of SRS was in 2016 and the minimum installation of SRS was in 2015**.**More importantly,the chart shows that the installation has started decreasing again in a big number after 2016. In 2016, 9 systems were installed and afterwards, the number of installation has reduced to only 3 till 2018 which is not a good sign.

4.4 Maintenance of the SRS

Most of the consumer does not test their system on a regular basis. Even if the system is found disorder, they don't either want to repair it. Majority of the consumers do not have the record of the solar electricity. As a matter of fact, a minor number ofconsumershave kept the record of the reading of solar electricity. They neitherassociate any trainer for the SRS operation nor clean their panel. So, the number of people who clean their panel is very limited.

4.4.1 Maintenance Information.

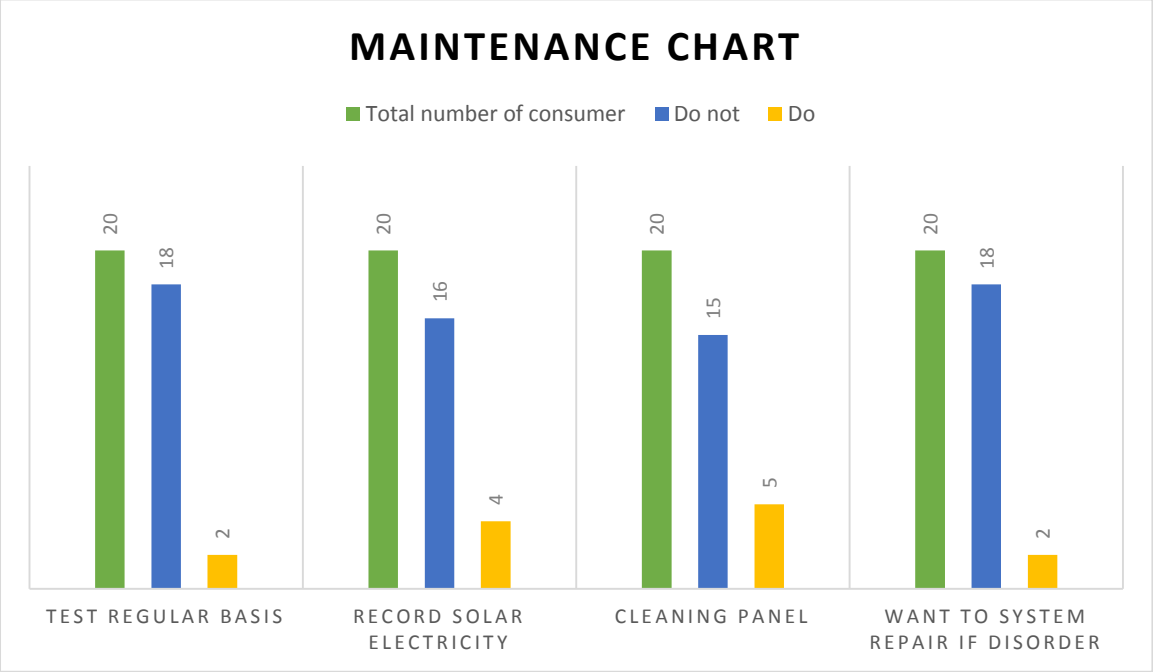


Fig 4.5: Maintenance chart.

The chart shows the proper maintenance condition of all the SRS. From this chart, it is seen that among 20 consumers, only 2 consumers have been testing the system on a regular basis. Only 4 consumers have got the record of the electricity from SRS, and 16 consumers haven't got the record right. Only 5 consumes clean the panel where 15 consumers do not either feel the necessity to clean the panel at all. In addition, only 2 consumers are interested to repair their system if it is disordered and the rest 18 consumers are not interested at all to repair the system.

4.5 Consumer satisfaction

Some consumers are satisfied and some of them are not. Almost 50% of the consumers do think that this SRS is just a waste of money. Some consumers said that the SRS is not appropriate according to their point of view. Most of the consumers are not influenced to increase the SRS capacity.Maximum consumers do not have any knowledge about the net metering system as well. When they were introduced to the net metering system by this survey, they were found to bequite interested. The following chart is made from the consumer satisfaction on the basis of the interviewed-consumer and their answers.

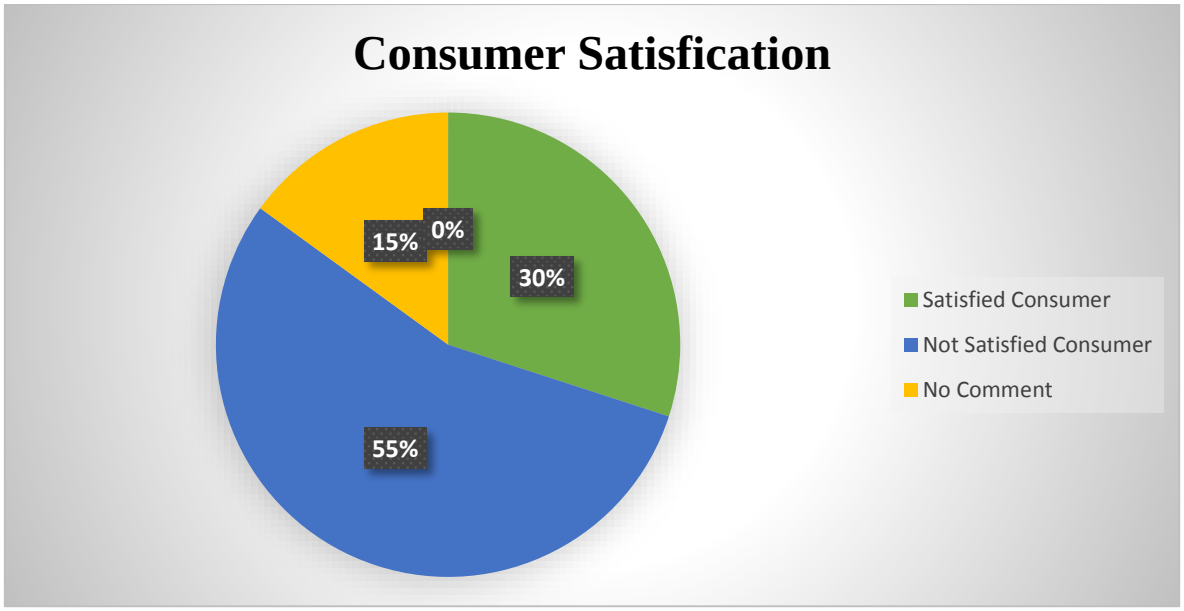


Fig 4.6: Consumer Satisfaction Chart.

In this chart, the comparison result is made from the information given by20 consumers where the result says that only 6 consumers are satisfied with the system and 11 consumers are not satisfied, 3 of them did not even comment on this question. So, thehigher percentage of the consumers find it inappropriate due to lack of knowledge of the net metering system and proper training of different uses.

4.5.1 Consumer opinion

In the following chart, the comparison gives the result of how many consumers accept the system as a waste of money and how many of them find it appropriate. To find out the result,20 consumers are judged totally where the result shows that 12 consumers think that the installed system has just been a waste of their money,6 consumers find the system appropriate, and rest of theconsumers did not eithermake any comments on this question.

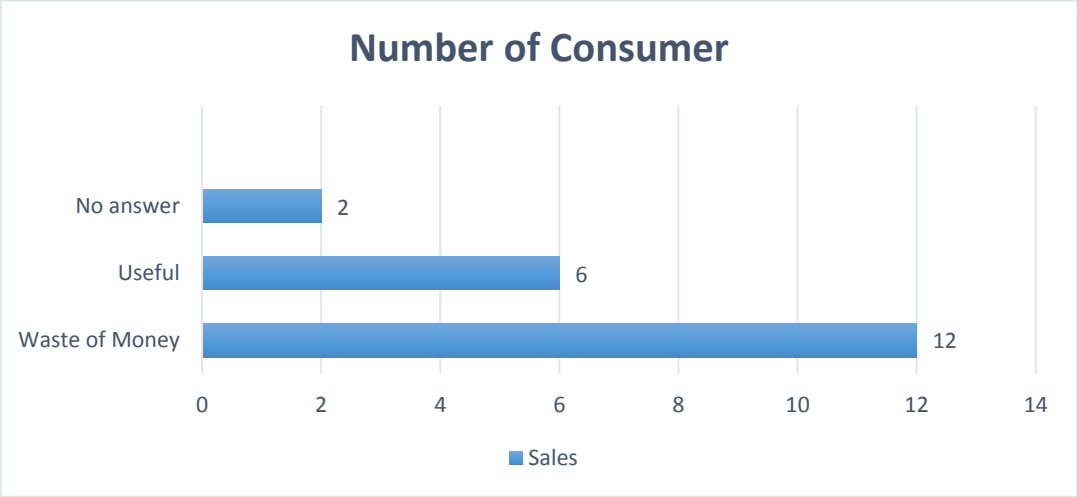


Fig 4.7:Consumer opinion.

From the judgement of 20 consumer opinions, it can be clarified that the less percentage of the consumers find it useful which is only by 30%. On the contrary, 60% of the consumers take it as just a waste of money. In fine, most of the consumers think that the system does not provide any noticeable benefits to them. In addition, many of them have totally lost their interest to run the system anymore.

4.5.2 Increase capacity

The following chart is as usually made from the same number of consumers. The collected data from the consumers is identified below.

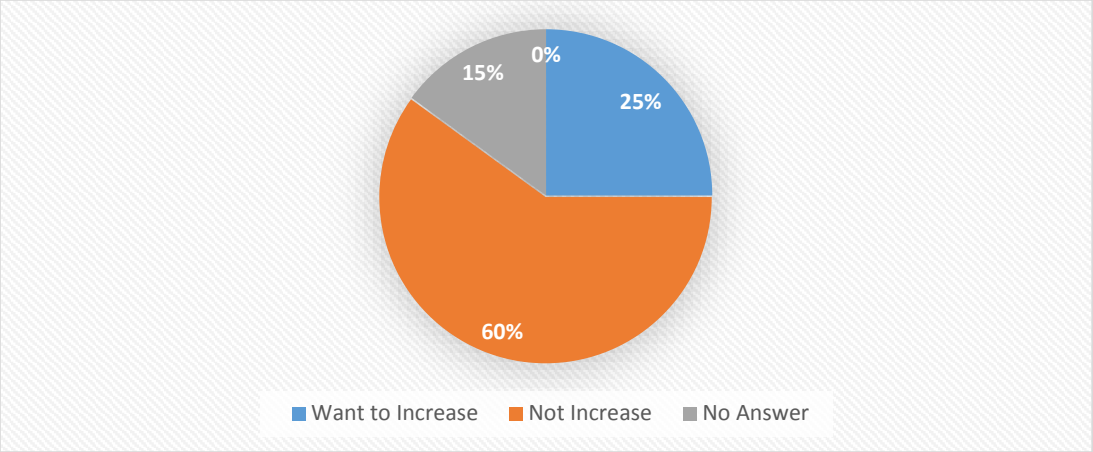


Fig 4.8: Increase capacity chart

From the survey, it is found that 5 consumers are interested and want to increase the capacity of the SRS.12 consumers are no way interested and do not want to waste their money to increase the capacity of the system, and no answers are found from the rest of the consumers. So, it can be clarified from the Pi-chart that 60% of the consumers do not want to increase its capacity as they are not being benefited from the system. Only 25% of the consumers are found to be influenced to increase the capacity of the system.

4.6 Cost Analysis

RajiyaTower (32/41, Esha Kha Road, Narayanganj) brought a SRS by 240000Tk in January 2017.Installation capacity is 4.8 kWh. The system wasInstalled 1 year ago.Present reading of the system is 1335.18 kWh. Life time of SRS is 15 years. What is the unit cost of this SRS per kWh?

Solution:

Date of Installation = 2017
Total cost of SRS = 338400 Tk
Present Reading = 6364.8 kWh
Installed capacity = 4.8 kWh

$$In\ 12\ month, the\ SRS\ produces = 6364.8\ kWh$$

$$In\ 1\ year, the\ SRS\ Produces = 6364.8\ kWh$$
$$\therefore In\ 15\ years, the\ SRS\ produces = 6364.8\ kWh \times 15$$
$$= 95472\ kWh$$

$$So, the\ \text{cost}\ of\ SRS\ Per\ kWh = \frac{338400}{95472} = 3.5\ Tk$$

A table is given below regarding all the cost-calculations.

SL No:	Name of Consumer	Total cost of SRS	Installation Capacity	Electricity Produce From Installation	Life Time	Per Watt cost
01	Anwar Fashion Lit. 5 No North Hajiganj, FatullahNarayanganj.	2,32,320 Tk	3.2 kWh	6 months - 2135.04 kWh	15 years	3.6 Tk/kWh
02	Jahanara Garden 40/1 New Khanpur Bank Colony ,Narayanganj	1,97,400 Tk	2.8 kWh	8 months - 2490.88kWh	15 years	3.5 Tk/kWh
03	K.Khan Classic Tower 55/58 S.M. Malleh Road,Narayanganj	1,81,250 Tk	2.5 kWh	15 months - 3127.5kWh	15 years	3.5Tk/kWh
04	West Apparels Woabdapul/Aynaeatpur, Narayanganj	1,05,750 Tk	1.5 kWh	1 year - 2001.6 kWh	15 years	3.5 Tk/kWh
05	MersasAmzad Dying Kutubail, Fatullah,Narayanganj	75,000 Tk	1 kWh	6 months - 673.2 kWh	15 years	3.7 TK/kWh
06	Rajiya Tower 32/41 Esha Kha Road Shitalakshya, Narayanganj	3,38,400 Tk	4.8 kWh	1 year 6364.8kWh	15 years	3.5 Tk/kWh
07	Eye Ar Bulb Company 615-Noyamati,Fatullah, Narayanganj	3,30,000 Tk	4.7 kWh	Not operation	15 years	
08	Pace View 39 Khapur,Fatullah ,Narayanganj	1,63,206 Tk	2.5 kWh	14 months - 3904.6 kWh	15 years	3.2 Tk/kWh
09						
10						

11	P.M Nittex Godnail,Narayanganj	Data not collected	Data not collected	Data not collected	15 years	Data not collected
12	Prime Jeans Culture 32 Esha Kha Road, Narayanganj	2,17,500 Tk	3 kWh	1 year - 4042.8 kWh	15 years	3.5 Tk/kWh
13	Paradise Complex Kutubail,Fatullah,Narayanganj	Data not collected	Data not collected	Data not collected	15 years	Data not collected
14	Lab-Aid Chashara, Narayanganj	Data not collected	Data not collected	Data not collected	15 years	Data not collected
15	Moyna Bhobon 43/3 North Chashara, Narayanganj	2,95,000 Tk	2.5 kWh	1 year 1334.4 kWh	15 years	3.2 Tk/kWh
16	G.M Garden 242 President Road,Chashara, Narayanganj	Data not collected	Data not collected	Data not collected	15 years	Data not collected
17	Zaman Tower 155 B.B Road ,Narayanganj	1,06,200 Tk	1.5 kWh	7 months - 1180.2 kWh	15 years	3.4 Tk/kWh
18	Topon Shah 5 No Adorsho, Chashara, Narayanganj	70,200 Tk	1 kWh	1 years – 1344 kWh	15 years	3.4 Tk/kWh
19	City Poddo Plaza 1 55 S.M. Malleh Road, Narayanganj	Data not collected	Data not collected	Data not collected	15 years	Data not collected
20	Rupali Bank Limited 32 S.M. Malleh Road ,Narayanganj	1,06,200 Tk	1.5 kWh	5 months - 843 kWh	15 years	3.4 Tk/kWh

Table 4.1: Consumer information and correlated data.

4.7 Finding and Suggestion

It is found from the overview of the research that a few among the interviewed people have a decent knowledge about the appropriateness of the system. They do not either clean their system or repair the disordered ones. They are not even sure about how to use the system properly to get more benefits. The main reason behind it is, they do not have proper knowledge over the net metering system or the training for the different uses of the system.On the other hand, Solar energy is expensive. The initial cost of installing the system is very high, as a result, the people not being benefited from the system are not willing to waste their money anymore to increase its capacity.

Being among the developing countries, the government should obviously be concerned to the extension of the system about how the system can be developed to the modern society. Some steps are to be taken as people get more queries and come to know about the system. More surveys are to be taken place among the users of the system. As a result, they will come to know more and more about the appropriateness of the system and benefits to operate the system. They should be given proper lesson over the net metering system, as well as, the necessity to clean the system, keep the record of the generated electricity, and test the system on a regular basis. If this happens orderly, people will definitely be influenced to increase the capacity of the system.

4.8 Summary

This chapter is made by the result of the survey.It is structured by the consumeranswer which is shown in the chart.This chapter is the most important one in this book.

Chapter 5

Conclusion

5.1 Conclusion

This paper discusses thoroughly the solar roof system with its appropriateness and significance to modern society. As the technology itself is growing days after days, the human being is getting used to this and using all of it for the betterment of future. The advantages and disadvantages, various limitations of solar rooftop system have been discussed here.

As it is mentioned earlier, the survey was done under the assistance of DPDC. DPDC is a very familiar name. It is one of the best practical fields for Electrical and Electronic Engineers in our country. The things what we learned at our university was ideally observed in a practical way in DPDC NOCS EAST Narayanganj area. It's obviously a thing to feel lucky to have the opportunity to work under this reputed Electricity distribution company. It absolutely provided a great scope to implement the theoretical knowledge in practical life. This was initially started to analysis the currentsolar home system under Dhaka Power Distribution Company.

This survey was taken place in various areas of Narayanganj throughout an inquiry form. It is found that 90% of the interviewed people are not satisfied with the appropriateness of SRS and its actualization. According to the consumer opinions, it is found that 35% of the consumers installed the system by their own choice and 65% of the consumers installed the system for Policy obligations, where it states that 25% of the systems are brought from local market and rest 75% systems are brought from an Agency. According to the maintenance and operating condition of the system,below 10% of the consumers test the system on a regular basis, only 25% consumers clean their system and 75% systems are not cleaned regularly. They were asked to provide the record of the electricity. 20% consumers have got the record of the produced electricity and rest 80% consumers do not feel the necessity to keep the record. More importantly, only 10% consumers are found who want to repair the system if it is disordered and 90% of them do not even want repair it. After the proper judgement from 20 consumers, the result says that 55% of the consumers are not satisfied since they are not being benefited from the system at all. Only 25% of them are found to be satisfied. 60%

consumers believe that they have just wasted their money by installing the system. None from the 60% consumers want to increase its capacity as well. So, in the research, it is found that a majority of people don't know either the significance or the usefulness of the solar rooftop system.To influence the people, we tried to circulate the appropriateness of the system and inspired themto increase the power generation from solar energy as well as the number of solar panels depending on renewable energy.

5.2 Future Scope of the work

A hypothetical discussion has been going on that another survey will be covered within Dhaka city under DPDC as well. The principal of this objective will be to circulate the usefulness and its effectiveness to more people who keep a limited knowledge about solar rooftop system. Among the circulation, an inquiry form will be also provided to the interviewed crew. It is hypothesized that a stimulation lesson will be discussed with the people, not going with the system due to having a minor knowledge about it.

So, more consumers and areas are to be visited within a while. Hopefully, this work will be more interesting. It is going to be another opportunity to go bigger. Village or rural areas are also on the frontline to be surveyed nearby. Solar mini-grid power plant will be visited soon as well. We are very keen to work with the Infrastructure Development Company Limited (IDCOL) and Bangladesh Power Development Board (BPDB). At the end of the lesson, it is hereby to say that there are a lot of scopes for us to work for the country. Some initiatives should be taken by the government orderly for the betterment of the country. If the government takes these time-authorized initiatives and gives proper support, a crew of the users will grow up rapidly and many of the present users will be influenced to increase the capacity of the solar rooftop system.

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